THE UNIVERSITY OF CHICAGO

ABRAMS ENVIRONMENTAL LAW CLINIC
OF THE UNIVERSITY OF CHICAGO LAW SCHOOL

November 7, 2018

Via E-Filing

Ms. Kavita Kale
Michigan Public Service Commission
7109 W. Saginaw Hwy.
P. O. Box 30221
Lansing, MI 48909

RE: MPSC Case No. U-20162

Dear Ms. Kale:

The following is attached for paperless electronic filing:

Direct Testimony of Jackson Koeppel on Behalf of Soulardarity and Exhibits 1-23. Also attached is a Proof of Service.

Sincerely,

By: __/s/ Mark Templeton_________

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xc: Parties to Case No. U-20162
Jackson Koeppel, Executive Director, Soulardarity (director@soulardarity.com)

STATE OF MICHIGAN

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

In the matter of the Application of **DTE ELECTRIC COMPANY** for authority to increase its rates, amend its rate schedules and rules governing the distribution and supply of electric energy, and for miscellaneous accounting authority.	Case No. U-20162 ALJ Sally L. Wallace

PROOF OF SERVICE

On the date below, an electronic copy of **DIRECT TESTIMONY OF JACKSON KOEPPEL ON BEHALF OF SOULARDARITY AND EXHIBITS 1-23** was served on the following:

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The statements above are true to the best of my knowledge, information and belief.

Date: November 7, 2018

UNIVERSITY OF CHICAGO LAW SCHOOL
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Counsel for Soulardarity

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STATE OF MICHIGAN

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

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DIRECT TESTIMONY OF JACKSON KOEPPEL

ON BEHALF OF SOULARDARITY

I. Introduction and Summary

Q: Please state your name, occupation, and business address.

A: My name is Jackson Koeppel. I am the Executive Director of Soulardarity, 21 Highland Street, Highland Park, Michigan, 48203.

Q: Please describe your work experience.

A: I studied climate change and social inequity at Oberlin College in Oberlin, Ohio until I transferred to Wayne State University to pursue my work on community solar advocacy. I moved to Highland Park, Michigan in 2012 and co-founded Soulardarity, an organization rooted in the Highland Park community, to organize community-owned solar streetlights and improve weatherization to reduce home energy-usage. I am presently co-directing and growing Soulardarity, as well as organizing regionally and nationally to democratize and decarbonize our energy economy. I am also working on wealth redistribution, democratization of land ownership, local development, and other projects to build community control and local assets. I have been part of the LeadNow Fellowship organized by SustainUS and the Will Steger Foundation's Intergenerational Co-Mentorship fellowship, and I recently received the Brower Youth Award and the Vehicle of Change Award for my work. I am currently a Detroit Innovation Fellow.

Q: For what purpose was Soulardarity created?

A: In 2011, DTE Energy repossessed more than 1,000 streetlights from Highland Park, Michigan, a predominantly low-income and minority city, after its municipal government defaulted on its utility payments. Soulardarity was formed in 2012 by a coalition of Highland Park residents who wanted to help alleviate the crisis by installing community-owned, solar-powered streetlights in Highland Park. Soulardarity's mission has subsequently broadened to include community energy education and advocacy for community solar and greater equity in Michigan's energy generation and delivery system. Through activism and advocacy, Soulardarity seeks to emphasize the particular needs, experiences, and perspectives of low-income communities and communities of color.

Q: What is Soulardarity's focus?

A: Soulardarity's goal is to improve access to affordable, clean energy for low-income communities and communities of color, including women, children, the elderly, people with disabilities, and others who are statistically more likely to live in poverty. As such, Soulardarity promotes solar street lighting, solar bulk purchasing, energy education, and expanding access to clean energy to improve the economic condition of low-income communities, especially low-income communities of color, in southeast Michigan. Soulardarity has developed partnerships with other Michigan stakeholders interested in energy justice and affordability, including experienced solar installers and developers.

Q: Has Soulardarity previously intervened in or commented on an MPSC matter?

A: Yes, Soulardarity intervened in MPSC matter U-18232 and advocated, through testimony and briefing, for the inclusion of community solar projects in DTE's Renewable Energy Plan and for accommodating diverse ratepayers in DTE's energy decision-making. Soulardarity filed a comment in MPSC matter U-18418 regarding the proposed Integrated Resource Planning process and advocated that the process include more robust engagement with diverse stakeholders. Soulardarity also commented during the MPSC Staff's development of the Distributed Generation Tariff in MPSC matter U-18383 and advocated for changes that would increase transparency and access to solar energy for low-income communities and communities of color. Finally, Soulardarity joined a Response to Prior Comments in U-18076 concerning DTE's application for approval of a previous amended Renewable Energy Plan.

Q: What is the purpose of your testimony?

A: I am presenting Soulardarity's objections to certain rate design proposals put forth or not clarified by DTE in its Application to increase rates and amend its rate schedules in U-20162 ("DTE's Application"). DTE's proposed rate structure inequitably withholds opportunities from ratepayers in low-income communities and communities of color to participate in and benefit from renewable energy programs. Renewable energy, especially community solar, is popular among

DTE's consumer base, and DTE itself purports to be "leading Michigan in solar power." Exhibit 1(b), page 5. However, DTE's proposed approach for implementing the Distributed Generation inflow/outflow mechanism frustrates the development and implementation of community solar. Particularly concerning is that DTE's proposed procedures and policies for individual customers' participation in its distributed generation program will have a disparate impact on low-income communities and communities of color. DTE's rate proposal is inconsistent with reducing carbon emissions to meet the global maximum 1.5°C of warming goal—which will have the most severe consequences for low-income communities and communities of color. Across its rate proposals, DTE does not accurately value the benefits of community solar. DTE's analyses focus exclusively on the costs of renewable energy programs and fail to account for the benefits of community solar as well as widespread participation in distributed generation programs.

Q. Are there any other purposes of your testimony?

A. I am also presenting Soulardarity's objections to certain of DTE's proposals that are not directly related to renewable energy programs. DTE's proposed rate structure inequitably increases rates for residential and public lighting consumers compared to industrial consumers. Not only is the absolute increase concerning, the relative increase is concerning for its regressivity: the highest increase for those who use the least energy and who have the least ability to pay. Even among residential consumers, the increases will be felt most acutely by low-income communities and communities of color, who generally spend a higher proportion of their incomes on energy costs.

Soulardarity also objects to DTE's failure to specifically address inequities related to customer service, safety, reliability of service, and health effects of fossil fuel generation in low-income communities and communities of color. This is particularly inequitable in light of the disproportionate increases these communities must shoulder to pay for general infrastructure improvements.

The purpose of Soulardarity's testimony is to inform the participants in this case and the Michigan Public Service Commission of DTE's failures on these fronts. Soulardarity's testimony advocates for a rate structure grounded in informed analysis that considers all costs and benefits to DTE and its ratepayers, particularly its ratepayers in low-income communities and communities of color.

Q: Please provide an overview of the topics you will discuss in your testimony.

A: I will first discuss Soulardarity's concerns about the lack of participation by people of color and low-income ratepayers in DTE's planning process, which has contributed to DTE's proposing a rate structure that inequitably withholds opportunities to participate in renewable energy programs for many of the ratepayers who could most benefit from them.

I will then present Soulardarity's concerns about certain other aspects of DTE's Application, and I will offer proposals for improving flawed or inequitable aspects of DTE's proposed rate design. Specifically, I will discuss the benefits of community solar, how DTE's customers desire community solar projects, how DTE's assessment of solar energy's cost effectiveness fails to adequately capture the value of solar and particularly community solar, and how DTE's calculations and analyses do not account for DTE's total contribution to carbon emission reductions. I will also discuss other aspects of DTE's rate proposal that are cost-prohibitive for low-income ratepayers, as well as issues of reliability, safety, and customer service that most affect low-income ratepayers. Lastly, I will present Soulardarity's concerns about DTE's responsibility in transitioning communities away from non-renewables and DTE's hiring and contracting policies as they relate to DTE's rate case.

Q: Are you sponsoring any exhibits?

A: Yes. I will sponsor the following exhibits:

1. DTE's website, including:

a. https://newlook.dteenergy.com/wps/wcm/connect/dte-web/home/about-dte/common/about-dte/about-dte

b. https://www.newlook.dteenergy.com/wps/wcm/connect/271ebc5d-43da-478b-8c87-c485afa7d0fe/DTE_CCR_2016-17_climate-change.pdf

c. https://www.newlook.dteenergy.com/wps/wcm/connect/dte-web/home/service-request/residential/pricing/electric-pricing

d. http://newsroom.dteenergy.com/2018-03-01-DTE-Energy-CEO-Gerry-Anderson-Receives-Prestigious-Climate-Leadership-Award (Exhibit 1);

2. "For the Poor, Historic 2014 Floods Still a Toxic Nightmare," an August 20, 2016 Dearborn Patch article (Exhibit 2);

3. "Fumes Across the Fence-Line: The Health Impacts of Air Pollution from Oil & Gas Facilities on African American Communities," a report created by the NAACP and Clean Air Task Force (Exhibit 3);

4. "Global Warming of 1.5°C: an IPCC Special Report on the Impacts of Global Warming of 1.5°C Above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty (Summary for Policymakers)" (Exhibit 4);

5. Home Energy Affordability:

a. Fact Sheet;

b. Michigan County Breakdown; (Exhibit 5)

6. Census Reporter: Detroit, Michigan (Exhibit 6);
7. "Poverty Facts," a summary report prepared by Poverty USA (Exhibit 7).
8. "Order Adopting Low Income Program Modifications and Directing Utility Filings," an order from the New York Public Service Commission in Case No. 14-M-0565 (Exhibit 8);
9. "Comments on MPSC Case No. U-18418 Regarding Stakeholder Engagement in the Integrated Resource Planning Process," comments from Soulardarity in a previous MPSC proceeding (Exhibit 9);
10. "A Guide to Community Solar: Utility, Private, and Non-profit Project Development," commissioned by the National Renewable Energy Lab (Exhibit 10);
11. "Michigan Utility's Gas Plant, Pipeline Plans Pose Conflict of Interest, Critics Say," an article published in Midwest Energy News (Exhibit 11);
12. "A Review of Solar PV Benefit and Cost Studies," a report created by the Electricity Innovation Lab at the Rocky Mountain Institute (Exhibit 12);
13. MPSC's Staff Report from Case No. U-20169, dated August 10, 2018 (Exhibit 13);
14. "The Vision for U.S. Community Solar: A Roadmap to 2030 and Beyond," a report commissioned by Vote Solar (Exhibit 14);
15. "Vote Solar – Memorandum Report," an analysis of the economic development and job benefits that would occur if DTE invested in renewable energy sources rather than a new gas plant, commissioned by Vote Solar and the Union of Concerned Scientists (Exhibit 15);

16. “PV Valuation Methodology: Recommendations for Regulated Utilities in Michigan,” a report prepared by Clean Power Research for the Michigan Renewable Energy Association (Exhibit 16);
17. “Michigan Utility Plans Major Shift from Coal to Solar in Coming Decades,” an article from Midwest Energy News (Exhibit 17).
18. “Get Free: Understanding the Potential for Community Solar Power in Highland Park,” a report written by Dow Sustainability Masters Fellows at the University of Michigan in partnership with Soulardarity (Exhibit 18);
19. “Lights Out in the Cold: Reforming Utility Shut-Off Policies as if Human Rights Matter,” a report created by the NAACP Environmental and Climate Justice Program (Exhibit 19)
20. “Targeting Energy Justice: Exploring Spatial, Racial/Ethnic and Socioeconomic Disparities in Urban Residential Heating Energy Efficiency,” a study published in *Energy Policy* by the Urban Energy Justice Lab (Exhibit 20);
21. “Social Equity in State Energy Policy: Indicators for Michigan’s Energy Efficiency Programs,” a report created by the Urban Energy Justice Lab at the University of Michigan’s School for Environment & Sustainability (Exhibit 21);
22. “A Force for Growth & Prosperity: 2017 Corporate Citizenship Report,” published by DTE Energy (Exhibit 22); and
23. DTE’s 2016-2017 Corporate Citizenship Report (Exhibit 23).

II. Problems with DTE's Process to Prepare the Application

Q: What are your concerns about the representation of low-income communities and communities of color in the formation of DTE's proposed rate structure?

A: These ratepayers deserve to have a voice in decisions that will affect them most. Low-income ratepayers are more financially vulnerable to changes in rates and less likely to have the resources to ensure that their voices are heard in public proceedings. DTE has not taken steps to seek out the input of its low-income and people of color ratepayers as it develops and proposes policies that will have the most acute effects on these very communities. To the contrary, DTE has proposed policies and programs that will further burden and reduce opportunities for its most vulnerable ratepayers. The lack of representation of these communities in the decision-making process has contributed to this failure.

Q: How do climate change and renewable energy affect low-income communities and communities of color?

A: Low-income communities and communities of color have a particular need for clean, reliable, and community-based energy. These ratepayers have historically borne a disproportionate share of the harms caused by fossil fuel-based energy systems. See Exhibit 2, which reports on how the historic 2014 floods hit poor residents in aging residences the hardest and had long-lasting financial and health consequences. Communities near central-generation facilities have experienced health problems due to pollution. See Exhibit 3. Their reduced health risks should be counted as a benefit of renewable energy projects. At the same time, these communities have been economically reliant on central-generation facilities, such as coal plants. They thus stand to benefit from the distributed generation model.

Our collective need for renewable energy is ever more urgent. The Intergovernmental Panel on Climate Change (IPCC) issued a special report last month about limiting global warming to 1.5°C in order to avoid the more severe climate risks to health and economic growth that would result, for example, from 2°C of global warming. See Exhibit 4, page 12. Importantly, the IPCC found with high confidence that, given the current carbon emissions rate, global warming is likely to reach 1.5°C as soon as 2030—a mere 12 years from now. See Exhibit 4, page 5. The IPCC specifically noted that staying at or below 1.5°C of global warming "would require rapid and far-reaching transitions in energy." See Exhibit 4, page 22. Not only is this unprecedented transition necessary for environmental and human health, it is critical for reducing inequalities. See Exhibit 4, page 25. These climate change realities make it all the more critical to immediately implement and plan long-term for renewable energy, equitable access to renewable energy, and costs-savings for low-income communities and communities of color to offset the brunt of climate change. While climate change is a global issue and every state faces similar challenges, Michigan has an opportunity to lead the way in combatting climate change's advancement and its negative impacts.

Low-income communities and communities of color in Michigan are especially vulnerable to the current and anticipated effects of climate change because there are high rates of energy poverty in the state and because DTE has a history of shutting off service in and for those communities. In Michigan, households with incomes of below 50% of the Federal Poverty Level use roughly one-third of their annual income for home energy bills, resulting in a home energy burden of 32% (in Wayne County, 29%). That is in stark contrast to the 17% home energy burden (in Wayne County, 15%) for those households with incomes at and between 50% to 100% of the Federal Poverty Level and even more so than the 7% home energy burden (in Wayne County, 6%) for those at and between 185% to 200% of the Federal Poverty Level. See Exhibit 5 (Fact Sheet and pages 3, 6, and 18 of the Michigan County Breakdown). This data makes clear that the affordability concern is extremely high for the poorest ratepayers. Not only do ratepayers and households experience accessibility issues, entire communities do as well, as evidenced by DTE's repossession of streetlights in Highland Park. Community solar, among other renewable energy solutions, can reduce the direct and indirect costs associated with climate change for these communities.

Within low-income communities and communities of color, certain populations face even greater risk from climate change and from electricity shutoff. For example, the elderly (22% of whom are in poverty in Michigan) and children (48% of whom are in poverty in Michigan) are more sensitive to the same polluting activities that increase carbon emissions. See Exhibit 6 for the poverty statistics. They are also sensitive to extreme weather events that are likely to increase with climate change. When households cannot afford air conditioning or electricity, these vulnerable populations are most at risk for weather-related illnesses or losing access to necessities like dialysis. Of note, low-income households are more likely to be female-headed. See Exhibit 7. These female heads of households bear the financial responsibilities of adapting to climate change and paying substantially higher electricity bills.

Q: Why is this proceeding before the MPSC an appropriate forum for the participation of all ratepayers in the development of DTE's rate structure?

A: The procedural, financial and technical requirements to participate in such a proceeding make participation by ordinary ratepayers almost prohibitively difficult. Thus, only established organizations with access to legal resources can hope to present their views in an administrative proceeding of this nature. MPSC should require DTE to proactively seek out the views of its ratepayers, including its low-income and people of color ratepayers, in order to make its rate structure fair and affordable for all ratepayers. Additionally, MPSC should seek direct, unbiased input itself from ratepayers.

As an example, the New York Public Service Commission ("NYPSC") sought input from low-income ratepayers in Case No. 14-M-0565, a proceeding to review the low-income programs offered by New York utilities. See Exhibit 8. The NYPSC held 12 public statement hearings in six different cities located throughout the state, with "more than 100 speakers . . . generating nearly 600 pages of transcript." See Exhibit 8, page 7. The NYPSC went on to set policy aiming for "an energy burden at or below 6% of household income" for low-income households, achieved through a "holistic approach" coordinating and leveraging "all available resources." Exhibit 8, page 3. This recent example from New York demonstrates the significant impact that low-income community members' voices should have on policy decisions, particularly policy decisions that have the potential for acute negative effects on their day-to-day lives.

Q: How could DTE ensure better representation of the diverse needs and concerns of its ratepayers?

A: DTE can take a number of steps to make its rate structure more responsive to the needs of its low-income and people of color ratepayers. DTE should hold both public meetings and meetings with members of and leaders from diverse communities to solicit their concerns. DTE should also conduct and make public an analysis of the impact of certain rate design proposals on low-income and people of color ratepayers. DTE should provide the information that it gathers from these sources to the MPSC as part of its rate proposal.

The concerns Soulardarity has now about representation on the procedural side echo those raised in our previous interventions in DTE matters U-18418 and U-18232. There, we offered recommendations that apply with equal force to the present proceeding. Those recommendations included providing for: a specific focus on the demographics of people most impacted by energy decisions; DTE-provided education to stakeholders who will be affected by DTE's decisions; engagement opportunities at multiple venues, times, and formats; and clear articulation of how stakeholder input will impact the process and binding requirements around that impact. The complete list of recommendations can be found at U-18418-0060, attached here as Exhibit 9.

The steps that DTE has taken to involve ratepayers thus far are inadequate. For example, while I was glad to see DTE hold an engagement session in Detroit on its Integrated Resource Plan, the outreach publicizing the event was conducted only in English. While translation services were available at the event, its advertising noted, in English, that those needing translation services should send an email requesting them. The event itself is a step in the right direction, but DTE needs to take additional thoughtful steps to make progress on this issue.

Given that DTE has not, to this point, meaningfully incorporated the voices and ideas of its low-income and people of color ratepayers in this rate proceeding and the analyses leading up to it, DTE should incorporate the feedback of organizations like Soulardarity that have intervened in the formal proceeding and who represent some of these communities.

III. DTE's Proposed Rate Structure and Community Solar

Q: What is community solar?

A: According to the National Renewable Energy Laboratory, community solar is "a solar-electric system that, through a voluntary program, provides power and/or financial benefit to, or is owned by, multiple community members." See Exhibit 10, page 4. Community solar is an increasingly popular source of renewable energy because it not only furthers the transition away from fossil fuels, which contribute to climate change and have numerous adverse public health impacts, but also does so in a way that empowers communities to work together toward energy self-sufficiency.

I use the term "community solar" flexibly to apply to projects with a variety of design characteristics. Pricing models, ownership structures, and project scales vary among projects. What all community solar projects have in common is the provision of equitable access to reliable, locally generated clean energy that provides both financial and environmental benefits to the area where it is sited.

Q: What are the advantages of community solar as compared to other energy sources?

A: Community solar is an excellent source of clean energy because it allows ordinary individuals to share in the economic and environmental benefits of clean energy generation while simultaneously making the electricity grid more reliable. Unlike rooftop solar systems, community solar makes solar energy accessible to DTE ratepayers who would not otherwise be able to participate in solar energy generation, such as low-income renters and homeowners. One does not need to own the property on which the solar facility is based to participate in a community solar program, which makes it accessible to renters or to ratepayers who do not control the roofs of the buildings they occupy. Furthermore, due to economies of scale, a large community solar installation can produce energy at lower cost while avoiding significantly more carbon emissions than single residential rooftop installations. Such systems provide reliability because they are located in the communities they serve, thereby potentially providing power to the local grid in the event of other outages in the power system. Community solar, like other renewable energy sources, also offers powerful benefits over fossil fuels-based energy sources, including substantial avoided health impacts, which are particularly acute in low-income and people of color communities.

Community solar is also preferable to nuclear energy, which reinforces a central generation model that relies on centralized infrastructure, large capital expenditures, and disproportionate health impacts and risk allotted to the communities in which it is sited. While nuclear has a preferable emissions rate to fossil fuel sources, the impacts from its entire life cycle are concerning: it carries weightier risks to its local communities and does nothing to solve the energy reliability issues associated with centralized sources that loom larger as climate change brings more extreme weather events.

Q: What are your primary concerns about the cost-effectiveness analysis underlying DTE's proposed rate structure?

A: DTE has not provided a clear picture of how it defines "cost-effectiveness" for the purposes of its analyses, but the information it has provided indicates its analyses are incomplete and potentially misleading. For example, DTE's cost calculations analyze emissions reductions from the demand side only. Further, DTE's cost-effectiveness analyses do not include impacts on the environment, health, and safety of its customers, nor do they consider the entire life cycle of the energy source.

Q: What are the analytical benefits of using a clear definition of cost-effectiveness?

A: By obfuscating in its use of the term "cost-effectiveness," DTE ignores the full brunt of its emissions on the supply side, which can be adequately mitigated by increasing its renewable energy portfolio. Specifically, DTE's 80% emissions reduction does not include extraction- or pipeline-related emissions despite the fact that DTE is a co-owner of the Nexus Pipeline. See Exhibit 11.

Relatedly, DTE seeks to raise rates in part to finance a new gas plant, which could be supplied by the Nexus pipeline, creating a possible conflict of interest. See Exhibit 11. In doing so, DTE asks low-income ratepayers to help fund a project that is less economically productive and will provide fewer jobs in their community and more air pollution than a comparable renewable energy infrastructure project could. Furthermore, the planned gas plant is not consistent with the goal of limiting global warming to 1.5°C degrees. See Exhibit 4.

The negative impacts of climate change disproportionately affect low-income communities and communities of color, yet DTE would have its customers from these very communities pay higher rates to fund the plant. In failing to incorporate the climate change effects of its proposed plant into its cost-effectiveness analysis, DTE pushes the economic, public health and other externalities of its decision onto its low-income and people of color ratepayers while simultaneously raising their rates.

Q. How does DTE's definition of cost-effectiveness lead it to erroneous conclusions with respect to the full value of distributed solar generation?

A: DTE maintains that community solar is not cost-effective, but DTE's valuation considers only costs and does not take into account the many benefits of distributed solar generation. For example, distributed solar generation provides net positive energy value to utilities through avoided energy costs and avoided loss of energy due to inherent system inefficiencies, such as electrical resistance, that are lessened or avoided when power is generated at or near customers. See Exhibit 12, page 14. Distributed solar generation can also provide value by reducing costs for central generation capacity and easing upstream capacity constraints by meeting demand locally. Exhibit 12, page 14. Because distributed solar generation occurs close to demand, the reduced demand for centrally supplied power and the fuel powering central plants can reduce both electricity prices and fuel-commodity prices on a larger scale.

Distributed solar generation systems' grid support services benefit the grid as a whole and include reactive supply and voltage control, frequency regulation, energy imbalance services, operating reserves, and scheduling and forecasting services. Exhibit 12, page 15. Distributed solar generation can lower the risk of large-scale outages by reducing congestion in transportation and delivery systems, as well as by diversifying the system's generation portfolio with geographically dispersed generators. Exhibit 12, page 37.

Increased solar generation, whether distributed or centralized, contributes to reductions in CO_2 emissions, reductions in criteria air pollutant emissions, and mitigation of environmental issues related to fossil fuel power sources' water consumption. Exhibit 12, pages 39-41.

Solar power also provides benefits specifically to low-income communities and communities of color by way of halting or reversing the negative effects of traditional power generation that disproportionately affect those communities. For example, low-income consumers bear significant health and wellness costs created by emissions of fossil fuel plants in their communities, and a shift away from those resources to solar would reduce those burdens. See Exhibit 3. Utilities have also historically underinvested in distribution services, maintenance, and repairs in low-income communities, so the reliability and resilience benefits of solar and distributed generation are especially important in these communities. Distributed solar generation also drives economic development by creating high value jobs in communities in which it is sited. See Exhibit 12, pages 17 and 42.

DTE's analysis underestimates the benefits of solar and overestimates the costs because it relies on proposed infrastructure that is best suited for large-scale gas and nuclear facilities. If DTE focused the same amount of investment on infrastructure compatible with distributed solar generation, it and its ratepayers would enjoy significant benefits as described above.

Q: How do concerns over DTE's cost analysis of renewable energy relate to DTE's unregulated businesses?

A: DTE has performed a cost-effectiveness analysis that excludes its upstream revenues yet includes investments that support that side of its business. As a result, DTE can not only call distributed solar generation inefficient in the near-term, but also ensure that its infrastructure will continue to be best suited to support its upstream fossil fuel extraction and transportation investments in the future, including the NEXUS pipeline, which could supply the natural gas-supplied electric generating plant for which DTE has advocated. This skewed analysis benefits DTE's shareholders primarily, while leaving its ratepayers to pay the price. The MPSC should push DTE on how it defines cost-effectiveness with these concerns and potential conflicts of interest in mind.

Q: What are your primary concerns related to access to DTE's proposed distributed generated program for low-income communities and communities of color?

A: DTE's proposed distributed generation policies, as reflected in the rates proposed in the Application, create barriers to access and participation that will acutely affect ratepayers from low-income communities and communities of color. DTE has not established set fees for applying to the program and interconnection with the existing infrastructure, nor has DTE provided transparent information about how the fees will be calculated.

There are also ambiguous guidelines regarding conditions for terminating a customer's account and the level of termination notice. All of these policies are costliest and most burdensome for low-income households, which are the most vulnerable to shut-offs and have the least resources to pay additional fees (on top of increased rates).

Q: Are there other concerns related to access for low-income communities and communities of color to DTE's proposed distributed generation program?

A: DTE's proposed requirement limiting distributed generation to technology located on the customer's "premises" and serving only the needs of that premise is vague as well as counter-productive from both an emissions reduction and equity perspective. While DTE has not provided a definition of "premises," such a requirement would frustrate the development of community solar systems. The requirement also has a disproportionate adverse impact on low-income households, customers who rent and do not own their homes, and customers in subsidized living arrangements. The "premise requirement" is not required by statute and drastically reduces the opportunities available for members of low-income communities and communities of color to participate in the distributed generation program, either as individuals or through community solar programs.

For example, even if a renter pays the utility bill and desires to participate in the distributed generation program, it may be the case that only the property owner could apply for the distributed generation program. We believe that DTE is unjustified in making individual participation in its distributed generation program exceedingly inaccessible for renters and potentially low-income customers.

DTE's strict re-enrollment requirements also deter property owners from investing in distributed generation technology since the average life of a distributed generation system is longer than the average length of time a person occupies his or her home.

Furthermore, DTE's proposed System Access Contribution fee for distributed generation customers means that, even if customers break even on their bill by generating enough power to offset their inflow, they will still have to pay a monthly fee that non-participants do not despite the myriad benefits they provide to the grid and the community by participating in distributed solar generation. This fee is not only an unfair burden on distributed generation participants, but also may tip the program into being unaffordable for low-income ratepayers who might otherwise have been able to participate.

Q: What are your primary concerns related to safety and reliability?

A: Within DTE's distribution area, Detroit—where many low-income and people of color ratepayers live—faces unique safety and reliability issues that DTE is not adequately addressing. Many of these issues are detailed in the MPSC Staff Report in the U-20169 proceeding (Exhibit 13). They are of concern in this rate proceeding because DTE is disproportionately increasing rates on residential ratepayers (a 9.1% increase, which is higher than the 6.7% increase for other ratepayers, 4.5% increase for primary ratepayers, and 4.3% increase for secondary ratepayers). See DTE's U-20162 Application Direct Testimony, page 11 (Attachment 2). DTE's regressive rate increases are especially troubling because, while these increases will hit low-income communities and communities of color the hardest, DTE is not allocating proportionally *more* toward improving safety and reliability in these communities.

Specifically, of the 20 incidents DTE reported over a five-year period (from June 2013 through June 2018), eight occurred in Detroit. See Exhibit 13, page 7. And of the eight downed wire incidents (the vast majority of which were related to storm events), all five of the Detroit incidents resulted in fatal injuries. Exhibit 13, page 7–8. Especially because such fatal incidents are clearly tied to a known cause—storm events—DTE should invest more of the increased rates in its efforts to prevent downed wires, educate the public about their dangers, and respond to them more quickly during storm events.

Safety and reliability in Detroit are complicated by unmaintained alleyways, the substantially higher tree density (which is correlated with more outages and downed wires), and greater urban density. However, state law obligates DTE to provide the same level of safe and reliable service regardless of location. Thus, DTE should allocate more resources in Detroit, especially as Detroit has received disproportionally less tree trimming resources in the past. See Exhibit 13, page 11.

Agreeing with the Staff's recommendations related to safety and reliability in U-20169, we request that DTE implement those recommendations. We further request that DTE specify how much it will spend on safety and reliability improvements in Detroit going forward.

Q: What are your primary concerns about the customer service elements of DTE's rate structure proposal?

A: While DTE is in the process of overhauling its customer service procedures under its new "Customer 360" system, its proposed uses of increased revenue from rate increases will not be allocated to the customer service issues that most affect low-income communities and communities of color. DTE also does not address its substandard treatment of low-income ratepayers in its customer service proposals.

For example, DTE's focus on automating customer service and shifting toward almost exclusively digital interfacing with the company may create barriers to access for low-income consumers who can less easily access or use a mobile or web-based app. This increasing reliance on digital customer service solutions also creates barriers to access for elderly ratepayers who are less comfortable or skilled with technologically complicated systems. Similarly, DTE's commitment to shift entirely to digital collection not only creates barriers for consumers with less access to technology or less experience using technology for customer service purposes, it also frustrates DTE's ability to effectively process complex customer service issues that do not fit precisely within the parameters of its digital systems.

As an example, I have personally experienced frustration with DTE's digital customer service when I was incorrectly billed at my home address for Soulardarity's electricity account. What should have been a simple correction instead resulted in numerous phone calls with DTE customer service representatives who were not connected with DTE's technical support office and were unable to even reset the password on my online customer account. The reliance on access to my online account, coupled with the inability of DTE's customer service representatives to resolve the issue, turned a simple problem into a frustrating ordeal. Increased reliance on digital customer service solutions will lead to more issues like mine, as well as a decline in customer service staff's ability to solve problems when they, too, lack the technical expertise to override the digital systems. As it stands, the digital system also provides no way for customers to file a complaint about their service and create an ongoing written record.

While DTE's focus on improving its customer service technology and infrastructure may increase customer satisfaction for routine processes like paying monthly bills, it sinks millions of dollars into streamlining its general processes while failing to address the customer service concerns that cause significant safety issues most affecting low-income communities and communities of color, such as public lighting shutoffs, downed wires, and outages. DTE routinely fails to resolve these and other issues in a timely manner. The entirety of its low-income-specific customer service programming focuses on billing programs and does not meet many of the fundamental needs and concerns of these ratepayers.

Utilities should not take advantage of their unique monopoly position to shirk their customer service responsibilities. For example, Green Mountain Power in Vermont became a B Corporation in 2014 to commit to prioritizing customer service and to serve its local communities and environment. Green Mountain Power serves as a good example of commitment to customer service, and while this commitment comes in different forms, DTE should take steps to orient its business model more equitably toward non-shareholder stakeholders.

Q: What are your primary concerns about how DTE's rate structure addresses DTE's hiring practices?

A: DTE should use its cost-savings from the proposed rate structure to invest in hiring people from low-income communities and communities of color, particularly members of the communities that bear the burden of DTE's fossil fuel facilities. This practice ultimately benefits both DTE and the communities. DTE should also commit to transitioning workforces from closed fossil fuel plants into renewable energy jobs.

Moreover, DTE's customers should have the option to choose the installer for interconnection or other renewable energy technology, such as PV panels. This option will both create jobs and reduce costs for DTE and the customers. One successful manifestation of this idea is Wisconsin's statewide energy efficiency program, funded by ratepayers of regulated utilities. This program, called Focus on Energy, provides for utility-sponsored training of independent contractors through its Trade Ally program and then lists the participating contractors on the utility's website for customers to access. While the implementation would be different in Michigan, the idea is sound to support jobs in low-income communities and communities of color.

A rate structure that better incentivizes solar energy would create economic opportunity within and outside of DTE's own workforce. Improved internal hiring practices at DTE would not only improve economic opportunity for DTE and for low-income communities and communities of color, but would also boost employment in the energy industry more generally.

Q: Please summarize the changes Soulardarity believes should be made to DTE's proposed plan.

A: Soulardarity's recommendations for this case are as follows:

1. Both DTE and the Commission should ensure that the determination of "cost-effectiveness" for the purposes of this rate case reflects all of the values that solar power and, specifically, community solar provide for its ratepayers. The valuation should address factors including, but not limited to, the benefits that community solar provides in terms of energy reliability, safety benefits, health benefits, avoided energy costs, economic and job benefits to communities in which solar is sited, and climate change benefits.

2. DTE should conduct and make public an analysis of the impact of certain rate design proposals on low-income and people of color ratepayers.

3. DTE should make public how the costs of its other operations, especially the new gas plant, will affect rates. In particular, DTE should account for the difference in long-term benefits offered by the gas plant in contrast to renewable energy and how that compares to the costs that ratepayers must bear to build and maintain the new gas plant.

4. DTE should eliminate or reduce fees for application, interconnection, and re-enrollment for its distributed generation program. DTE must, at the very least, specify and commit to amounts for the fees.

5. DTE should waive the monthly System Access Contribution (SAC) fee for distributed generation customers who qualify as low-income. This is particularly important for equalizing costs for low-income communities and communities of color, as well as their opportunities and access to participate in renewable energy growth. This not only furthers DTE's commitment to affordability, it also helps ensure that low-income communities and communities of color do not face disproportionate burdens from climate change and the renewable-energy transition.

6. DTE should remove the requirement that distributed generation be limited to the premises of the system owner in order to allow renters to participate in community solar programs and to facilitate distributed generation programs generally. If DTE maintains the premise requirement, it should ensure that implementation preserves the affordability and accessibility of community solar distributed generation programs. Specifically, DTE should credit the payments made by a renter when that renter moves to a different unit. Additionally, when a new renter moves into a unit that already has DG installed, that new renter should not be charged any additional fees.

7. DTE should commit to hire residents of low-income communities and communities of color and, in particular, communities that bear the burdens of DTE's fossil fuel facilities.
8. DTE should allow distributed generation customers to choose their own contractors for interconnection.
9. DTE should commit to policies that ensure customer service is as timely and responsive to the needs of low-income and people of color communities as it is to other communities, particularly when responding to safety concerns.
10. DTE should state how much it plans in Detroit going forward to address safety and reliability concerns, especially with respect to downed wires.

Q: Does this conclude your testimony?

A: Yes, it does.

About DTE

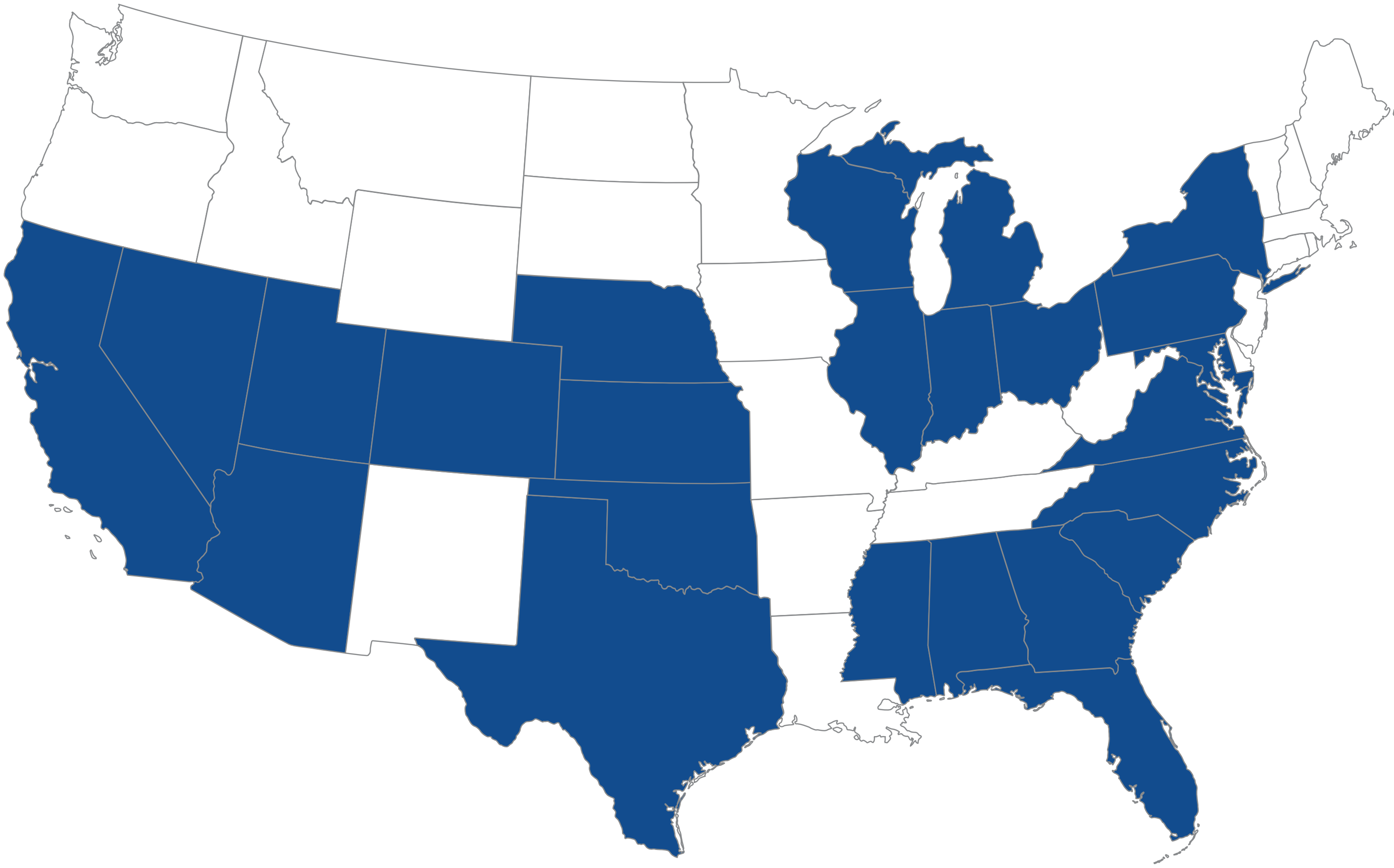
Leading the Way to a Cleaner, Safer and Smarter Energy Future

At DTE Energy our aspiration is to be the best-operated energy company in North America and a force for growth and prosperity in the communities where we live and serve.

DTE Energy (NYSE: DTE) is a Detroit-based diversified energy company involved in the development and management of energy-related businesses and services nationwide. Its operating units include an electric utility serving 2.2 million customers in Southeastern Michigan and a natural gas utility serving 1.3 million customers in Michigan. The DTE Energy portfolio includes non-utility energy businesses focused on power and industrial projects, natural gas pipelines, gathering and storage, and energy marketing and trading.

As one of Michigan's leading corporate citizens, DTE Energy is a force for growth and prosperity in the 450 Michigan communities it serves in a variety of ways, including philanthropy, volunteerism and economic progress. Information about DTE Energy is available on the DTE Energy home page, Twitter account and Facebook page.

DTE Energy has more than 10,000 employees in utility and non-utility subsidiaries involved in a wide range of energy-related businesses. The company's growing non-utility businesses are built around the strengths, skills and assets of DTE Energy's electric and gas utilities.



States We Serve

DTE Energy Utilities

DTE Electric

DTE Electric generates, transmits and distributes electricity to 2.2 million customers in southeastern Michigan. With an 11,084 megawatt system capacity, the company uses coal, nuclear fuel, natural gas, hydroelectric pumped storage and renewable sources to generate its electrical output. Founded in 1903, DTE Electric is the largest electric utility in Michigan and one of the largest in the nation.

At 1.1 million kilowatts, the company's Fermi 2 nuclear power plant represents 30% of Michigan's total nuclear generation capacity. This single plant is capable of producing enough electricity to serve a city of about one million people. Fermi 2 has been providing reliable, cost-effective power to DTE Electric customers for more than 20 years. The plant also has been designated as one of the nation's best-performing nuclear facilities.

DTE Gas

U-20162 - November 7, 2018
Official Exhibits of Soulardarity
Exhibit SOU-1a
Page 4 of 12

DTE Gas is engaged in the purchase, storage, transmission, distribution and sale of natural gas to approximately 1.2 million customers in Michigan. The company owns and operates 278 storage wells representing approximately 34 percent of the underground working capacity in Michigan. There is more gas storage capacity in Michigan than in any other state. Founded in 1849, DTE Gas is one of the nation's largest natural gas utilities.

DTE Energy Subsidiaries

DTE Gas
Company
Storing and transporting natural gas across the U.S. and Canada.
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DTE Gas Storage
& Pipeline
A national leader in natural gas storage and pipelines.
Learn More >

DTE Power
& Industrial
Energy products and expertise for commerce and industry.
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DTE Biomass

Energy

Producing renewable energy by capturing methane from landfills.

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DTE Energy
Trading
Energy sourcing and management for gas and electric utilities.
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Subsidiaries
Discover other growing DTE Energy groups and services.
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DTE at a Glance

Company Name:
DTE Energy Co. (NYSE:DTE)

Corporate
Headquarters:
One Energy Plaza
Detroit, Michigan 48226

Chief Executive Officer:
Gerard M. Anderson

Employees:
10,000

Financial Information:

2016 Annual Report Data
Operating Revenues
$10.6 billion
Net Income
$838 million
Assets
$32.0 billion
Diluted Earnings per Share
$4.83

Board of Directors:
Gerard M. Anderson (Chairman)
David Brandon
W. Frank Fountain
Charles "Chip" McClure
Gail J. McGovern
Mark A. Murray
James B. Nicholson (Presiding Director)
Charles W. Pryor Jr.
Josue Robles Jr.
Ruth G. Shaw
Robert C. Skaggs Jr.
David A. Thomas
James H. Vandenberghe

DTE Energy Leadership:
For more information about our leadership team, see our Executive Committee page.

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Police/Fire

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Builders

Landlord

Large Commercial and Industrial

Supply Chain

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Climate Change: Taking Action for the Future

The energy industry across the United States is undergoing a major transformation by seeking lower-carbon energy sources while meeting growing demand. At DTE Energy, we recognize our role in this industry-wide transformation and our responsibility to provide affordable, reliable and cleaner energy for our customers. Today, we are pursuing a deliberate course of action to meet the challenges of the future.

Climate Change

Greenhouse Gas Emissions

Emission Reduction Goals:

Reduce carbon dioxide emissions from electric generation by **75 percent below 2005 levels by 2040**

and

Reduce carbon dioxide emissions from electric generation by **80 percent below 2005 levels by 2050**

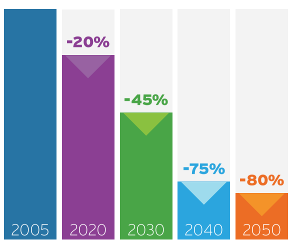
DTE Energy recognizes climate change as a key long-term policy issue we must address. Taking into account the long-term needs of our business, our customers and the environment, we have committed to reduce greenhouse gas emissions from electric generation by 75 percent below 2005 levels by 2040 and 80 percent by 2050. These long-term commitments include milestone reductions of 20 percent below 2005 levels by 2020 and 45 percent by 2030.

These goals will be met by retiring existing coal plants, building new natural gas-fired generation, developing more wind and solar projects and continuing to operate our Fermi 2 Power Plant. In addition to our investments in new energy generation, we are taking action across the company to reduce and offset greenhouse gas emissions:

- We are helping our customers reduce energy usage and lower their bills by becoming more energy efficient.
- We are national leaders in developing landfill gas capture systems and in converting small coal-fired power plants to run on biomass fuels.
- In 2016, we received an operating license renewal for our Fermi 2 Power Plant to extend operation from 2025 to 2045. We already hold a license to construct and operate a new nuclear unit at the Fermi site. We have not committed to building new nuclear capacity, but nuclear power is the only proven carbon-free power source that can operate around the clock.
- As a founding partner in the United States Environmental Protection Agency's Natural Gas STAR Methane Challenge Program, DTE has committed to use best management practices to reduce methane emissions from our gas operations over the next five years.

Climate Change

Emission Reduction Goals



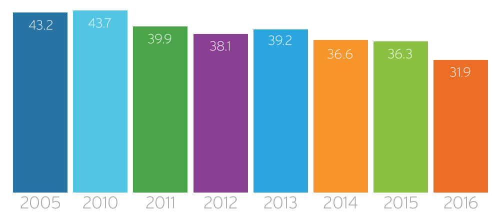
DTE Energy is committed to a long-term strategy to reduce greenhouse gas emissions that will guide our investment in new clean energy generation while minimizing financial impacts on customers.

Beginning in 2016, we moved our baseline for evaluating emission reductions from 2010 levels back to 2005 levels to be consistent with how we report other air emissions. This year's report shows performance against both the 2005 and 2010 baselines. For more information, see our discussion in the Air Quality section.

Controls to reduce carbon dioxide (CO_2) emissions have not been commercially demonstrated. Additional reductions in CO_2 must be achieved through reduced use of fossil fuels to produce electricity, improved efficiency at power plants, switching to less carbon-intensive fuels and other technological alternatives that cut CO_2 emissions for every megawatt-hour (MWh) of generation. We are already on a trajectory to reduce our CO_2 emissions from electric generation by 30 percent below 2005 levels in the early 2020s. Our 2016 total emissions of CO_2 from electric generation were 26 percent below 2005 levels. Some decrease in emissions is due to the extended shutdown of our St. Clair Power Plant following a fire in August 2016. For more information, see our Safety Section.

DTE actively participates with the following organizations to shape carbon performance standards: the United States Environmental Protection Agency (EPA), Michigan's Agency for Energy, Michigan's Department of Environmental Quality, the Edison Electric Institute and other business and community stakeholder groups to shape carbon performance standards, including the Clean Power Plan issued by the EPA in 2015. Regardless of possible changes in policy, DTE CO_2 emission reductions will continue, driven by our customers' economic and environmental interests. Our greenhouse gas reduction goals meet or exceed the reduction requirements of the Clean Power Plan – a policy designed to lower CO_2 emissions by power generators.

Greenhouse Gas Emissions in millions of tons of carbon dioxide equivalent (CO_2e)



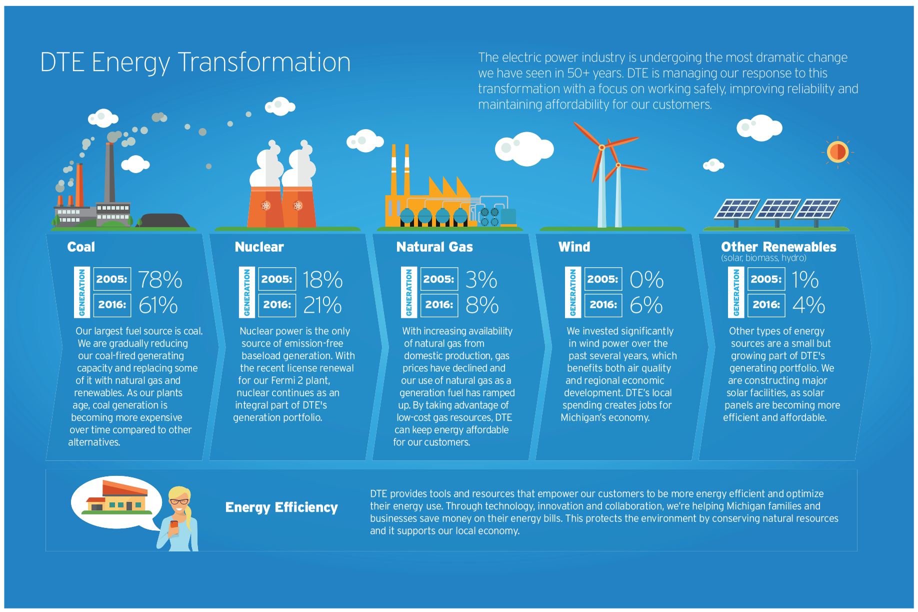
We believe regulations can be established to achieve national environmental and economic goals, plus coordinate with energy policy development in Michigan. Our goals align with Michigan Governor Rick Snyder's focus on adaptable energy and environmental policy. Every decision is based on excellent reliability, affordable prices and protecting/sustaining the environment. In 2016, Michigan passed significant energy legislation to enhance the state's commitment to reliable, clean energy. DTE's approach to managing our energy generation fleet will continue to be coordinated with federal and state policies.

Alternative Fuel Vehicles

Out of our company-wide fleet of vehicles across Michigan, about 500 are either fueled by compressed natural gas or are electric or hybrid vehicles. This represents nearly 13 percent of DTE Energy vehicles. Our alternative fuel vehicles create less greenhouse gas emissions and other air pollution compared to conventional service trucks and cars.

Climate Change

Transformation of Electric Generation



Our power is generated or purchased from a variety of sources including nuclear, coal, natural gas, oil and renewable energy. The overall mix of generation assets – especially the proportion of coal-fired capacity – is already changing and will continue to evolve. The shift in our generation portfolio is expected to cost between $7 billion and $8 billion. It is a dramatic transformation we are preparing for and will manage, while being mindful of our customers' needs for affordability and reliability.

Compared to newer energy generating alternatives, our coal fleet is aging and becoming more expensive to operate. Our generation mix is shifting over time from a portfolio of heavily-weighted coal toward a more balanced mix of coal, natural gas, renewable energy and nuclear energy. DTE recently closed the Marysville and Harbor Beach plants. In 2016, we announced plans to retire eight additional coal-fired energy-generating units at three sites in Michigan within the next seven years. The energy-generating units slated for retirement include units at our River Rouge Power Plant, St. Clair Power Plant and Trenton Channel Power Plant. Combined, these three power plants generated about 25 percent of the electricity produced by DTE in 2015 – enough energy to power 900,000 homes. The retirements are part of the fundamental transformation in the way electricity is being supplied across Michigan and throughout the United States.

Managing the Impacts of Coal Plant Closures

DTE Energy, in partnership with the United States Economic Development Administration (EDA), is providing grants to help St. Clair County and the City of Harbor Beach redevelop property following retirements of DTE Energy coal-fired power plants in an effort to help mitigate economic and social impacts of plant retirements in these two cities. DTE Energy's Harbor Beach Power Plant was retired in 2013 and the St. Clair Power Plant is expected to retire by 2023.

We recognize these plants have served communities for decades, providing jobs and significant revenue for municipal and community services. These grants will help St. Clair and Harbor Beach identify potential solutions to reinvest in the community and generate a new tax base. Specifically, the grant money will be used to commission a comprehensive economic impact study for the St. Clair plant closure that will assess the economic value of the plant and recommend strategies for economic diversification and reinvestment. We are also helping Harbor Beach develop a comprehensive feasibility study for a local multipurpose space that could serve as a business start-up hub.

DTE employees at those plants being closed are offered transfers to other positions within the company. We have not laid off any workers as a result of coal plant retirements within our generating fleet.

Pinnebog Wind Park

In December 2016, our Pinnebog Wind Park in Huron County began generating electricity. An expansion of our existing Echo Wind Park, the Pinnebog facility consists of 30 wind turbines with the ability to produce a combined 50 megawatts of clean, renewable energy – enough to power more than 22,000 homes. Pinnebog brings the number of DTE owned or operated wind parks to 13 across Michigan.

Approximately 150 people were employed to work on various aspects of the project during construction. DTE now has a total of 30 full-time employees working at its Huron County Renewable Energy Center. In addition to the creation of construction and operations jobs and local economic development, DTE wind projects in Huron County will generate tax revenue of more than $20 million by 2020.

We are actively working to replace retiring coal-fired capacity with other generating assets to maintain adequate reserves. DTE is evaluating options for new capacity to ensure safe, clean and reliable energy for our customers. One alternative under consideration is construction of a new, state-of-the-art natural gas-fired power plant. We have also brought in a substantial amount of new renewable energy capacity to our system. Building new generating assets in Michigan has the added benefit of creating jobs for Michigan residents.

To address immediate capacity needs, in 2015 we purchased two natural gas-fired simple cycle plants that, combined, can provide more than 1,000 megawatts of power during peak demand periods. Our major investments in natural gas transmission and storage infrastructure, including the NEXUS interstate pipeline and our new Link lateral and gathering pipeline system, also support the overall energy industry transformation.

Nuclear power generation provides a significant amount of carbon-free, base-load electricity, which is crucial for helping the state of Michigan and the entire United States meet the challenges of reducing greenhouse gases. In fact, 87 percent of Michigan's carbon-free electricity output is generated by the state's three nuclear energy facilities. In 2016, DTE received a 20-year license renewal from the United States Nuclear Regulatory Commission (NRC) for the Fermi 2 Power Plant, enabling the plant to continue operating through 2045. In addition, we hold an NRC license – obtained in 2015 – to construct and operate a new nuclear energy facility on the site of the existing plant, although we have no immediate plans to build a new nuclear plant. With these NRC approvals in hand, DTE Energy now possesses a diverse, comprehensive slate of options to plan for Michigan's energy future.

Climate Change

Renewable Energy

In 2016, we generated or contracted for more than 3.4 million megawatt hours of electricity from renewable energy sources – enough to power nearly 450,000 households.

Electricity from renewable resources – wind, sunlight and biomass – plays an important role in meeting our customers' energy needs while reducing our environmental impact. DTE is Michigan's largest investor in and producer of renewable energy. In 2016, our capital spending was $83 million for solar projects and $49 million for wind projects. The company has driven over $2 billion in investments in renewable energy since 2008.

In 2016, we generated or contracted for more than 3.4 million megawatt hours (MWh) of electricity from renewable energy sources – enough to power nearly 450,000 households.

In compliance with state-mandated targets, DTE Energy met the 10 percent renewable energy standard for 2016 based on retail sales. This was accomplished by retiring approximately 4.2 million certified Renewable Energy Credits (RECs) and other eligible credits that equated to 10 percent of our total 2014 retail sales of 42.4 million MWh, weather-normalized. Each of the RECs represents one MWh of renewable energy generated by DTE or purchased from third-party renewable sources.

Under the new Michigan energy legislation, electricity suppliers must meet a 12.5 percent renewable energy target by 2019 and 15 percent by 2021. DTE is well positioned to meet these future goals with the addition of wind and solar resources.

Climate Change

Wind Energy

Wind power is increasingly cost-competitive with traditional power generation technologies and we anticipate this trend to continue. Over the past six years, the average price of United States wind power has declined by 66 percent. For our region of the country, it is also the most efficient and cost-effective form of renewable energy.

Michigan is among the top 15 states in the nation for wind production. The cost to produce wind energy is now on par with natural gas generation.

DTE Energy values its relationships with landowners and local communities at our wind power sites. We work diligently to maintain strong community support as we pursue new wind projects. Wind energy continues to be valuable to DTE Energy as part of a well-balanced generation portfolio.

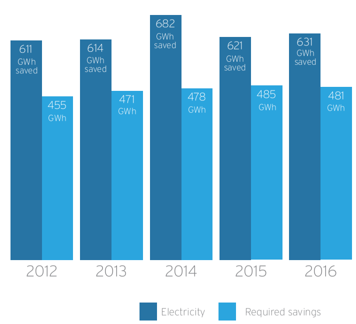
Leading Michigan in Solar Power

With 28 solar projects in its portfolio, DTE Energy continues to be Michigan's largest producer of solar energy. The company has additional solar projects in various stages of development. In 2016, DTE broke ground on three new solar projects in Michigan, two in the city of Lapeer and one in Detroit. The two Lapeer projects combined represent the largest utility-owned solar installation in Michigan and rank among the top five in the Eastern United States. Comprised of nearly 200,000 solar panels, the arrays (pictured at left) will produce enough clean, emission-free energy to power 9,000 homes when they begin generating electricity in 2017. The O'Shea Park array on the west side of Detroit — also scheduled for operation in 2017 — will be one of the largest urban solar arrays in the country.

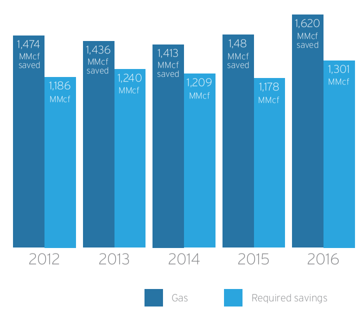
Climate Change

Energy Efficiency

Annual Energy Efficiency Savings – Electricity



Annual Energy Efficiency Savings – Gas



Customers

We provide incentives, information and techniques to help residential and business customers use energy more efficiently. This helps our customers reduce their costs, strengthening Michigan's economy. Energy efficiency also provides environmental benefits by conserving resources and reducing pollution.

DTE's energy efficiency programs help reduce customers' energy use by increasing awareness of energy saving possibilities and provide products and services. Rebates, tips, comparison tools, strategies and energy efficiency education help customers make informed energy saving decisions. Programs are designed to capture both electric and natural gas savings for all customers. For those DTE customers with only electric or only natural gas service, we make efforts to coordinate with other utility companies so that these customers can easily take advantage of energy efficiency program offerings to reduce both electricity and gas usage.

Michigan enacted legislation in 2008 that set energy optimization targets for utility companies and provided a funding mechanism to pay for program costs. As the charts to the left demonstrate, we have consistently exceeded the legislated targets. During 2016, utility customers saved energy by implementing measures such as installing more efficient appliances and lights, adding insulation, weatherizing homes and conducting boiler tune-ups. The efficiency programs are managed by DTE Energy and serviced by expert contractors. Our Energy Optimization Annual Report provides more detail about the specific programs in place.

Efficiency at DTE Energy Facilities

Across the organization, we are re-designing our workspaces to be more energy efficient, particularly our lighting systems, which are significant users of electricity. We completed light-emitting diode (LED) retrofits in office spaces and warehouses and developed a corporate standard for controlled temperatures. We have switched to all LED lighting with automated controls in our Detroit headquarters building. Company-wide, these facility improvements will save an estimated 2.8 million kilowatt hours annually, representing about 2,000 tons of greenhouse gases avoided.

Visit the DTE website to find our Energy Optimization Annual Report and other DTE newsletters, magazines and reports for residential and business customers.

Metro Detroit Freeways Light Up with New Energy Efficient LEDs

At DTE Energy, we create energy efficiency programs designed to save customers money, reduce energy waste and safeguard the environment. In 2016, DTE Energy partnered with the Michigan Department of Transportation to install energy efficient LED lighting on a number of major Metro Detroit freeways as part of DTE's Energy Efficiency Business Program. In total, nearly 13,000 high-pressure sodium, metal halide and mercury vapor fixtures were replaced by new, efficient LED fixtures. This lighting upgrade successfully reduced energy use by 65 percent and is expected to save Michigan residents an estimated $2 million in energy costs in 2017.

Electric Pricing

DTE Energy Ensures Customers Pay a Fair Price

Delivering affordable and reliable energy is our top priority.

DTE Energy is working hard to continue to lower your monthly electric service charge. Through operating efficiencies, technology and innovation, DTE Energy has controlled the rise of electric prices. On average, energy bills are the same today as they were five years ago.
DTE Energy is committed to keeping prices affordable for our customers while also making significant investments in our energy grid to upgrade infrastructure and improve electric reliability.

Keeping Electricity Costs Low

Electric Pricing Factors

Manage Your Electricity Usage

Electric Pricing Options

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Investors
Builders
Landlord
Large Commercial and Industrial
Supply Chain
Municipalities
Careers
Site Map
Terms & Conditions
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DTE Energy CEO Gerry Anderson Receives Prestigious Climate Leadership Award

Aggressive sustainability initiative earns recognition from Climate Registry, C2ES

DETROIT, March 1, 2018 /**PRNewswire**/ -- DTE Energy Chairman and CEO Gerry Anderson has been selected as the recipient of the Individual Climate Leadership award by the Center for Climate and Energy Solutions (C2ES) and The Climate Registry for driving DTE Energy's goal to reduce carbon emissions by more than **80 percent by 2050**.

Presented at the eighth annual Climate Leadership Conference in Denver, Anderson is among the first energy company CEOs to win the prestigious award, which honors exemplary corporate, organizational, and individual leadership in reducing carbon emissions and addressing climate change.

"Gerry Anderson is extremely deserving of the Climate Leadership Award," said Chris Kolb, president, Michigan Environmental Council. "His recognition that climate change is one of the defining public policy issues of our era and the defining issue within the energy industry is critical to the future health of the state of Michigan. He recognized the need for DTE Energy to take the lead in moving Michigan and the country forward to cleaner sources of energy that still provide reliable and affordable power for customers."

DTE Energy is Michigan's largest investor in renewable energy, having driven investments of $2 billion in wind farms and solar arrays since 2008, providing enough clean energy to power 450,000 homes. These investments helped DTE cut carbon emissions by nearly 25 percent in 2017 since 2005.

By continuing to incorporate substantially more renewable energy, transitioning its 24/7 power sources from coal to natural gas, continuing to operate its zero-emission Fermi 2 power plant, and improving options for customers to save energy and reduce bills, DTE plans to reduce carbon emissions by 45 percent by 2030, 75 percent by 2040 and more than 80 percent by 2050. These plans define a long-term shift by DTE to produce over three-quarters of its power from renewable energy and highly efficient natural gas-fired power plants.

"Fundamentally addressing climate change is among our greatest responsibilities," Anderson said. "Reducing our company's carbon footprint and developing cleaner sources of energy is a key priority for us. Over time, I suspect this work will also bring great opportunity – for example, when we invest to enable electric vehicles to drive similar transformation in the transportation sector."

DTE studied the engineering and the economics of Michigan's energy future for two years before announcing its 2050 carbon reduction goals – a timeframe that aligns with the target scientists broadly have identified as necessary to help address climate change.

"We've concluded not only that the 80 percent reduction goal is achievable, it is achievable in a way that ensures Michigan's power is safe, secure, affordable, reliable – and sustainable," Anderson said. "There doesn't have to be a choice between a healthy environment and a healthy economy, although the debate often gets framed that way. We can have both, if we invest in a smart way."

DTE's plans include:

- The construction of an additional 4,000 megawatts of renewable energy capacity – enough to supply the energy for nearly 2 million homes – supplementing the 1,000 megawatts of renewable energy DTE has built since 2008.
- The steady retirement of the company's aging coal-fired plants, which continued in 2016 with the **announced shutdown of 11 coal units** by the early 2020s.
- The construction of a highly efficient, state-of-the-art **natural gas-fired power plant** of about 1,100 megawatts on existing company property in East China Township, Mich., that will, beginning in 2022, supply 24/7 power and ensure reliability as the coal plant retirements proceed.
- Continued investment in energy efficiency and energy waste reduction, helping customers to both save money and take greater control over their energy use.
- The investment of $5 billion over the next five years to modernize the **electric grid** and **gas infrastructure**, ensuring reliability while creating and supporting more than 10,000 Michigan jobs.
- An aggressive plan to reduce energy and water within DTE's own facilities by a minimum of 25 percent.

The annual Climate Leadership Conference is dedicated to professionals addressing global climate change through policy, innovation, and business solutions. The conference gathers forward-thinking leaders from business, government, academia, and the non-profit community, to explore energy and climate related solutions, introduce new opportunities, and provide support to leaders taking action on climate change. The Climate Leadership Conference is hosted by the Center for Climate and Energy Solutions and The Climate Registry.

About DTE Energy

DTE Energy (NYSE:DTE) is a Detroit-based diversified energy company involved in the development and management of energy-related businesses and services nationwide. Its operating units include an electric utility serving 2.2 million customers in Southeastern Michigan and a natural gas utility serving 1.3 million customers in Michigan. The DTE Energy portfolio includes non-utility energy businesses focused on power and industrial projects, natural gas pipelines, gathering and storage, and energy marketing and trading. As one of Michigan's leading corporate citizens, DTE Energy is a force for growth and prosperity in the 450 Michigan communities it serves in a variety of ways, including philanthropy, volunteerism and economic progress. Information about DTE Energy is available at **dteenergy.com**, **twitter.com/dte_energy** and **facebook.com/dteenergy**.

DTE Energy (PRNewsFoto/DTE Energy) SOURCE DTE Energy

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For the Poor, Historic 2014 Floods Still a Toxic Nightmare

Torrential rains swamped the Tri County area two years ago. Many of the poorest residents of the area haven't been able to move on.

By Beth Dalbey | Aug 20, 2016 1:58 pm ET | Updated Aug 20, 2016 1:58 pm ET

METRO DETROIT, MI – For most of the 100,000 residents of Wayne, Macomb and Oakland whose homes were swamped two years ago this month, the historic 2014 floods are just an unpleasant memory — but not for the poorest victims, who live in Detroit, where aging infrastructure was unable to handle the torrential rainfall, and who are still living in flood damaged houses.

The Aug. 11, 2014, flash flooding was the country's worst natural disaster that year, according to the Federal Emergency Management Agency and the American Red Cross. Sewage spewed from floor drains, leaving a smelly mess behind.

The Red Cross said many low-income residents of Detroit are still waiting for help and are living in homes where they're exposed to toxic molds that can cause asthma and other chronic diseases, and where they haven't had working furnaces for two winters, Bridge magazine reported.

One reason they haven't received FEMA assistance is that they're renters, not homeowners. And, according to the Bridge story, FEMA workers were told not to go door to door because Detroit's streets are dangerous. Those who did apply for assistance were often too poor to pay for their share of the repair bills.

Take a Look Back

- Woman Reported Dead in Floods to Meet Rescuer on TV
- Harrowing, Heartbreaking Tales and Worry Written in the Muck Left By Floods of 2014
- Climate Change Bigger Threat Than Aging Infrastructure: City Official
- 'Houses Smell Like Sewers,' Mayor Says in Plea for Federal Aid
- How Copper Scrappers May Have Caused Freeway to Swallow Cars

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"The devastating effects of the flooding can still be seen in a number of Detroit communities," Kimberly Burton, regional chief executive officer for the American Red Cross Michigan Region, told Bridge. "Sadly, the aftermath of the disaster left … ongoing challenges to many who survived the initial rains."
Several local relief organizations have stepped forward, but the need is substantial and exceeds their resources.

How to Help

If you'd like to help, contact the Northwest Detroit Flood Recovery Project at (313) 646-4052, or email . Donations may be mailed to The Detroit Annual Conference Treasury Office, 1309 N. Ballenger Hwy., Suite 1, Flint, MI 48504. Memo Line: NW Detroit Flood Recovery. The Northwest Detroit Flood Recovery Project said 100 percent of all donations go to direct assistance.

» For the rest of this story, go to Bridge magazine.

Image credit: Patch file photo

See article on Patch >

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NOVEMBER 2017

Fumes Across the Fence-Line

The Health Impacts of Air Pollution from Oil & Gas Facilities on African American Communities

NAACP FOUNDED 1909 NATIONAL ASSOCIATION FOR THE ADVANCEMENT OF COLORED PEOPLE

CLEAN AIR TASK FORCE

Fumes Across the Fence-Line: The Health Impacts of Air Pollution from Oil & Gas Facilities on African American Commmunities

November 2017

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www.naacp.org

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DISCLAIMER

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Executive Summary

The oil and gas industry dumps 9 million tons of methane and toxic pollutants like benzene into our air each year. Methane is a greenhouse gas 87 times more potent than carbon dioxide at driving climate change and the oil and gas industry is now the largest source of methane pollution in the U.S. But methane is just one harmful air pollutant from the oil and gas industry. This paper sheds light on the health impacts of air pollutants from oil and gas facilities that specifically threaten the health of African American communities living near oil and gas facilities and in areas far from oil and gas production.

The life-threatening burdens placed on communities of color near oil and gas facilities are the result of systemic oppression perpetuated by the traditional energy industry, which exposes communities to health, economic, and social hazards. Communities impacted by oil and gas facility operations remain affected due to energy companies' heavy polluting, low wages for dangerous work, and government lobbying against local interests. The nature of the vulnerability of African American and other person of color fence-line communities is intersectional–subject to connected systems of discrimination based on social categorizations such as race, gender, class, etc.

Health impacts from the natural gas supply chain (natural gas facilities as well as oil production facilities with associated gas) were quantified in two reports published by Clean Air Task Force (CATF). As demonstrated in the CATF's *Fossil Fumes* report, many of these toxic pollutants are linked to increased risk of cancer and respiratory disorders in dozens of counties that exceed U.S. EPA's level of concern. These pollutants from the natural gas supply chain also contribute to the ozone smog pollution that blankets the U.S. in the warmer months. The 2016 *Gasping for Breath* report, published by CATF, found that ozone smog from natural gas industry pollution is associated with 750,000 summertime asthma attacks in children and 500,000 missed school days. Among adults, this pollution results in 2,000 asthma related emergency room visits and 600 hospital admissions and 1.5 million reduced activity days. (Chapter 2)

The life-threatening burdens placed on communities of color near oil and gas facilities are the result of systemic oppression perpetuated by the traditional energy industry, which exposes communities to health, economic, and social hazards.

This paper also shows the health impacts from petroleum refinery pollution. While we do

Air pollution is emitted from dozens of types of equipment and processes throughout the oil and gas sector. Many proven, low-cost technologies and practices are available to reduce these emissions, while also reducing emissions of methane, the main constituent of natural gas.

not quantify health impacts from oil refineries, as we did for impacts from natural gas facilities, we include case studies and stories from community members that have been impacted by pollution from these facilities. In this chapter, we focus solely on petroleum refineries, not the entire petroleum supply chain. (Chapter 3)

Many African American communities face serious health risks caused by air pollution. Higher poverty levels increase these health threats from air pollution translating into a bigger health burden on African American communities. And, companies often site high polluting facilities in or near communities of color, furthering the unequal distribution of health impacts. This paper for the first time quantifies the elevated health risk that millions of African Americans face due to pollution from oil and gas facilities. Specifically, the paper finds that:

- More than 1 million African Americans live within a half mile of existing natural gas facilities and the number is growing every year.
- As a result, many African American communities face an elevated risk of cancer due to air toxics emissions from natural gas development: Over 1 million African Americans live in counties that face a cancer risk above EPA's level of concern from toxics emitted by natural gas facilities.
- The air in many African American communities violates air quality standards for ozone smog. Rates of asthma are relatively high in African American communities. And, as a result of ozone increases due to natural gas emissions during the summer ozone season, African American children are burdened by 138,000 asthma attacks and 101,000 lost school days each year.
- More than 6.7 million African Americans live in the 91 counties with oil refineries.

The impacts described in this paper are just one layer of the many public health issues that these communities face. For example, this analysis only accounts for the risks associated with air pollution from oil and gas facilities—water and soil contamination may also harm communities living near oil and gas facilities. We also only included health impacts directly linked to oil and gas facilities—oil and gas development may also bring increased truck traffic, oil trains, and changes in land use, which can have significant public health impacts. In addition, many African American communities are located near other major sources of pollution, like power plants, chemical plants, hazardous waste facilities, and others. These communities already face high levels of pollution from various sources, and the added health threats from oil and gas development exacerbate their problems.

Air pollution is emitted from dozens of types of equipment and processes throughout the oil and gas sector, such as wells, completion equipment, storage tanks, compressors, and valves. Many proven, low-cost technologies and practices are available to reduce these emissions, while also reducing emissions of methane, the main constituent of natural gas. Thus, policies that reduce pollution from the oil and gas industry can help protect the health of local communities while addressing global climate change. In the Waste Not report, Clean Air Task Force (CATF), the Natural Resources Defense Council (NRDC), and the Sierra Club called for EPA regulations to cut methane emissions from the oil and gas industry by half. These methane standards would also significantly cut toxic and ozone-causing air pollution, which could have important benefits for air quality and public health in and downwind of oil and gas producing areas. In addition, stringent standards specifically for toxic and ozone causing pollutants emitted throughout the oil and gas supply chain are needed to ensure compliance with the Clean Air Act and protect public health.

Defending the safeguards finalized during the Obama administration and pushing for additional protections against pollution from the oil and gas industry will help improve the health of many African American communities while addressing global climate change. In June 2016, the EPA finalized strong methane standards covering new and modified oil and gas facilities. Although cutting methane from new oil and gas facilities is a step in the right direction, more important is cutting pollution from the nearly 1.3 million existing oil and gas facilities. These standards will reduce the risk from the air toxics and ozone smog-forming pollutants from this industry, but without a comprehensive standard, the vast majority, at least 75 percent, of all of the wells and oil and gas infrastructure in use today, will remain virtually unregulated and can continue to pollute without limit. Existing facilities spewed over 8 million metric tons of methane in 2015—equivalent in near-term warming potential to the greenhouse gas emissions from 200+ coal-fired power plants. To reduce the risk from air toxics and smog-forming pollution from this industry, EPA must require pollution reductions from all oil and gas facilities, and not roll back the protections that are already in place.

Environmental and energy justice issues are multilayered. Thus, the approach to tackling these issues must also be multilayered. People of color and low-income communities are disproportionately affected by exposure to air pollution, and standards that protect communities from this pollution are critical. In addition, these communities have a lot to gain from the transition from the current fossil fuel energy economy to one based on equitable, affordable, and clean energy sources. African American and other fence-line communities, such as people who are low-income, can organize to fight the intentional polluting of their neighborhoods. The first step is to address the many ways fossil fuels taint our communities, including the air pollution from oil and gas development.


© CATF

Equipment at a gas well.

Defending the safeguards finalized during the Obama administration and pushing for additional protections against pollution from the oil and gas industry will help improve the health of many African American communities while addressing global climate change.

CHAPTER 1

Environmental Pollution and the Health Impact in African American Communities

The racial disparities among communities impacted by environmental pollution in the United States are stark. African Americans are exposed to 38 percent more polluted air than Caucasian Americans, and they are 75 percent more likely to live in fence-line communities than the average American.[1] Fence-line communities are communities that are next to a company, industrial, or service facility and are directly affected in some way by the facility's operation (e.g. noise, odor, traffic, and chemical emissions). Most fence-line communities in the United States are low-income individuals and communities of color who experience systemic oppression such as environmental racism.

> It is not a coincidence that so many African Americans live near oil gas development. Historically, polluting facilities have often been sited in or near African American communities.

Many African Americans are exposed to high levels of pollution.

The air in many African American communities violates air quality standards intended to protect human health.

Over 1 million, or two percent of African Americans, live in areas where toxic air pollution from natural gas facilities is so high that the cancer risk due to this industry alone exceeds EPA's level of concern.[2] And, over 1 million African American individuals live within a half mile of an oil and gas facility—those within this half mile radius have cause for concern about potential health impacts from oil and gas toxic air pollution.[3] These figures only account for air pollution from wells and natural gas compressors and processors—the numbers would be much higher if pollution from oil refineries was factored.

It is not a coincidence that so many African Americans live near oil gas development. Historically, polluting facilities have often been sited in or near African American communities. Companies take advantage of communities that have low levels of political power.[4] In these communities, companies may face lower transaction costs associated with getting needed permits, and they have more of an ability to influence local government in their favor.[5]

African Americans and other environmental justice communities face heavy burdens because of the millions of pounds of hazardous emissions released by the oil and gas industry each year. Many African American communities face serious health risks as a result of toxic pollution from industrial facilities that are often located blocks from their homes. These life-threatening burdens are the result of systemic oppression perpetuated by the traditional energy industry, which exposes communities to health, economic, and social hazards. Communities impacted by oil and gas facility operations remain affected due to energy companies' heavy polluting, low wages for dangerous work, and government lobbying against local interests.[6] African American and other person of color living in fence-line communities experience connected systems of discrimination based on social categorizations such as race, gender, class, disability, etc. These communities are impacted by the negative health impacts of oil and gas facility operations because of discrimination.

The impacts described in this paper are just one layer of the many public health issues that African American and other communities of color face as a result of oil and gas operations. For example, this analysis only accounts for the risks associated with air pollution from oil and gas facilities—the exposure risks from water and soil contamination may also harm communities living near

CASE STUDY

Siting of natural gas infrastructure in environmental justice communities

The Atlantic Coast Pipeline (ACP), North Carolina, Virginia, and West Virginia

Set for completion in 2019, Duke Energy and Dominion Resources have begun steps to build a 600-mile transmission pipeline from West Virginia through eastern North Carolina. The Atlantic Coast Pipeline (ACP), being built to bring natural gas from hydraulic fracturing sites in West Virginia and Pennsylvania to power plants in North Carolina.[10] This expansion of coastal infrastructure along the densely populated East Coast, will increase the likelihood of facilities being sited in heavily populated areas. Typically, areas with a high concentration of low-income and people of color, as well as other fence-line communities.

The North Carolinian coastline from the Outer Banks north to the Virginia line, is heavily populated by low-income, African American residents. The proposed route of the ACP directly impacts a number of African-American, and other vulnerable communities, in the state. In seven of the eight counties along the proposed route the African American population ranges from 24.3 to 58.4 percent, compared to the 21.3 percent at the state level. These counties also reflect income vulnerability, as seven of the eight counties have median household incomes below the statewide median of $46,693. Seven of the eight counties along the proposed route have poverty levels higher than the state average (17.2 percent), ranging from 17.6 to 33.1 percent.[11] The expansion of the ACP and other natural gas infrastructure along the North Carolinian coast would have unavoidable adverse impacts on already vulnerable communities.

The pipeline is not the only piece of infrastructure to be established as a part of the project. As part of the plan for the Atlantic Coast Pipeline, Dominion intends to build a compressor station in Northampton County, North Carolina, a county that share's a border with Virginia. Northampton's African American population is 54.6 percent, and the median household income in $31,453, nearly $15,000 below the state average. Almost 32 percent of Northampton residents live in poverty, compared to 17.2 percent statewide.[12]

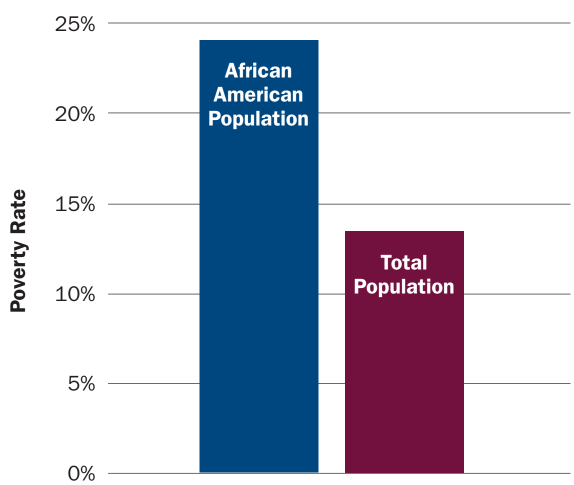
The overall cancer rate in Northampton County exceeds that for the state of North Carolina at 516.6 per 100,000 (the state average is 488.9 per 100,000 people). Lung and bronchial cancers, two forms of cancer caused by common air pollutant, are specifically elevated: 80.5 per 100,000 people compared to 70.1 per 100,000.[13] Given the current state of vulnerable populations in the area of impact of the proposed pipeline, particularly in in North Hampton, a compressor station, pipeline, and other natural gas infrastructure, could exacerbate health problems from increased air pollution.

For more on the communities affected by the ACP project visit the Southern Environmental Law Center, Path of the Pipeline.[14]

oil and gas facilities.[7] We also only included health impacts directly associated with oil and gas facilities—oil and gas development may also entail increased truck traffic, oil trains, and changes in land use, which can have significant public health impacts.[8] In addition, many African American communities are located near other major sources of pollution, like power plants, chemical plants, hazardous waste facilities, and others.[9] These communities already face high levels of pollution from various sources, and the added health threats from oil and gas development exacerbate their problems.

This paper sheds light on the health impacts many African American communities face from oil and natural gas production, processing, and transmission facilities. It also underscores both the need to implement commonsense standards that reduce pollution from these facilities, and the need to transform the current energy economy into one that is based on clean energy sources and the principles of energy democracy (local energy choice) and energy sovereignty (local control of energy systems). This new energy economy will need to address the overlapping systems of oppression that allow whole communities to be poisoned.

FIGURE 1
Poverty Rate



Source: U.S. Census Bureau, National Center for Health Statistics

Asthma threatens the health of children in African American communities.
Approximately 13.4 percent of African American children have asthma (over 1.3 million children), compared to 7.3 percent for white children.[15] The death rate for African American children with asthma is one per 1 million, while for white children it is one per 10 million.[16]

Many African Americans are particularly burdened with the health impacts from air pollution, due to high levels of poverty and relatively lower rates of health insurance.
Individuals living below the poverty level are particularly burdened by the effects of air pollution. In 2015, 24 percent of the African American population (including 32 percent of African American children) were living in poverty, compared to 14 percent for the overall US population (and 20 percent of US children).[17] High poverty rates restrict housing options for African American families. African Americans are also somewhat less likely to have health insurance than the population as a whole. In 2015, 11.5 percent was the uninsured rate for African Americans under the age of 65, versus 10.8 percent for the population as a whole and 7.5 percent for the white population.[18] The combination of higher poverty rates and lower prevalence of health insurance exacerbates the impact air pollution has on low-income African American families.

"Common sense would suggest that a pipeline carrying a highly flammable substance and a massive polluting industrial facility should not be placed in any residential community, much less an environmental justice community."

– Congressman Sanford D. Bishop, Jr. John Lewis, Hank Johnson Jr., and David Scott in a 2015 response to the Saber Trail Pipeline Project in Alabama, Southern Georgia, and Central Florida.[19]

COMMUNITY STORY

"My parents grew up on the Permian Basin where we have some of the largest frack fields and very old oil wells, as well. Thinking about the impacts of these chemicals and toxins that persist in the area, I realized that I never been out of this stuff. Even in the womb of my mother and her own sort of chemistry and biology that she grew up with having spent her whole life there.... The city of Houston did a study and identified 12 carcinogens and that research is available and some of the highest concentrations are in areas that I grew up in and spent majority of my childhood in. Some of the things that I experienced were frequent headaches, irritability, and nose bleeds, gastrointestinal problems, a lot of things that I said I can show and we have seen are the same symptoms are as a result from being exposed to some of these carcinogens."

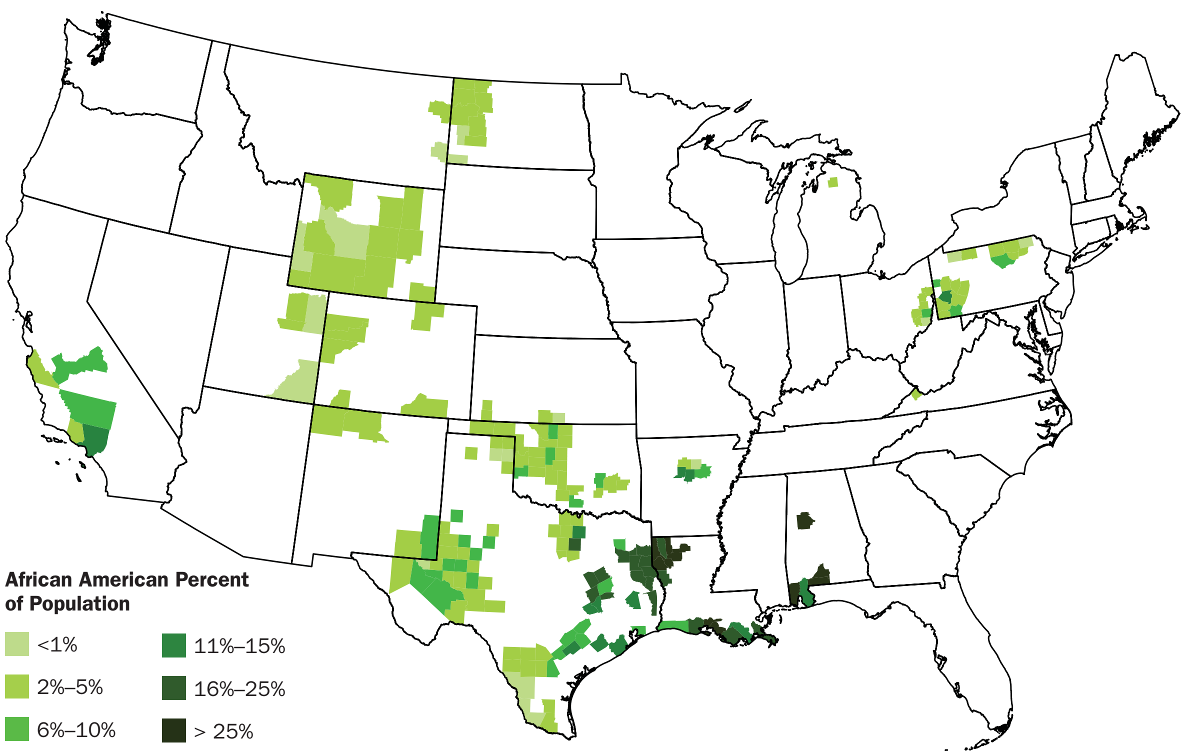
— Bryan Parras, Houston, TX

A large number of African Americans live in states with large numbers of polluting oil and gas facilities.

Many of the states with the highest amount of oil and gas development also have large African American populations. In three of the top ten oil and gas production states of 2015—Louisiana, Texas, and Pennsylvania—African Americans made up more than 10 percent of the population. And, in two of the other top oil and gas states–North Dakota and Wyoming–the African American population has grown significantly since 2000, a time when oil and gas production in these states has also grown.[20]

FIGURE 2

African American Percent of Population in 200 Counties with Highest Oil and Gas Production (2015)

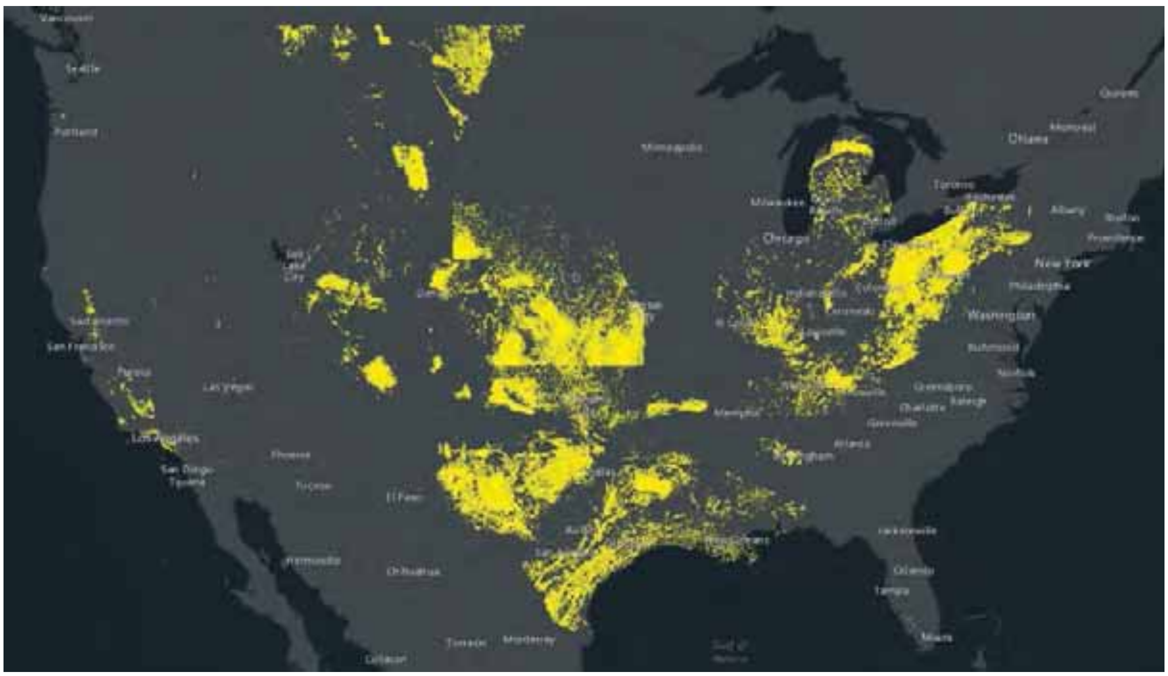


Source: U.S. Census Bureau, DI Desktop

Earthworks released the "Oil and Gas Threat Map," an interactive map of the nearly 1.3 million active oil and gas wells, compressors and processors in the U.S.[21] The map shows how many African Americans live within a half mile of oil and gas facilities, and it indicates that those within this radius have cause for concern about potential health impacts from oil and gas pollution. It is not a declaration that those near oil and gas facilities will definitely have negative health impacts, and it also does not mean that people living further than a half mile are safe from health impacts. As we document later in this paper, there is ample evidence that the pollution from oil and gas operations impacts individuals and communities both close to and far from these facilities.

FIGURE 3

Threat Radius—The Area within a Half Mile of Active Oil and Gas Wells, Compressors, and Processing Plants



The oil and gas well data was downloaded directly from state government agencies, and it includes all active conventional and unconventional wells in 2016 and 2017. Gas compressor and processing plant data were primarily taken from a variety of state and federal databases. State and federal agencies do not monitor compressors and processing plants as closely as they do wells, so this data is not comprehensive in all states.

Source: http://oilandgasthreatmap.com/threat-map

COMMUNITY STORY

"Fortunately, no one was seriously injured as a result of the explosion, but nearby residents were concerned about what they might be exposed to as a result of the explosion [BP Amoco and Enterprise Products, LLC gas processing plant in Jackson County, MS]…Unlike oil and chemical plants, gas processing plants are not required to report the list and quantity of hazard pollutants they release to the Environmental Protection Agency's Toxic Release Inventory (TRI) Program."

— Steps Coalition, Biloxi, MS

More than 1 million African Americans nationally (2.4 percent of the total African American population) live within a a half mile radius of oil and gas facilities (see Table 1).

- Ohio, Texas, and California have the most African Americans living within a half mile radius of oil and gas facilities.
- And, in Oklahoma, Ohio, and West Virginia, approximately one in five African Americans in the states live within the half mile radius of oil and gas facilities.

TABLE 1

Top 10 States by African American Population Living within a Half Mile Radius of Oil and Gas Facilities (2010 Census)

State	African American Population within a Half Mile Radius	Percent of African American Population in State within a Half Mile Radius
Texas	337,011	10%
Ohio	291,733	19%
California	103,713	4%
Louisiana	79,810	5%
Pennsylvania	79,352	5%
Oklahoma	73,303	22%
West Virginia	13,453	17%
Arkansas	10,477	2%
Mississippi	10,448	1%
Illinois	10,227	1%
TOTAL	**1,052,680**	**2%**

Source: http://oilandgasthreatmap.com

Equipment at a gas well. © CATF

BOX 1

Air Pollutants & Associated Health Concerns from Oil and Gas

Methane, the primary component of natural gas, is over 80 times more potent than carbon pollution's projected disruption to our climate over the coming decades. Methane also contributes to ozone smog formation.

Toxic and Hazardous Air Pollutants include a wide range of chemicals that are known or probable carcinogens and/or cause other serious health impacts. Among other chemicals of concern, oil and natural gas facilities are responsible for the following air pollutants, either emitted as a component of raw natural gas or a by-product of natural gas combustion that occurs at these sites. Exposure studies based on air measurements have identified levels of benzene, hydrogen sulfide, and formaldehyde near oil and gas sites that exceed health-based thresholds.

- **Benzene** has been linked to cancer, anemia, brain damage, and birth defects, and it is asso-ciated with respiratory tract irritation.[22] Over time, benzene exposure can also lead to reproductive, developmental, blood, and neurological disorders. A 2012 study estimated a 10 in a million cancer risk–well over EPA's level of concern–for residents near a well pad, attributable primarily to benzene levels measured in the air near the well site.[23] The EPA's National Emissions Inventory (NEI) estimates that over 20,000 tons of benzene was emitted by oil and gas sources in 2011.[24] Benzene is a constituent of raw natural gas, so leaks and vents are the primary source of benzene pollution from the oil and gas industry.
- **Ethylbenzene** has been associated with respiratory and eye irritation, as well as blood and neurological disorders.[25] The NEI estimates that over 2,000 tons of ethylbenzene was emitted by oil and gas sources in 2011.[26] Like benzene, ethylbenzene is a constituent of raw natural gas and leaks and vents of gas are the primary sources of ethylbenzene.
- **Hydrogen sulfide** gas is primarily found near wells producing "sour gas." At high concentrations, it can cause severe respiratory irritation and death. At lower levels, it can lead to eye, nose, and throat irritation; asthma attacks; headaches, dizziness, nausea, and difficulty breathing.[27]
- **Formaldehyde** has been linked to certain types of cancer, and chronic exposure is known to cause respiratory symptoms.[28] The NEI estimates that nearly 22,000 tons of formaldehyde was emitted by oil and gas sources in 2011.[29] Formaldehyde is primarily emitted from combustion sources such as flares and compressor engines.

Volatile Organic Compounds (VOCs) are precursors to ground level ozone smog. Ozone smog can impair lung function, trigger asthma attacks, and aggravate conditions of people with bronchitis and emphysema.[30] Children, the elderly, and people with existing respiratory conditions are the most at risk from ozone pollution.

BOX 2

Air Pollution Sources in the Oil and Gas Industry

The oil and gas industry includes a large number of industrial sites across the country. These include hundreds of thousands of wellpads where oil and gas are produced, thousands of compressor stations which move natural gas from wells to markets, and hundreds of processing plants which prepare gas for high-pressure pipelines that take it to markets.

Raw natural gas (i.e., gas as it is produced from underground formations, before significant processing is done) usually contains significant amounts of ozone-forming volatile organic compounds (VOCs) and often contains significant amounts of toxic hazardous air pollutants (HAPs), though gas varies in composition from source to source. The HAPs in raw gas include hexane, benzene, and other aromatic chemicals; poisonous gases like hydrogen sulfide can also be present. As such, natural gas wellpads and the natural gas gathering pipeline and compression systems that move gas from wells emit substantial amounts of VOCs and HAPs, as do the processing plants that separate natural gas liquids (VOC species that are valuable components of raw natural gas) from the natural gas that is sent through pipelines to customers. Some of those pollutants remain in the gas even after processing. Emissions from facilities further downstream in the natural gas supply chain, like transmission compressor stations and local distribution equipment, still include some of these pollutants.

Crude oil production operations also emit substantial amounts of VOCs and HAPs. Methane, as the main constituent of natural gas, is emitted from all types of oil and natural gas facilities, from wellpads to the natural gas distribution systems in urban areas.

- **Oil and Gas Production:** The oil and gas production segment includes many diverse activities, such as production of hydrocarbons from underground geologic formations; separation of natural gas, oil, and, water; and collection of gas from multiple wells through natural gas gathering pipeline and compressor systems. These activities in turn involve processes such as well drilling, hydraulic fracturing or other well stimulation, and well workovers; and they require equipment such as tanks, piping, valves, meters, separators, dehydrators, pipelines, and gathering compressors.
- **Natural Gas Processing:** Gas processing plants separate raw natural gas into natural gas liquids and processed natural gas that meets specifications for transport in high-pressure pipelines and consumption in furnaces and power plants. Natural gas liquids are hydrocarbons such as propane, butane, etc., which are valuable products of gas processing. The processing removes most of the toxic components from the gas, but some toxins remain.
- **Natural Gas Transmission and Storage:** Natural gas transmission pipelines carry gas from production regions to markets. This segment also includes facilities where gas is stored, either underground or in tanks. Compressor stations along pipelines maintain pressure and provide the energy to move the gas.
- **Natural Gas Distribution:** Finally, natural gas is delivered to customers (residential, commercial, and light industrial) via low-pressure underground distribution pipelines.
- **Oil Refineries:** Refineries are large industrial plants that process crude oil into various petroleum products, such as gasoline, diesel fuel, jet fuel, and others. Emissions of toxic and hazardous pollution from these facilities are very high, while methane emissions are relatively small.

CHAPTER 2

Health Impacts from Natural Gas Facilities

Natural gas facilities emit toxic air pollution and pollution that forms ozone smog. In two previous reports, "Fossil Fumes" and "Gasping for Breath," CATF presented the public health impact of toxic air pollution and ozone smog, respectively, from the natural gas industry. Here, we break out and discuss the public health impacts of these pollutants specifically for African American communities.

"Just because the oil company brings jobs and other benefits, doesn't mean it can do it at the expense of my health and well-being."

— Charles Zacharie, Baldwin Village resident, Los Angeles, CA[32]

The health impacts described in this chapter are the result of air pollution that is directly due to natural gas facilities and equipment (for impacts of petroleum refineries, see Chapter 3).[31] As noted above, we are not fully accounting for the public health impact of natural gas development: water pollution and soil con-tamination can also have a significant public health impact, as can ancillary activities such as increased truck traffic. As such, the impacts presented in this chapter should be understood as minimum amount of impact; the true public health impact of natural gas development is certainly much higher.

In this chapter, we discuss the following public health impacts of natural gas facilities:

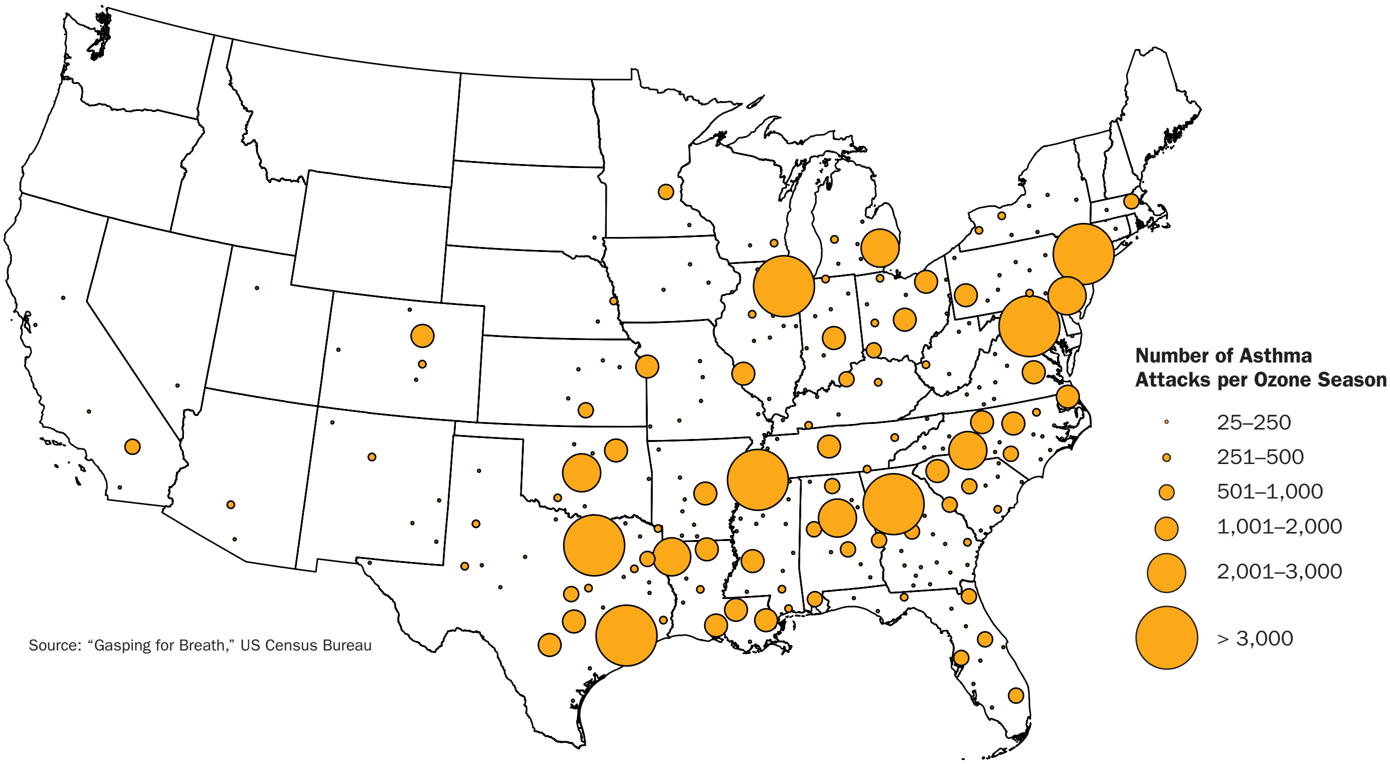
- Excessive concentrations of ozone (smog)
- Increased risk of cancer due to toxic air emissions.

The air in many African American communities violates air quality standards for ozone. High ozone levels are caused by emissions from a variety of industries, but it is possible to separate out the increase in ozone that can be directly attributed to emissions from natural gas facilities and its associated health impact.[33] CATF's "Gasping for Breath" describes an ozone modeling analysis that compares ozone levels in a 2025 "Baseline" case and a 2025 "Zero Natural Gas Emissions" case. The difference in ozone levels between these two cases is the ozone that can be directly attributable to natural gas.[34]

The increased level of ozone can be associated with an increase in a variety of health impacts. The EPA uses peer-reviewed literature to estimate how these changes in ozone will affect public health.[35] Using the same studies and methodology as the EPA used in its recent Ozone National Ambient Air Quality Standards (NAAQS) rulemaking process, CATF's ozone modeling estimates the impact on public health that can be directly attributable to ozone caused by emissions from the natural gas sector. Nationally, CATF estimates that over 750,000 asthma attacks for children and over 500,000 lost school days during the summer ozone season are due to ozone increases resulting from natural gas emissions.[36] After adjusting these total incidence rates based on the county level African American population, the African American population is burdened by approximately 138,000 asthma attacks and 101,000 lost school days attributable to natural gas air pollution each year. The burden of these health impacts falls more heavily on populations that already

FIGURE 4

Number of Asthma Attacks Experienced by African American Children Caused by Ozone Attributable to Oil and Gas by Metropolitan Area



Source: "Gasping for Breath," US Census Bureau

TABLE 2

Top 10 Metropolitan Areas by African American Health Impacts Attributable to Ozone caused by Natural Gas Pollution

Metropolitan Area	Asthma Attacks (per year)	Lost School Days (per year)
Dallas-Fort Worth (TX, OK)	8,059	5,896
Atlanta (GA)	7,499	5,469
Washington-Baltimore (DC, MD, VA, WV, PA)	7,216	5,269
New York-Newark (NY, NJ, CT, PA)	5,235	3,821
Houston (TX)	4,256	3,111
Chicago (IL, IN, WI)	3,777	2,760
Memphis (TN, MS, AR)	3,674	2,692
Philadelphia (PA, NJ, DE, MD)	2,887	2,104
Shreveport-Bossier City (LA)	2,536	1,871
Detroit (MI)	2,402	1,751
National African American Total	**137,688**	**100,564**

Source: "Gasping for Breath," US Census Bureau have high levels of asthma or who are already systemically oppressed. Figure 4 on page 15 shows the number of asthma attacks due to natural gas air pollution among African American children in metropolitan areas across the county each year.[37]

Two of the ten metropolitan areas with the most asthma attacks attributable to natural gas ozone pollution are located in Texas: the areas in and around Dallas and Houston. The Shreveport, Louisiana metropolitan area is located near natural gas production. In addition, the air pollution from natural gas facilities has a large impact on some metropolitan areas that are located far from natural gas producing regions, like in Atlanta, Washington DC, New York, Chicago, Memphis, Philadelphia, and Detroit.

CASE STUDY

Downwind Air Pollution in the Mid-Atlantic

Baltimore, MD

While health risks are greatest near the original sources of pollution, airborne pollution from oil and gas facilities can have health impacts far downwind. The air pollution from natural gas facilities in Pennsylvania and West Virginia has had significant impacts on air quality in Maryland, particularly in the Baltimore—District of Columbia (D.C.) corridor where there is a high concentration of African Americans and other people of color.

A 2015 study from the University of Maryland evaluated the longer-term and long-range effects of hydraulic fracturing on regional air pollution. The study analyzed hourly measurements of air pollutants, including ethane—gases found in natural gas mixtures—in Baltimore and Washington, D.C. between 2010 and 2013. It found that ethane measurements increased by 25 percent between 2010 and 2013 in the region. Ethane is the second-most abundant compound in natural gas, which when inhaled can cause nausea, headaches, and dizziness. While there has been an overall decline in non-methane organic carbons and improvement in air quality since 1996, the atmospheric concentration of ethane in the region managed to rise between 2010 and 2013.[38]

Maryland officially banned the practice of hydraulic fracturing in 2017, although even before the ban, hydraulic fracturing was a rare practice. After comparing the rise in ethane to natural gas extraction in neighboring states, the researchers found a correlation. After tracking the wind direction, distribution, and speed in the Marcellus shale play region, researchers determined that Baltimore and other areas in Maryland and Washington DC were on the tail end of natural gas emissions originating from sites in Pennsylvania, West Virginia, and Ohio.

In 2015, people in Baltimore experienced 89 days of elevated smog, and on 20 days it was at unhealthy levels, increasing the risk of premature death, asthma attacks, and other adverse health impacts.[39] Baltimore is a predominately African American city, with African Americans accounting for 63 percent of the city's population. The city's fence-line neighborhoods have a history steeped in toxic fumes, industry dumping, and hazardous air pollutants. The impacts of methane and other gases from out of state have further worsened of air quality in these communities and the entire region. With poor air quality already, residents of Baltimore should not also be exposed to pollution from oil and gas development in other states.

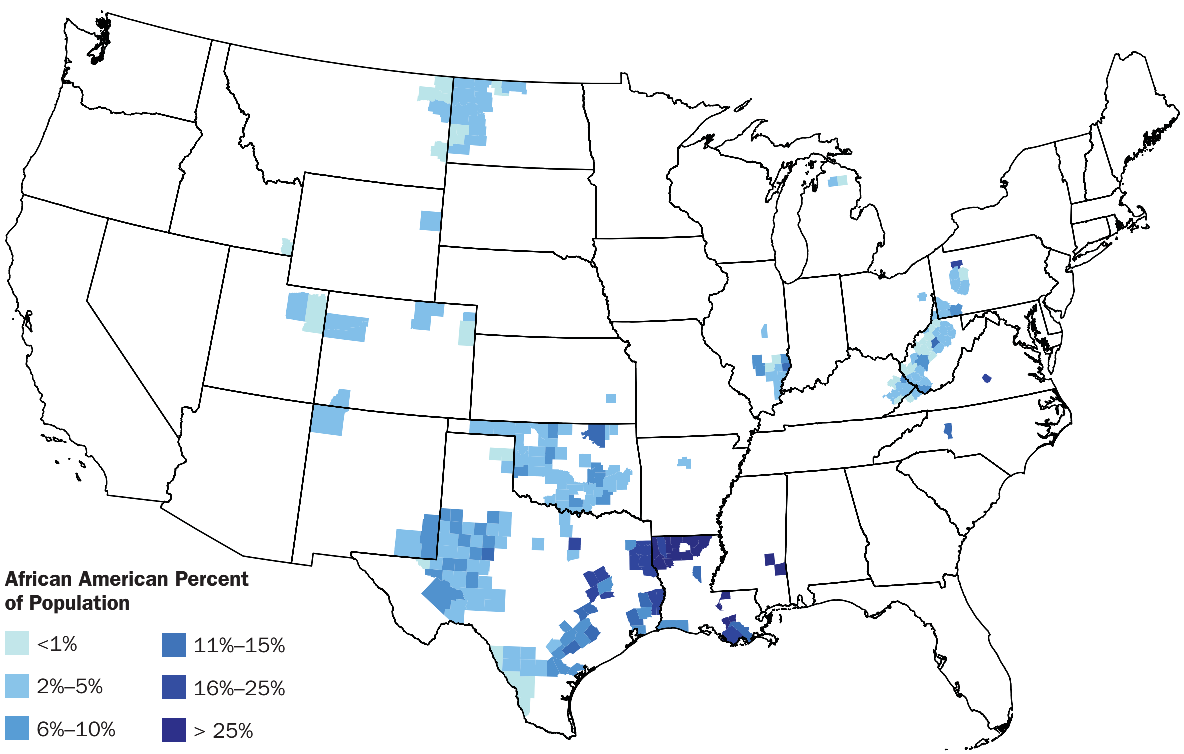
COMMUNITY STORY

"Over 200 cities in Texas have local ordinances regulating oil and gas activity where people are living with these consequences. Cities all over Texas have ordinances regulating things like reasonable distances for drilling away from neighborhoods. They have rules to protect fresh water to decide where pipelines can be constructed. They even regulate where trucks can drive and the hours in which facilities can operate and these are all locally regulated... Ordinances like Dallas's and any of the other ordinances across Texas could be overturned as soon as the company sues the city and future ordinances have to move industry standards.... This is a human rights violation because people pass these laws to protect their health and safety from explosions and to prevent water and air pollution and the state agencies and the federal government will not. It was a power grab and it weakens our most democratic institution."

— Melanie Scruggs, TX

FIGURE 5

African American Percent of Population in Counties above EPA's Level of Concern for Cancer Risk from Oil and Gas Emissions



Source: "Fossil Fumes," U.S. Census Bureau

Many African American communities face an elevated risk of cancer due to toxic air emissions from natural gas development. In the EPA's National Air Toxics Assessment (NATA), the EPA identifies and prioritizes air toxics, emission source types, and locations that are of greatest potential concern when looking at health risk from air emissions in populations. NATA estimates cancer risk that can result from toxic air emissions. The metric for cancer risk is the number of cancer cases per million people exposed; areas with cancer risk above one-in-a-million are considered to be above EPA's level of concern. In CATF's *Fossil Fumes* report, 238 counties in

21 states faced a cancer risk above EPA's one-in-a-million level of concern due to toxic emissions from natural gas operations.[40] In 2015, over 9 million people lived in these counties, of whom 1.1 million were African American.

Of the African Americans living in counties above EPA's level of concern for cancer risk, most live in Texas, Louisiana, and Oklahoma.

The inventory that our analysis relied on, the National Emissions Inventory, may underestimate the total emissions of toxics from natural gas.[41] Many peer-reviewed studies based on independent measurements conducted in both natural gas producing basins and urban areas consuming natural gas have concluded that official emissions inventories such as the National Emissions Inventory (NEI)underestimate actual emissions from natural gas.

While the cancer risk estimates are based on the EPA's most recent NEI projections, there is still a degree of uncertainty regarding emissions levels reported to the NEI. For example, in 2015, an expert review analysis in California identified the need to update emissions estimates, particularly in relation to understanding health threats for communities in the Los Angeles Basin. Thus, while no counties in California are above EPA's level of concern in the current analysis, this may be a result of underestimated emissions reported to EPA, not an actual indication of low risk levels.

TABLE 3

Top 10 States with African American Population Living in Counties Above EPA's Level of Concern for Cancer Risk (2015 Population Data)

State	Number of Counties Above EPA's Level of Concern for Cancer Risk	Total Population in High Risk Counties	Total African American Population in High Risk Counties	Percent of Population in High Risk Counties that is African American
Texas	82	4,189,179	528,357	13%
Louisiana	19	1,027,556	354,952	35%
Oklahoma	40	796,695	37,130	5%
West Virginia	28	804,850	30,589	4%
Pennsylvania	8	624,764	25,071	4%
North Carolina	1	169,866	22,682	13%
Mississippi	2	37,135	17,039	46%
Colorado	6	419,023	7,458	2%
Illinois	13	205,829	7,417	4%
New Mexico	3	247,495	7,093	3%
Total	**238**	**9,086,228**	**1,050,372**	**12%**

Source: "Fossil Fumes," US Census Bureau

COMMUNITY STORY

"Oil and gas development poses more elevated health risks when conducted in areas of high population density, such as the Los Angeles Basin, because it results in larger population exposures to toxic air contaminants."

— The California Council on Science & Technology

CASE STUDY

A History of Urban Drilling

Inglewood Oilfield, Inglewood, CA

Los Angeles has a long history of urban oil drilling. Across Los Angeles, drilling pumps can be found in and near public parks, as well as throughout commercial and residential areas. The 1000-acre Inglewood Oil Field, operated by Freeport-McMoRan Oil and Gas, is one of the largest urban oil fields in the United States. The field contains 959 wells that extract over three million barrels of oil a year. The environmental hazards of this urban drilling have caused countless environmental and public health issues, lawsuits, and community actions.

Inglewood oil field, located in the north-western area of the Los Angeles Basin, has more than one million residents within five miles of the oil field. 50,000 households sit immediately next to the field.[42] Many of these fence-line communities are predominately communities of color. The neighborhoods surrounding the oilfield include Baldwin Hills, Inglewood, and Culver City neighborhoods, which together are 50 percent African American. Residents and local organizations surrounding the Inglewood Oil Fields have expressed concerns about the environmental, health, and seismic effects of drilling in their community. Given the proximity of the oil field to residential areas, emissions from the site result in continuous human exposure.

People have detailed smelling diesel or industrial smells, as well as soapy smelling odor suppressants. A number of advocacy groups in Los Angeles, including the coalition Stand Together Against Neighborhood Drilling (STAND L.A.), have called for a 2,500 foot setback requirement for oil facilities to protect the health and safety of nearby residents. This distance is on the lower end of the range researchers have recommended as necessary to protect human health and quality of life from the impacts of toxic emissions and exposures.[43] Although community groups and members have come forward about the toxic nature of the fumes and other air pollutants coming from the Inglewood oilfield, local decision makers have not addressed these concerns, claiming that the public health impacts of this air pollution are still unknown.[44]

© CATF

Oil wells in a residential neighborhood in Los Angeles.

© CATF

Oil wells in a residential neighborhood in Los Angeles.

CASE STUDY

Uneven Responses to Community Oil and Gas Air Pollution

Los Angeles, CA

Not only are the rates of health impacts from oil and gas facilities drastically different between communities, so is local and state responses to air pollution from these facilities. Low-income and communities of color seldom receive the same amount of attention as higher income, white communities when faced with major pollution related events. From October 2015 to February 2016, the affluent, suburban Los Angeles neighborhood of Porter Ranch experienced the worst reported methane leak in the United States. The $400,000 plus homes inside gated communities are located a mile away from the Aliso Canyon natural gas storage facility, which leaked a total of 96,000 metric tons of methane as well as other air pollutants over the course of five months.[45] This pollution caused many to experience symptoms including vomiting, rashes, headaches, dizziness, and bloody noses.[46]

With the declaration of a state of emergency from Governor Jerry Brown, came an overwhelming response. Over 4,000 households in Porter Ranch were evacuated. Alongside community and state insistence for the shut-down of the facility, the city ordered the gas company to provide temporary housing for residents. As the largest methane leak in U.S. history, the Porter Ranch disaster, unique in its size and suddenness, deserved a substantial response. However, Los Angeles residents who live right next to some of the 5,000 active drilling sites in the city–disproportionately low-income communities of color–have dealt with similar issues for years and deserve a similar response to their plight.[47]

Oil operations look a lot different in low-income communities of color, where drilling sites are often adjacent to residential areas. Jefferson Park, a South L.A. neighborhood impacted by drilling, is 90 percent African American or Latinx This is in stark contrast to Porter Ranch, where the majority of the population is white and median household income is more than triple that of Jefferson Park and other neighborhoods.[48]

The AllenCo drilling site in Jefferson Park—now closed but pending reopening—was 30 feet away from the nearest home. Residents filed hundreds of complaints about odors, nausea, body spasms, and respiratory illnesses, before the site was finally closed in 2013.[49] Despite the efforts of community members, the site was only closed after EPA officials became sick while investigating the site. Communities across Los Angeles have faced the same burdens from urban oil and gas drilling faced by the residents of Porter Ranch. The major difference is the amount of time and the nature of the response. Other communities have faced these health impacts for decades, with no evacuations or government response.

CHAPTER 3

Health Impacts from Oil Refineries

In this chapter, we include case studies and stories of community members that have been impacted by pollution from oil refineries. We do not quantify health impacts from oil refineries, as we did for impacts from natural gas facilities, but the case studies demonstrate the range of impacts that are felt by fence-line communities around the country. In addition, in this chapter, we focus solely on petroleum refineries, not the entire petroleum supply chain.

Refineries release toxic air pollution in communities in 32 states. This toxic mix of carcinogens, neurotoxins, and hazardous metals—such as benzene, hydrogen cyanide, and lead—can cause cancer, birth defects, and chronic conditions like asthma. While about 90 million Americans live within 30 miles of at least one refinery, 6.1 million Americans live within three miles of one refinery or more.[50] There are even cases, similar to natural gas and other oil facilities, where houses are a mere few feet away from refinery property lines.

There are 142 large refineries in the United States, the majority of which are sited in low-income areas and communities of color. In 2010, oil refineries reported approximately 22,000 tons of hazardous air pollution to the U.S. Environmental Protection Agency (EPA).[51] However, this number fails to take into account unreported emissions from refinery sources, like flares, tanks, and cooling towers, as well as accidents, which can release 10 or even 100 times more pollution than what is reported.[52] Proximity to oil refineries and other oil and gas facilities also poses serious risk during natural disasters. Air pollution from refineries during and after extreme weather events severely impacts fence-line communities. As during Hurricane Harvey in August 2017, refineries in the Houston, TX metro area released thousands of pounds of toxic air pollutants, resulting in further evacuations and curfews for local residents. The full impact of these chemical released during natural disasters and other events are often immeasurable.

While about 90 million Americans live within 30 miles of at least one refinery, 6.1 million Americans live within three miles of one refinery or more.

Oil refineries are one of numerous plights for African American and other fence-line communities, who are subject to the environmental burdens of the fossil fuel industry. People of color, including African Americans and Hispanic Americans, have a higher cancer risk from toxic air emissions from refineries than the average person. Risk factors are increased when also looking at adults living in poverty.

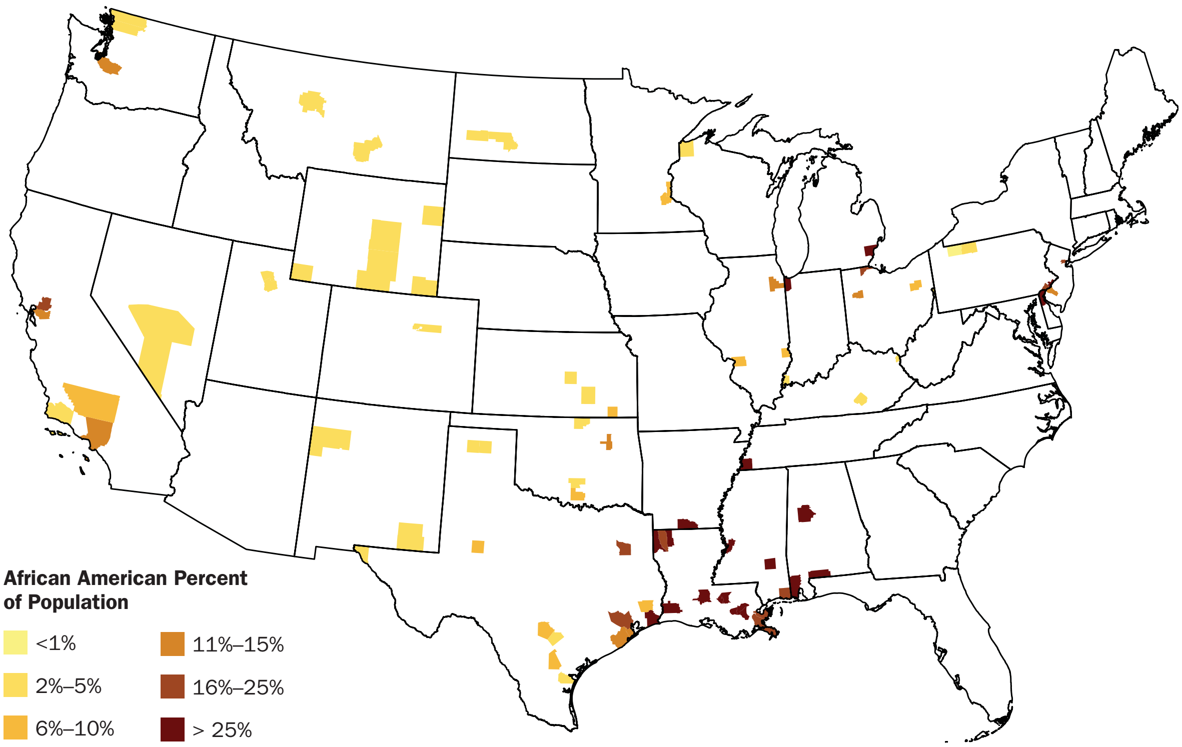
- Most counties with oil refineries and higher percentages of African American residents are concentrated in the Gulf Coast Basin (Texas, Louisiana, Alabama, and Mississippi).
- Texas, California, and Pennsylvania have the most African American residents living in counties with oil refineries.
- Michigan, Louisiana, and Tennessee have the highest percent of African American residents living in oil refinery counties.

Figure 6 (p. 22) shows the percent of African Americans in U.S. counties with oil refineries.

This chapter highlights the health impacts of oil refinery air pollution on predominately African American fence-line communities—communities that sit adjacent to polluting facilities and sources. We do not quantify health impacts using atmospheric models, as we did for air pollution from natural gas facilities, as we did in Chapter 2. However, through case studies in Port Arthur, Texas; Baton Rouge, Louisiana; East Bay, California; and South Philadelphia, Pennsylvania we explore the various impacts oil refinery operation and related events impact African American and fence-line communities.

FIGURE 6

African American Percent of Population in Counties with Oil Refineries



Source: U.S. Census, Energy Information Administration Form 820

TABLE 4

Top 10 States by African American Population Living Counties with Oil Refineries

State	Total Population in Refinery Counties	African American Population in Refinery Counties	Percent African American in Refinery Counties
Texas	8,973,679	1,397,018	16%
California	13,060,074	1,302,860	10%
Pennsylvania	2,214,144	848,064	38%
Michigan	1,759,335	712,290	40%
Louisiana	1,358,443	540,435	40%
Tennessee	938,069	509,942	54%
Alabama	657,160	228,846	35%
New Jersey	847,265	173,852	21%
Delaware	556,779	148,994	27%
Ohio	913,279	146,192	16%
Total	**39,793,311**	**6,709,206**	**17%**

Source: U.S. Census, Energy Information Administration Form 820

CASE STUDY

East Bay Refinery Corridor

East Bay, CA

The burden placed on communities of color in the north coast of the East Bay region, which is home to a variety of petrochemical industry sites, cannot be ignored. The five petroleum refineries in this region emit a unique cocktail of toxic and carcinogenic compounds that impact cardiovascular health of surrounding communities. This region, nicknamed the "refinery corridor," has a petroleum refining capacity of roughly 800,000 barrels per day of crude oil.[53] While there have been many strides to clean up these major sources of air pollution, health impacts in the region, including cancer rates, are still disproportionately high. The City of Richmond's residents of color disproportionately live near the refineries and chemical plants.

CASE STUDY

Burdens of a Fence-Line Community: Valero Oil and Gas Refinery

West Port Arthur, TX

The Carver Terrace housing project sits next to an oil refinery in West Port Arthur, Texas.

© AP Photo/LM Otero

On the border of Texas and Louisiana lies the city of Port Arthur, Texas, which houses two notorious oil refineries: a 3,600-acre Motiva Enterprises plant, to the northeast, and a 4,000-acre plant owned by Texas-based Valero to the west. The two facilities refine more than 900,000 barrels of crude per day. Like many Gulf Coast cities and towns, Port Arthur is not only exposed to the hazards of neighboring oil and gas infrastructure, it is also downwind of nearly every coastal refinery in Texas, as well as other industrial facilities.[54]

The western Valero refinery—one of the largest in the world—borders West Port Arthur, a predominately African American community (95 percent African American in 2013) with several complexes of low-income public housing that exist directly on the refineries' fence. For decades, West Port Arthur's enormous refineries have released and leaked benzene, carbon monoxide, sulfur dioxide, and other pollutants. The U.S. Environmental Protection Agency's Toxics Release Inventory ranks Jefferson County, Texas among the worst nationally for chemical emissions known to cause cancer, birth defects, and reproductive disorders. Port Arthur is near the top of the list of offending cities.[55] According to the Texas Cancer Registry, cancer rates among African Americans in Jefferson County are 15 percent higher than for the average Texan. The mortality

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© Eugene Richards, OnEarth

Valero Refinery in West Port Arthur, Texas

rate from cancer is more than 40 percent higher.[56] In addition to higher cancer rates, residents of Port Arthur were found to be four times more likely than people approximately 100 miles upwind to report suffering from heart and respiratory conditions; nervous system and skin disorders; headaches and muscle aches; and ear, nose, and throat ailments.[57]

Community activists in Port Arthur have been fighting against the refineries polluting their communities' air for more than a decade. Organizations, such as the Community in-Power Development Association (CIDA, Inc.), work with community members in Port Arthur to collect and analyze air, water, and soil samples, conduct direct action events, lobby local and state legislatures, and hold large industries accountable for the pollution they create. CIDA has won many victories alongside other local groups in Port Arthur. In 2007, CIDA Inc. was able to negotiate an agreement for the Valero oil refinery to assist with health care cost for residents West Port Arthur residents and for the construction of a health clinic in the community.[58]

The organization, with other major environmental groups, helped establish the national Start-up Shut-down and Malfunction (SSM) Law for refineries. SSM removes exemptions for large industrial pollution sources from meeting protective standards during facility start up, shutdown, or malfunction and bars the use of the "affirmative defense" by industrial facilities—the defense allowed facilities to avoid paying penalties if violations occurred because of malfunctions.[59]

— CONTINUED —

COMMUNITY STORY

"Our communities have had to work hard to force the EPA to do something about the hazardous pollution from these refineries that we live with every day and we will keep fighting to protect our families' and our children's health. We refuse to just stand by while the petroleum industry tries to undo important progress to finally reduce the toxic air coming from oil refineries."

— Hilton Kelley, executive director of Community In-Power & Development Association, Port Arthur, TX

Challenges to SSM were denied by the Supreme Court in the summer of 2017.[60] The role of community organizations, like CIDA Inc., as well as community members themselves was critical and preserving this law.

In addition to air pollution from refinery operations, those from accidents and natural disasters must also be acknowledged. Air pollution from refineries during and after extreme weather events severely impacts fence-line communities. During Hurricane Harvey, in September 2017, many oil refineries along the Gulf Coast of Texas and Louisiana shutdown due to severe flooding. Refinery shutdowns, even under normal circumstances, are a major cause of abnormal emission events. Sudden shutdown events can release large plumes of sulfur dioxide or toxic chemicals in a matter of hours, worsening already life-threatening situations, exposing downwind communities to peak levels of pollution that increase the prevalence of negative health conditions.[61] The Port Arthur community was not spared these extra pollutants in the wake of this storm.

The ills brought onto the West Port Arthur community violate basic human rights to a clean and livable environment. Air pollution from oil and gas facilities, permitted or otherwise, is a continued violation of this basic right.

A video *by Hilton Kelley, a local Port Arthur environmental and community activist, and Executive Director of CIDA Inc., shows Valero refinery towers spewing huge flags of orange fire and thick, black smoke into over West Port Arthur.*

CASE STUDY

Toxic Emission in South Philadelphia

Pennsylvania, PA

Impacts are also severely felt by communities in South Philadelphia that share a neighborhood with the Philadelphia Energy Solutions (PES), the largest fossil fuel refinery on the East Coast and one of the oldest in the world. The refinery is responsible for 72 percent of the toxic air emissions in Philadelphia, which contributes largely to a citywide childhood asthma rate that is more than two times the national average.[62] Toxics released from the refinery include ammonia, hydrogen cyanide, benzene, and sulfuric acid, which cause effects ranging from headaches to cancer.[63]

© Grid Magazine

Philadelphia Energy Solutions (PES) fossil fuel refinery in South Philadelphia.

CASE STUDY

Accidents at Oil and Gas Facilities: ExxonMobil Refinery

Baton Rouge, LA

In 2010, there was significant increase in air pollution released due to accidents at oil and gas refineries in Louisiana. That year, facilities released 950,750 pounds of toxic pollution to the air. Between 2005 and 2014, Louisiana's refineries experienced 3,339 accidents that released 24 million pounds of air pollution. According to the Louisiana Bucket Brigade, from January to April 2017 there have been 647 petrochemical accidents. 117 of these accidents were reported from oil and gas facilities in April 2017 alone.[64] These accidents are common for the majority of oil and gas facilities nationwide. Leaks, holes, ruptures in pipelines and other infrastructure are common and often unreported. Over 200,000 people live within two miles of most of Louisiana's refineries. The potential public health impacts of oil and gas accidents is considerable.

In an effort to document the impact of petrochemical accidents on local communities, a number of community and labor groups in Louisiana—including the Louisiana Bucket Brigade, United Steelworkers, Standard Heights Community Association, and Residents for Air Neutralization—have produced a series of reports entitled, *Common Ground,* since 2009. The fourth publication, released in 2012, found that Louisiana's 17 oil and gas refineries reported 301 accidents that leaked over a million pounds of toxic chemicals into the air. Among these air pollutants were large quantities of benzene, a chemical known to cause cancer, and sulfur dioxide, which triggers asthma attacks. These types of accidents are an ongoing burden for Louisiana's vulnerable populations.

ExxonMobil, one of the many petrochemical companies present in Louisiana, reported the most accidents of any refiner in the state, in 2011. The company reported 138 accidents between two of its facilities in Chalmette and Baton Rouge. The 1,800-acre ExxonMobil Standard Heights plant in Baton Rouge, like many refineries, sits adjacent to a number of low-income and communities of color. The city of Baton Rouge is 50 percent African American and the child

— CONTINUED —

A mostly abandoned square of the Standard Heights neighborhood tucks into a corner of the Exxon Mobile plant in North Baton Rouge.

© Bitter Southerner

poverty rate in the Standard Heights neighborhood next to Exxon Mobil refinery is 45 percent. The Baton Rouge refinery is the second largest in the country and is part of a 67 million square foot (6.25 million m^2) industrial complex. Tens of thousands of people live within two miles of the complex, which produces gasoline for much of the East Coast.[65]

The state permits Exxon to release millions of pounds of air pollution each year from its Baton Rouge complex. However, air pollution exceeds allowed levels due to accidents and leaks. From 2008 to 2011 the Exxon Mobil Baton Rouge complex released four million pounds of unpermitted volatile organic compounds (VOCs).[66] VOCs contribute to increases in ozone concentration and smog. East Baton Rouge and adjacent parishes have teetered between normal and hazardous levels of ozone.

In 2016, the EPA finally indicated that the air quality in Baton Rouge was compliant with EPA standards. Despite this declaration, concerned community members still report accidents or otherwise unhealthy conditions. One citizen complaint received by the Louisiana Bucket Brigade in April 2017, detailed air contaminants from Exxon's Baton Rouge Refinery. One individual who lives close to the Exxon Refinery in north Baton Rouge, made 11 calls reporting:[67]

- "foul gassy odor"
- "a strong odor of sulfur"
- "a smell that makes me sick of the stomach nauseous"
- "a flame that is burning real high and there's a foul odor in the air"
- "a really strong odor that is like burning your nose."

The constant release of air pollutants from oil and gas facilities, whether legal or illegal, intentional or accidental, contributes to the health problems plaguing African American and vulnerable communities. The efforts of local organizations in Louisiana to document accidents and make that information transparent to citizens has greatly benefited community action. Information gathered by community groups has been critical in the many actions against the construction of the Bayou Bridge Pipeline that will cut through more low income and communities of color in 11 South Louisianan parishes. To learn more about this pipeline and the impacts potential accidents may have visit the Louisiana Bucket Brigade website here.

COMMUNITY STORY

"It's often not worth risking a dangerous encounter in a small southern town to stop and record pollution. What we're recording is another form of violence—this kind the long, steady attack of carcinogens and neurotoxins that ruin the health and the lives of those in Louisiana, usually African Americans, who are unfortunate enough to live cheek to cheek with Big Oil's refineries."

— Anna Rolfes, Founding Director, Louisiana Bucket Brigade

CHAPTER 4

Call to Action

Air pollution that affects many African American communities is emitted throughout the oil and gas sector. In the current regulatory environment, the disproportionate burden of pollution will only increase for low-income communities and communities of color. That means more "code red" air quality days, more trips to the emergency room for asthma sufferers, and more instances of cancer and respiratory disease. It is critical to remember that:

Oil and gas infrastructure including drilling sites, pipelines, and refineries are typically located in low-income communities and communities of color. These are also the areas where drilling is likely to expand and new pipelines will likely be built.

- More than 1 million African Americans live within ½ mile of existing oil and gas facilities and the number is growing every year.
- Many African Americans are particularly burdened with health impacts from this air pollution due to high levels of poverty.
- The air in many African Americans communities violates air quality standards for ozone smog. Rates of asthma are relatively high in African American communities. And, due to ozone increases resulting from natural gas emissions, African American children are burdened by 138,000 asthma attacks and 101,000 lost school days each year.
- Many African American communities face an elevated risk of cancer due to air toxics emissions from natural gas development. Over one million Americans live in counties that face a cancer risk above EPA's level of concern from toxics emitted by oil and gas facilities.
- 6.7 million African Americans live in counties with petroleum refineries.

Oil and gas infrastructure including drilling sites, pipelines, and refineries are typically located in low-income communities and communities of color. These are also the areas where drilling is likely to expand and new pipelines will likely be built. The energy industry has and continues to commit the same oppressive behaviors that have ravaged communities of color for centuries. In order to create an energy economy that upholds communities' rights to a healthy environment, communities must demand changes in the oil and gas industry, and regulators and companies must be held accountable for the continued suffering of fence-line communities.

We must reform the energy and industrial sectors into cleaner, sustainable, and vibrant economies, that work for the communities they serve.

This means more than shifting to clean energy sources; it requires also giving local communities control over their energy sources and promoting local economic growth through stable employment opportunities. Intersectional issues demand intersectional solutions that uphold social, economic, and ecological justice. The just energy future will serve to reduce both the poverty and the pollution plaguing communities throughout the United States.

In order to combat the often overlooked, life-threatening actions of oil and gas operations, we must both implement commonsense standards that reduce pollution from these facilities, and transform the current energy economy.

It will take the combined effort of community members, decision-makers, industry, and others to create meaningful change, which is grounded in principles of energy democracy (local energy choice), energy sovereignty (local control over energy systems), and the right to live free from pollution. Before the transition to a clean energy economy can be achieved, it is first necessary to eliminate the injustices that are taking human life now. In the short term, more needs to be done to address the air pollution resulting from the oil and gas sector that harms the health of our families and our communities:

1. We must all learn about the oil and gas facilities that are located in our communities.

Companies disproportionately build polluting facilities in or near communities of color, leading to unequal health impacts. In order to change this, we need to make more communities aware that their safety, health, and longevity are at stake. Go to *www.oilandgasthreatmap.com* to learn more about the oil and gas facilities that are located in your community. Be sure to learn about the impacts these facilities have in your community. The NAACP's Environmental and Climate Justice Program's publication, *Just Energy Policies and Practices Action Toolkit*, can be used to help guide community groups through energy justice campaigns. The toolkit provides resources and guidance for communities to organize around energy justice issues and execute community projects that move power back to communities and improve local quality of life. It is crucial to remember that any community can change, that every community can be healthy, and that every community has power.

It is now more important than ever for communities to become informed about nearby polluting facilities. If the current administration has its way, the EPA's Office of Environmental Justice will be dismantled. The purpose of this office has been to ensure that all communities, regardless of race,

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Completion equipment at a gas well.

national origin, or income, have the same degree of protection from environmental and health hazards. The loss of this office means one fewer safeguard from the unequal impacts of all types of air pollution.

2. We must support technology that cuts air pollution.

Many proven, low-cost technologies and practices are available to reduce methane pollution and toxic chemicals released along with it. In fact, dozens of companies in the methane mitigation industry are providing technologies and services to the oil and gas industry to help reduce methane and other air polluting emissions. These companies employ people at 531 locations in 46 states and are often offering well-paying and secure manufacturing jobs.[68] The companies that do this work can create jobs that should be targeted to local communities.

3. We must urge national leaders to address the pollution from the oil and gas sector.

Defending the methane pollution safeguards finalized during the Obama administration and pushing for additional protections against pollution from the oil and gas industry will help improve the health of many African American communities while also addressing global climate change. In June 2016, the EPA finalized strong methane standards covering new and modified oil and gas facilities. The rule will cut 510,000 tons of methane pollution from new and modified oil and gas facilities—the equivalent of 11 coal-fired power plants, or taking 8.5 million cars off the road every year. In addition, the rule is also expected to reduce 210,000 tons of volatile organic compounds and 3,900 tons of air toxics annually by 2025. These EPA standards must be enforced, and more also needs to be done to address the nearly 1.3 million existing oil and gas facilities across the country. Without government intervention, the vast majority, at least 75 percent, of all of the wells and oil and gas infrastructure in use today, will remain virtually unregulated and can continue to pollute methane without limit.[69]

Existing facilities spewed over 8 million metric tons of methane in 2014—equivalent to 200+ coal-fired power plants.[70] Common sense, low-cost standards can both cut methane pollution by at least half and also significantly cut toxic and ozone smog-forming air pollution, which would have important benefits for air quality and public health in and downwind of oil and gas producing areas.

4. We must urge our states to reduce oil and gas air pollution.

Several states have stepped up to work on cleaning up the existing infrastructure within their borders, including California, Colorado, and Wyoming, and we call on additional states to follow their lead and protect the health of communities.

Please visit *www.methanefacts.org* to learn more and connect with organizations involved in the campaign.

Environmental and energy justice issues are multilayered. Thus, the approach to tackling these issues must also be multilayered. People of color and low-income communities are disproportionately affected by exposure to air pollution, and standards that protect communities from this pollution are critical. In addition, these communities have a lot to gain from the transition from the current fossil fuel energy economy to one based on equitable, affordable, and clean energy sources. The first step is to address the many ways fossil fuels taint our communities, including the air pollution from oil and gas development.

The fight against the oil and gas air pollution is not about making things better for fence-line communities; it is about eliminating poverty, racism, and other social and structural inequities that render communities vulnerable. The air pollution that plagues communities across the country does not have to and should not exist. It is time to ask ourselves, what are we willing to do to ensure a clean and healthy future?

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Fumes Across the Fence-Line

The Health Impacts of Air Pollution from Oil & Gas Facilities on African American Communities

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GLOBAL WARMING OF 1.5 °C

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Summary for Policymakers

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Date of Summary for Policymakers: 6 October 2018

Introduction

This report responds to the invitation for IPCC '... to provide a Special Report in 2018 on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways' contained in the Decision of the 21st Conference of Parties of the United Nations Framework Convention on Climate Change to adopt the Paris Agreement.[1]

The IPCC accepted the invitation in April 2016, deciding to prepare this Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.

This Summary for Policy Makers (SPM) presents the key findings of the Special Report, based on the assessment of the available scientific, technical and socio-economic literature[2] relevant to global warming of 1.5°C and for the comparison between global warming of 1.5°C and 2°C above pre-industrial levels. The level of confidence associated with each key finding is reported using the IPCC calibrated language.[3] The underlying scientific basis of each key finding is indicated by references provided to chapter elements. In the SPM, knowledge gaps are identified associated with the underlying chapters of the report.

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[1] Decision 1/CP.21, paragraph 21.

[2] The assessment covers literature accepted for publication by 15 May 2018.

[3] Each finding is grounded in an evaluation of underlying evidence and agreement. A level of confidence is expressed using five qualifiers: very low, low, medium, high and very high, and typeset in italics, for example, *medium confidence*. The following terms have been used to indicate the assessed likelihood of an outcome or a result: virtually certain 99–100% probability, very likely 90–100%, likely 66–100%, about as likely as not 33–66%, unlikely 0–33%, very unlikely 0–10%, exceptionally unlikely 0–1%. Additional terms (extremely likely 95–100%, more likely than not >50–100%, more unlikely than likely 0–<50%, extremely unlikely 0–5%) may also be used when appropriate. Assessed likelihood is typeset in italics, for example, *very likely*. This is consistent with AR5.

A. Understanding Global Warming of 1.5°C[4]

A1. Human activities are estimated to have caused approximately 1.0°C of global warming[5] above pre-industrial levels, with a *likely* range of 0.8°C to 1.2°C. Global warming is *likely* to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate. (*high confidence*) {1.2, Figure SPM.1}

A1.1. Reflecting the long-term warming trend since pre-industrial times, observed global mean surface temperature (GMST) for the decade 2006–2015 was 0.87°C (*likely* between 0.75°C and 0.99°C)[6] higher than the average over the 1850–1900 period (*very high confidence*). Estimated anthropogenic global warming matches the level of observed warming to within ±20% (*likely* range). Estimated anthropogenic global warming is currently increasing at 0.2°C (*likely* between 0.1°C and 0.3°C) per decade due to past and ongoing emissions (*high confidence*). {1.2.1, Table 1.1, 1.2.4}

A1.2. Warming greater than the global annual average is being experienced in many land regions and seasons, including two to three times higher in the Arctic. Warming is generally higher over land than over the ocean. (*high confidence*) {1.2.1, 1.2.2, Figure 1.1, Figure 1.3, 3.3.1, 3.3.2}

A1.3. Trends in intensity and frequency of some climate and weather extremes have been detected over time spans during which about 0.5°C of global warming occurred (*medium confidence*). This assessment is based on several lines of evidence, including attribution studies for changes in extremes since 1950. {3.3.1, 3.3.2, 3.3.3}

A.2. Warming from anthropogenic emissions from the pre-industrial period to the present will persist for centuries to millennia and will continue to cause further long-term changes in the climate system, such as sea level rise, with associated impacts (*high confidence*), but these emissions alone are *unlikely* to cause global warming of 1.5°C (*medium confidence*) {1.2, 3.3, Figure 1.5, Figure SPM.1}

A2.1. Anthropogenic emissions (including greenhouse gases, aerosols and their precursors) up to the present are *unlikely* to cause further warming of more than 0.5°C over the next two to three decades (*high confidence*) or on a century time scale (*medium confidence*). {1.2.4, Figure 1.5}

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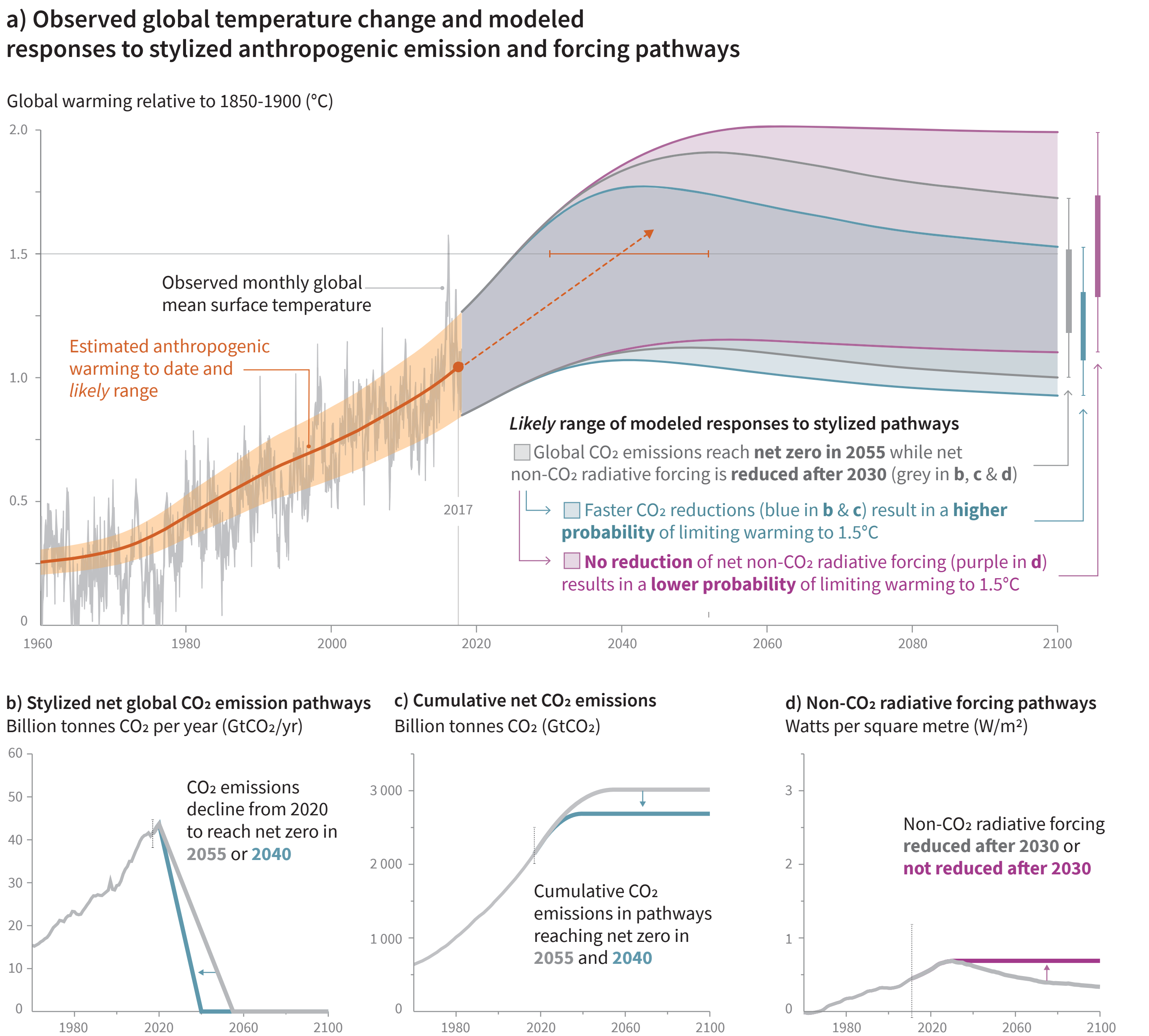
[4] SPM BOX.1: Core Concepts

[5] Present level of global warming is defined as the average of a 30-year period centered on 2017 assuming the recent rate of warming continues.

[6] This range spans the four available peer-reviewed estimates of the observed GMST change and also accounts for additional uncertainty due to possible short-term natural variability. {1.2.1, Table 1.1}

A2.2. Reaching and sustaining net-zero global anthropogenic CO_2 emissions and declining net non-CO_2 radiative forcing would halt anthropogenic global warming on multi-decadal timescales (*high confidence*). The maximum temperature reached is then determined by cumulative net global anthropogenic CO_2 emissions up to the time of net zero CO_2 emissions (*high confidence*) and the level of non-CO_2 radiative forcing in the decades prior to the time that maximum temperatures are reached (*medium confidence*). On longer timescales, sustained net negative global anthropogenic CO_2 emissions and/or further reductions in non-CO_2 radiative forcing may still be required to prevent further warming due to Earth system feedbacks and reverse ocean acidification (*medium confidence*) and will be required to minimise sea level rise (*high confidence*). {Cross-Chapter Box 2 in Chapter 1, 1.2.3, 1.2.4, Figure 1.4, 2.2.1, 2.2.2, 3.4.4.8, 3.4.5.1, 3.6.3.2}

Cumulative emissions of CO_2 and future non-CO_2 radiative forcing determine the probability of limiting warming to 1.5°C



Faster immediate CO_2 emission reductions limit cumulative CO_2 emissions shown in panel **(c)**.

Maximum temperature rise is determined by cumulative net CO_2 emissions and net non-CO_2 radiative forcing due to methane, nitrous oxide, aerosols and other anthropogenic forcing agents.

Figure SPM.1: Panel a: Observed monthly global mean surface temperature (GMST) change grey line up to 2017, from the HadCRUT4, GISTEMP, Cowtan–Way, and NOAA datasets) and estimated anthropogenic global warming (solid orange line up to 2017, with orange shading indicating assessed *likely* range). Orange dashed arrow and horizontal orange error bar show respectively central estimate and *likely* range of the time at which 1.5°C is reached if the current rate of warming continues. The grey plume on the right of Panel a) shows the *likely* range of warming responses, computed with a simple climate model, to a stylized pathway (hypothetical future) in which net CO_2 emissions (grey line in panels b and c) decline in a straight line from 2020 to reach net zero in 2055 and net non-CO_2 radiative forcing (grey line in panel d) increases to 2030 and then declines. The blue plume in panel a) shows the response to faster CO_2 emissions reductions (blue line in panel b), reaching net zero in 2040, reducing cumulative CO_2 emissions (panel c). The purple plume shows the response to net CO_2 emissions declining to zero in 2055, with net non-CO_2 forcing remaining constant after 2030. The vertical error bars on right of panel a) show the *likely* ranges (thin lines) and central terciles (33rd – 66th percentiles, thick lines) of the estimated distribution of warming in 2100 under these three stylized pathways. Vertical dotted error bars in panels b, c and d show the *likely* range of historical annual and cumulative global net CO_2 emissions in 2017 (data from the Global Carbon Project) and of net non-CO_2 radiative forcing in 2011 from AR5, respectively. Vertical axes in panels c and d are scaled to represent approximately equal effects on GMST. {1.2.1, 1.2.3, 1.2.4, 2.3, Chapter 1 Figure 1.2 & Chapter 1 Supplementary Material, Cross-Chapter Box 2}

A3. Climate-related risks for natural and human systems are higher for global warming of 1.5°C than at present, but lower than at 2°C (*high confidence*). These risks depend on the magnitude and rate of warming, geographic location, levels of development and vulnerability, and on the choices and implementation of adaptation and mitigation options (*high confidence*) (Figure SPM.2). {1.3, 3.3, 3.4, 5.6}

A3.1. Impacts on natural and human systems from global warming have already been observed (*high confidence*). Many land and ocean ecosystems and some of the services they provide have already changed due to global warming (*high confidence*). {1.4, 3.4, 3.5, Figure SPM.2}

A3.2. Future climate-related risks depend on the rate, peak and duration of warming. In the aggregate they are larger if global warming exceeds 1.5°C before returning to that level by 2100 than if global warming gradually stabilizes at 1.5°C, especially if the peak temperature is high (e.g., about 2°C) (*high confidence*). Some impacts may be long-lasting or irreversible, such as the loss of some ecosystems (*high confidence*). {3.2, 3.4.4, 3.6.3, Cross-Chapter Box 8}

A3.3. Adaptation and mitigation are already occurring (*high confidence*). Future climate-related risks would be reduced by the upscaling and acceleration of far-reaching, multi-level and cross-sectoral climate mitigation and by both incremental and transformational adaptation (*high confidence*). {1.2, 1.3, Table 3.5, 4.2.2, Cross-Chapter Box 9 in Chapter 4, Box 4.2, Box 4.3, Box 4.6, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 4.3.5, 4.4.1, 4.4.4, 4.4.5, 4.5.3}

B. Projected Climate Change, Potential Impacts and Associated Risks

B1. Climate models project robust[7] differences in regional climate characteristics between present-day and global warming of 1.5°C,[8] and between 1.5°C and 2°C.[8] These differences include increases in: mean temperature in most land and ocean regions (*high confidence*), hot extremes in most inhabited regions (*high confidence*), heavy precipitation in several regions (*medium confidence*), and the probability of drought and precipitation deficits in some regions (*medium confidence*). {3.3}

B1.1. Evidence from attributed changes in some climate and weather extremes for a global warming of about 0.5°C supports the assessment that an additional 0.5°C of warming compared to present is associated with further detectable changes in these extremes (*medium confidence*). Several regional changes in climate are assessed to occur with global warming up to 1.5°C compared to pre-industrial levels, including warming of extreme temperatures in many regions (*high confidence*), increases in frequency, intensity, and/or amount of heavy precipitation in several regions (*high confidence*), and an increase in intensity or frequency of droughts in some regions (*medium confidence*). {3.2, 3.3.1, 3.3.2, 3.3.3, 3.3.4, Table 3.2}

B1.2. Temperature extremes on land are projected to warm more than GMST (*high confidence*): extreme hot days in mid-latitudes warm by up to about 3°C at global warming of 1.5°C and about

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[7] Robust is here used to mean that at least two thirds of climate models show the same sign of changes at the grid point scale, and that differences in large regions are statistically significant.

[8] Projected changes in impacts between different levels of global warming are determined with respect to changes in global mean surface air temperature.

4°C at 2°C, and extreme cold nights in high latitudes warm by up to about 4.5°C at 1.5°C and about 6°C at 2°C (*high confidence*). The number of hot days is projected to increase in most land regions, with highest increases in the tropics (*high confidence*). {3.3.1, 3.3.2, Cross-Chapter Box 8 in Chapter 3}

B1.3. Risks from droughts and precipitation deficits are projected to be higher at 2°C compared to 1.5°C global warming in some regions (*medium confidence*). Risks from heavy precipitation events are projected to be higher at 2°C compared to 1.5°C global warming in several northern hemisphere high-latitude and/or high-elevation regions, eastern Asia and eastern North America (*medium confidence*). Heavy precipitation associated with tropical cyclones is projected to be higher at 2°C compared to 1.5°C global warming (*medium confidence*). There is generally *low confidence* in projected changes in heavy precipitation at 2°C compared to 1.5°C in other regions. Heavy precipitation when aggregated at global scale is projected to be higher at 2.0°C than at 1.5°C of global warming (*medium confidence*). As a consequence of heavy precipitation, the fraction of the global land area affected by flood hazards is projected to be larger at 2°C compared to 1.5°C of global warming (*medium confidence*). {3.3.1, 3.3.3, 3.3.4, 3.3.5, 3.3.6}

B2. By 2100, global mean sea level rise is projected to be around 0.1 metre lower with global warming of 1.5°C compared to 2°C (*medium confidence*). Sea level will continue to rise well beyond 2100 (*high confidence*), and the magnitude and rate of this rise depends on future emission pathways. A slower rate of sea level rise enables greater opportunities for adaptation in the human and ecological systems of small islands, low-lying coastal areas and deltas (*medium confidence*). {3.3, 3.4, 3.6 }

B2.1. Model-based projections of global mean sea level rise (relative to 1986-2005) suggest an indicative range of 0.26 to 0.77 m by 2100 for 1.5°C global warming, 0.1 m (0.04-0.16 m) less than for a global warming of 2°C (*medium confidence*). A reduction of 0.1 m in global sea level rise implies that up to 10 million fewer people would be exposed to related risks, based on population in the year 2010 and assuming no adaptation (*medium confidence*). {3.4.4, 3.4.5, 4.3.2}

B2.2. Sea level rise will continue beyond 2100 even if global warming is limited to 1.5°C in the 21st century (*high confidence*). Marine ice sheet instability in Antarctica and/or irreversible loss of the Greenland ice sheet could result in multi-metre rise in sea level over hundreds to thousands of years. These instabilities could be triggered around 1.5°C to 2°C of global warming (*medium confidence*). {3.3.9, 3.4.5, 3.5.2, 3.6.3, Box 3.3, Figure SPM.2}

B2.3. Increasing warming amplifies the exposure of small islands, low-lying coastal areas and deltas to the risks associated with sea level rise for many human and ecological systems, including increased saltwater intrusion, flooding and damage to infrastructure (*high confidence*). Risks associated with sea level rise are higher at 2°C compared to 1.5°C. The slower rate of sea level rise at global warming of 1.5°C reduces these risks enabling greater opportunities for adaptation including managing and restoring natural coastal ecosystems, and infrastructure reinforcement (*medium confidence*). {3.4.5, Figure SPM.2, Box 3.5}

B3. On land, impacts on biodiversity and ecosystems, including species loss and extinction, are projected to be lower at 1.5°C of global warming compared to 2°C. Limiting global warming to 1.5°C compared to 2°C is projected to lower the impacts on terrestrial, freshwater, and coastal ecosystems and to retain more of their services to humans (*high confidence*). (Figure SPM.2) {3.4, 3.5, Box 3.4, Box 4.2, Cross-Chapter Box 8 in Chapter 3}

B3.1. Of 105,000 species studied,[9] 6% of insects, 8% of plants and 4% of vertebrates are projected to lose over half of their climatically determined geographic range for global warming of 1.5°C, compared with 18% of insects, 16% of plants and 8% of vertebrates for global warming of 2°C (*medium confidence*). Impacts associated with other biodiversity-related risks such as forest fires, and the spread of invasive species, are lower at 1.5°C compared to 2°C of global warming (*high confidence*). {3.4.3, 3.5.2}

B3.2. Approximately 4% (interquartile range 2–7%) of the global terrestrial land area is projected to undergo a transformation of ecosystems from one type to another at 1ºC of global warming, compared with 13% (interquartile range 8–20%) at 2°C (*medium confidence*). This indicates that the area at risk is projected to be approximately 50% lower at 1.5°C compared to 2°C (*medium confidence*). {3.4.3.1, 3.4.3.5}

B3.3. High-latitude tundra and boreal forests are particularly at risk of climate change-induced degradation and loss, with woody shrubs already encroaching into the tundra (*high confidence*) and will proceed with further warming. Limiting global warming to 1.5°C rather than 2°C is projected to prevent the thawing over centuries of a permafrost area in the range of 1.5 to 2.5 million km^2 (*medium confidence*). {3.3.2, 3.4.3, 3.5.5}

B4. Limiting global warming to 1.5°C compared to 2ºC is projected to reduce increases in ocean temperature as well as associated increases in ocean acidity and decreases in ocean oxygen levels (*high confidence*). Consequently, limiting global warming to 1.5°C is projected to reduce risks to marine biodiversity, fisheries, and ecosystems, and their functions and services to humans, as illustrated by recent changes to Arctic sea ice and warm water coral reef ecosystems (*high confidence*). {3.3, 3.4, 3.5, Boxes 3.4, 3.5}

B4.1. There is *high confidence* that the probability of a sea-ice-free Arctic Ocean during summer is substantially lower at global warming of 1.5°C when compared to 2°C. With 1.5°C of global warming, one sea ice-free Arctic summer is projected per century. This likelihood is increased to at least one per decade with 2°C global warming. Effects of a temperature overshoot are reversible for Arctic sea ice cover on decadal time scales (*high confidence*). {3.3.8, 3.4.4.7}

B4.2. Global warming of 1.5°C is projected to shift the ranges of many marine species, to higher latitudes as well as increase the amount of damage to many ecosystems. It is also expected to drive the loss of coastal resources, and reduce the productivity of fisheries and aquaculture (especially at low latitudes). The risks of climate-induced impacts are projected to be higher at 2°C than those at global warming of 1.5°C (*high confidence*). Coral reefs, for example, are projected to decline by a further 70–90% at 1.5°C (*high confidence*) with larger losses (>99%) at 2ºC (*very high confidence*). The risk of irreversible loss of many marine and coastal ecosystems increases with global warming, especially at 2°C or more (*high confidence*). {3.4.4, Box 3.4}

B4.3. The level of ocean acidification due to increasing CO_2 concentrations associated with global warming of 1.5°C is projected to amplify the adverse effects of warming, and even further at 2°C,

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[9] Consistent with earlier studies, illustrative numbers were adopted from one recent meta-study.

impacting the growth, development, calcification, survival, and thus abundance of a broad range of species, e.g., from algae to fish (*high confidence*). {3.3.10, 3.4.4}

B4.4. Impacts of climate change in the ocean are increasing risks to fisheries and aquaculture via impacts on the physiology, survivorship, habitat, reproduction, disease incidence, and risk of invasive species (*medium confidence)* but are projected to be less at 1.5ºC of global warming than at 2ºC. One global fishery model, for example, projected a decrease in global annual catch for marine fisheries of about 1.5 million tonnes for 1.5°C of global warming compared to a loss of more than 3 million tonnes for 2°C of global warming (*medium confidence*). {3.4.4, Box 3.4}

B5. Climate-related risks to health, livelihoods, food security, water supply, human security, and economic growth are projected to increase with global warming of 1.5°C and increase further with 2°C. (Figure SPM.2) {3.4, 3.5, 5.2, Box 3.2, Box 3.3, Box 3.5, Box 3.6, Cross-Chapter Box 6 in Chapter 3, Cross-Chapter Box 9 in Chapter 4, Cross-Chapter Box 12 in Chapter 5, 5.2}

B5.1. Populations at disproportionately higher risk of adverse consequences of global warming of 1.5°C and beyond include disadvantaged and vulnerable populations, some indigenous peoples, and local communities dependent on agricultural or coastal livelihoods (*high confidence*). Regions at disproportionately higher risk include Arctic ecosystems, dryland regions, small-island developing states, and least developed countries (*high confidence)*. Poverty and disadvantages are expected to increase in some populations as global warming increases; limiting global warming to 1.5°C, compared with 2°C, could reduce the number of people both exposed to climate-related risks and susceptible to poverty by up to several hundred million by 2050 (*medium confidence*). {3.4.10, 3.4.11, Box 3.5, Cross-Chapter Box 6 in Chapter 3, Cross-Chapter Box 9 in Chapter 4, Cross-Chapter Box 12 in Chapter 5, 4.2.2.2, 5.2.1, 5.2.2, 5.2.3, 5.6.3}

B5.2. Any increase in global warming is projected to affect human health, with primarily negative consequences (*high confidence*). Lower risks are projected at 1.5°C than at 2°C for heat-related morbidity and mortality (*very high confidence*) and for ozone-related mortality if emissions needed for ozone formation remain high (*high confidence)*. Urban heat islands often amplify the impacts of heatwaves in cities (*high confidence*). Risks from some vector-borne diseases, such as malaria and dengue fever, are projected to increase with warming from 1.5°C to 2°C, including potential shifts in their geographic range (*high confidence*). {3.4.7, 3.4.8, 3.5.5.8}

B5.3. Limiting warming to 1.5°C, compared with 2ºC, is projected to result in smaller net reductions in yields of maize, rice, wheat, and potentially other cereal crops, particularly in sub-Saharan Africa, Southeast Asia, and Central and South America; and in the CO_2 dependent, nutritional quality of rice and wheat (*high confidence*). Reductions in projected food availability are larger at 2ºC than at 1.5°C of global warming in the Sahel, southern Africa, the Mediterranean, central Europe, and the Amazon (*medium confidence*). Livestock are projected to be adversely affected with rising temperatures, depending on the extent of changes in feed quality, spread of diseases, and water resource availability (*high confidence*). {3.4.6, 3.5.4, 3.5.5, Box 3.1, Cross-Chapter Box 6 in Chapter 3, Cross-Chapter Box 9 in Chapter 4}

B5.4. Depending on future socioeconomic conditions, limiting global warming to 1.5°C, compared to 2°C, may reduce the proportion of the world population exposed to a climate-change induced increase in water stress by up to 50%, although there is considerable variability between regions (*medium confidence*). Many small island developing states would experience lower water stress as a result of projected changes in aridity when global warming is limited to 1.5°C, as compared to 2°C (*medium confidence*). {3.3.5, 3.4.2, 3.4.8, 3.5.5, Box 3.2, Box 3.5, Cross-Chapter Box 9 in Chapter 4}

B5.5. Risks to global aggregated economic growth due to climate change impacts are projected to be lower at 1.5°C than at 2°C by the end of this century[10] (*medium confidence*). This excludes the costs of mitigation, adaptation investments and the benefits of adaptation. Countries in the tropics and Southern Hemisphere subtropics are projected to experience the largest impacts on economic growth due to climate change should global warming increase from 1.5°C to 2 °C (*medium confidence*). {3.5.2, 3.5.3}

B5.6. Exposure to multiple and compound climate-related risks increases between 1.5°C and 2°C of global warming, with greater proportions of people both so exposed and susceptible to poverty in Africa and Asia (*high confidence*). For global warming from 1.5°C to 2°C, risks across energy, food, and water sectors could overlap spatially and temporally, creating new and exacerbating current hazards, exposures, and vulnerabilities that could affect increasing numbers of people and regions (*medium confidence*). {Box 3.5, 3.3.1, 3.4.5.3, 3.4.5.6, 3.4.11, 3.5.4.9}

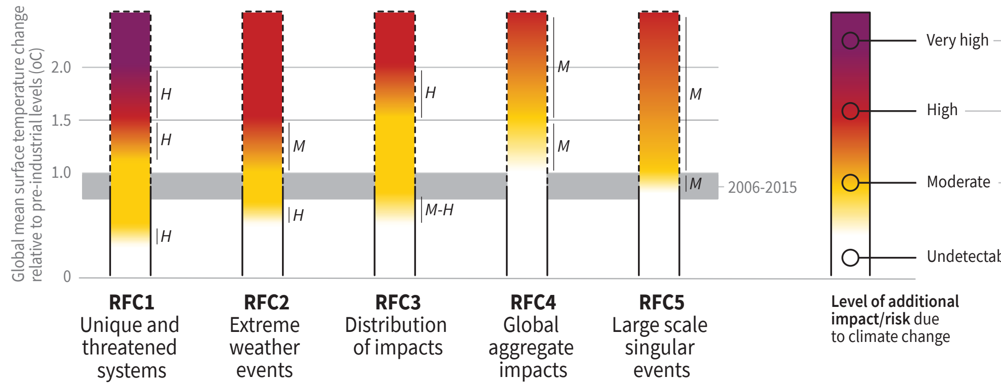
B5.7. There are multiple lines of evidence that since the AR5 the assessed levels of risk increased for four of the five Reasons for Concern (RFCs) for global warming to 2°C (*high confidence*). The risk transitions by degrees of global warming are now: from high to very high between 1.5°C and 2°C for RFC1 (Unique and threatened systems) (*high confidence*); from moderate to high risk between 1.0°C and 1.5°C for RFC2 (Extreme weather events) (*medium confidence*); from moderate to high risk between 1.5°C and 2°C for RFC3 (Distribution of impacts) (*high confidence*); from moderate to high risk between 1.5°C and 2.5°C for RFC4 (Global aggregate impacts) (*medium confidence*); and from moderate to high risk between 1°C and 2.5°C for RFC5 (Large-scale singular events) (*medium confidence*). (Figure SPM.2) {3.4.13; 3.5, 3.5.2}

[10] Here, impacts on economic growth refer to changes in GDP. Many impacts, such as loss of human lives, cultural heritage, and ecosystem services, are difficult to value and monetize.

How the level of global warming affects impacts and/or risks associated with the Reasons for Concern (RFCs) and selected natural, managed and human systems

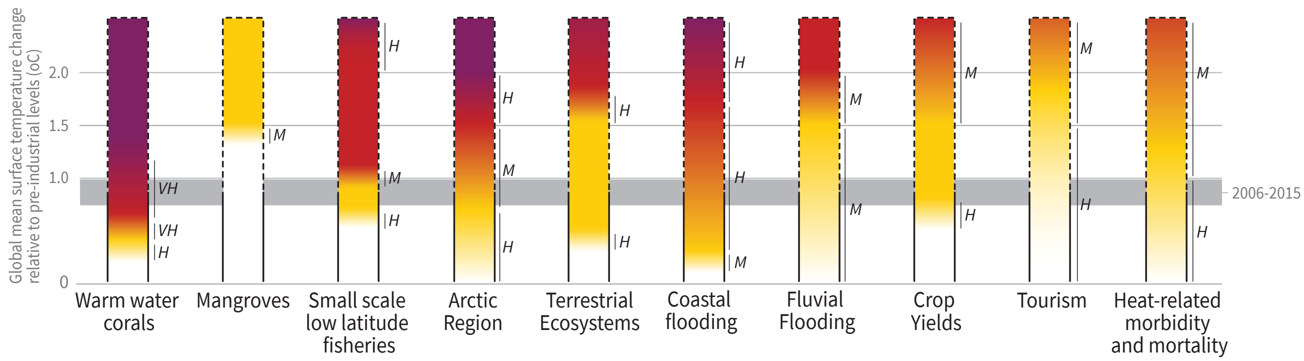
Five Reasons For Concern (RFCs) illustrate the impacts and risks of different levels of global warming for people, economies and ecosystems across sectors and regions.

Impacts and risks associated with the Reasons for Concern (RFCs)



Purple indicates very high risks of severe impacts/risks and the presence of significant irreversibility or the persistence of climate-related hazards, combined with limited ability to adapt due to the nature of the hazard or impacts/risks.
Red indicates severe and widespread impacts/risks.
Yellow indicates that impacts/risks are detectable and attributable to climate change with at least medium confidence.
White indicates that no impacts are detectable and attributable to climate change.

Impacts and risks for selected natural, managed and human systems



Confidence level for transition: *L*=Low, *M*=Medium, *H*=High and *VH*=Very high

Figure SPM.2: Five integrative reasons for concern (RFCs) provide a framework for summarizing key impacts and risks across sectors and regions, and were introduced in the IPCC Third Assessment Report. RFCs illustrate the implications of global warming for people, economies, and ecosystems. Impacts and/or risks for each RFC are based on assessment of the new literature that has appeared. As in the AR5, this literature was used to make expert judgments to assess the levels of global warming at which levels of impact and/or risk are undetectable, moderate, high or very high. The selection of impacts and risks to natural, managed and human systems in the lower panel is illustrative and is not intended to be fully comprehensive. **RFC1 Unique and threatened systems:** ecological and human systems that have restricted geographic ranges constrained by climate related conditions and have high endemism or other distinctive properties. Examples include coral reefs, the Arctic and its indigenous people, mountain glaciers, and biodiversity hotspots. **RFC2 Extreme weather events**: risks/impacts to human health, livelihoods, assets, and ecosystems from extreme weather events such as heat waves, heavy rain, drought and associated wildfires, and coastal flooding. **RFC3 Distribution of impacts:** risks/impacts that disproportionately affect particular groups due to uneven distribution of physical climate change hazards, exposure or vulnerability. **RFC4 Global aggregate impacts:** global monetary damage, global scale degradation and loss of ecosystems and biodiversity. **RFC5 Large-scale singular events:** are relatively large, abrupt and sometimes irreversible changes in systems that are caused by global warming. Examples include disintegration of the Greenland and Antarctic ice sheets. {3.4, 3.5, 3.5.2.1, 3.5.2.2, 3.5.2.3, 3.5.2.4, 3.5.2.5, 5.4.1 5.5.3, 5.6.1, Box 3.4}

B6. Most adaptation needs will be lower for global warming of 1.5°C compared to 2°C (*high confidence*). There are a wide range of adaptation options that can reduce the risks of climate change (*high confidence*). There are limits to adaptation and adaptive capacity for some human and natural systems at global warming of 1.5°C, with associated losses (*medium confidence*). The number and availability of adaptation options vary by sector (*medium confidence*). {Table 3.5, 4.3, 4.5, Cross-Chapter Box 9 in Chapter 4, Cross-Chapter Box 12 in Chapter 5}

B6.1. A wide range of adaptation options are available to reduce the risks to natural and managed ecosystems (e.g., ecosystem-based adaptation, ecosystem restoration and avoided degradation and deforestation, biodiversity management, sustainable aquaculture, and local knowledge and indigenous knowledge), the risks of sea level rise (e.g., coastal defence and hardening), and the risks to health, livelihoods, food, water, and economic growth, especially in rural landscapes (e.g., efficient irrigation, social safety nets, disaster risk management, risk spreading and sharing, community-based adaptation) and urban areas (e.g., green infrastructure, sustainable land use and planning, and sustainable water management) (*medium confidence*). {4.3.1, 4.3.2, 4.3.3, 4.3.5, 4.5.3, 4.5.4, 5.3.2, Box 4.2, Box 4.3, Box 4.6, Cross-Chapter Box 9 in Chapter 4}.

B6.2. Adaptation is expected to be more challenging for ecosystems, food and health systems at 2°C of global warming than for 1.5°C (*medium confidence*). Some vulnerable regions, including small islands and Least Developed Countries, are projected to experience high multiple interrelated climate risks even at global warming of 1.5°C (*high confidence*). {3.3.1, 3.4.5, Box 3.5, Table 3.5, Cross-Chapter Box 9 in Chapter 4, 5.6, Cross-Chapter Box 12 in Chapter 5, Box 5.3}

B6.3. Limits to adaptive capacity exist at 1.5°C of global warming, become more pronounced at higher levels of warming and vary by sector, with site-specific implications for vulnerable regions, ecosystems, and human health (*medium confidence*) {Cross-Chapter Box 12 in Chapter 5, Box 3.5, Table 3.5}

C. Emission Pathways and System Transitions Consistent with 1.5°C Global Warming

C1. In model pathways with no or limited overshoot of 1.5°C, global net anthropogenic CO_2 emissions decline by about 45% from 2010 levels by 2030 (40–60% interquartile range), reaching net zero around 2050 (2045–2055 interquartile range). For limiting global warming to below 2°C[11] CO_2 emissions are projected to decline by about 20% by 2030 in most pathways (10–30% interquartile range) and reach net zero around 2075 (2065–2080 interquartile range). Non-CO_2 emissions in pathways that limit global warming to 1.5°C show deep reductions that are similar to those in pathways limiting warming to 2°C. (*high confidence*) (Figure SPM.3a) {2.1, 2.3, Table 2.4}

C1.1. CO_2 emissions reductions that limit global warming to 1.5°C with no or limited overshoot can involve different portfolios of mitigation measures, striking different balances between lowering energy and resource intensity, rate of decarbonization, and the reliance on carbon dioxide removal. Different portfolios face different implementation challenges, and potential synergies and trade-offs with sustainable development. (*high confidence*). (Figure SPM.3b) {2.3.2, 2.3.4, 2.4, 2.5.3}

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[11] References to pathways limiting global warming to 2°C are based on a 66% probability of staying below 2°C.

C1.2. Modelled pathways that limit global warming to 1.5°C with no or limited overshoot involve deep reductions in emissions of methane and black carbon (35% or more of both by 2050 relative to 2010). These pathways also reduce most of the cooling aerosols, which partially offsets mitigation effects for two to three decades. Non-CO_2 emissions[12] can be reduced as a result of broad mitigation measures in the energy sector. In addition, targeted non-CO_2 mitigation measures can reduce nitrous oxide and methane from agriculture, methane from the waste sector, some sources of black carbon, and hydrofluorocarbons. High bioenergy demand can increase emissions of nitrous oxide in some 1.5°C pathways, highlighting the importance of appropriate management approaches. Improved air quality resulting from projected reductions in many non-CO_2 emissions provide direct and immediate population health benefits in all 1.5°C model pathways. (*high confidence*) (Figure SPM.3a) {2.2.1, 2.3.3, 2.4.4, 2.5.3, 4.3.6, 5.4.2}

C1.3. Limiting global warming requires limiting the total cumulative global anthropogenic emissions of CO_2 since the preindustrial period, i.e. staying within a total carbon budget (*high confidence*).[13] By the end of 2017, anthropogenic CO_2 emissions since the preindustrial period are estimated to have reduced the total carbon budget for 1.5°C by approximately 2200 ± 320 $GtCO_2$ (*medium confidence*). The associated remaining budget is being depleted by current emissions of 42 ± 3 $GtCO_2$ per year (*high confidence*). The choice of the measure of global temperature affects the estimated remaining carbon budget. Using global mean surface air temperature, as in AR5, gives an estimate of the remaining carbon budget of 580 $GtCO_2$ for a 50% probability of limiting warming to 1.5°C, and 420 $GtCO_2$ for a 66% probability (*medium confidence*).[14] Alternatively, using GMST gives estimates of 770 and 570 $GtCO_2$, for 50% and 66% probabilities,[15] respectively (*medium confidence*). Uncertainties in the size of these estimated remaining carbon budgets are substantial and depend on several factors. Uncertainties in the climate response to CO_2 and non-CO_2 emissions contribute ±400 $GtCO_2$ and the level of historic warming contributes ±250 $GtCO_2$ (*medium confidence*). Potential additional carbon release from future permafrost thawing and methane release from wetlands would reduce budgets by up to 100 $GtCO_2$ over the course of this century and more thereafter (*medium confidence*). In addition, the level of non-CO_2 mitigation in the future could alter the remaining carbon budget by 250 $GtCO_2$ in either direction (*medium confidence*). {1.2.4, 2.2.2, 2.6.1, Table 2.2, Chapter 2 Supplementary Material}

C1.4. Solar radiation modification (SRM) measures are not included in any of the available assessed pathways. Although some SRM measures may be theoretically effective in reducing an overshoot, they face large uncertainties and knowledge gaps as well as substantial risks,

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[12] Non-CO_2 emissions included in this report are all anthropogenic emissions other than CO_2 that result in radiative forcing. These include short-lived climate forcers, such as methane, some fluorinated gases, ozone precursors, aerosols or aerosol precursors, such as black carbon and sulphur dioxide, respectively, as well as long-lived greenhouse gases, such as nitrous oxide or some fluorinated gases. The radiative forcing associated with non-CO_2 emissions and changes in surface albedo is referred to as non-CO_2 radiative forcing. {x.y}

[13] There is a clear scientific basis for a total carbon budget consistent with limiting global warming to 1.5°C. However, neither this total carbon budget nor the fraction of this budget taken up by past emissions were assessed in this report.

[14] Irrespective of the measure of global temperature used, updated understanding and further advances in methods have led to an increase in the estimated remaining carbon budget of about 300 $GtCO_2$ compared to AR5. (*medium confidence*) {x.y}

[15] These estimates use observed GMST to 2006–2015 and estimate future temperature changes using near surface air temperatures.

institutional and social constraints to deployment related to governance, ethics, and impacts on sustainable development. They also do not mitigate ocean acidification. (*medium confidence*). {4.3.8, Cross-Chapter Box 10 in Chapter 4}

Global emissions pathway characteristics

General characteristics of the evolution of anthropogenic net emissions of CO_2, and total emissions of methane, black carbon, and nitrous oxide in model pathways that limit global warming to 1.5°C with no or limited overshoot. Net emissions are defined as anthropogenic emissions reduced by anthropogenic removals. Reductions in net emissions can be achieved through different portfolios of mitigation measures illustrated in Figure SPM3B.

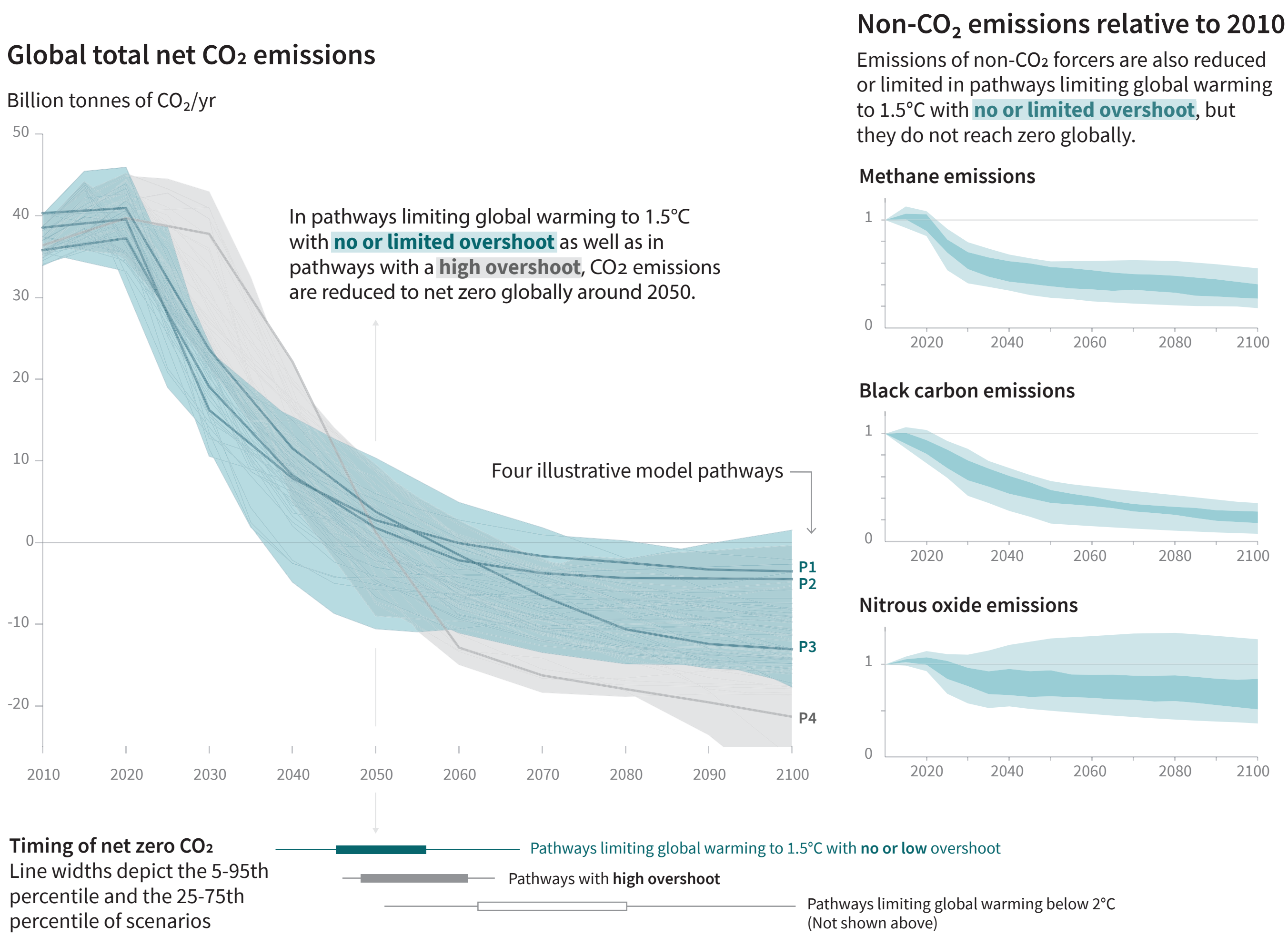
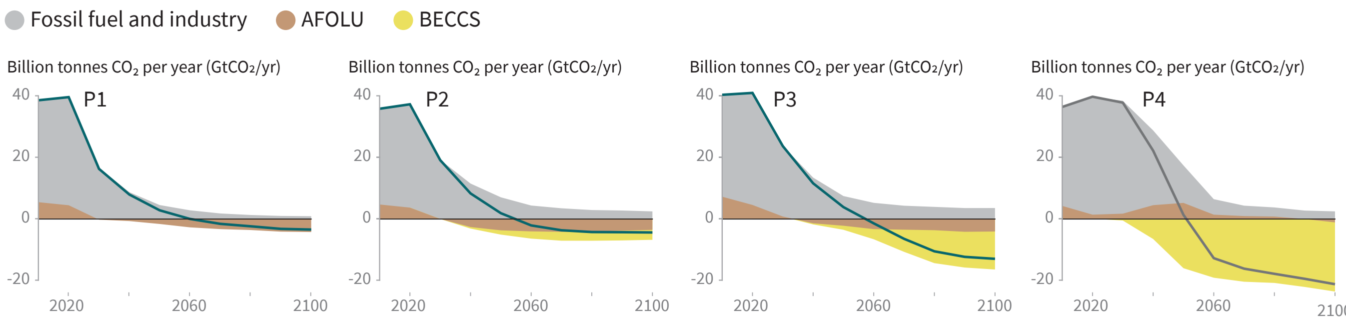


Figure SPM.3a: Global emissions pathway characteristics. The main panel shows global net anthropogenic CO_2 emissions in pathways limiting global warming to 1.5°C with no or limited (less than 0.1°C) overshoot and pathways with higher overshoot. The shaded area shows the full range for pathways analysed in this report. The panels on the right show non-CO_2 emissions ranges for three compounds with large historical forcing and a substantial portion of emissions coming from sources distinct from those central to CO_2 mitigation. Shaded areas in these panels show the 5–95% (light shading) and interquartile (dark shading) ranges of pathways limiting global warming to 1.5°C with no or limited overshoot. Box and whiskers at the bottom of the figure show the timing of pathways reaching global net zero CO_2 emission levels, and a comparison with pathways limiting global warming to 2°C with at least 66% probability. Four illustrative model pathways are highlighted in the main panel and are labelled P1, P2, P3 and P4, corresponding to the LED, S1, S2, and S5 pathways assessed in Chapter 2. Descriptions and characteristics of these pathways are available in Figure SPM3b. {2.1, 2.2, 2.3, Figure 2.5, Figure 2.10, Figure 2.11}

Characteristics of four illustrative model pathways

Different mitigation strategies can achieve the net emissions reductions that would be required to follow a pathway that limit global warming to 1.5°C with no or limited overshoot. All pathways use Carbon Dioxide Removal (CDR), but the amount varies across pathways, as do the relative contributions of Bioenergy with Carbon Capture and Storage (BECCS) and removals in the Agriculture, Forestry and Other Land Use (AFOLU) sector. This has implications for the emissions and several other pathway characteristics.

Breakdown of contributions to global net CO_2 emissions in four illustrative model pathways



P1: A scenario in which social, business, and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A down-sized energy system enables rapid decarbonisation of energy supply. Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.

P2: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal acceptability for BECCS.

P3: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

P4: A resource and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making strong use of CDR through the deployment of BECCS.

Global indicators	P1	P2	P3	P4	**Interquartile range**
Pathway classification	No or low overshoot	No or low overshoot	No or low overshoot	High overshoot	No or low overshoot
CO_2 emission change in 2030 (% rel to 2010)	-58	-47	-41	4	(-59,-40)
↳ in 2050 (% rel to 2010)	-93	-95	-91	-97	(-104,-91)
Kyoto-GHG emissions in 2030 (% rel to 2010)*	-50	-49	-35	-2	(-55,-38)
↳ in 2050 (% rel to 2010)	-82	-89	-78	-80	(-93,-81)
*Final energy demand** in 2030 (% rel to 2010)*	-15	-5	17	39	(-12, 7)
↳ in 2050 (% rel to 2010)	-32	2	21	44	(-11, 22)
Renewable share in electricity in 2030 (%)	60	58	48	25	(47, 65)
↳ in 2050 (%)	77	81	63	70	(69, 87)
Primary energy from coal in 2030 (% rel to 2010)	-78	-61	-75	-59	(-78, -59)
↳ in 2050 (% rel to 2010)	-97	-77	-73	-97	(-95, -74)
from oil in 2030 (% rel to 2010)	-37	-13	-3	86	(-34,3)
↳ in 2050 (% rel to 2010)	-87	-50	-81	-32	(-78,-31)
from gas in 2030 (% rel to 2010)	-25	-20	33	37	(-26,21)
↳ in 2050 (% rel to 2010)	-74	-53	21	-48	(-56,6)
from nuclear in 2030 (% rel to 2010)	59	83	98	106	(44,102)
↳ in 2050 (% rel to 2010)	150	98	501	468	(91,190)
from biomass in 2030 (% rel to 2010)	-11	0	36	-1	(29,80)
↳ in 2050 (% rel to 2010)	-16	49	121	418	(123,261)
from non-biomass renewables in 2030 (% rel to 2010)	430	470	315	110	(243,438)
↳ in 2050 (% rel to 2010)	832	1327	878	1137	(575,1300)
Cumulative CCS until 2100 ($GtCO_2$)	0	348	687	1218	(550, 1017)
↳ of which BECCS ($GtCO_2$)	0	151	414	1191	(364, 662)
Land area of bioenergy crops in 2050 (million hectare)	22	93	283	724	(151, 320)
Agricultural CH_4 emissions in 2030 (% rel to 2010)	-24	-48	1	14	(-30,-11)
in 2050 (% rel to 2010)	-33	-69	-23	2	(-46,-23)
Agricultural N_2O emissions in 2030 (% rel to 2010)	5	-26	15	3	(-21,4)
in 2050 (% rel to 2010)	6	-26	0	39	(-26,1)

NOTE: Indicators have been selected to show global trends identified by the Chapter 2 assessment. National and sectoral characteristics can differ substantially from the global trends shown above.

** Kyoto-gas emissions are based on SAR GWP-100*
*** Changes in energy demand are associated with improvements in energy efficiency and behaviour change*

Figure SPM.3b: Characteristics of four illustrative model pathways in relation to global warming of 1.5°C introduced in Figure SPM3a. These pathways were selected to show a range of potential mitigation approaches and vary widely in their projected energy and land use, as well as their assumptions about future socioeconomic developments, including economic and population growth, equity and sustainability. A breakdown of the global net anthropogenic CO_2 emissions into the contributions in terms of CO_2 emissions from fossil fuel and industry, agriculture, forestry and other land use (AFOLU), and bioenergy with carbon capture and storage (BECCS) is shown. AFOLU estimates reported here are not necessarily comparable with countries' estimates. Further characteristics for each of these pathways are listed below each pathway. These pathways illustrate relative global differences in mitigation strategies, but do not represent central estimates, national strategies, and do not indicate requirements. For comparison, the right-most column shows the interquartile ranges across pathways with no or limited overshoot of 1.5°C. Pathways P1, P2, P3 and P4, correspond to the LED, S1, S2, and S5 pathways assessed in Chapter 2. (Figure SPM.3a) {2.2.1, 2.3.1, 2.3.2, 2.3.3, 2.3.4, 2.4.1, 2.4.2, 2.4.4, 2.5.3, Figure 2.5, Figure 2.6, Figure 2.9, Figure 2.10, Figure 2.11, Figure 2.14, Figure 2.15, Figure 2.16, Figure 2.17, Figure 2.24, Figure 2.25, Table 2.4, Table 2.6, Table 2.7, Table 2.9, Table 4.1}

C2. Pathways limiting global warming to 1.5°C with no or limited overshoot would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems (*high confidence*). These systems transitions are unprecedented in terms of scale, but not necessarily in terms of speed, and imply deep emissions reductions in all sectors, a wide portfolio of mitigation options and a significant upscaling of investments in those options (*medium confidence*). {2.3, 2.4, 2.5, 4.2, 4.3, 4.4, 4.5}

C2.1. Pathways that limit global warming to 1.5°C with no or limited overshoot show system changes that are more rapid and pronounced over the next two decades than in 2°C pathways (*high confidence*). The rates of system changes associated with limiting global warming to 1.5°C with no or limited overshoot have occurred in the past within specific sectors, technologies and spatial contexts, but there is no documented historic precedent for their scale (*medium confidence*). {2.3.3, 2.3.4, 2.4, 2.5, 4.2.1, 4.2.2, Cross-Chapter Box 11 in Chapter 4}

C2.2. In energy systems, modelled global pathways (considered in the literature) limiting global warming to 1.5°C with no or limited overshoot (for more details see Figure SPM.3b), generally meet energy service demand with lower energy use, including through enhanced energy efficiency, and show faster electrification of energy end use compared to 2°C (*high confidence*). In 1.5°C pathways with no or limited overshoot, low-emission energy sources are projected to have a higher share, compared with 2°C pathways, particularly before 2050 (*high confidence*). In 1.5°C pathways with no or limited overshoot, renewables are projected to supply 70–85% (interquartile range) of electricity in 2050 (*high confidence*). In electricity generation, shares of nuclear and fossil fuels with carbon dioxide capture and storage (CCS) are modelled to increase in most 1.5°C pathways with no or limited overshoot. In modelled 1.5°C pathways with limited or no overshoot, the use of CCS would allow the electricity generation share of gas to be approximately 8% (3–11% interquartile range) of global electricity in 2050, while the use of coal shows a steep reduction in all pathways and would be reduced to close to 0% (0–2%) of electricity (*high confidence*). While acknowledging the challenges, and differences between the options and national circumstances, political, economic, social and technical feasibility of solar energy, wind energy and electricity storage technologies have substantially improved over the past few years (*high confidence*). These improvements signal a potential system transition in electricity generation (Figure SPM.3b) {2.4.1, 2.4.2, Figure 2.1, Table 2.6, Table 2.7, Cross-Chapter Box 6 in Chapter 3, 4.2.1, 4.3.1, 4.3.3, 4.5.2}

C2.3. CO_2 emissions from industry in pathways limiting global warming to 1.5°C with no or limited overshoot are projected to be about 75–90% (interquartile range) lower in 2050 relative to 2010, as compared to 50–80% for global warming of 2°C (*medium confidence*). Such reductions can be achieved through combinations of new and existing technologies and practices, including electrification, hydrogen, sustainable bio-based feedstocks, product substitution, and carbon capture, utilization and storage (CCUS). These options are technically proven at various scales but their large-scale deployment may be limited by economic, financial, human capacity and institutional constraints in specific contexts, and specific characteristics of large-scale industrial installations. In industry, emissions reductions by energy and process efficiency by themselves are insufficient for limiting warming to 1.5°C with no or limited overshoot (*high confidence*). {2.4.3, 4.2.1, Table 4.1, Table 4.3, 4.3.3, 4.3.4, 4.5.2}

C2.4. The urban and infrastructure system transition consistent with limiting global warming to 1.5°C with no or limited overshoot would imply, for example, changes in land and urban planning practices, as well as deeper emissions reductions in transport and buildings compared to pathways that limit global warming below 2°C (see 2.4.3; 4.3.3; 4.2.1) (*medium confidence*). Technical measures and practices enabling deep emissions reductions include various energy efficiency options. In pathways limiting global warming to 1.5°C with no or limited overshoot, the electricity share of energy demand in buildings would be about 55–75% in 2050 compared to 50–70% in 2050 for 2°C global warming (*medium confidence*). In the transport sector, the share of low-emission final energy would rise from less than 5% in 2020 to about 35–65% in 2050 compared to 25–45% for 2°C global warming (*medium confidence*). Economic, institutional and socio-cultural barriers may inhibit these urban and infrastructure system transitions, depending on national, regional and local circumstances, capabilities and the availability of capital (*high confidence*). {2.3.4, 2.4.3, 4.2.1, Table 4.1, 4.3.3, 4.5.2}.

C2.5. Transitions in global and regional land use are found in all pathways limiting global warming to 1.5°C with no or limited overshoot, but their scale depends on the pursued mitigation portfolio. Model pathways that limit global warming to 1.5°C with no or limited overshoot project the conversion of 0.5–8 million km^2 of pasture and 0–5 million km^2 of non-pasture agricultural land for food and feed crops into 1–7 million km^2 for energy crops and a 1 million km^2 reduction to 10 million km^2 increase in forests by 2050 relative to 2010 (*medium confidence*).[16] Land use transitions of similar magnitude can be observed in modelled 2°C pathways (*medium confidence*). Such large transitions pose profound challenges for sustainable management of the various demands on land for human settlements, food, livestock feed, fibre, bioenergy, carbon storage, biodiversity and other ecosystem services (*high confidence*). Mitigation options limiting the demand for land include sustainable intensification of land use practices, ecosystem restoration and changes towards less resource-intensive diets (*high confidence*). The implementation of land-based mitigation options would require overcoming socio-economic, institutional, technological, financing and environmental barriers that differ across regions (*high confidence*). {2.4.4, Figure 2.24, 4.3.2, 4.5.2, Cross-Chapter Box 7 in Chapter 3}

C2.6 Total annual average energy-related mitigation investment for the period 2015 to 2050 in pathways limiting warming to 1.5°C is estimated to be around 900 billion USD2015 (range of 180 billion to 1800 billion USD2015 across six models[17]). This corresponds to total annual average energy supply investments of 1600 to 3800 billion USD2015 and total annual average energy demand investments of 700 to 1000 billion USD2015 for the period 2015 to 2050, and an increase in total energy-related investments of about 12% (range of 3% to 23%) in 1.5°C pathways relative to 2°C pathways. Average annual investment in low-carbon energy technologies and energy efficiency are upscaled by roughly a factor of five (range of factor of 4 to 5) by 2050 compared to 2015 (*medium confidence*). {2.5.2, Box 4.8, Figure 2.27}

C2.7. Modelled pathways limiting global warming to 1.5°C with no or limited overshoot project a wide range of global average discounted marginal abatement costs over the 21st century. They are roughly 3-4 times higher than in pathways limiting global warming to below 2°C (*high confidence*). The economic literature distinguishes marginal abatement costs from total mitigation costs in the economy. The literature on total mitigation costs of 1.5°C mitigation pathways is limited and was not assessed in this report. Knowledge gaps remain in the integrated assessment of the economy wide costs and benefits of mitigation in line with pathways limiting warming to 1.5°C. {2.5.2; 2.6; Figure 2.26}

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[16] The projected land use changes presented are not deployed to their upper limits simultaneously in a single pathway.

[17] Including two pathways limiting warming to 1.5°C with no or limited overshoot and four pathways with high overshoot.

C3. All pathways that limit global warming to 1.5°C with limited or no overshoot project the use of carbon dioxide removal (CDR) on the order of 100–1000 $GtCO_2$ over the 21st century. CDR would be used to compensate for residual emissions and, in most cases, achieve net negative emissions to return global warming to 1.5°C following a peak (*high confidence*). CDR deployment of several hundreds of $GtCO_2$ is subject to multiple feasibility and sustainability constraints (*high confidence*). Significant near-term emissions reductions and measures to lower energy and land demand can limit CDR deployment to a few hundred $GtCO_2$ without reliance on bioenergy with carbon capture and storage (BECCS) (*high confidence*). {2.3, 2.4, 3.6.2, 4.3, 5.4}

C3.1. Existing and potential CDR measures include afforestation and reforestation, land restoration and soil carbon sequestration, BECCS, direct air carbon capture and storage (DACCS), enhanced weathering and ocean alkalinization. These differ widely in terms of maturity, potentials, costs, risks, co-benefits and trade-offs (*high confidence*). To date, only a few published pathways include CDR measures other than afforestation and BECCS. {2.3.4, 3.6.2, 4.3.2, 4.3.7}

C3.2. In pathways limiting global warming to 1.5°C with limited or no overshoot, BECCS deployment is projected to range from 0–1, 0–8, and 0–16 $GtCO_2\ yr^{-1}$ in 2030, 2050, and 2100, respectively, while agriculture, forestry and land-use (AFOLU) related CDR measures are projected to remove 0–5, 1–11, and 1–5 $GtCO_2\ yr^{-1}$ in these years (*medium confidence*). The upper end of these deployment ranges by mid-century exceeds the BECCS potential of up to 5 $GtCO_2\ yr^{-1}$ and afforestation potential of up to 3.6 $GtCO_2\ yr^{-1}$ assessed based on recent literature (*medium confidence*). Some pathways avoid BECCS deployment completely through demand-side measures and greater reliance on AFOLU-related CDR measures (*medium confidence*). The use of bioenergy can be as high or even higher when BECCS is excluded compared to when it is included due to its potential for replacing fossil fuels across sectors (*high confidence*). (Figure SPM.3b) {2.3.3, 2.3.4, 2.4.2, 3.6.2, 4.3.1, 4.2.3, 4.3.2, 4.3.7, 4.4.3, Table 2.4}

C3.3. Pathways that overshoot 1.5°C of global warming rely on CDR exceeding residual CO_2 emissions later in the century to return to below 1.5°C by 2100, with larger overshoots requiring greater amounts of CDR (Figure SPM.3b). (*high confidence*). Limitations on the speed, scale, and societal acceptability of CDR deployment hence determine the ability to return global warming to below 1.5°C following an overshoot. Carbon cycle and climate system understanding is still limited about the effectiveness of net negative emissions to reduce temperatures after they peak (*high confidence*). {2.2, 2.3.4, 2.3.5, 2.6, 4.3.7, 4.5.2, Table 4.11}

C3.4. Most current and potential CDR measures could have significant impacts on land, energy, water, or nutrients if deployed at large scale (*high confidence*). Afforestation and bioenergy may compete with other land uses and may have significant impacts on agricultural and food systems, biodiversity and other ecosystem functions and services (*high confidence*). Effective governance is needed to limit such trade-offs and ensure permanence of carbon removal in terrestrial, geological and ocean reservoirs (*high confidence*). Feasibility and sustainability of CDR use could be enhanced by a portfolio of options deployed at substantial, but lesser scales, rather than a single option at very large scale (*high confidence*). (Figure SPM.3b). {2.3.4, 2.4.4, 2.5.3, 2.6, 3.6.2, 4.3.2, 4.3.7, 4.5.2, 5.4.1, 5.4.2; Cross-Chapter Boxes 7 and 8 in Chapter 3, Table 4.11, Table 5.3, Figure 5.3}

C3.5. Some AFOLU-related CDR measures such as restoration of natural ecosystems and soil carbon sequestration could provide co-benefits such as improved biodiversity, soil quality, and local food security. If deployed at large scale, they would require governance systems enabling sustainable land management to conserve and protect land carbon stocks and other ecosystem functions and services (*medium confidence*). (Figure SPM.4) {2.3.3, 2.3.4, 2.4.2, 2.4.4, 3.6.2, 5.4.1, Cross-Chapter Boxes 3 in Chapter 1 and 7 in Chapter 3, 4.3.2, 4.3.7, 4.4.1, 4.5.2, Table 2.4}

D. Strengthening the Global Response in the Context of Sustainable Development and Efforts to Eradicate Poverty

D1. Estimates of the global emissions outcome of current nationally stated mitigation ambitions as submitted under the Paris Agreement would lead to global greenhouse gas emissions[18] in 2030 of 52–58 $GtCO_2eq\ yr^{-1}$ (*medium confidence*). Pathways reflecting these ambitions would not limit global warming to 1.5°C, even if supplemented by very challenging increases in the scale and ambition of emissions reductions after 2030 (*high confidence*). Avoiding overshoot and reliance on future large-scale deployment of carbon dioxide removal (CDR) can only be achieved if global CO_2 emissions start to decline well before 2030 (*high confidence*). {1.2, 2.3, 3.3, 3.4, 4.2, 4.4, Cross-Chapter Box 11 in Chapter 4}

D1.1. Pathways that limit global warming to 1.5°C with no or limited overshoot show clear emission reductions by 2030 (*high confidence*). All but one show a decline in global greenhouse gas emissions to below 35 $GtCO_2eq\ yr^{-1}$ in 2030, and half of available pathways fall within the 25–30 $GtCO_2eq\ yr^{-1}$ range (interquartile range), a 40–50% reduction from 2010 levels (*high confidence*). Pathways reflecting current nationally stated mitigation ambition until 2030 are broadly consistent with cost-effective pathways that result in a global warming of about 3°C by 2100, with warming continuing afterwards (*medium confidence*). {2.3.3, 2.3.5, Cross-Chapter Box 11 in Chapter 4, 5.5.3.2}

D1.2. Overshoot trajectories result in higher impacts and associated challenges compared to pathways that limit global warming to 1.5°C with no or limited overshoot (*high confidence*). Reversing warming after an overshoot of 0.2°C or larger during this century would require upscaling and deployment of CDR at rates and volumes that might not be achievable given considerable implementation challenges (*medium confidence*). {1.3.3, 2.3.4, 2.3.5, 2.5.1, 3.3, 4.3.7, Cross-Chapter Box 8 in Chapter 3, Cross-Chapter Box 11 in Chapter 4}

D1.3. The lower the emissions in 2030, the lower the challenge in limiting global warming to 1.5°C after 2030 with no or limited overshoot (*high confidence*). The challenges from delayed actions to reduce greenhouse gas emissions include the risk of cost escalation, lock-in in carbon-emitting infrastructure, stranded assets, and reduced flexibility in future response options in the medium to long-term (*high confidence*). These may increase uneven distributional impacts between countries at different stages of development (*medium confidence*). {2.3.5, 4.4.5, 5.4.2}

D2. The avoided climate change impacts on sustainable development, eradication of poverty and reducing inequalities would be greater if global warming were limited to 1.5°C rather than 2°C, if mitigation and adaptation synergies are maximized while trade-offs are minimized (*high confidence*). {1.1, 1.4, 2.5, 3.3, 3.4, 5.2, Table 5.1}

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[18] GHG emissions have been aggregated with 100-year GWP values as introduced in the IPCC Second Assessment Report

D2.1. Climate change impacts and responses are closely linked to sustainable development which balances social well-being, economic prosperity and environmental protection. The United Nations Sustainable Development Goals (SDGs), adopted in 2015, provide an established framework for assessing the links between global warming of 1.5°C or 2°C and development goals that include poverty eradication, reducing inequalities, and climate action (*high confidence*) {Cross-Chapter Box 4 in Chapter 1, 1.4, 5.1}

D2.2. The consideration of ethics and equity can help address the uneven distribution of adverse impacts associated with 1.5°C and higher levels of global warming, as well as those from mitigation and adaptation, particularly for poor and disadvantaged populations, in all societies (*high confidence*). {1.1.1, 1.1.2, 1.4.3, 2.5.3, 3.4.10, 5.1, 5.2, 5.3. 5.4, Cross-Chapter Box 4 in Chapter 1, Cross-Chapter Boxes 6 and 8 in Chapter 3, and Cross-Chapter Box 12 in Chapter 5}

D2.3. Mitigation and adaptation consistent with limiting global warming to 1.5°C are underpinned by enabling conditions, assessed in SR1.5 across the geophysical, environmental-ecological, technological, economic, socio-cultural and institutional dimensions of feasibility. Strengthened multi-level governance, institutional capacity, policy instruments, technological innovation and transfer and mobilization of finance, and changes in human behaviour and lifestyles are enabling conditions that enhance the feasibility of mitigation and adaptation options for 1.5°C consistent systems transitions. (*high confidence*) {1.4, Cross-Chapter Box 3 in Chapter 1, 4.4, 4.5, 5.6}

D3. Adaptation options specific to national contexts, if carefully selected together with enabling conditions, will have benefits for sustainable development and poverty reduction with global warming of 1.5℃, although trade-offs are possible (*high confidence*). {1.4, 4.3, 4.5}

D3.1. Adaptation options that reduce the vulnerability of human and natural systems have many synergies with sustainable development, if well managed, such as ensuring food and water security, reducing disaster risks, improving health conditions, maintaining ecosystem services and reducing poverty and inequality (*high confidence*). Increasing investment in physical and social infrastructure is a key enabling condition to enhance the resilience and the adaptive capacities of societies. These benefits can occur in most regions with adaptation to 1.5℃ of global warming (*high confidence*). {1.4.3, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.5, 4.4.1, 4.4.3, 4.5.3, 5.3.1, 5.3.2}

D3.2. Adaptation to 1.5°C global warming can also result in trade–offs or maladaptations with adverse impacts for sustainable development. For example, if poorly designed or implemented, adaptation projects in a range of sectors can increase greenhouse gas emissions and water use, increase gender and social inequality, undermine health conditions, and encroach on natural ecosystems (*high confidence*). These trade-offs can be reduced by adaptations that include attention to poverty and sustainable development (*high confidence*). {4.3.2, 4.3.3, 4.5.4, 5.3.2; Cross-Chapter Boxes 6 and 7 in Chapter 3}

D3.3. A mix of adaptation and mitigation options to limit global warming to 1.5℃, implemented in a participatory and integrated manner, can enable rapid, systemic transitions in urban and rural areas (*high confidence*). These are most effective when aligned with economic and sustainable development, and when local and regional governments and decision makers are supported by national governments (*medium confidence*) {4.3.2, 4.3.3, 4.4.1, 4.4.2}

D3.4. Adaptation options that also mitigate emissions can provide synergies and cost savings in most sectors and system transitions, such as when land management reduces emissions and disaster risk, or when low carbon buildings are also designed for efficient cooling. Trade-offs between mitigation and adaptation, when limiting global warming to 1.5℃, such as when bioenergy crops, reforestation or afforestation encroach on land needed for agricultural adaptation, can undermine food security, livelihoods, ecosystem functions and services and other aspects of sustainable development. (*high confidence*) {3.4.3, 4.3.2, 4.3.4, 4.4.1, 4.5.2, 4.5.3, 4.5.4}

D4. Mitigation options consistent with 1.5°C pathways are associated with multiple synergies and trade-offs across the Sustainable Development Goals (SDGs). While the total number of possible synergies exceeds the number of trade-offs, their net effect will depend on the pace and magnitude of changes, the composition of the mitigation portfolio and the management of the transition. *(high confidence*) (Figure SPM.4) {2.5, 4.5, 5.4}

D4.1. 1.5°C pathways have robust synergies particularly for the SDGs 3 (health), 7 (clean energy), 11 (cities and communities), 12 (responsible consumption and production), and 14 (oceans) (*very high confidence*). Some 1.5°C pathways show potential trade-offs with mitigation for SDGs 1 (poverty), 2 (hunger), 6 (water), and 7 (energy access), if not carefully managed (*high confidence*) (Figure SPM.4). {5.4.2; Figure 5.4, Cross-Chapter Boxes 7 and 8 in Chapter 3}

D4.2. 1.5°C pathways that include low energy demand (e.g., see P1 in Figure SPM.3a and SPM.3b), low material consumption, and low GHG-intensive food consumption have the most pronounced synergies and the lowest number of trade-offs with respect to sustainable development and the SDGs (*high confidence*). Such pathways would reduce dependence on CDR. In modelled pathways sustainable development, eradicating poverty and reducing inequality can support limiting warming to 1.5◦C. (*high confidence*) (Figure SPM.3b, Figure SPM.4) {2.4.3, 2.5.1, 2.5.3, Figure 2.4, Figure 2.28, 5.4.1, 5.4.2, Figure 5.4}

D4.3. 1.5°C and 2°C modelled pathways often rely on the deployment of large-scale land-related measures like afforestation and bioenergy supply, which, if poorly managed, can compete with food production and hence raise food security concerns (*high confidence*). The impacts of carbon dioxide removal (CDR) options on SDGs depend on the type of options and the scale of deployment (*high confidence*). If poorly implemented, CDR options such as BECCS and AFOLU options would lead to trade-offs. Context-relevant design and implementation requires considering people's needs, biodiversity, and other sustainable development dimensions (*very high confidence*). {Figure SPM.4, 5.4.1.3, Cross-Chapter Box 7 in Chapter 3}

D4.4. Mitigation consistent with 1.5°C pathways creates risks for sustainable development in regions with high dependency on fossil fuels for revenue and employment generation (*high confidence*). Policies that promote diversification of the economy and the energy sector can address the associated challenges (*high confidence*). {5.4.1.2, Box 5.2}

D4.5. Redistributive policies across sectors and populations that shield the poor and vulnerable can resolve trade-offs for a range of SDGs, particularly hunger, poverty and energy access. Investment needs for such complementary policies are only a small fraction of the overall mitigation investments in 1.5°C pathways. (*high confidence*) {2.4.3, 5.4.2, Figure 5.5}

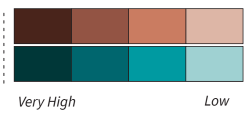
Indicative linkages between mitigation options and sustainable development using SDGs (The linkages do not show costs and benefits)

Mitigation options deployed in each sector can be associated with potential positive effects (synergies) or negative effects (trade-offs) with the Sustainable Development Goals (SDGs). The degree to which this potential is realized will depend on the selected portfolio of mitigation options, mitigation policy design, and local circumstances and context. Particularly in the energy-demand sector, the potential for synergies is larger than for trade-offs. The bars group individually assessed options by level of confidence and take into account the relative strength of the assessed mitigation-SDG connections.

Length shows strength of connection

The overall **size of the coloured bars** depict **the relative** for synergies and trade-offs between the sectoral mitigation options and the SDGs.

Shades show level of confidence



The shades depict **the level of confidence** of the assessed potential for **Trade-offs/Synergies**.

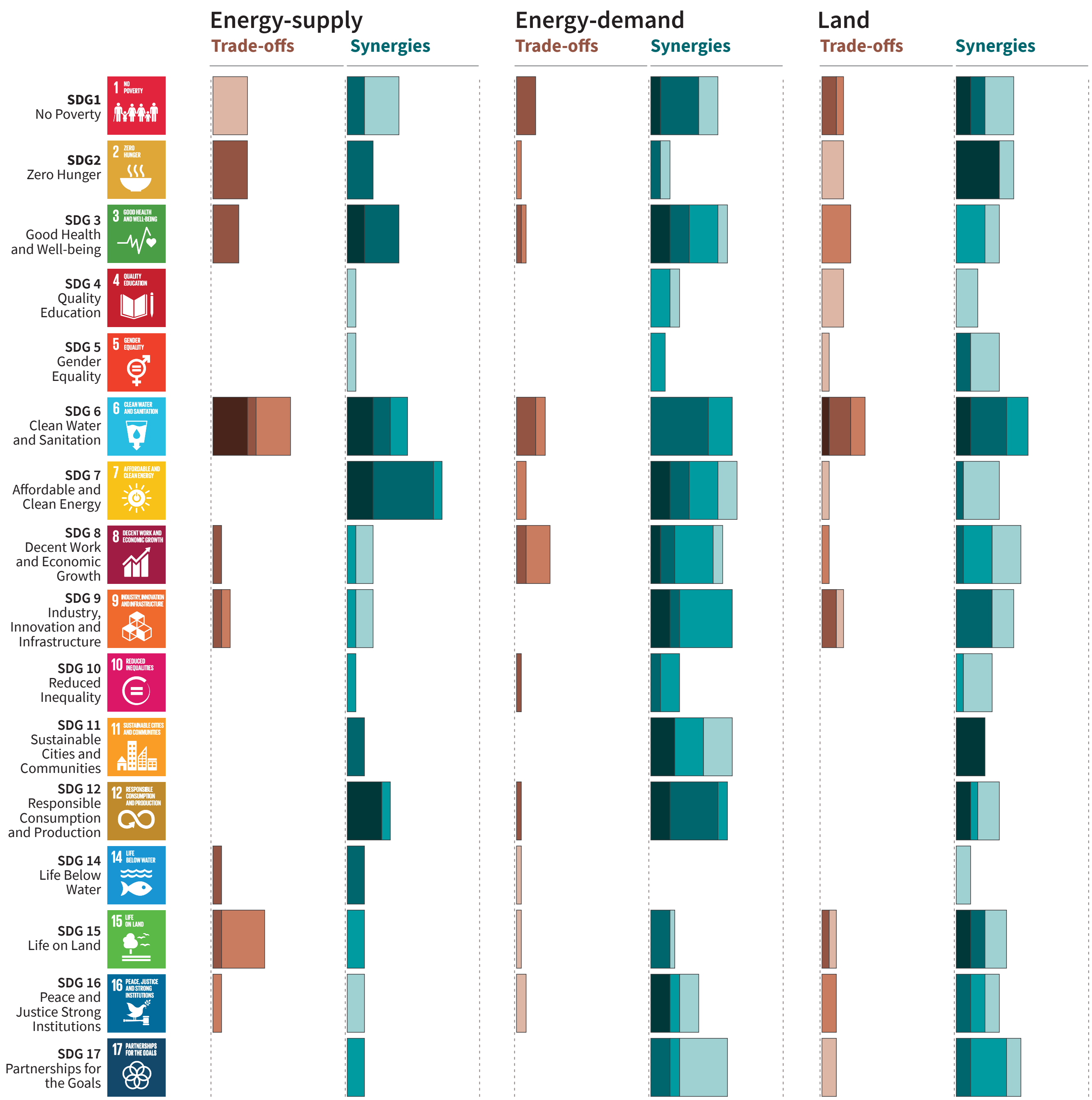


Figure SPM.4: Potential synergies and trade-offs between the sectoral portfolio of climate change mitigation options and the Sustainable Development Goals (SDGs). The SDGs serve as an analytical framework for the assessment of the different sustainable development dimensions, which extend beyond the time frame of the 2030 SDG targets. The assessment is based on literature on mitigation options that are considered relevant for 1.5ºC. The assessed strength of the SDG interactions is based on the qualitative and quantitative assessment of individual mitigation options listed in Table 5.2. For each mitigation option, the strength of the SDG-connection as well as the associated confidence of the underlying literature (shades of green and red) was assessed. The strength of positive connections (synergies) and negative connections (trade-offs) across all individual options within a sector (see Table 5.2) are aggregated into sectoral potentials for the whole mitigation portfolio. The (white) areas outside the bars, which indicate no interactions, have *low confidence* due to the uncertainty and limited number of studies exploring indirect effects. The strength of the connection considers only the effect of mitigation and does not include benefits of avoided impacts. SDG 13 (climate action) is not listed because mitigation is being considered in terms of interactions with SDGs and not vice versa. The bars denote the strength of the connection, and do not consider the strength of the impact on the SDGs. The energy demand sector comprises behavioural responses, fuel switching and efficiency options in the transport, industry and building sector as well as carbon capture options in the industry sector. Options assessed in the energy supply sector comprise biomass and non-biomass renewables, nuclear, CCS with bio-energy, and CCS with fossil fuels. Options in the land sector comprise agricultural and forest options, sustainable diets & reduced food waste, soil sequestration, livestock & manure management, reduced deforestation, afforestation & reforestation, responsible sourcing. In addition to this figure, options in the ocean sector are discussed in the underlying report. {5.4, Table 5.2, Figure 5.2}

Statement for knowledge gap:
Information about the net impacts of mitigation on sustainable development in 1.5°C pathways is available only for a limited number of SDGs and mitigation options. Only a limited number of studies have assessed the benefits of avoided climate change impacts of 1.5°C pathways for the SDGs, and the co-effects of adaptation for mitigation and the SDGs. The assessment of the indicative mitigation potentials in Figure SPM.4 is a step further from AR5 towards a more comprehensive and integrated assessment in the future.

D5. Limiting the risks from global warming of 1.5°C in the context of sustainable development and poverty eradication implies system transitions that can be enabled by an increase of adaptation and mitigation investments, policy instruments, the acceleration of technological innovation and behaviour changes (*high confidence*). {2.3, 2.4, 2.5, 3.2, 4.2, 4.4, 4.5, 5.2, 5.5, 5.6}

D5.1. Directing finance towards investment in infrastructure for mitigation and adaptation could provide additional resources. This could involve the mobilization of private funds by institutional investors, asset managers and development or investment banks, as well as the provision of public funds. Government policies that lower the risk of low-emission and adaptation investments can facilitate the mobilization of private funds and enhance the effectiveness of other public policies. Studies indicate a number of challenges including access to finance and mobilisation of funds (*high confidence*) {2.5.2, 4.4.5}

D5.2. Adaptation finance consistent with global warming of 1.5°C is difficult to quantify and compare with 2°C. Knowledge gaps include insufficient data to calculate specific climate resilience-enhancing investments, from the provision of currently underinvested basic infrastructure. Estimates of the costs of adaptation might be lower at global warming of 1.5°C than for 2°C. Adaptation needs have typically been supported by public sector sources such as national and subnational government budgets, and in developing countries together with support from development assistance, multilateral development banks, and UNFCCC channels (*medium confidence*). More recently there is a growing understanding of the scale and increase in NGO and private funding in some regions (*medium confidence*). Barriers include the scale of adaptation financing, limited capacity and access to adaptation finance (*medium confidence*).{4.4.5, 4.6}

D5.3. Global model pathways limiting global warming to 1.5°C are projected to involve the annual average investment needs in the energy system of around 2.4 trillion USD2010 between 2016 and 2035 representing about 2.5% of the world GDP (*medium confidence*). {2.5.2, 4.4.5, Box 4.8}

D5.4. Policy tools can help mobilise incremental resources, including through shifting global investments and savings and through market and non-market based instruments as well as accompanying measures to secure the equity of the transition, acknowledging the challenges related with implementation including those of energy costs, depreciation of assets and impacts on international competition, and utilizing the opportunities to maximize co-benefits (*high confidence*) {1.3.3, 2.3.4, 2.3.5, 2.5.1, 2.5.2, Cross-Chapter Box 8 in Chapter 3 and 11 in Chapter 4, 4.4.5, 5.5.2}

D5.5. The systems transitions consistent with adapting to and limiting global warming to 1.5°C include the widespread adoption of new and possibly disruptive technologies and practices and enhanced climate-driven innovation. These imply enhanced technological innovation capabilities, including in industry and finance. Both national innovation policies and international cooperation can contribute to the development, commercialization and widespread adoption of mitigation and adaptation technologies. Innovation policies may be more effective when they combine public support for research and development with policy mixes that provide incentives for technology diffusion. (*high confidence*) {4.4.4, 4.4.5}.

D5.6. Education, information, and community approaches, including those that are informed by Indigenous knowledge and local knowledge, can accelerate the wide scale behaviour changes consistent with adapting to and limiting global warming to 1.5°C. These approaches are more effective when combined with other policies and tailored to the motivations, capabilities, and resources of specific actors and contexts (*high confidence*). Public acceptability can enable or inhibit the implementation of policies and measures to limit global warming to 1.5°C and to adapt to the consequences. Public acceptability depends on the individual's evaluation of expected policy consequences, the perceived fairness of the distribution of these consequences, and perceived fairness of decision procedures (*high confidence*). {1.1, 1.5, 4.3.5, 4.4.1, 4.4.3, Box 4.3, 5.5.3, 5.6.5}

D6. Sustainable development supports, and often enables, the fundamental societal and systems transitions and transformations that help limit global warming to 1.5°C. Such changes facilitate the pursuit of climate-resilient development pathways that achieve ambitious mitigation and adaptation in conjunction with poverty eradication and efforts to reduce inequalities *(high confidence)*. {Box 1.1, 1.4.3, Figure 5.1, 5.5.3, Box 5.3}

D6.1. Social justice and equity are core aspects of climate-resilient development pathways that aim to limit global warming to 1.5°C as they address challenges and inevitable trade-offs, widen opportunities, and ensure that options, visions, and values are deliberated, between and within countries and communities, without making the poor and disadvantaged worse off (*high confidence*). {5.5.2, 5.5.3, Box 5.3, Figure 5.1, Figure 5.6, Cross-Chapter Boxes 12 and 13 in Chapter 5}

D6.2. The potential for climate-resilient development pathways differs between and within regions and nations, due to different development contexts and systemic vulnerabilities (*very high confidence*). Efforts along such pathways to date have been limited (*medium confidence*) and enhanced efforts would involve strengthened and timely action from all countries and non-state actors (*high confidence*). {5.5.1, 5.5.3, Figure 5.1}

D6.3. Pathways that are consistent with sustainable development show fewer mitigation and adaptation challenges and are associated with lower mitigation costs. The large majority of modelling studies could not construct pathways characterized by lack of international cooperation, inequality and poverty that were able to limit global warming to 1.5°C. (*high confidence*) {2.3.1, 2.5.3, 5.5.2}

D7. Strengthening the capacities for climate action of national and sub-national authorities, civil society, the private sector, indigenous peoples and local communities can support the implementation of ambitious actions implied by limiting global warming to 1.5°C (*high confidence*). International cooperation can provide an enabling environment for this to be achieved in all countries and for all people, in the context of sustainable development. International cooperation is a critical enabler for developing countries and vulnerable regions (*high confidence*). {1.4, 2.3, 2.5, 4.2, 4.4, 4.5, 5.3, 5.4, 5.5, 5.6, 5, Box 4.1, Box 4.2, Box 4.7, Box 5.3, Cross-Chapter Box 9 in Chapter 4, Cross-Chapter Box 13 in Chapter 5}

D7.1. Partnerships involving non-state public and private actors, institutional investors, the banking system, civil society and scientific institutions would facilitate actions and responses consistent with limiting global warming to 1.5°C (*very high confidence*). {1.4, 4.4.1, 4.2.2, 4.4.3, 4.4.5, 4.5.3, 5.4.1, 5.6.2, Box 5.3}.

D7.2. Cooperation on strengthened accountable multilevel governance that includes non-state actors such as industry, civil society and scientific institutions, coordinated sectoral and cross-sectoral policies at various governance levels, gender-sensitive policies, finance including innovative financing and cooperation on technology development and transfer can ensure participation, transparency, capacity building, and learning among different players (*high confidence*). {2.5.2, 4.2.2, 4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.5.3, Cross-Chapter Box 9 in Chapter 4, 5.3.1, 4.4.5, 5.5.3, Cross-Chapter Box 13 in Chapter 5, 5.6.1, 5.6.3}

D7.3. International cooperation is a critical enabler for developing countries and vulnerable regions to strengthen their action for the implementation of 1.5°C-consistent climate responses, including through enhancing access to finance and technology and enhancing domestic capacities, taking into account national and local circumstances and needs (*high confidence*). {2.3.1, 4.4.1, 4.4.2, 4.4.4, 4.4.5, 5.4.1 5.5.3, 5.6.1, Box 4.1, Box 4.2, Box 4.7}.

D7.4. Collective efforts at all levels, in ways that reflect different circumstances and capabilities, in the pursuit of limiting global warming to 1.5ºC, taking into account equity as well as effectiveness, can facilitate strengthening the global response to climate change, achieving sustainable development and eradicating poverty (*high confidence*). {1.4.2, 2.3.1, 2.5.2, 4.2.2, 4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5, 4.5.3, 5.3.1, 5.4.1, 5.5.3, 5.6.1, 5.6.2, 5.6.3}

Box SPM 1: Core Concepts Central to this Special Report

Global mean surface temperature (GMST): Estimated global average of near-surface air temperatures over land and sea-ice, and sea surface temperatures over ice-free ocean regions, with changes normally expressed as departures from a value over a specified reference period. When estimating changes in GMST, near-surface air temperature over both land and oceans are also used.[19] {1.2.1.1}

Pre-industrial: The multi-century period prior to the onset of large-scale industrial activity around 1750. The reference period 1850–1900 is used to approximate pre-industrial GMST. {1.2.1.2}

Global warming: The estimated increase in GMST averaged over a 30-year period, or the 30-year period centered on a particular year or decade, expressed relative to pre-industrial levels unless otherwise specified. For 30-year periods that span past and future years, the current multi-decadal warming trend is assumed to continue. {1.2.1}

Net zero CO_2 emissions: Net-zero carbon dioxide (CO_2) emissions are achieved when anthropogenic CO_2 emissions are balanced globally by anthropogenic CO_2 removals over a specified period.

Carbon dioxide removal (CDR): Anthropogenic activities removing CO_2 from the atmosphere and durably storing it in geological, terrestrial, or ocean reservoirs, or in products. It includes existing and potential anthropogenic enhancement of biological or geochemical sinks and direct air capture and storage, but excludes natural CO_2 uptake not directly caused by human activities.

Total carbon budget: Estimated cumulative net global anthropogenic CO_2 emissions from the preindustrial period to the time that anthropogenic CO_2 emissions reach net zero that would result, at some probability, in limiting global warming to a given level, accounting for the impact of other anthropogenic emissions. {2.2.2}

Remaining carbon budget: Estimated cumulative net global anthropogenic CO_2 emissions from a given start date to the time that anthropogenic CO_2 emissions reach net zero that would result, at some probability, in limiting global warming to a given level, accounting for the impact of other anthropogenic emissions. {2.2.2}

Temperature overshoot: The temporary exceedance of a specified level of global warming.

Emission pathways: In this Summary for Policymakers, the modelled trajectories of global anthropogenic emissions over the 21st century are termed emission pathways. Emission pathways are classified by their temperature trajectory over the 21st century: pathways giving at least 50% probability based on current knowledge of limiting global warming to below 1.5°C are classified as 'no overshoot'; those limiting warming to below 1.6°C and returning to 1.5°C by 2100 are classified as '1.5°C limited-overshoot'; while those exceeding 1.6°C but still returning to 1.5°C by 2100 are classified as 'higher-overshoot'.

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[19] Past IPCC reports, reflecting the literature, have used a variety of approximately equivalent metrics of GMST change.

Impacts: Effects of climate change on human and natural systems. Impacts can have beneficial or adverse outcomes for livelihoods, health and well-being, ecosystems and species, services, infrastructure, and economic, social and cultural assets.

Risk: The potential for adverse consequences from a climate-related hazard for human and natural systems, resulting from the interactions between the hazard and the vulnerability and exposure of the affected system. Risk integrates the likelihood of exposure to a hazard and the magnitude of its impact. Risk also can describe the potential for adverse consequences of adaptation or mitigation responses to climate change.

Climate-resilient development pathways (CRDPs): Trajectories that strengthen sustainable development at multiple scales and efforts to eradicate poverty through equitable societal and systems transitions and transformations while reducing the threat of climate change through ambitious mitigation, adaptation, and climate resilience.

MICHIGAN

THE HOME ENERGY AFFORDABILITY GAP 2017

(2ND SERIES) PUBLISHED APRIL 2018

Finding #1

Poverty Level	Home Energy Burden
Below 50%	32%
50 – 100%	17%
100 – 125%	12%
125 – 150%	10%
150 – 185%	8%
185% - 200%	7%

Home energy is a crippling financial burden for low-income Michigan households. Michigan households with incomes of below 50% of the Federal Poverty Level pay 32% of their annual income simply for their home energy bills.

Home energy unaffordability, however, is not only the province of the very poor. Bills for households with incomes between 150% and 185% of Poverty take up 8% of income. Michigan households with incomes between 185% and 200% of the Federal Poverty Level have energy bills equal to 7% of income.

Finding #2

Poverty Level	Number of Households	
	Last Year	This Year
Below 50%	292,413	284,402
50 – 100%	348,047	342,671
100 – 125%	175,660	173,784
125 – 150%	179,322	176,667
150 – 185%	247,638	249,131
185% - 200%	102,395	101,860
Total < 200%	1,345,475	1,328,515

The number of households facing unaffordable home energy burdens is staggering. According to the most recent five-year American Community Survey, more than 284,000 Michigan households live with income at or below 50% of the Federal Poverty Level and face a home energy burden of 32%. And nearly 343,000 *additional* Michigan households live with incomes between 50% and 100% of the Federal Poverty Level and face a home energy burden of 17%.

In 2017 the total number of Michigan households below 200% of the Federal Poverty Level stayed relatively constant from the prior year.

Finding #3

Home Energy Affordability Gap: 2011 (base year)	$1,793,445,416
Home Energy Affordability Gap: 2017 (current year)	$1,617,216,881
Home Energy Affordability Gap Index (2011 = 100)	90.2

The Home Energy Affordability Gap Index (2nd Series) indicates the extent to which the Home Energy Affordability Gap has increased between the base year and the current year. In Michigan, this Index was 90.2 for 2017.

The Home Energy Affordability Gap Index (2nd Series) uses the year 2011 as its base year. The Index for 2011 is set equal to 100. A current year Index of more than 100 thus indicates that the Home Energy Affordability Gap for has increased since 2011. A current year Index of less than 100 indicates that the Home Energy Affordability Gap has decreased since 2011.

Finding #4

	Last Year	This Year
Gross LIHEAP Allocation ($000's)	$140,599	$139,926
Number of Households <150% FPL	995,442	977,524
Heating/Cooling Bills "Covered" by LIHEAP	155,015	122,100

Existing sources of energy assistance do not adequately address the Home Energy Affordability Gap in Michigan. LIHEAP is the federal fuel assistance program designed to help pay low-income heating and cooling bills. The gross LIHEAP allocation to Michigan was $139.9 million in 2017 and the number of average annual low-income heating and cooling bills "covered" by LIHEAP was 122,100.

In comparison, the gross LIHEAP allocation to Michigan in 2016 reached $140.6 million and covered 155,015 average annual bills.

Finding #5

Primary Heating Fuel	Penetration by Tenure: Owner	Renter
Electricity	5%	19%
Natural gas	78%	74%
Fuel Oil	2%	1%
Propane	10%	4%
All other	5%	2%
Total	100%	100%

The Home Energy Affordability Gap in Michigan is not solely a function of household incomes and fuel prices. It is also affected by the extent to which low-income households use each fuel. All other things equal, the Affordability Gap will be greater in areas where more households use more expensive fuels.

In 2017, the primary heating fuel for Michigan homeowners was Natural Gas (78% of homeowners). The primary heating fuel for Michigan renters was also Natural Gas (74% of renters).

Changes in the prices of home energy fuels over time are presented in Finding #6 below.

Finding #6

Fuel	2015 Price	2016 Price	2017 Price
Natural gas heating (ccf)	$0.878	$0.794	$1.147
Electric heating (kWh)	$0.145	$0.156	$0.111
Propane heating (gallon)	$2.293	$1.866	$2.804
Fuel Oil heating (gallon)	$2.547	$1.802	$2.154
Electric cooling (kWh)	$0.162	$0.167	$0.111

In Michigan, natural gas prices rose 44.5% during the 2016/2017 winter heating season. Fuel oil prices rose substantially 19.5% and propane prices rose 50.3%.

Heating season electric prices fell substantially 28.8% in the same period and cooling season electric prices fell 33.5%.

Home Energy Affordability Gap Dashboard -- Michigan 2017 versus 2016

AVERAGE DOLLAR AMOUNT BY WHICH ACTUAL HOME ENERGY BILLS EXCEEDED AFFORDABLE HOME ENERGY BILLS FOR HOUSEHOLDS BELOW 200% OF POVERTY LEVEL.

2016: $1,250 per household

2017: $1,217 PER HOUSEHOLD

AVERAGE TOTAL HOME ENERGY BURDEN FOR HOUSEHOLDS BELOW 50% OF POVERTY LEVEL.

2016: 33% of household income

2017: 32% OF HOUSEHOLD INCOME

PERCENT OF INDIVIDUALS BELOW 100% OF POVERTY LEVEL.

2016: 17% Of all individuals

2017: 16% OF ALL INDIVIDUALS

NUMBER OF AVERAGE LOW-INCOME HEATING/COOLING BILLS COVERED BY FEDERAL HOME ENERGY ASSISTANCE.

2016: 155,015 bills covered

2017: 122,100 BILLS COVERED

PRIMARY HEATING FUEL (2017):

HOMEOWNERS - NATURAL GAS * TENANTS - NATURAL GAS**

NOTES AND EXPLANATIONS

The 2012 Home Energy Affordability Gap, published in May 2013, introduced the 2nd Series of the annual Affordability Gap analysis. The 2012 Home Energy Affordability Gap going forward cannot be directly compared to the Affordability Gap (1st Series) for 2011 and earlier years. While remaining fundamentally the same, several improvements have been introduced in both data and methodology in the Affordability Gap (2nd Series).

The most fundamental change in the Home Energy Affordability Gap (2nd Series) is the move to a use of the American Community Survey (ACS) (5-year data) as the source of foundational demographic data. The Affordability Gap (1st Series) relied on the 2000 Census as its source of demographic data. The ACS (5-year data) offers several advantages compared to the Decennial Census. While year-to-year changes are smoothed out through use of 5-year averages, the ACS nonetheless is updated on an annual basis. As a result, numerous demographic inputs into the Affordability Gap (2nd Series) will reflect year-to-year changes on a county-by-county basis, including:

- The distribution of heating fuels by tenure;
- The average household size by tenure;
- The number of rooms per housing unit by tenure;
- The distribution of owner/renter status;
- The distribution of household size;
- The distribution of households by ratio of income to Poverty Level;

Data on housing unit size (both heated square feet and cooled square feet) is no longer calculated based on the number of rooms. Instead, Energy Information Administration/Department of Energy (EIA/DOE) data on square feet of heated and cooled living space per household member is used beginning with the Home Energy Affordability Gap (2nd Series). A distinction is now made between heated living space and cooled living space, rather than using total living space.

The change resulting in perhaps the greatest dollar difference in the aggregate and average Affordability Gap for each state is a change in the treatment of income for households with income at or below 50% of the Federal Poverty Level. In recent years, it has become more evident that income for households with income below 50% of Poverty Level is not normally distributed. Rather than using the mid-point of the Poverty range (i.e., 25% of Poverty Level) to determine income for these households, income is set somewhat higher (40% of Poverty). By setting income higher, both the average and aggregate Affordability Gap results not only for that Poverty range, but also for the state as a whole, will be lower. The Affordability Gap results for other Poverty ranges remain unaffected by this change.

Another change affecting both the aggregate and average Affordability Gap is a change in the definition of "low-income." The Home Energy Affordability Gap (2nd Series) has increased the definition of "low-income" to 200% of the Federal Poverty Level (up from 185% of Poverty). While this change may increase the aggregate Affordability Gap, it is likely to decrease the average Affordability Gap. Since more households are added to the analysis, the aggregate is likely to increase, but since the contribution of each additional household is less than the contributions of households with lower incomes, the overall average will most likely decrease.

Most of the Home Energy Affordability Gap calculation remains the same. All references to "states" include the District of Columbia as a "state." Low-income home energy bills are calculated in a two-step process: First, low-income energy consumption is calculated for the following end-uses: (1) space heating; (2) space cooling; (3) domestic hot water; and (4) electric appliances (including lighting and refrigeration). All space cooling and appliance consumption is assumed to involve only electricity. Second, usage is multiplied by a price per unit of energy by fuel type and end use by time of year. The price of electricity, for example, used for space cooling (cooling months), space heating (heating months), and appliances (total year) differs to account for the time of year in which the consumption is incurred.

Each state's Home Energy Affordability Gap is calculated on a county-by-county basis. Once total energy bills are determined for each county, each county is weighted by the percentage of persons at or below 200% of the Federal Poverty Level to the total statewide population at or below 200% of the Federal Poverty Level to derive a statewide result. Bills are calculated by end-use and summed before county weighting.

LIHEAP comparisons use gross allotments from annual baseline LIHEAP appropriations as reported by the federal LIHEAP office. They do not reflect supplemental appropriations or the release of LIHEAP "emergency" funds. The number of average heating/cooling bills covered by each state's LIHEAP allocation is determined by dividing the total base LIHEAP allocation for each state by the average heating/cooling bill in that state, the calculation of which is explained below. No dollars are set aside for administration; nor are Tribal set-asides considered.

State financial resources and utility-specific rate discounts are not considered in the calculation of the Affordability Gap. Rather, such funding should be considered available to fill the Affordability Gap. While the effect in any given state may perhaps seem to be the same, experience shows there to be an insufficiently authoritative source of state-by-state data, comprehensively updated on an annual basis, to be used as an input into the annual Affordability Gap calculation.

Energy bills are a function of the following primary factors:

- Tenure of household (owner/renter)
- Housing unit size (by tenure)
- Heating Degree Days (HDDs) and Cooling Degree Days (CDDs)
- Housing size (by tenure)
- Heating fuel mix (by tenure)
- Energy use intensities (by fuel and end use)

Bills are estimated using the U.S. Department of Energy's "energy intensities" most-recently published in the DOE's Residential Energy Consumption Survey (RECS). The energy intensities used for each state are those published for the Census Division in which the state is located. Heating Degree Days (HDDs) and Cooling Degree Days (CDDs) are obtained from the National Weather Service's Climate Prediction Center on a county-by-county basis for the entire country.

End-use consumption by fuel is multiplied by fuel-specific price data to derive annual bills. State price data for each end-use is obtained from the Energy Information Administration's (EIA) fuel-specific price reports (e.g., Natural Gas Monthly, Electric Power Monthly). State-specific data on fuel oil and kerosene is not available for all states. For those states in which these bulk fuels have insufficient penetration for state-specific prices to be published, prices from the Petroleum Administration for Defense Districts (PADD) of which the state is a part are used.

The Home Energy Affordability Gap Index (2nd Series) uses 2011 as its base year. The base year (2011) Index has been set equal to 100. A current year Index of more than 100 thus indicates that the Home Energy Affordability Gap has increased since 2011. A current year Index of less than 100 indicates that the Affordability Gap has decreased since 2011. The Affordability Gap Index was, in other words, re-set in 2011. The Affordability Gap Index (2nd Series) for 2012 and beyond cannot be compared to the Affordability Gap Index (1st Series) for 2011 and before.

The Home Energy Affordability Gap is a function of many variables, annual changes in which are now tracked for nearly all of them. For example, all other things equal: increases in income would result in decreases in the Affordability Gap; increases in relative penetrations of high-cost fuels would result in an increase in the Gap; increases in amount of heated or cooled square feet of living space would result in an increase in the Gap. Not all variables will result in a change in the Affordability Gap in the same direction. The annual Affordability Gap Index allows the reader to determine the net cumulative impact of these variables, but not the impact of individual variables.

Since the Affordability Gap is calculated assuming normal Heating Degree Days (HDDs) and Cooling Degree Days (CDDs), annual changes in weather do not have an impact on the Affordability Gap or on the Affordability Gap Index.

Price data for the various fuels underlying the calculation of the Home Energy Affordability Gap (2nd Series) was used from the following time periods:

Heating prices	
Natural gas	February 2017
Fuel oil * **	Week of 02/06/2017
Liquefied petroleum gas (LPG) * **	Week of 02/06/2017
Electricity	February 2017
Cooling prices	August 2017
Non-heating prices	
Natural gas	May 2017
Fuel oil * **	Week of 10/02/2017
Liquefied petroleum gas (LPG) * **	Week of 10/02/2017
Electricity	May 2017

*****Monthly bulk fuel prices are no longer published. Weekly bulk fuel prices are published during the heating months (October through March). The prices used are taken from the weeks most reflective of the end-uses to which they are to be applied. Prices from the middle of February best reflect heating season prices. Bulk fuel prices from October best reflect non-heating season prices.**

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- Less than 50% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Alcona County	$2,387	339	$809,108	42.0%
Alger County	$2,746	129	$354,225	44.1%
Allegan County	$2,364	2,057	$4,862,974	37.0%
Alpena County	$2,064	822	$1,696,972	35.9%
Antrim County	$2,586	448	$1,158,743	42.7%
Arenac County	$2,511	534	$1,341,061	41.7%
Baraga County	$2,394	222	$531,439	41.5%
Barry County	$2,446	1,000	$2,445,636	38.9%
Bay County	$1,954	2,988	$5,839,381	33.3%
Benzie County	$2,488	325	$808,753	40.8%
Berrien County	$1,846	5,175	$9,550,468	31.7%
Branch County	$2,254	1,079	$2,431,864	36.3%
Calhoun County	$1,875	3,540	$6,637,582	31.8%
Cass County	$2,269	1,443	$3,274,721	36.7%
Charlevoix County	$2,334	530	$1,237,159	39.0%
Cheboygan County	$2,233	911	$2,034,593	38.2%
Chippewa County	$2,498	1,090	$2,723,164	40.5%
Clare County	$2,595	1,166	$3,025,702	42.8%
Clinton County	$2,295	1,355	$3,109,674	36.3%
Crawford County	$2,751	435	$1,196,721	45.8%
Delta County	$2,265	886	$2,006,746	38.5%
Dickinson County	$2,190	719	$1,574,910	37.5%
Eaton County	$2,028	2,240	$4,543,639	34.1%
Emmet County	$2,281	659	$1,503,439	38.6%
Genesee County	$1,850	16,084	$29,761,748	31.5%
Gladwin County	$2,535	955	$2,421,299	42.1%
Gogebic County	$2,224	529	$1,176,570	39.2%
Grand Traverse County	$2,088	1,366	$2,852,432	34.7%
Gratiot County	$2,232	1,364	$3,044,858	36.9%
Hillsdale County	$2,424	1,526	$3,698,726	39.1%
Houghton County	$2,394	1,775	$4,250,086	38.1%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- Less than 50% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Huron County	$2,141	883	$1,890,557	36.8%
Ingham County	$1,782	12,621	$22,492,919	30.9%
Ionia County	$2,450	1,139	$2,790,985	38.0%
Iosco County	$1,989	751	$1,493,856	35.3%
Iron County	$2,350	345	$810,856	41.8%
Isabella County	$2,199	4,150	$9,126,742	35.4%
Jackson County	$1,978	4,602	$9,101,669	33.2%
Kalamazoo County	$1,784	8,006	$14,281,151	30.6%
Kalkaska County	$2,968	590	$1,750,855	47.1%
Kent County	$1,966	15,091	$29,662,221	32.0%
Keweenaw County	$2,672	77	$205,768	45.8%
Lake County	$3,139	595	$1,867,650	48.7%
Lapeer County	$2,459	1,436	$3,531,147	38.5%
Leelanau County	$2,279	353	$804,610	38.0%
Lenawee County	$1,979	1,920	$3,798,856	33.2%
Livingston County	$2,179	1,798	$3,917,939	34.7%
Luce County	$2,381	152	$361,910	39.8%
Mackinac County	$2,225	383	$852,235	39.8%
Macomb County	$1,819	16,647	$30,279,438	30.8%
Manistee County	$2,133	682	$1,454,755	36.4%
Marquette County	$2,128	2,209	$4,701,464	35.8%
Mason County	$2,215	884	$1,957,805	37.5%
Mecosta County	$2,421	1,810	$4,382,323	38.4%
Menominee County	$2,276	541	$1,231,114	39.4%
Midland County	$2,027	1,549	$3,139,920	34.0%
Missaukee County	$3,010	314	$945,024	46.7%
Monroe County	$1,965	2,917	$5,732,189	32.6%
Montcalm County	$2,516	1,787	$4,496,219	39.5%
Montmorency County	$2,313	239	$552,784	39.7%
Muskegon County	$1,983	5,379	$10,665,439	32.7%
Newaygo County	$2,735	1,391	$3,804,321	42.7%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- Less than 50% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Oakland County	$1,803	20,361	$36,701,309	30.8%
Oceana County	$2,655	783	$2,078,696	42.0%
Ogemaw County	$2,523	846	$2,134,441	42.7%
Ontonagon County	$2,331	248	$577,990	41.4%
Osceola County	$2,906	883	$2,565,986	45.0%
Oscoda County	$2,630	231	$607,559	43.9%
Otsego County	$2,561	484	$1,239,645	41.6%
Ottawa County	$2,054	4,546	$9,339,153	32.6%
Presque Isle County	$2,304	346	$797,025	40.1%
Roscommon County	$2,044	829	$1,694,511	36.8%
Saginaw County	$1,929	6,275	$12,102,522	32.8%
St. Clair County	$1,980	3,881	$7,685,725	33.3%
St. Joseph County	$2,178	1,788	$3,894,323	35.1%
Sanilac County	$2,362	1,172	$2,768,317	38.7%
Schoolcraft County	$2,602	327	$850,942	42.2%
Shiawassee County	$2,197	1,708	$3,751,638	36.1%
Tuscola County	$2,418	1,427	$3,450,356	39.3%
Van Buren County	$2,129	2,068	$4,401,742	34.5%
Washtenaw County	$1,745	11,773	$20,545,653	30.1%
Wayne County	$1,714	78,366	$134,335,282	28.8%
Wexford County	$2,592	1,128	$2,923,615	41.3%
Total Michigan	$1,928	284,402	$548,435,547	32.25%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- 50% - 99% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Alcona County	$2,039	400	$815,474	22.4%
Alger County	$2,367	322	$762,221	23.5%
Allegan County	$1,964	2,847	$5,592,241	19.8%
Alpena County	$1,702	1,238	$2,107,492	19.2%
Antrim County	$2,216	824	$1,826,374	22.8%
Arenac County	$2,142	714	$1,529,546	22.2%
Baraga County	$2,040	219	$446,686	22.1%
Barry County	$2,055	1,133	$2,328,812	20.7%
Bay County	$1,579	3,922	$6,192,851	17.8%
Benzie County	$2,113	481	$1,016,448	21.8%
Berrien County	$1,468	6,013	$8,829,917	16.9%
Branch County	$1,863	1,788	$3,330,576	19.3%
Calhoun County	$1,494	5,502	$8,217,811	17.0%
Cass County	$1,881	1,564	$2,941,794	19.6%
Charlevoix County	$1,963	841	$1,651,200	20.8%
Cheboygan County	$1,869	1,170	$2,187,314	20.4%
Chippewa County	$2,119	1,367	$2,896,198	21.6%
Clare County	$2,225	1,962	$4,365,321	22.8%
Clinton County	$1,898	1,928	$3,658,848	19.4%
Crawford County	$2,388	599	$1,430,471	24.4%
Delta County	$1,899	1,729	$3,283,945	20.5%
Dickinson County	$1,825	912	$1,664,216	20.0%
Eaton County	$1,650	2,655	$4,379,754	18.2%
Emmet County	$1,914	831	$1,590,552	20.6%
Genesee County	$1,470	18,726	$27,524,480	16.8%
Gladwin County	$2,166	1,243	$2,692,664	22.4%
Gogebic County	$1,873	843	$1,578,574	20.9%
Grand Traverse County	$1,707	2,150	$3,669,503	18.5%
Gratiot County	$1,853	1,426	$2,641,861	19.7%
Hillsdale County	$2,039	1,778	$3,625,119	20.8%
Houghton County	$2,003	1,268	$2,540,235	20.3%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- 50% - 99% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Huron County	$1,776	1,055	$1,874,018	19.6%
Ingham County	$1,407	12,126	$17,060,164	16.5%
Ionia County	$2,048	2,045	$4,187,947	20.2%
Iosco County	$1,632	1,178	$1,922,868	18.8%
Iron County	$2,006	590	$1,183,396	22.3%
Isabella County	$1,806	2,965	$5,355,931	18.9%
Jackson County	$1,595	5,532	$8,826,124	17.7%
Kalamazoo County	$1,402	9,741	$13,660,654	16.3%
Kalkaska County	$2,589	578	$1,496,307	25.1%
Kent County	$1,568	19,777	$31,017,017	17.1%
Keweenaw County	$2,320	97	$225,026	24.4%
Lake County	$2,753	601	$1,654,613	26.0%
Lapeer County	$2,062	1,941	$4,001,948	20.5%
Leelanau County	$1,905	433	$824,845	20.2%
Lenawee County	$1,596	3,519	$5,617,288	17.7%
Livingston County	$1,781	2,342	$4,171,002	18.5%
Luce County	$2,011	337	$677,701	21.2%
Mackinac County	$1,880	440	$827,081	21.2%
Macomb County	$1,433	24,204	$34,686,869	16.4%
Manistee County	$1,765	929	$1,639,518	19.4%
Marquette County	$1,754	2,162	$3,791,988	19.1%
Mason County	$1,846	1,099	$2,028,295	20.0%
Mecosta County	$2,028	1,698	$3,444,126	20.5%
Menominee County	$1,918	1,054	$2,021,476	21.0%
Midland County	$1,647	2,576	$4,243,701	18.1%
Missaukee County	$2,621	566	$1,483,593	24.9%
Monroe County	$1,577	3,413	$5,381,127	17.4%
Montcalm County	$2,121	2,216	$4,701,211	21.1%
Montmorency County	$1,953	435	$849,360	21.2%
Muskegon County	$1,593	7,307	$11,643,508	17.5%
Newaygo County	$2,344	1,953	$4,577,596	22.8%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- 50% - 99% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Oakland County	$1,421	27,204	$38,659,903	16.4%
Oceana County	$2,267	1,247	$2,827,225	22.4%
Ogemaw County	$2,162	1,009	$2,181,207	22.8%
Ontonagon County	$1,985	205	$406,961	22.1%
Osceola County	$2,515	1,129	$2,839,336	24.0%
Oscoda County	$2,265	483	$1,094,180	23.4%
Otsego County	$2,183	906	$1,978,108	22.2%
Ottawa County	$1,648	5,130	$8,456,138	17.4%
Presque Isle County	$1,949	458	$892,795	21.4%
Roscommon County	$1,696	1,403	$2,379,459	19.6%
Saginaw County	$1,551	7,690	$11,925,507	17.5%
St. Clair County	$1,600	5,248	$8,395,780	17.8%
St. Joseph County	$1,785	1,956	$3,491,857	18.7%
Sanilac County	$1,982	1,482	$2,937,890	20.6%
Schoolcraft County	$2,224	387	$860,828	22.5%
Shiawassee County	$1,813	2,182	$3,956,696	19.3%
Tuscola County	$2,036	1,959	$3,989,484	20.9%
Van Buren County	$1,737	2,970	$5,157,552	18.4%
Washtenaw County	$1,365	9,324	$12,731,801	16.1%
Wayne County	$1,320	85,691	$113,079,372	15.4%
Wexford County	$2,207	1,304	$2,877,833	22.1%
Total Michigan	$1,557	342,671	$533,514,707	17.32%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- 100% - 124% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Alcona County	$1,666	300	$499,729	14.9%
Alger County	$1,961	198	$388,339	15.7%
Allegan County	$1,536	2,038	$3,130,050	13.2%
Alpena County	$1,314	660	$867,480	12.8%
Antrim County	$1,820	516	$939,139	15.2%
Arenac County	$1,747	365	$637,555	14.8%
Baraga County	$1,660	110	$182,617	14.7%
Barry County	$1,637	899	$1,471,996	13.8%
Bay County	$1,177	2,147	$2,526,856	11.9%
Benzie County	$1,711	326	$557,825	14.5%
Berrien County	$1,065	3,617	$3,850,335	11.3%
Branch County	$1,444	921	$1,329,675	12.9%
Calhoun County	$1,085	2,901	$3,147,415	11.3%
Cass County	$1,465	751	$1,100,031	13.0%
Charlevoix County	$1,566	598	$936,468	13.9%
Cheboygan County	$1,480	531	$785,692	13.6%
Chippewa County	$1,712	936	$1,602,311	14.4%
Clare County	$1,828	778	$1,422,571	15.2%
Clinton County	$1,472	798	$1,174,776	12.9%
Crawford County	$1,999	335	$669,727	16.3%
Delta County	$1,508	898	$1,353,823	13.7%
Dickinson County	$1,433	662	$948,689	13.3%
Eaton County	$1,244	1,685	$2,095,775	12.1%
Emmet County	$1,520	614	$933,529	13.7%
Genesee County	$1,062	9,129	$9,696,196	11.2%
Gladwin County	$1,771	620	$1,097,875	15.0%
Gogebic County	$1,496	377	$563,947	13.9%
Grand Traverse County	$1,298	1,453	$1,886,114	12.4%
Gratiot County	$1,446	643	$929,685	13.1%
Hillsdale County	$1,626	856	$1,392,241	13.9%
Houghton County	$1,584	727	$1,151,809	13.6%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- 100% - 124% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Huron County	$1,386	757	$1,048,844	13.1%
Ingham County	$1,005	4,992	$5,016,103	11.0%
Ionia County	$1,617	1,403	$2,268,175	13.5%
Iosco County	$1,250	712	$889,990	12.5%
Iron County	$1,637	310	$507,344	14.9%
Isabella County	$1,385	1,290	$1,787,289	12.6%
Jackson County	$1,186	2,598	$3,080,874	11.8%
Kalamazoo County	$994	4,966	$4,934,835	10.9%
Kalkaska County	$2,183	302	$659,243	16.8%
Kent County	$1,143	9,981	$11,405,746	11.4%
Keweenaw County	$1,942	70	$135,956	16.3%
Lake County	$2,340	320	$748,715	17.3%
Lapeer County	$1,636	1,700	$2,781,549	13.7%
Leelanau County	$1,504	279	$419,564	13.5%
Lenawee County	$1,187	1,881	$2,232,127	11.8%
Livingston County	$1,354	1,283	$1,737,727	12.4%
Luce County	$1,615	114	$184,058	14.1%
Mackinac County	$1,510	318	$480,061	14.2%
Macomb County	$1,020	14,135	$14,414,015	10.9%
Manistee County	$1,370	496	$679,651	12.9%
Marquette County	$1,353	1,130	$1,528,649	12.7%
Mason County	$1,450	784	$1,136,868	13.3%
Mecosta County	$1,607	905	$1,454,745	13.6%
Menominee County	$1,535	553	$848,656	14.0%
Midland County	$1,241	1,272	$1,578,065	12.1%
Missaukee County	$2,205	364	$802,620	16.6%
Monroe County	$1,160	2,006	$2,327,901	11.6%
Montcalm County	$1,699	1,380	$2,344,226	14.0%
Montmorency County	$1,566	271	$424,511	14.1%
Muskegon County	$1,176	3,359	$3,951,345	11.6%
Newaygo County	$1,925	1,027	$1,976,842	15.2%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- 100% - 124% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Oakland County	$1,012	13,759	$13,930,272	11.0%
Oceana County	$1,852	709	$1,313,050	14.9%
Ogemaw County	$1,775	603	$1,070,156	15.2%
Ontonagon County	$1,615	234	$377,927	14.7%
Osceola County	$2,096	549	$1,150,651	16.0%
Oscoda County	$1,875	240	$449,902	15.6%
Otsego County	$1,778	380	$675,808	14.8%
Ottawa County	$1,213	3,226	$3,914,341	11.6%
Presque Isle County	$1,570	300	$470,948	14.3%
Roscommon County	$1,323	787	$1,041,245	13.1%
Saginaw County	$1,146	4,274	$4,897,492	11.7%
St. Clair County	$1,192	2,585	$3,081,535	11.8%
St. Joseph County	$1,364	1,114	$1,519,845	12.5%
Sanilac County	$1,576	791	$1,246,299	13.7%
Schoolcraft County	$1,819	173	$314,767	15.0%
Shiawassee County	$1,403	1,369	$1,920,421	12.8%
Tuscola County	$1,628	1,210	$1,969,671	14.0%
Van Buren County	$1,317	1,498	$1,972,267	12.3%
Washtenaw County	$959	4,213	$4,039,024	10.7%
Wayne County	$897	36,583	$32,809,366	10.2%
Wexford County	$1,795	840	$1,507,382	14.7%
Total Michigan	$1,167	173,784	$202,728,932	11.66%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- 125% - 149% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Alcona County	$1,417	280	$396,801	12.2%
Alger County	$1,691	172	$290,808	12.8%
Allegan County	$1,250	1,703	$2,129,150	10.8%
Alpena County	$1,056	727	$767,506	10.5%
Antrim County	$1,556	579	$900,777	12.4%
Arenac County	$1,483	388	$575,428	12.1%
Baraga County	$1,407	165	$232,180	12.1%
Barry County	$1,359	1,263	$1,715,986	11.3%
Bay County	$909	1,956	$1,777,751	9.7%
Benzie County	$1,443	398	$574,340	11.9%
Berrien County	$795	3,331	$2,648,823	9.2%
Branch County	$1,164	828	$964,116	10.5%
Calhoun County	$812	2,953	$2,399,310	9.3%
Cass County	$1,187	821	$974,771	10.7%
Charlevoix County	$1,301	487	$633,627	11.4%
Cheboygan County	$1,220	628	$765,999	11.1%
Chippewa County	$1,441	757	$1,090,597	11.8%
Clare County	$1,564	739	$1,155,949	12.5%
Clinton County	$1,188	816	$969,753	10.6%
Crawford County	$1,740	317	$551,552	13.3%
Delta County	$1,246	1,092	$1,361,114	11.2%
Dickinson County	$1,172	690	$808,617	10.9%
Eaton County	$973	1,913	$1,861,774	9.9%
Emmet County	$1,258	716	$900,725	11.2%
Genesee County	$790	8,053	$6,364,416	9.2%
Gladwin County	$1,507	842	$1,268,980	12.2%
Gogebic County	$1,245	447	$556,406	11.4%
Grand Traverse County	$1,026	1,436	$1,472,820	10.1%
Gratiot County	$1,175	867	$1,018,436	10.7%
Hillsdale County	$1,351	940	$1,270,410	11.4%
Houghton County	$1,305	899	$1,173,188	11.1%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- 125% - 149% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Huron County	$1,125	781	$878,624	10.7%
Ingham County	$737	4,885	$3,599,147	9.0%
Ionia County	$1,329	981	$1,303,916	11.0%
Iosco County	$995	573	$570,193	10.3%
Iron County	$1,390	361	$501,965	12.2%
Isabella County	$1,105	1,103	$1,218,707	10.3%
Jackson County	$913	2,968	$2,709,175	9.6%
Kalamazoo County	$721	4,451	$3,210,427	8.9%
Kalkaska County	$1,912	591	$1,130,207	13.7%
Kent County	$859	11,048	$9,490,429	9.3%
Keweenaw County	$1,690	59	$99,738	13.3%
Lake County	$2,064	295	$608,927	14.2%
Lapeer County	$1,352	1,550	$2,096,339	11.2%
Leelanau County	$1,236	425	$525,465	11.0%
Lenawee County	$914	1,996	$1,823,549	9.6%
Livingston County	$1,070	2,022	$2,163,681	10.1%
Luce County	$1,350	158	$213,340	11.6%
Mackinac County	$1,263	250	$315,723	11.6%
Macomb County	$744	13,222	$9,839,314	8.9%
Manistee County	$1,107	449	$497,145	10.6%
Marquette County	$1,085	1,070	$1,161,336	10.4%
Mason County	$1,186	840	$996,595	10.9%
Mecosta County	$1,327	858	$1,138,446	11.2%
Menominee County	$1,279	666	$851,898	11.5%
Midland County	$969	1,372	$1,330,057	9.9%
Missaukee County	$1,928	381	$734,394	13.6%
Monroe County	$883	2,926	$2,583,691	9.5%
Montcalm County	$1,417	1,271	$1,800,839	11.5%
Montmorency County	$1,309	272	$356,066	11.5%
Muskegon County	$898	3,658	$3,285,837	9.5%
Newaygo County	$1,646	974	$1,602,748	12.4%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- 125% - 149% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Oakland County	$740	15,039	$11,128,950	9.0%
Oceana County	$1,575	758	$1,193,959	12.2%
Ogemaw County	$1,517	526	$797,783	12.4%
Ontonagon County	$1,368	217	$296,930	12.0%
Osceola County	$1,817	587	$1,066,323	13.1%
Oscoda County	$1,614	228	$368,006	12.8%
Otsego County	$1,509	449	$677,320	12.1%
Ottawa County	$923	3,886	$3,588,235	9.5%
Presque Isle County	$1,317	398	$524,095	11.7%
Roscommon County	$1,074	655	$703,758	10.7%
Saginaw County	$876	4,716	$4,130,962	9.5%
St. Clair County	$920	2,971	$2,734,117	9.7%
St. Joseph County	$1,084	1,097	$1,188,841	10.2%
Sanilac County	$1,304	991	$1,292,672	11.2%
Schoolcraft County	$1,550	179	$277,365	12.3%
Shiawassee County	$1,129	1,251	$1,412,498	10.5%
Tuscola County	$1,355	1,103	$1,494,990	11.4%
Van Buren County	$1,037	1,714	$1,776,791	10.0%
Washtenaw County	$688	5,086	$3,496,712	8.8%
Wayne County	$615	34,227	$21,049,617	8.4%
Wexford County	$1,520	930	$1,413,184	12.0%
Total Michigan	$899	176,667	$158,823,135	9.57%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- 150% - 184% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Alcona County	$1,119	582	$651,146	10.0%
Alger County	$1,366	279	$381,134	10.5%
Allegan County	$908	2,908	$2,639,022	8.8%
Alpena County	$745	1,127	$839,996	8.6%
Antrim County	$1,239	764	$946,288	10.2%
Arenac County	$1,167	586	$683,665	10.0%
Baraga County	$1,104	268	$295,750	9.9%
Barry County	$1,024	1,543	$1,580,348	9.3%
Bay County	$587	2,695	$1,582,524	8.0%
Benzie County	$1,121	624	$699,755	9.7%
Berrien County	$472	4,263	$2,012,286	7.6%
Branch County	$829	1,300	$1,077,939	8.7%
Calhoun County	$486	4,035	$1,959,270	7.6%
Cass County	$854	1,621	$1,384,898	8.8%
Charlevoix County	$983	745	$732,469	9.3%
Cheboygan County	$908	1,084	$984,122	9.1%
Chippewa County	$1,115	1,167	$1,301,505	9.7%
Clare County	$1,247	1,185	$1,477,763	10.2%
Clinton County	$848	1,417	$1,201,544	8.7%
Crawford County	$1,429	456	$651,524	10.9%
Delta County	$933	996	$929,322	9.2%
Dickinson County	$859	895	$768,377	8.9%
Eaton County	$649	2,702	$1,752,380	8.1%
Emmet County	$943	1,110	$1,046,846	9.2%
Genesee County	$464	10,544	$4,893,873	7.5%
Gladwin County	$1,191	841	$1,001,383	10.0%
Gogebic County	$943	595	$561,328	9.4%
Grand Traverse County	$699	2,738	$1,913,068	8.3%
Gratiot County	$849	1,242	$1,054,758	8.8%
Hillsdale County	$1,022	1,424	$1,454,701	9.3%
Houghton County	$970	1,163	$1,127,861	9.1%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- 150% - 184% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Huron County	$812	1,051	$853,794	8.8%
Ingham County	$415	7,228	$3,000,427	7.4%
Ionia County	$984	1,714	$1,686,889	9.1%
Iosco County	$689	1,071	$738,173	8.4%
Iron County	$1,095	474	$519,104	10.0%
Isabella County	$768	1,531	$1,176,100	8.5%
Jackson County	$585	4,137	$2,420,608	7.9%
Kalamazoo County	$394	6,387	$2,518,725	7.3%
Kalkaska County	$1,588	619	$982,780	11.3%
Kent County	$519	15,355	$7,962,247	7.6%
Keweenaw County	$1,388	82	$113,847	10.9%
Lake County	$1,733	281	$487,104	11.6%
Lapeer County	$1,012	2,340	$2,368,088	9.2%
Leelanau County	$915	611	$559,356	9.1%
Lenawee County	$586	2,492	$1,460,110	7.9%
Livingston County	$729	3,199	$2,331,571	8.3%
Luce County	$1,033	197	$203,522	9.5%
Mackinac County	$967	527	$509,508	9.5%
Macomb County	$413	20,035	$8,283,869	7.3%
Manistee County	$792	766	$606,353	8.7%
Marquette County	$764	1,810	$1,383,654	8.6%
Mason County	$870	988	$859,585	9.0%
Mecosta County	$990	1,221	$1,208,971	9.2%
Menominee County	$973	822	$799,404	9.4%
Midland County	$644	1,936	$1,246,791	8.1%
Missaukee County	$1,595	567	$904,135	11.1%
Monroe County	$550	3,626	$1,994,523	7.8%
Montcalm County	$1,079	1,902	$2,051,595	9.4%
Montmorency County	$1,000	500	$500,096	9.5%
Muskegon County	$565	4,967	$2,804,162	7.8%
Newaygo County	$1,310	1,521	$1,993,004	10.2%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- 150% - 184% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Oakland County	$413	22,389	$9,248,349	7.4%
Oceana County	$1,243	877	$1,090,064	10.0%
Ogemaw County	$1,207	756	$912,547	10.2%
Ontonagon County	$1,072	220	$235,897	9.9%
Osceola County	$1,481	730	$1,081,391	10.7%
Oscoda County	$1,301	354	$460,705	10.5%
Otsego County	$1,185	607	$719,044	9.9%
Ottawa County	$575	6,226	$3,582,299	7.8%
Presque Isle County	$1,013	456	$462,027	9.6%
Roscommon County	$776	1,178	$914,246	8.8%
Saginaw County	$552	5,708	$3,150,960	7.8%
St. Clair County	$594	4,294	$2,551,023	8.0%
St. Joseph County	$747	2,050	$1,531,368	8.4%
Sanilac County	$979	1,541	$1,508,618	9.2%
Schoolcraft County	$1,226	303	$371,359	10.1%
Shiawassee County	$801	2,164	$1,732,627	8.6%
Tuscola County	$1,028	1,663	$1,710,320	9.4%
Van Buren County	$701	2,148	$1,505,050	8.2%
Washtenaw County	$362	6,449	$2,335,128	7.2%
Wayne County	$277	45,164	$12,500,670	6.9%
Wexford County	$1,190	998	$1,187,233	9.9%
Total Michigan	$574	249,131	$142,905,867	7.88%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- 185% - 199% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Alcona County	$870	133	$115,735	8.7%
Alger County	$1,096	119	$130,366	9.2%
Allegan County	$622	1,504	$935,330	7.7%
Alpena County	$487	400	$194,676	7.5%
Antrim County	$974	435	$423,823	8.9%
Arenac County	$903	208	$187,824	8.7%
Baraga County	$851	114	$96,961	8.6%
Barry County	$745	796	$593,412	8.1%
Bay County	$319	1,223	$390,326	6.9%
Benzie County	$853	163	$139,096	8.5%
Berrien County	$203	1,815	$367,952	6.6%
Branch County	$550	561	$308,463	7.5%
Calhoun County	$213	1,828	$389,596	6.6%
Cass County	$577	629	$362,864	7.6%
Charlevoix County	$718	254	$182,439	8.1%
Cheboygan County	$648	383	$248,169	7.9%
Chippewa County	$844	392	$330,875	8.4%
Clare County	$983	495	$486,469	8.9%
Clinton County	$564	659	$371,822	7.5%
Crawford County	$1,170	136	$159,053	9.5%
Delta County	$672	478	$321,168	8.0%
Dickinson County	$597	265	$158,302	7.8%
Eaton County	$378	1,163	$439,600	7.1%
Emmet County	$681	523	$356,003	8.0%
Genesee County	$192	4,575	$879,879	6.6%
Gladwin County	$927	359	$332,808	8.7%
Gogebic County	$692	171	$118,381	8.1%
Grand Traverse County	$426	1,266	$539,655	7.2%
Gratiot County	$578	396	$228,909	7.7%
Hillsdale County	$747	664	$495,749	8.1%
Houghton County	$690	393	$271,346	7.9%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- 185% - 199% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Huron County	$552	445	$245,566	7.7%
Ingham County	$147	3,103	$456,323	6.4%
Ionia County	$697	742	$516,946	7.9%
Iosco County	$434	406	$176,347	7.3%
Iron County	$849	149	$126,508	8.7%
Isabella County	$488	653	$318,401	7.4%
Jackson County	$312	1,525	$475,865	6.9%
Kalamazoo County	$122	2,621	$319,526	6.3%
Kalkaska County	$1,317	231	$304,257	9.8%
Kent County	$235	6,387	$1,499,771	6.6%
Keweenaw County	$1,137	83	$94,340	9.5%
Lake County	$1,458	112	$163,284	10.1%
Lapeer County	$728	858	$624,860	8.0%
Leelanau County	$648	162	$104,984	7.9%
Lenawee County	$313	980	$306,593	6.9%
Livingston County	$444	1,295	$575,613	7.2%
Luce County	$769	70	$53,817	8.3%
Mackinac County	$720	142	$102,251	8.3%
Macomb County	$138	8,675	$1,196,221	6.4%
Manistee County	$529	443	$234,146	7.6%
Marquette County	$497	711	$353,384	7.4%
Mason County	$606	381	$231,024	7.8%
Mecosta County	$710	531	$376,774	8.0%
Menominee County	$717	301	$215,816	8.2%
Midland County	$373	834	$310,928	7.1%
Missaukee County	$1,317	231	$304,258	9.7%
Monroe County	$273	1,526	$415,993	6.8%
Montcalm County	$797	733	$584,058	8.2%
Montmorency County	$743	170	$126,276	8.2%
Muskegon County	$286	2,203	$631,101	6.8%
Newaygo County	$1,031	682	$703,133	8.9%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Shortfall Calculation -- 185% - 199% of Federal Poverty Level			
	Individual HH Shortfall	Number of Households	Aggregate Shortfall	Home Energy Burden
Oakland County	$141	9,626	$1,353,739	6.4%
Oceana County	$966	379	$366,158	8.7%
Ogemaw County	$949	422	$400,500	8.9%
Ontonagon County	$826	80	$66,042	8.6%
Osceola County	$1,202	217	$260,838	9.4%
Oscoda County	$1,041	157	$163,421	9.1%
Otsego County	$915	403	$368,605	8.6%
Ottawa County	$285	2,242	$639,820	6.8%
Presque Isle County	$760	212	$161,165	8.3%
Roscommon County	$527	373	$196,752	7.7%
Saginaw County	$282	2,061	$581,390	6.8%
St. Clair County	$322	1,585	$510,806	6.9%
St. Joseph County	$466	865	$403,450	7.3%
Sanilac County	$708	658	$465,731	8.0%
Schoolcraft County	$956	110	$105,124	8.8%
Shiawassee County	$527	773	$407,343	7.5%
Tuscola County	$756	731	$552,645	8.2%
Van Buren County	$421	1,141	$480,029	7.2%
Washtenaw County	$91	2,531	$230,077	6.3%
Wayne County	-	16,983	-	6.0%
Wexford County	$915	426	$389,646	8.6%
Total Michigan	$302	101,860	$30,808,693	6.86%

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Total Shortfall < 200% of FPL Number of Households	Aggregate Shortfall
Alcona County	2,034	$3,287,993
Alger County	1,219	$2,307,093
Allegan County	13,057	$19,288,768
Alpena County	4,974	$6,474,123
Antrim County	3,566	$6,195,143
Arenac County	2,795	$4,955,079
Baraga County	1,098	$1,785,632
Barry County	6,634	$10,136,191
Bay County	14,931	$18,309,689
Benzie County	2,317	$3,796,217
Berrien County	24,214	$27,259,781
Branch County	6,477	$9,442,633
Calhoun County	20,759	$22,750,984
Cass County	6,829	$10,039,079
Charlevoix County	3,455	$5,373,361
Cheboygan County	4,707	$7,005,890
Chippewa County	5,709	$9,944,650
Clare County	6,325	$11,933,774
Clinton County	6,973	$10,486,418
Crawford County	2,278	$4,659,047
Delta County	6,079	$9,256,118
Dickinson County	4,143	$5,923,110
Eaton County	12,358	$15,072,922
Emmet County	4,453	$6,331,094
Genesee County	67,111	$79,120,593
Gladwin County	4,860	$8,815,009
Gogebic County	2,962	$4,555,206
Grand Traverse County	10,409	$12,333,591
Gratiot County	5,938	$8,918,507
Hillsdale County	7,188	$11,936,945
Houghton County	6,225	$10,514,525

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Total Shortfall < 200% of FPL Number of Households	Aggregate Shortfall
Huron County	4,972	$6,791,404
Ingham County	44,955	$51,625,083
Ionia County	8,024	$12,754,858
Iosco County	4,691	$5,791,426
Iron County	2,229	$3,649,174
Isabella County	11,692	$18,983,170
Jackson County	21,362	$26,614,314
Kalamazoo County	36,172	$38,925,319
Kalkaska County	2,911	$6,323,649
Kent County	77,639	$91,037,431
Keweenaw County	468	$874,675
Lake County	2,204	$5,530,293
Lapeer County	9,825	$15,403,932
Leelanau County	2,263	$3,238,825
Lenawee County	12,788	$15,238,523
Livingston County	11,939	$14,897,532
Luce County	1,028	$1,694,349
Mackinac County	2,060	$3,086,858
Macomb County	96,918	$98,699,726
Manistee County	3,765	$5,111,570
Marquette County	9,092	$12,920,476
Mason County	4,976	$7,210,171
Mecosta County	7,023	$12,005,384
Menominee County	3,937	$5,968,364
Midland County	9,539	$11,849,464
Missaukee County	2,423	$5,174,024
Monroe County	16,414	$18,435,424
Montcalm County	9,289	$15,978,147
Montmorency County	1,887	$2,809,092
Muskegon County	26,873	$32,981,392
Newaygo County	7,548	$14,657,645

Michigan 2017
Home Energy Affordability Gap
(Published April 2018)

County_Only	Total Shortfall < 200% of FPL Number of Households	Total Shortfall < 200% of FPL Aggregate Shortfall
Oakland County	108,378	$111,022,522
Oceana County	4,753	$8,869,152
Ogemaw County	4,162	$7,496,635
Ontonagon County	1,204	$1,961,747
Osceola County	4,095	$8,964,526
Oscoda County	1,693	$3,143,772
Otsego County	3,229	$5,658,529
Ottawa County	25,256	$29,519,986
Presque Isle County	2,170	$3,308,056
Roscommon County	5,225	$6,929,970
Saginaw County	30,724	$36,788,832
St. Clair County	20,564	$24,958,986
St. Joseph County	8,870	$12,029,685
Sanilac County	6,635	$10,219,527
Schoolcraft County	1,479	$2,780,385
Shiawassee County	9,447	$13,181,222
Tuscola County	8,093	$13,167,465
Van Buren County	11,539	$15,293,432
Washtenaw County	39,376	$43,378,394
Wayne County	297,014	$313,774,307
Wexford County	5,626	$10,298,892
Total Michigan	1,328,515	$1,617,216,881 $1,217

Detroit, MI

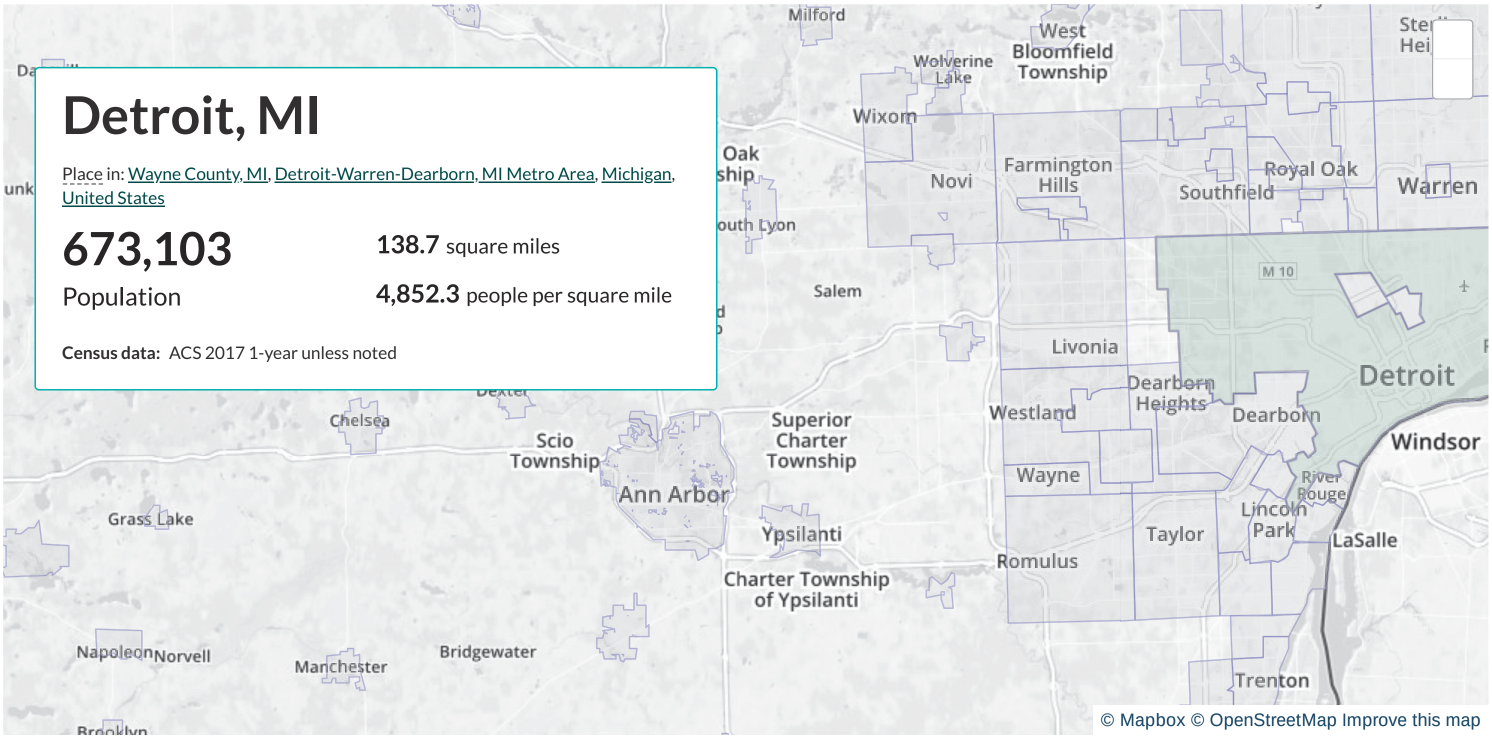
Place in: Wayne County, MI, Detroit-Warren-Dearborn, MI Metro Area, Michigan, United States

673,103
Population

138.7 square miles

4,852.3 people per square mile

Census data: ACS 2017 1-year unless noted



Find data for this place

Search by table or column name...

Interact with charts and statistics for margins of error and additional information.

Demographics

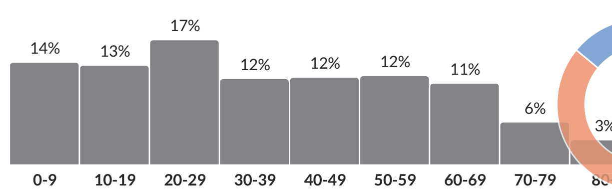
Age

34.6
Median age

about 90 percent of the figure in the Detroit-Warren-Dearborn, MI Metro Area: 40

about 90 percent of the figure in Michigan: 39.8

Population by age range



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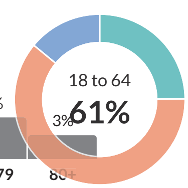
Population by age category



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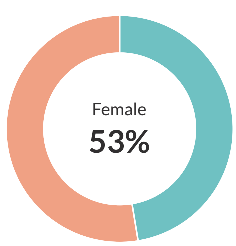
† Margin of error is at least 10 percent of the total value. Take care with this statistic.

Sex



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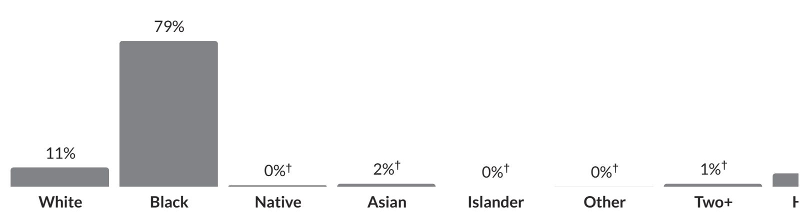
Race & Ethnicity



* Hispanic includes respondents of any race. Other categories are non-Hispanic.

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Economics

Income

† Margin of error is at least 10 percent of the total

$17,667

$30,344

Household income

72%

value. Take care with this statistic.

Per capita income

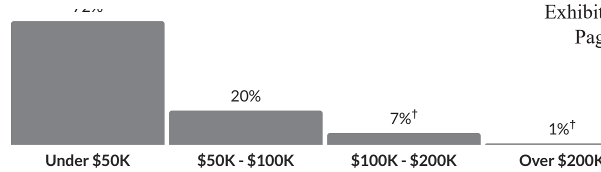
about half the amount in the Detroit-Warren-Dearborn, MI Metro Area: $32,924

about three-fifths of the amount in Michigan: $30,488

Median household income

about half the amount in the Detroit-Warren-Dearborn, MI Metro Area: $58,411

about half the amount in Michigan: $54,909



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Poverty

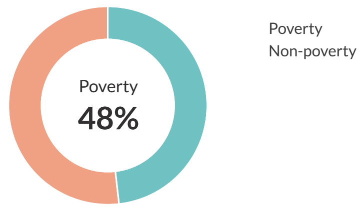
34.5%

Persons below poverty line

more than double the rate in the Detroit-Warren-Dearborn, MI Metro Area: 14.6%

more than double the rate in Michigan: 14.2%

Children (Under 18)



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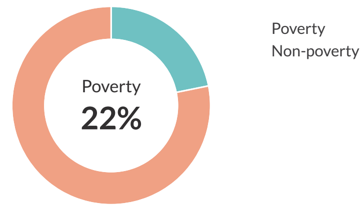
Seniors (65 and over)



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Transportation to work

25.4 minutes

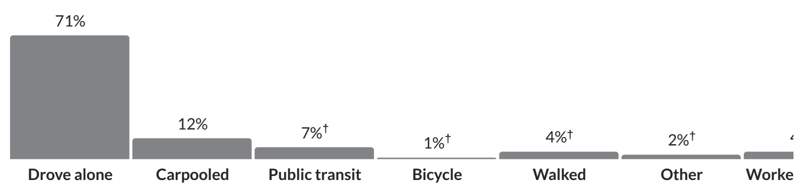
Mean travel time to work

a little less than the figure in the Detroit-Warren-Dearborn, MI Metro Area: 26.7

a little higher than the figure in Michigan: 24.3

† Margin of error is at least 10 percent of the total value. Take care with this statistic.

Means of transportation to work



* Universe: Workers 16 years and over

Show data / Embed

Families

Households

264,360

Number of households

the Detroit-Warren-Dearborn, MI Metro Area: 1,707,501

Michigan: 3,930,017

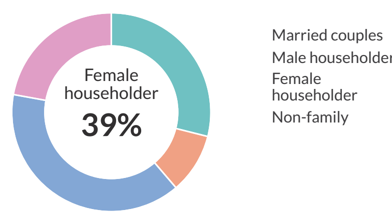
2.5

Persons per household

about the same as the figure in the Detroit-Warren-Dearborn, MI Metro Area: 2.5

about the same as the figure in Michigan: 2.5

Population by household type



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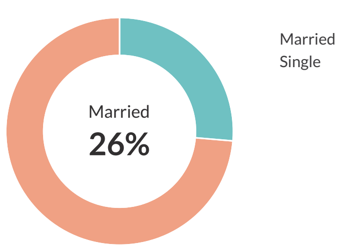
Marital status

† Margin of error is at least 10 percent of the total value. Take care with this statistic.



* Universe: Population 15 years and over

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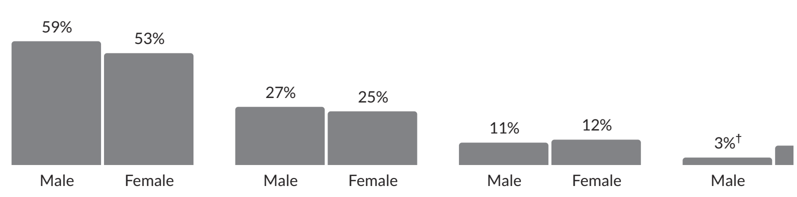
Marital status, by sex



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† Margin of error is at least 10 percent of the total value. Take care with this statistic.

Fertility

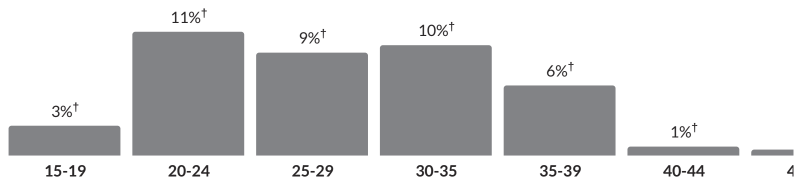
6%

Women 15-50 who gave birth during past year

about 10 percent higher than the rate in the Detroit-Warren-Dearborn, MI Metro Area: 5.4%

about 20 percent higher than the rate in Michigan: 5.2%

Women who gave birth during past year, by age group



* Universe: Women 15 to 50 years

Show data / Embed

Housing

Units & Occupancy

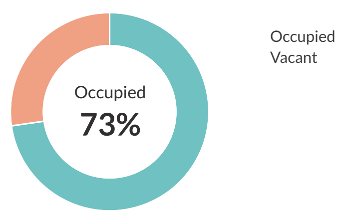
363,525

Number of housing units

the Detroit-Warren-Dearborn, MI Metro Area: 1,906,028

Michigan: 4,595,274

Occupied vs. Vacant



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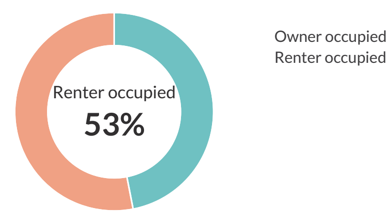
Ownership of occupied units



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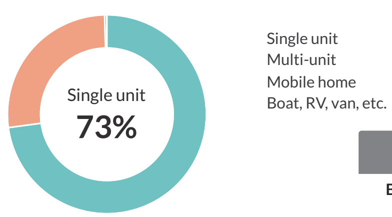
Types of structure



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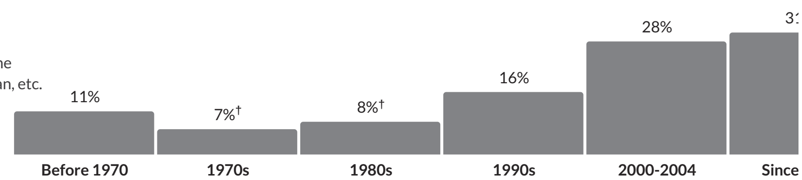
Year moved in, by percentage of population



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† Margin of error is at least 10 percent of the total value. Take care with this statistic.

Value

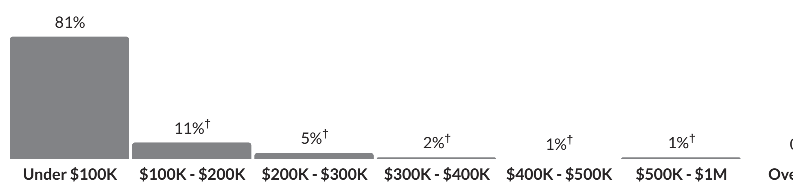
$50,200

Median value of owner-occupied housing units

about one-quarter of the amount in the Detroit-Warren-Dearborn, MI Metro Area: $171,600

about one-third of the amount in Michigan: $155,700

Value of owner-occupied housing units



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† Margin of error is at least 10 percent of the total value. Take care with this statistic.

Geographical mobility

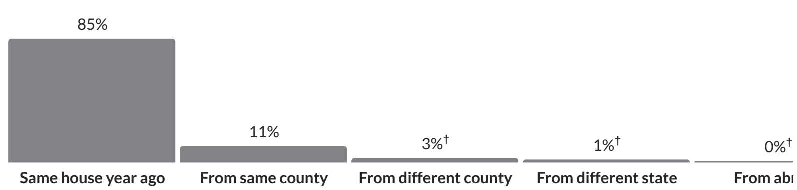
15.5%

Moved since previous year

about 20 percent higher than the rate in the Detroit-Warren-Dearborn, MI Metro Area: 12.8%

about 10 percent higher than the rate in Michigan: 14.2%

Population migration since previous year



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Social

Educational attainment

81.2%
High school grad or higher

about 90 percent of the rate in the Detroit-Warren-Dearborn, MI Metro Area: 90.2%

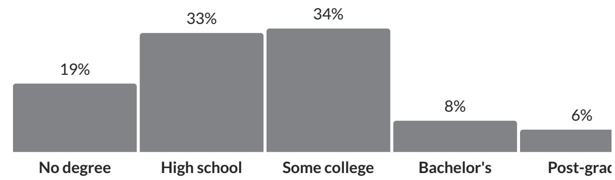
about 90 percent of the rate in Michigan: 90.9%

14.6%
Bachelor's degree or higher

about half the rate in the Detroit-Warren-Dearborn, MI Metro Area: 31.1%

about half the rate in Michigan: 29.1%

Population by minimum level of education



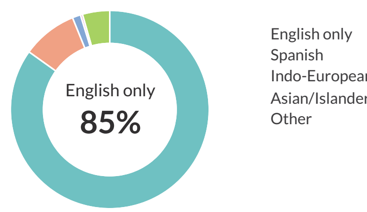
* Universe: Population 25 years and over

Show data / Embed

Language

N/A
Persons with language other than English spoken at home
* ACS 2016 5-year data

Language at home, children 5-17



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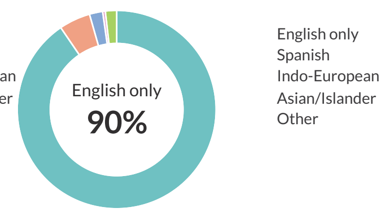
Language at home, adults 18+



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Place of birth

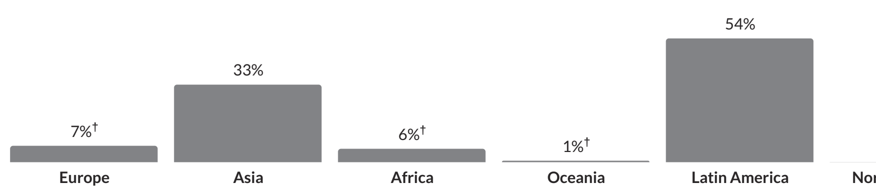
† Margin of error is at least 10 percent of the total value. Take care with this statistic.

6.2%
Foreign-born population

about three-fifths of the rate in the Detroit-Warren-Dearborn, MI Metro Area: 10.3%

about 90 percent of the rate in Michigan: 7.1%

Place of birth for foreign-born population



* ACS 2016 5-year data

Show data / Embed

Veteran status

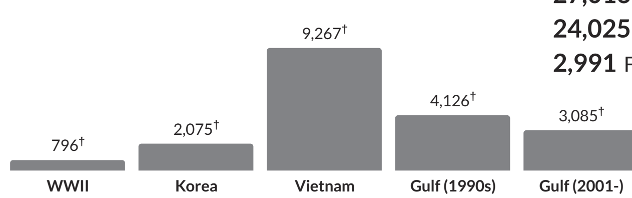
† Margin of error is at least 10 percent of the total value. Take care with this statistic.

5.3%
Population with veteran status

about 80 percent of the rate in the Detroit-Warren-Dearborn, MI Metro Area: 6.4%

about three-quarters of the rate in Michigan: 7.1%

Veterans by wartime service



* Civilian veterans who served during wartime only

Show data / Embed

27,016 Total veterans
24,025 Male
2,991 Female

Interact with charts and statistics for margins of error and additional information.

*This profile displays data from more than one ACS release. Charts not derived from ACS 2017 1-year data are noted with an *.*

POVERTY USA

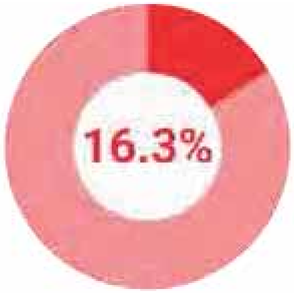
POVERTY FACTS

The Population of Poverty USA

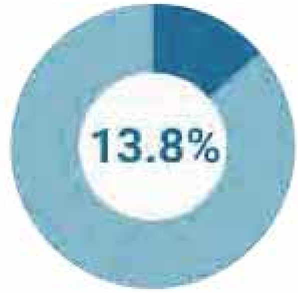
In 2016, 40.6 million people lived in Poverty USA. That means the poverty rate for 2016 was 12.7%. Use our interactive map to take a closer look at poverty statistics in the United States.

Who lives in Poverty USA?

All those who make less than the Federal government's official poverty threshold... which for a family of four is about $24,000.00. People working at minimum wage, even holding down several jobs. Seniors living on fixed incomes. Wage earners suddenly out of work. Millions of families everywhere from our cities to rural communities.



Women

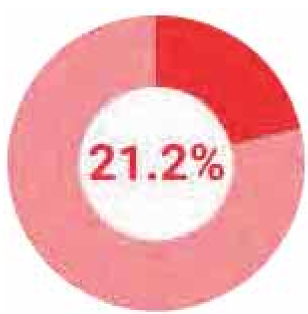


Men

Poverty does not strike all demographics equally. For example, in 2016, 13.8% of men, and 16.3% of women lived in Poverty USA. Along the same lines, the poverty rate for married couples in 2016 was only 5.1% - but the poverty rate for single-parent families with no wife present was 13.1%, and for single-parent families with no husband present was 26.6%.

In 2016, the poverty rate for people living with a disability was 21.0%. That's more than 4 million people living with a disability—in poverty.

Poverty by Age



Children

Children in Poverty

In 2016, 21.2% of all children (15.3 million kids) lived in Poverty USA—that's almost 1 in every 5 children.

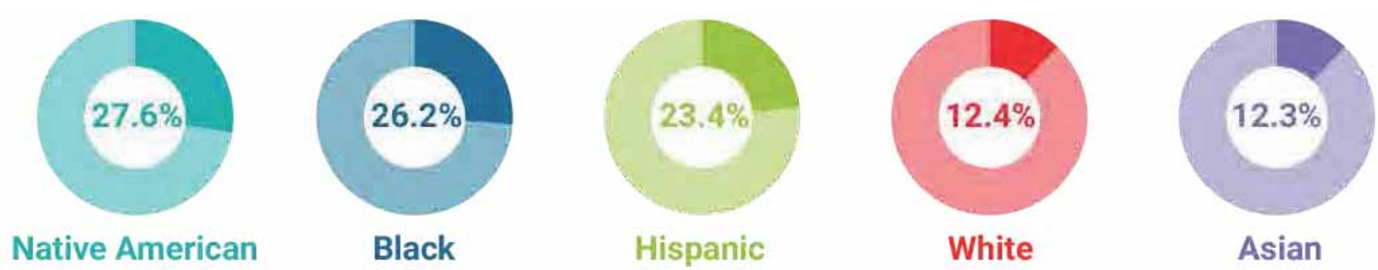
In 2014, the National Center on Family Homelessness analyzed state-level data and found that nationwide, 2.5 million children experience homelessness in a year.

Seniors in Poverty

Though the official census data gives seniors a 2016 poverty rate of only 9.3%, the Supplemental Poverty Measure, which accounts for expenses such as the rising costs of health care, raises the senior poverty rate to 14.5%.

Poverty by Ethnicity

According to 2016 US Census Data, the highest poverty rate by race is found among Native Americans (27.6%), with Blacks (26.2%) having the second highest poverty rate, and Hispanics (of any race) having the third highest poverty rate (23.4%). Whites had a poverty rate of 12.4%, while Asians had a poverty rate at 12.3%.



The Economics of Poverty

Poverty thresholds are determined by the US government, and vary according to the size of a family, and the ages of its members. In 2016, the poverty threshold—also known as the poverty line—for an individual was $12,228. For two people, the weighted average threshold was $15,569.

Poverty Thresholds

Three people	$19,105
Four people	$24,563
Five people	$29,111
Six people	$32,928
Seven people	$37,458
Eight people	$41,781
Nine or more people	$49,721

For more details about poverty thresholds, visit the US Census Bureau. Poverty thresholds are intended for use as a statistical yardstick, not a complete description of what people and/or families actually need to live.

What's worse, 6.7% of the population—or 21.3 million people—live in deep poverty, with incomes below 50% of their poverty thresholds.

And 29.8% of the population—or 95 million—live close to poverty, with incomes less than two times that of their poverty thresholds. To learn more about poverty thresholds and what it is like to live at the poverty line, take a look at the statistics.

Sources: *How the US Census Measures Poverty, US Census Bureau; Income, Poverty, and Health Insurance Coverage in the United States: 2016, US Census Bureau (p. 17).*

Employment

According to the most recent Census data, median household incomes have increased by 3.2% since 2015. This is only the second annual increase in median household income since 2007. In 2016, the median income for family households was $75,062, while the median income for nonfamily households was $35,761.

In 2016, an estimated 74.8% of men with earnings and 62.2% of women with earnings worked full time, year-round. However, in 2016, the earnings of women who worked full time, year-round were only 80.5% of that for men working full time, year-round.

Source: *US Census Bureau; Income and Poverty in the United States: 2016*

Food Insecurity

The USDA estimated that 12.3% of US households were food insecure in 2016. This means that approximately 15.6 million households had difficulty providing enough food for all their members due to a lack of resources. Rates of food insecurity were substantially higher than the national average for households with incomes near or below the Federal poverty line.

There are programs that help.

61% of food-insecure households in the USDA survey reported that in the previous month, they had participated in one or more of the three largest Federal food and nutrition assistance programs. One of these programs is known as SNAP, or the Supplemental Nutrition Program. Learn more about policies that help.

Source: *United States Department of Agriculture, Food Security Status of US Households in 2016*

In addition, every day, thousands of people—working with their neighbors and community—are finding ways out of Poverty USA by strengthening families, creating jobs, and improving neighborhoods. For nearly five decades, CCHD has supported nearly 11,000 community-based projects led by low-income people through our grant program. Read some of their stories.

NCOUNTER NOW

STORIES OF HOPE

MULTIMEDIA

ACT NOW

TEACH

TAKE ACTIO

PRAY

SUPPO CCHD

STATE OF NEW YORK
PUBLIC SERVICE COMMISSION

At a session of the Public Service
Commission held in the City of
Albany on May 19, 2016

COMMISSIONERS PRESENT:

Audrey Zibelman, Chair
Patricia L. Acampora
Gregg C. Sayre
Diane X. Burman, dissenting

CASE 14-M-0565 - Proceeding on Motion of the Commission to Examine Programs to Address Energy Affordability for Low Income Utility Customers.

ORDER ADOPTING LOW INCOME PROGRAM MODIFICATIONS AND DIRECTING UTILITY FILINGS

(Issued and Effective May 20, 2016)

BY THE COMMISSION:

INTRODUCTION

In January 2015, the Commission opened this proceeding to examine the low income programs offered by the major electric and gas utilities in New York State.[1] The primary purposes of the proceeding are to standardize utility low income programs to reflect best practices where appropriate, streamline the regulatory process, and ensure consistency with the Commission's statutory and policy objectives.

The Commission directed Staff of the Department of Public Service (Staff) to conduct an examination of the utility low income programs, in order to identify best practices, evaluate the effectiveness of the current low income program

[1] Case 14-M-0565, Utility Low Income Programs, Order Instituting Proceeding (issued January 9, 2015) (Instituting Order).

designs, and develop a set of recommendations for any improvements that may be warranted. Staff conducted its program review in conjunction with multiple interested parties, including the utility companies and low income consumer advocates.

On June 1, 2015, Staff filed a Report on the results of its examination.[2] The Staff Report includes a Straw Proposal for a new statewide approach to low income programs that addresses numerous design and implementation elements including eligibility, enrollment processes, benefit structures, rate discount levels, budgeting, treatment of participant arrears, and reconnection fees.

Interested parties were provided a variety of opportunities to comment on the Staff Report. First, a technical conference was held on July 30, 2015, where Staff discussed the report with interested parties and answered questions regarding its content, in order to assist the parties in preparing their comments. Initial written comments on the Staff Report were solicited through August 24, 2015, and reply comments were solicited through September 8, 2015. In addition, 12 public statement hearings were held in six locations throughout the state, including Glens Falls, Poughkeepsie, Buffalo, New York City, Syracuse, and Albany.

Based on this extensive record, the Commission hereby adopts a regulatory policy framework for addressing low income customer needs as described in this Order. The Order also addresses implementation of this framework, and directs filings by certain utilities to achieve that goal.

[2] Case 14-M-0565, Staff Report (issued June 1, 2015).

A brief summary of our conclusions follows:

- The Commission adopts a policy that an energy burden at or below 6% of household income shall be the target level for all 2.3 million low income households in New York.[3]
- Success in this endeavor can only be achieved through a holistic approach that coordinates and leverages all available resources. The Commission authorizes and directs Staff to work with sister agencies to create an inter-agency task force, to achieve greater program coordination.
- Reaching all 2.3 million households will involve establishing new partnerships and new ways for utilities to identify and enroll eligible customers. As an initial step, the Commission directs that utilities open their low income discount programs to all households that currently receive HEAP, regardless of fuel or benefit type.
- A funding limit is established such that the total budget for each utility may not exceed 2% of total electric or gas revenues for sales to end-use customers.
- Con Edison is allowed to continue its file match approach which extends the low income discount program to customers receiving other income based benefits in addition to HEAP. National Grid NY is authorized to pursue such an approach.
- A default process of setting benefit levels is established which varies levels of discounts based on need. Utilities will be allowed some flexibility in designing rate discounts; however, alternatives must be shown to

[3] The current utility programs reach about 1.1 million customers. Because customers could receive both a gas and electric discount, the 1.1 million customers equates to approximately 700,000 households.

accomplish the same results, and leave no class of participant underserved.

- Statewide, the enhanced low income discount program will serve approximately 1.65 million customers, at a cost of approximately $248 million, an increase of approximately 87% to existing programs.
- Customers enrolled in the utility discount program will also be enrolled in levelized or budget billing. Participants will have the ability to opt-out.
- The costs of the programs will be borne by all classes of customers; however, the specific mode of cost recovery will be determined in rate cases, where the total impacts of all revenue requirement changes can be considered.
- Arrears forgiveness programs may continue for utilities who see value, but are not required for other utilities. A limit of funding for arrears forgiveness programs of no more than 10% of the budget shall be imposed.

BACKGROUND

The Staff Report, which included a detailed procedural history, was issued on June 1, 2015 after extensive information gathering efforts. The Report also described the various low income program approaches utilized by several key states, and summarized the existing programs in New York. The overview of energy affordability in New York included data on the “energy burden,” or percentage of a customer's income that is spent on energy, compiled by the consulting firm of Fisher, Sheehan & Colton. This data reveals that the energy burden faced by low income households, those below 200% of federal poverty level (FPL), increases dramatically as household income decreases; an insight which helped guide the development of the Staff Report’s recommendations. The energy burdens calculated for households at different income levels is reproduced here:

New York Low Income Household Energy Burdens

Percent of FPL	Annual Income[4]	Households	Energy Burden
0% - 50%	$12,150	489,000	41%
50% - 100%	$24,300	600,000	22%
100% - 125%	$30,375	311,000	15%
125% - 150%	$36,450	314,000	12%
150% - 185%	$44,955	422,000	10%
185% - 200%	$48,600	170,000	9%

NOTICE OF PROPOSED RULE MAKING

Pursuant to the State Administrative Procedure Act (SAPA) §202(1), a Notice of Proposed Rulemaking was published in the State Register on June 2, 2015 [SAPA No. 14-M-0565SP1]. The time for submission of comments pursuant to the Notice expired on August 3, 2016. Moreover, Notices by the Secretary were issued in the case dated January 16, 2015, February 12, 2015, June 1, 2015, July 7, 2015, August 21, 2015, and October 2, 2015, seeking additional comment, with the last date for comments due October 21, 2015. The comments received are addressed below.

COMMENTS OF THE PARTIES

Written comments on the Staff Report were submitted by the following parties: Alliance for a Green Economy (AGREE); American Association for Retired Persons (AARP); Association for Energy Affordability (AEA); Central Hudson Gas & Electric Corp. (Central Hudson); Citizens' Environmental Coalition (CEC); City

[4] Federal Poverty Level varies by family size; income is for a family of four, at the upper end of the given income range.

of New York (NYC); Consolidated Edison Company of New York, Inc./Orange & Rockland Utilities, Inc. (CEOR); Multiple Intervenors (MI); National Fuel Gas Distribution Corp. (National Fuel); National Grid, consisting of the Brooklyn Union Gas Co. d/b/a National Grid NY, KeySpan Gas East Corporation d/b/a National Grid and Niagara Mohawk Power Corporation d/b/a National Grid. (National Grid); New York State Department of State, Division of Consumer Protection, Utility Intervention Unit (UIU); New York State Electric & Gas Corp./Rochester Gas and Electric Corp. (NYSEG/RG&E); New York State Energy Research and Development Authority (NYSERDA); New York State Office of Temporary and Disability Assistance (OTDA); PSEG Long Island, LLC (PSEG); Public Utility Law Project (PULP); Solix, Inc. (Solix); and Natural Resources Defense Council, Pace Energy and Climate Center, WE ACT for Environmental Justice, Association for Energy Affordability, Center for Working Families, Enterprise Community Partners, and Green and Healthy Homes Initiative, jointly as Energy Efficiency for All (EE4All). Reply comments were filed by AEA, AGREE, CEC, Central Hudson, EE4All, MI, NYC, NYSERDA, and PULP.

In addition, over 80 written public comments (public comments are those filed by individuals and organizations who are not formally registered as active parties) were filed in this Case. Commenters included Affordability for All; Roger Colton;[5] Community Service Society; Laundry, Distribution and Food Service Joint Board, Workers United; Energy Democracy Alliance, NY Communities for Change; Nobody Leaves Mid-Hudson; State Senator Robert G. Ortt, 62nd District; State Senator Kevin S. Parker, 21st District; and the Sierra Club; as well as

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[5] Mr. Colton is a co-founder and principal of Fisher, Sheehan and Colton, the consulting firm whose analysis of energy burdens is cited in the Staff Report and above.

comments filed by unaffiliated individuals. A summary of all written comments is included as Appendix A of this order.

Finally, 12 public statement hearings were held in six locations throughout the state, including Glens Falls, Poughkeepsie, Buffalo, New York City, Syracuse, and Albany. Over the course of these hearings, more than 100 speakers offered statements on the Staff Report, generating nearly 600 pages of transcript. Many of the speakers were low income electric and natural gas customers, who testified to the difficulties that they have faced paying for service, and the need to improve energy affordability for the poorest New Yorkers.

Specific comments of the parties are addressed in the discussion that follows.[6]

VISION AND GOALS FOR LOW INCOME REGULATORY POLICY

In Governor Cuomo's Reforming the Energy Vision (REV) proceeding, the Commission articulated a new approach to regulation of energy markets, and new business models that create opportunities for customers and other third parties to be active participants, utilizing distributed energy resources (DER) as an integral tool. The Commission's policy to maintain universal, affordable service is a critical driver of the REV initiative.[7]

There is no universal measure of energy affordability; however, a widely accepted principle is that total shelter costs

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[6] In many cases, several parties made the same or similar comments; attribution of comments to specific parties is intended to be illustrative, and does not necessarily identify all parties who made such comments.

[7] Case 14-M-0101, Reforming the Energy Vision, Order Adopting Regulatory Policy Framework and Implementation Plan (issued February 26, 2015).

should not exceed 30% of income. For example, this percentage is often used by lenders to determine affordability of mortgage payments. It is further reasonable to expect that utility costs should not exceed 20% of shelter costs, leading to the conclusion that an affordable energy burden should be at or below 6% of household income (20% x 30% = 6%). A 6% energy burden is the target energy burden used for affordability programs in several states (e.g., New Jersey and Ohio), and thus appears to be reasonable. It also corresponds to what U.S. Energy Information Administration data reflects is the upper end of middle and upper income customer household energy burdens (generally in the range of 1 to 5%). The Commission therefore adopts a policy that an energy burden at or below 6% of household income shall be the target level for all low income customers.[8]

The energy burden statistics cited in the Staff Report suggest a significant energy divide exists for low income households. About 2.3 million households are at or below 200% of FPL, with an energy affordability "gap," i.e., an average annual energy burden above the 6% level, of \$807.[9] Approximately 1.4 million of these households receive a HEAP benefit; however, for the 2013-2014 program year, only about 316,000 of those households received a benefit for utility service.[10]

Closing such a wide gap for 2.3 million low income households is a non-trivial pursuit, and will require a comprehensive effort that involves all of the tools at the state's disposal, including, but not limited to, utility

[8] The policy applies to customers who heat with electricity or natural gas.

[9] See http://www.homeenergyaffordabilitygap.com/index.html.

[10] Staff Report at 26.

ratepayer-funded programs. A central role in achieving energy affordability for low income customers is played by the financial assistance programs administered by the Office of Temporary and Disability Assistance (OTDA), including the Home Energy Assistance Program (HEAP). Another important role is played by low income energy efficiency programs such as the Weatherization Assistance Program administered by New York State Homes and Community Renewal (HCR) and the ratepayer-funded EmPower-NY program administered by the New York State Energy Research and Development Authority (NYSERDA). Utility ratepayer funded programs also include the rate discount programs under discussion here, as well as investments designed to create opportunities for low income households to benefit from the cost savings offered by DER.

Success in this endeavor can best be achieved through a holistic approach that coordinates and leverages all of these resources. Working together, low income financial assistance, DER, energy efficiency, and other social services programs can be delivered more efficiently, so New York can make smarter investments in our communities and serve more customers with the resources at hand.

A key to the success of these initiatives therefore lies in better coordination among the various governmental and private agencies that administer these programs. The Commission directs Staff to work with sister agencies to create an inter-agency task force to achieve greater program coordination, share information, eliminate duplicative efforts, lower costs and increase effectiveness, and advise in the development of low income energy-related policies and programs.

Achievement of the 6% energy burden goal for all low income utility customers will also require a phased approach to implementing program changes, as many parties, including CEC and

UIU, suggested in their comments. Among other things, achieving an optimal design will require building new partnerships and new mechanisms for identifying and enrolling eligible households. As these are put in place, the utilities will be able to enlarge the populations they are able to serve.

In addition, the best solution for all customers, including low income, lies in facilitating opportunities to invest in clean energy and the means to reduce energy costs. Greater access and support for low income and underserved communities to DER is the best way to narrow the affordability gap that needs to be filled with direct financial assistance for customers with low incomes. Greater access to advanced energy management products to increase efficiency for low income customers will empower those for whom these savings may have the greatest value, as well as allowing the most disadvantaged customers more choice in how they manage and consume energy.

Through a variety of efforts, the Commission is taking steps to promote affordability of utility service and provide opportunities to offer benefits to low and moderate income customers to participate in DER. For example, the reauthorization of funding for the NY Sun photovoltaic program included an allocation of up to $13 million to support penetration of solar technology into low and moderate income markets.[11]

Within the past year, the Commission also approved the reallocation of $11 million of uncommitted System Benefit Charge (SBC) funds to supplement the EmPower-NY low income energy efficiency program budget, as well as an additional increase of

[11] Case 03-E-0188, Retail Renewable Portfolio Standard, Order Authorizing Funding and Implementation of the Solar Photovoltaic MW Block Programs (issued April 24, 2014).

up to $8 million.[12] In addition, interconnection of community distributed generation (DG) projects was prioritized to projects that promote low income customer participation during the introductory Phase One period.[13] Staff also initiated a collaborative to develop means for encouraging low income customer participation and to address obstacles to such participation in Community DG during Phase Two.

In January, 2016, the Commission authorized a Clean Energy Fund (CEF) framework, to accelerate the growth of New York's clean energy economy, address climate change, strengthen resiliency in the face of extreme weather and lower energy bills for New Yorkers.[14] The CEF is designed to meet four primary objectives: (1) greenhouse gas emission reductions; (2) affordability, as measured by reductions in customer energy bills; (3) statewide penetration and scale of energy efficiency and clean energy generation; and (4) growth in the State's clean energy economy. Additionally, the fund will attract and leverage third-party capital to support Governor Cuomo's aggressive Clean Energy Standard, mandating achievement of meeting 50 percent of our electricity needs with renewable resources by 2030.

As these other relevant proceedings evolve, greater opportunities to achieve affordability through increased energy efficiencies, demand response and DER deployment will reduce

[12] Case 07-M-0548, Energy Efficiency Portfolio Standard, Order Authorizing Reallocation of System Benefits Charge Funds to the Empower Program (issued June 19, 2015).

[13] Case 15-E-0082, Community Net Metering, Order Establishing a Community Distributed Generation Program and Making Other Findings (issued July 17, 2015).

[14] Case 14-M-0094, Clean Energy Fund Order Authorizing the Clean Energy Fund Framework (issued January 21, 2016).

reliance on rate subsidies. In later phases, as these new markets and tools continue to develop, the Commission expects that a greater portion of the burden for ensuring affordability for low income customers will shift from direct financial assistance to such innovative approaches.

In the meantime, as the Commission continues to work with utilities and third parties to develop innovative programs to expand the reach of DER within low income communities, the utility low income rate assistance programs will continue to be funded where market solutions are not yet a viable option. Through a phased approach, best practices under the current operating environment can be incorporated now, and further steps towards increased benefits can be pursued.

In the balance of this order, the Commission addresses the various recommendations in the Staff Report to implement the program described in the Straw Proposal, and the Commission's decisions with respect to such recommendations; and concludes by establishing further filings and process to implement the decision.

THE STRAW PROPOSAL

The Straw Proposal is organized by sections in the Staff Report, and this Order follows largely the same organization. In the sections that follow, Staff's Straw Proposal is briefly summarized, followed by a summary of party comments and discussion of the issues.

Eligibility/Enrollment

The Straw Proposal program would automatically enroll all customers for whom the utility received a regular Home Energy Assistance Program (HEAP) payment on his or her behalf. Staff reasoned that customers seeking a utility HEAP benefit self-select into a program that provides utility bill assistance, demonstrating a relatively stronger need for the utility low income program.[15] Existing programs with additional eligibility criteria (e.g., Con Edison's program) would maintain such existing eligibility criteria, subject to certain limitations. Other eligibility criteria (e.g., non-utility HEAP benefits) could be revisited, provided an automatic enrollment process could be implemented; however, Staff also noted that it "is aware of the balance that must be struck between widening the scope of eligible customers, and the rate impacts that are borne by nonparticipants."[16] Alternative means, whether by file match or manual enrollment would be permitted, but not required.

Party Comments

Many parties opposed limiting utility low income program eligibility to regular utility HEAP recipients. NYSEG/RG&E suggested that, at a minimum, Emergency HEAP should be included; and Central Hudson urged the Commission to extend eligibility beyond HEAP. UIU opined that HEAP was not necessarily the best indicator of need. In contrast, National Fuel stated that full enrollment of all HEAP recipients is not achievable, or necessary, since many HEAP recipients are not in arrears. Many parties, including CEOR, National Grid, NYC and PULP had concerns that many current participants would lose benefits under the Straw Proposal. Several parties, including CH, NYSEG/RG&E and PSEG, recommended that existing programs and benefits should be grandfathered.

A large number of parties recommend that the Commission adopt very broad eligibility criteria, similar to the telephone Lifeline program. National Grid and NYC both state

[15] Staff Report at 24.

[16] Staff Report at 25.

that Con Edison's matching approach, which reaches substantially the same eligible population as telephone Lifeline, is a best practice which National Grid and NYC are exploring for National Grid NY.

Some parties, including CEC and Solix, suggest that the Commission utilize a third-party administrator to identify and enroll eligible customers. National Fuel states that the costs for its third-party vendor, which performs income verification, is fairly low. Other parties, such as EE4A, recommend utilizing community-based organizations that operate in the low income communities the utilities are serving.

While it favors broad, Lifeline eligibility, PULP recommends as an interim measure, that utilities enroll all HEAP recipients, regardless of heating fuel or benefit type. PULP states that the target enrollment level for this effort should be 1.65 million participants at a cost of $1.15 billion annually.

Discussion

As discussed above, the Commission adopts a goal of reducing household energy burden to 6% of household income for all low income utility customers. Approximately 2.3 million New York State households face energy burdens in excess of that level. At present, enrollment in most utility low income affordability programs generally is provided automatically to customers on whose behalf the utility received a HEAP payment; however, recent events may clear a path for extending eligibility to all HEAP recipients, regardless of fuel type. Due to federal requirements, OTDA has instituted new performance measures that are intended to ensure that HEAP benefits are targeted to those households with the greatest need. OTDA, with the assistance of the utilities, will now be required to gather and report certain data for all HEAP recipients, regardless of fuel type. To comply with the federal requirements, beginning with the 2015-2016 HEAP program year, OTDA intends to begin providing lists of all HEAP recipients in their respective service territories to the utilities, so that they can provide the required data.[17]

As a result, utilities will soon have the ability to identify all of the state's HEAP recipients, and enroll those customers in each utility's low income program.[18] Last year, approximately 1.4 million households participated in the HEAP program. The Commission directs that utilities open their low income programs to all HEAP recipients, as soon as practicable to do so. The utilities' filings herein should discuss the expected timeline for OTDA to begin sharing this data, and for the utilities to begin using it to enroll customers.

Reaching all 2.3 million households below 200% of FPL will involve establishing new enrollment mechanisms. Currently, the most significant initiative in this regard is by Con Edison, which identifies and automatically enrolls customers from several different social services programs. To accomplish this, Con Edison has established a file matching procedure with the New York City Human Resources Administration and the Westchester County Department of Social Services, the two social services agencies covering its service territory.

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[17] Currently, OTDA would limit the data gathering effort to the largest HEAP vendors of each fuel type. OTDA's criteria would include all New York State utilities with more than 25,000 customers, except Con Edison which, as discussed below, will be permitted to maintain its expanded eligibility criteria, and its current matching process to identify such customers.

[18] As OTDA's lists will also include Emergency HEAP recipients, such recipients will also be automatically enrolled. However, they may be subject to benefit adjustments as described later in this order.

In future phases, a statewide file match between OTDA and all utilities may be feasible, which would similarly identify and automatically enroll additional low income customers into utility programs. This is an area that can be addressed through the inter-agency task force. In the meantime, existing programs with broader income eligibility criteria (e.g., Con Edison and National Grid NY's programs) shall maintain such existing eligibility criteria. Limiting eligibility to utility HEAP recipients as recommended in the Straw Proposal would result in a substantial reduction in the number of eligible low income customers served at Con Edison and National Grid NY.

National Grid NY serves a geographically concentrated service territory and a customer population similar to Con Edison's. It therefore faces similar circumstances in regard to identifying eligible customers, and estimating the level of need. As National Grid NY's program already incorporates broad eligibility criteria similar to Con Edison's, using a similar file matching approach is appropriate. National Grid must include any such modification in its filings as directed in this order; which must indicate whether such modification would cause the program to exceed the budget limits described herein.[19] With these enhancements, the Commission projects that utility low income programs will reach 1.65 million households, or about the number PULP suggested would be appropriate.

As noted in the Staff Report, some utilities allow manual enrollment of customers that meet the income eligibility

[19] Staff's analysis for National Grid NY indicates that this would not cause National Grid's program to exceed the prescribed budget limits. The budget for National Grid NY shown in Appendix C includes projected participation based on file matching.

guidelines, but did not apply for HEAP. The Commission will allow manual enrollment to continue where practicable; i.e., not administratively burdensome and within the budget constraints described below.

Benefit Levels

Under the Straw Proposal, separate discounts would be established at each utility for electric and/or natural gas service, and within each service, for heating and non-heating customers. The discounts would be set at a level sufficient to achieve a 6% energy burden, on an affordability block corresponding to the levelized monthly total bill for the average participant in each class, assuming income at 60% of State Median Income (SMI), the upper limit of income eligibility for the HEAP program.[20] For gas-only utilities, the average non-heating electric bills for electric utilities covering substantially the same territory would be used in determining total energy bill, for the purposes of calculating the discount.

A regular utility HEAP payment is increased by $25 if household income is at or below 130% of FPL. Such payments is also increased by $25 if the household contains a vulnerable individual (i.e., household member who is age 60 or older, under age 6 or younger, or permanently disabled); or by $50 if both conditions apply. Under the Straw Proposal, if the customer receives either or both HEAP incremental (“add-on”) benefits, or if the utility receives payment on the customer’s behalf by direct voucher, discounts would be increased accordingly (other eligible categories of customers, if any, would not be eligible

[20] Depending on family size, 60% of SMI corresponds to approximately 218% of FPL.

for these higher levels of benefit).[21] All participants would be automatically enrolled in the utility's levelized (budget) billing program; however, opt-out would be permitted.

Party Comments

Many parties approved of the concept of an affordability block, but had concerns with the way it was implemented under the Staff proposal. Some stated that Staff's proposed benefit structure was too complex. NYC stated that using the HEAP adders as a proxy for indication of financial need was inappropriate, and could have unintended results. National Fuel stated that calculating a gas utility's discount based on the neighboring electric utility's average bill invited controversy. As a result, many parties recommended providing low income customers a straight percentage discount, with discount levels ranging from 30% to 50%.

Conversely, some parties suggested ways to improve Staff's proposed discount structure. All of the utilities noted that the highest discounts under the Straw Proposal were reserved for direct voucher customers – which means the bills are paid by the local social services agency, and the customer's direct energy burden is effectively 0%. The utilities questioned why such bills should be discounted at all. NYSEG/RG&E noted that utility guarantee customers (those receiving benefits under SSL §131-s) were similarly situated, since payment of their utility bills is guaranteed by social services agencies, and recommended they be excluded as well. Addressing the concern that there are legitimate reasons why customers might consume above average, Mr. Colton recommended

[21] Direct vouchered customers are those on whose behalf the utility bill is paid directly by OTDA or the local social services district. Such customers are participants in New York State Public Assistance programs.

increasing the affordability block incrementally, so that the discount would be based on usage at 120% or 130% of the average.

Many parties objected to the requirement that customers participate in budget billing. In contrast, Mr. Colton stated that automatic enrollment of participants in the utility's budget billing program is appropriate.

Discussion

The Commission recognizes that rate discounts offered to low income customers must be integrated into utility tariffs, which can vary in form, and processed through utility billing systems, which vary in capabilities. As a result, the utilities may vary in their abilities to implement rate discounts in precisely the manner described below. The Commission therefore establishes the below process of setting benefit levels as a default methodology, and will allow utilities flexibility in designing rate discounts to accommodate such variances, provided that any alternative must be shown to accomplish substantially the same results, and leave no class of participant underserved. Utilities will be required, in the filings required herein, to explain and justify any departure from the default method.

Although the straight percentage discount favored by some parties may be simpler to administer, it directs relatively larger benefits to households with higher energy consumption. This makes program costs less predictable, and also reduces the price signal to conserve on marginal usage. In addition, since fixed discounts are not reduced by conservation or efficiency, they represent an enhanced price signal for low income customers, a traditionally hard to reach segment, to conserve and use electricity and gas more efficiently. The Commission therefore adopts the fixed discount approach recommended in the Straw Proposal.

The Commission furthermore concludes that low income programs utilize funding resources most efficiently when they consider the customer's financial circumstances, which the straight discount approach fails to address. Consequently, the Commission adopts the approach of varying discounts based on level of need, with level of need demonstrated by receipt of one or more HEAP "add-on" benefits. The add-ons may be an imperfect tool; however, they provide a simple and expedient way to achieve the goal of targeting assistance based on need.

As discussed above, the utilities will soon have the means to automatically enroll all HEAP recipients in their service territory, regardless of fuel or benefit type (and, as described above, Con Edison as well as National Grid NY may go further). At this time; however, the Commission adopts the Straw Proposal recommendation that the higher levels of discounts are reserved for the utility's regular HEAP recipients. At least initially, these are the only customers for whom the utility will have information on the add-ons the customer receives. Moreover, a key concern underlying ratepayer support for low income programs is controlling utility arrearages and terminations. When heat is not part of the utility bill, those concerns carry less weight. Non-utility HEAP recipients would therefore receive the utility's lowest tier non-heating electric or gas discounts.

Better methods of identifying and targeting discounts based on differing levels of need are among the improvements that may be made in later phases. For example, if, in the future, as National Fuel suggests, OTDA establishes different dollar amounts for the two add-ons, this tool can be further refined. Another strategy, which can be examined by the inter-agency task force, involves comparison of income eligibility criteria for various OTDA programs, and stratification of program benefits based on variances in presumed income levels of participants in different programs.[22]

As previously noted, the unique challenges presented by the New York City metropolitan service area for identifying the low income population and estimating the level of need justify allowing existing eligibility criteria to be grandfathered. For the same reasons, Con Edison and National Grid NY are authorized to grandfather their respective existing discount levels; however, the existing discount level is not grandfathered, if the discount calculations the Commission adopts here would yield a higher level. In future phases, the Commission may consider when grandfathered discount levels can be phased out. For the present, the Commission will allow its prior decisions on the appropriate benefit levels for these utilities to substitute for the formulaic approach established here.

Aside from the unique circumstances presented by the New York City market, grandfathering of existing discount levels is inappropriate. Addressing those parties who were concerned that existing discounts may be reduced, the Commission generally agrees with the observation from the Staff Report that best practices cannot be adopted if no reductions to benefit levels of current programs are allowed.[23] Any customers who are receiving a benefit that places them below the 6% energy burden are presumably receiving a benefit that can be more efficiently applied, and for which there is greater need elsewhere.

[22] Among other things, the inter-agency task force must address the extent to which such information can be shared with utilities.

[23] Staff Report at 28.

For all other utilities, therefore, the Commission addresses the concerns about adverse impacts on existing program participants by adopting a minimum monthly discount of $3.00. The minimum discount applies to any eligible customer, regardless of service type or income tier, except direct voucher and utility guarantee customers, as in those cases benefits do not flow directly to the customer. This modification shall apply to any programs that currently provide discounts to such customers, including the Con Edison and National Grid NY programs.

To be clear, direct voucher and utility guarantee customers should be formally enrolled in the programs, but with a monthly discount amount set at $0. This helps ensure that all eligible customers, including direct voucher and utility guarantee customers, are enrolled in and connected to the programs, so that the utility can adjust benefit levels if a customer's status changes, and they also will be included in program activities (e.g., mailings) and utility program reporting. As with grandfathered discounts, it will be appropriate to consider in later phases when minimum discount levels that exceed what is required to reduce bills to the target energy burden level can be phased out.

In order to address the concern that average usage may not be a sufficient basis for the discount calculation, the Commission adopts an approach that bases the affordability block on 110% of average usage. This level can be revisited in future phases, if experience under this structure indicates that further adjustment is warranted; however, there is no basis for applying larger gross adjustments at this time.

As discussed in the Staff Report, New York SMI as reported by the U.S. Census is $58,003, and 60% of SMI is $34,802, or a monthly income of $2,900. This monthly income calculation closely corresponds to a two person household's income under the HEAP guidelines of $2,869. At a 6% energy burden, this household's energy burden would be $172 monthly. The household energy cost is adjusted to account for the $350 HEAP payment received by the customer, or $29 per month, which is added to the customer's allowed energy burden.[24] The 6% energy burden of $172 is therefore increased to $201. Similar procedures apply to calculation of the allowable monthly energy burden for each of the higher discount tiers.

The Staff Report provided only a partial explanation of its discount calculations, which were explained largely by reference to the example of Niagara Mohawk. Many parties found the benefit structure complex and, for National Fuel and other single-service utilities, contentious.

The Commission therefore takes this opportunity to clarify and simplify the process used to calculate discounts. With flexibility to propose alternative means as described above, utility procedures will be based on the following principles:

- The affordability block on which discounts are based is equal to 110% of a 12-month levelized bill for the respective average monthly heating and non-heating electric and gas usage, as calculated by each utility for its residential customers.
- Gas service (whether designated as heating or non-heating) is discounted to one-half of a customer's total home energy burden.

[24] As discussed later in this Order, utilities may further consider the impact of any Emergency HEAP payments on the customer's net energy burden when setting the level of discount for customers who receive such payments.

- Electric non-heating service is discounted to one-half of a customer’s total home energy burden.[25]
- For electric heating customers, the electric bill is considered to be the customer’s total home energy burden, and is discounted to a level of 6% of the customer’s monthly income. In addition, for equity reasons, the electric heating discount provided by any utility shall not be less than its electric non-heating discount.[26]
- As previously noted, Con Edison and National Grid NY may grandfather existing discount levels; however, the existing discount level is not grandfathered, if these discount calculations would yield a higher level.
- Regardless of the results of the calculations above, a minimum monthly discount of $3.00 shall apply, for any eligible customer of any service type, and any income level; except direct voucher and utility guarantee customers, whose discount level will be set at $0.

The changes to benefit levels for each utility that are yielded by the calculations above are shown in Appendix B. A summary of the current and proposed discounts is included below.

[25] Taken together with the preceding, this arrangement avoids gas utilities having to consider the level of the electric bill of the overlapping utility, while ensuring that discounts are sufficient to bring the customer’s total energy burden to the level of 6%.

[26] In some cases, this may result in discounts for low income electric heating customers that are larger than the calculation would suggest is necessary to achieve a 6% energy burden. The Commission concludes that this is an acceptable trade-off, as electric heating customers are a relatively small population overall, and in addition, may be most at risk for facing high bills.

	Gas/Electric Heating		Gas/Electric Non-Heating	
	Current	Proposed	Current	Proposed
Central Hudson	$18	$23-$72	$6	$23-$56
Con Edison	$10-$50	$10-$50	$2-$10	$3-$14
NYSEG	$13-$19	$3-$34	$7-$10	$3-$28
NMPC	$11-15	$3-$44	$5-$11	$3-$44
O&R	$17-27	$35-$91	$6-$18	$3-$88
RGE	$6-$24	$3-$30	$2-$5	$3-$26
KEDLI	$18	$41-$74	$4	$3
Bug	$17	$17-$30	$3	$3
NFG	$5	$3-$31	$5	$3

The Commission agrees that requiring budget billing maximizes the potential for using the rate discounts as a tool for achieving affordability. Budget billing is a required offering by utilities, and is an important benefit for low income households, as it reduces bill volatility due to seasonal changes in consumption.[27] In addition, as noted in the Staff Report, absent a levelized bill, the enhanced discounts could potentially result in net credits for some small-usage customers, which is not the intent of the program. This creates greater administrative complexity for the utility, and greater difficulty for the customer affording service during winter or other peak usage months. To address OTDA's comment that mandating budget billing for HEAP recipients is contrary to their statute, this Order clarifies that budget billing is not required for receipt of HEAP, but for participation in the utility's low income program. Participants will additionally have the ability to opt-out of budget billing. As part of the utility filings required herein, the utilities shall propose

[27] 16 NYCRR §11.11.

processes for participating customers to be notified of the option to refuse budget billing, and to exercise such option.

Perhaps some of the concerns regarding the budget billing requirement would be alleviated if utility budget billing programs were strengthened and improved. Although budget billing plans are intended to reduce fluctuations in customer bills, such plans can have a contrary effect, when large adjustments are required to reconcile the budget billing amount with actual billings. As part of the utility filings required herein, the Commission directs that each utility include a detailed description of its budget billing plan, including a description of its method for estimating bills when 12 months of billing data are not available. The Commission will also require billing adjustments for low income program participants to be tracked and reported as part of the reporting requirements discussed below.

Program Budgets

If the Straw Proposal were implemented statewide in 2015, program budgets would have increased to about $179 million.[28] Budgets would be established at each utility based on projected costs for the rate year (or for multi-year plans, the average annual cost for the term of the rate plan), and subject to full reconciliation to actual costs.

A funding limit would be established under the Straw Proposal such that the total budget may not exceed the amount recovered by annual charges of $20 per electric customer, or $35 per gas customer, if collected from all residential, commercial and industrial end-use customers of the utility. If the budget

[28] Staff Report, Appendix D at 2, which included PSEG-LI. Excluding PSEG-LI, the figure would be $166 million.

(per the benefit level calculation above) exceeded the funding limit and program eligibility extended beyond utility receipt of HEAP, one or more other programs were to be eliminated from eligibility criteria until the funding limit is met. If only HEAP recipients are eligible, and the budget still exceeded the funding limit, the target energy burden would be increased until the funding limit is met. A lower limit would also be established such that the monthly average bill discount would provide a discount that produces a 10% energy burden. Staff emphasized the budget limits were intended to be used as planning tools, and "the method of establishing the funding cap should not necessarily dictate the mode of cost recovery."[29]

Party Comments

Several parties were concerned that Staff's program would be too costly. National Fuel believes Staff budget projections may have been understated, and is also concerned that programs will increasingly meet the budget caps if commodity costs rise. National Fuel also believes gas and electric customer contributions should be equal.

Conversely, other parties were "bitterly disappointed" in the Straw Proposal (AGREE), finding it constrained by a "false notion of limited financial resources" (CEC), and that it "fails to reflect the voices of people who are actually low income" (NLMH). These parties seek substantial increases in program budgets, to upwards of $600 million. PULP projects the cost of its proposed 30% discount program at $1.15 billion. On reply comments; however, NYC expressed concerns that such proposed funding levels could negatively impact moderate income customers.

[29] Staff Report at 42.

Many parties perceived Staff's proposed cost recovery structure as fundamentally regressive and unfair. These parties argued that large customers should contribute a larger share of the costs (CEC proposed 2% of bills). CEOR suggested that costs could be recovered volumetrically, while MI strongly opposed volumetric recovery. National Grid proposed that cost recovery be among the matters to be determined in rate cases.

Some parties proposed alternative funding sources. AARP and PULP proposed to reallocate unspent SBC funds for low income rate discounts (on reply, this was opposed by AEA). PULP additionally proposed to stream NYPA power to low income populations.

Discussion

Whether considering low income programs, energy efficiency programs, expansion of renewable resources, or any of its policies, the Commission must always balance achievement of policy goals with the costs. This tension lies at the heart of the Commission's statutory mandates to achieve "safe and adequate" service at "just and reasonable" rates.[30]

As discussed above, the Commission's vision is that utility discount programs will be one of many complementary strategies for addressing energy affordability. Reducing the energy burden of low income households to the 6% level will require a range of initiatives, and cannot be accomplished through rate discounts alone. Utility low income programs thus should be designed to coordinate with, and not to supplant or replace public assistance programs to assist households in deepest poverty.

Although low income discounts represent subsidies from nonparticipating customers to participants, neither is it the

[30] PSL §65.

goal of these programs to radically redistribute utility costs among utility customers. Proposals that would provide large, unbounded discounts to broad segments of the residential class, and/or that would shift a disproportionate share of the costs of such subsidies to commercial and industrial customers, or utility shareholders, are inappropriate.

The costs of low income discount programs are predominately a function of (a) the size of the eligible customer population, and (b) the size of the benefit. This Order establishes the appropriate parameters for these factors in the discussion above. Statewide, the program will cost approximately $248 million, a substantial increase of over 87% to existing programs.[31] What remains is to allocate the costs fairly, and to consider the matter of budget constraints.

The guiding principle recommended in the Straw Proposal is adopted, that the costs of the programs should be borne by all classes of customers. This is appropriate as low income programs achieve social policy goals, and society as a whole benefits from their successful implementation. Cost allocation among the classes must be fair and impartial, and avoid adverse impacts on any customer class; however, the Commission adopts the National Grid proposal that the specific mode of cost recovery should otherwise be determined in rate cases, where the total impacts of all revenue requirement changes can be considered.

NYPA hydropower and SBC, Energy Efficiency Portfolio Standard (EEPS), Regional Greenhouse Gas Initiative (RGGI), or other funds will not be redirected for the low income discount programs. Such funding was collected for achieving specific

[31] Excludes PSEG-LI. Specific electric and gas program costs for each utility are shown in Appendix C.

policy goals, and has already been proposed for, or is already committed to such purposes. In addition, this Order establishes that low income programs will be funded in utility rates on a continuing basis. Appropriation of unspent funds would at best be a "one-shot" solution, where continual funding for these programs is needed.[32]

The approach to achieving affordability adopted here is essentially formulaic; therefore, maintaining the balance described above similarly calls for a formulaic approach to applying budget constraints. The Straw Proposal's budget cap, however, expressed as annual costs of $20 and $35 respectively per electric and gas customer, caused confusion.

To avoid this, the budget cap will be restated as 2% of electric revenues and gas revenues, respectively; for sales to end-use customers, i.e., including both total utility revenues and the commodity portion of Energy Service Company revenues collected through consolidated utility billing to those customers.[33] Allocation of program costs between electric and gas services is partly a function of discount design. Among other things, the revised and simplified approach to discount calculation described above also tends to equalize the amount

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[32] NYPA hydropower furthermore is fully committed for distribution to municipal electric utilities, NYPA's Replacement & Expansion and Preservation power programs, and for enhancing the state's economic development through the ReCharge-NY program.

[33] Pursuant to PSL §18-a, utilities must include an estimate of the sales revenue for commodities sold to end-use customers by ESCOs, for the purposes of calculating its gross operating revenue. NYPA supply-related revenues are exempt from 18-a assessment.

needed, as a percentage of revenues, to fund the electric and gas programs.[34]

As a result, costs are allocated fairly evenly between electric and gas services, on a percentage of revenue basis (at about 1.2% overall), and the same 2% budget limit will apply to both services. In addition, only National Fuel's program reaches the 2% budget cap, which requires an adjustment to the energy burden target to 6.82% (more precisely, one half of the target energy burden of 6.82%, or 3.41%).[35]

To avoid any further confusion, no party should infer that restating the budget cap as a percentage of total revenues necessarily implies that costs should be allocated to the classes or recovered from customers on a percent of total revenue basis. As expressed above, the programs should generally be borne by all classes of customers, and the specific mode of cost recovery should otherwise be determined in rate cases.

Finally, establishing the budget cap on the basis of total revenues means the cap will vary with changes in commodity costs. This is appropriate, as low income programs seek to make the total bill affordable, and the resources needed to accomplish this will vary as commodity costs change (and as costs are reduced through implementation of DER). This further avoids the problem identified by National Fuel that the budget

[34] The discount calculation to some degree represents the Commission's decision regarding how best to apportion program costs, rather than an estimation of the relative size of average electric and gas bills.

[35] For National Fuel to achieve the 6% energy burden target would require additional funding of approximately $8.5 million, to $24.6 million, approximately 2.98% of total revenues.

caps proposed in the Straw Proposal do not account for such changes.

The budget limits otherwise are applied in the same manner as outlined in the Straw Proposal. If higher than expected participation causes the budget limit to be exceeded, there would be no change in benefit levels for that year, nor would participation be capped, and the utility would be allowed to fully recover its program costs. The utility would adjust the energy burden target in the following year, so as to reduce discounts until the program costs are contained within the budget limit for that year.

The differences between actual program costs and the respective amounts allowed in rates would be reconciled using traditional deferred accounting procedures. Variances between actual costs and the amounts allowed in rates would be recorded in a regulatory asset or liability account. The regulatory asset or liability would accrue interest, with the appropriate rate to be determined, along with other matters related to the method of cost recovery, in each utility's rate proceeding. For the filings directed in this Order, utilities should utilize their existing low income program cost recovery methods, to the extent practicable, and estimate the cost allocation among the classes resulting from such an approach.

Arrearage Forgiveness

Arrearage forgiveness programs target additional assistance to customers who are payment-troubled. The Straw Proposal recommended that arrearage forgiveness programs should be further studied to better define best practices and their appropriate rate treatment. It nevertheless recommended some basic principles for structuring arrearage forgiveness programs.

A customer's need for arrears forgiveness should be evaluated upon each customer's enrollment (or re-enrollment) in the low income program. Arrearage forgiveness programs should use established procedures for assessing a customer's financial circumstances in order to reach fair and equitable deferred payment agreements (DPAs) as required under HEFPA.[36] Such programs should forgive the remainder of a customer's arrearage, provided that the customer has made timely payments over the course of a given period (a sliding scale from 12 to 48 months, depending on the customer's benefit level). Only if the customer makes the required payments does the utility forgive the remaining arrears.

Arrearage forgiveness costs should not exceed 10% of total program budgets, and must fit within the budget limits described above. Amounts diverted to arrearage forgiveness should not reduce amounts available for discounts below an energy burden of 10%. The Straw Proposal would allow no administrative expenses for arrearage forgiveness (positing that administrative expenses of arrears forgiveness programs should be offset by collection cost savings), and amounts expended for arrearage forgiveness should be fully or partially offset by reductions in utility uncollectible expense allowances established in rate cases.

Party Comments

Some parties believe arrears forgiveness is an essential component of low income programs. PULP recommended as an initial step, the Commission should focus on rate discounts, and defer consideration of arrears forgiveness. PULP also recommended that the Commission consider the approach to arrears programs taken in New Jersey and Massachusetts, where customers

[36] 16 NYCRR §11.10.

are offered “significant relief from old arrears balances in return for a modest payment that is designed to be affordable and ensure success.”[37]

On the other hand, National Grid, which participates in the Massachusetts program, recommends that arrears forgiveness programs be eliminated, as they are resource intensive and of limited benefit. National Fuel, while it supports continuation of arrears forgiveness, states that arrears forgiveness should not be offered to all low income program participants, and should exclude any customers who are not otherwise eligible for rate discounts.

Regarding the relationship of arrears forgiveness programs to uncollectible expense allowance, NYSEG/RG&E argues that no uncollectible adjustments are necessary for mature programs. National Grid states that while there may be a slight impact on uncollectible expense, it would be difficult to quantify. NYSEG/RG&E argues against imposing a 10% cap on arrears forgiveness programs, and states that the tiered timeframes recommended in the Straw Proposal are confusing. NYSG/RG&E proposes using a uniform timeframe of 24 months instead.

Discussion

Perhaps with closer study, and better data collection as described below, a set of best practices and the appropriate rate treatment for arrears forgiveness programs can be identified and implemented in later phases; however, a uniform approach to arrears forgiveness programs may not be possible at this time. Under these circumstances, the Commission will allow arrears forgiveness programs to continue for utilities who see value, but not presently require them for all companies.

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[37] PULP Comments, page 17.

The arrears forgiveness program design principles proposed by Staff are reasonable, and the Commission generally adopts them. Given that best practices are not fully defined; however, utilities can justify alternate approaches. For example, the uniform 24 month timeframe proposed by NYSEG/RG&E may be a reasonable alternative to the sliding scale proposed by Staff.

Until best practices for such programs are better understood; however, a limit of funding for arrears forgiveness programs of no more than 10% of the budget is adopted. The 10% allocation shall be incremental to, and not reduce, the amount directed to rate discounts as described above. Overall program budgets must also fit below the 2% budget cap.

While arrears forgiveness can produce clear participant benefits for customers facing unpayable arrears and at risk of termination, arrears forgiveness should also directly impact utility collection costs and bad debt expense. Arrears forgiveness programs must generate cost savings in these areas, not additional costs.

The Commission recognizes that there are administrative costs for implementing arrears forgiveness programs, but they must be considered as part of general utility costs (and generate other savings of such costs), not separately recovered as a cost of the low income program. For example, personnel who implement the arrears forgiveness program are presumably captured in labor expense. To some extent, their labors will offset labor costs that would otherwise be incurred in avoided collection activities. If also recovered as a low income program cost; however, such costs are double-recovered, and the offsetting collection savings ignored.

The Commission also agrees with the findings of the Staff Report that an effective arrears forgiveness programs must reduce the amount of arrears that would otherwise be written off as bad debt. Here again, better data collection may shed light on the appropriate ratio of these factors.

For mature programs, the Commission agrees with NYSEG/RG&E that the effects of arrears forgiveness activities are likely already reflected in the net write off amounts used determine the uncollectible revenues expense allowance. For any new programs, or incremental expenditures to existing programs, the initial approach shall be to assume at least a 50% offset - annual utility uncollectible expense allowances in revenue requirement shall be reduced by 50% of any new or incremental amounts allocated to arrears forgiveness. This ensures that other ratepayers will share in the benefits of effective arrears forgiveness implementation.

Reconnection Fee Waivers

Reconnection fee waivers avoid the diversion of a low income customer's scarce resources from payment of the bill to payment of reconnection fees. Reviewing data for a portion of 2014; however, Staff concluded that "having other customers cover the reconnection fee appears to remove the disincentive for utilities to use termination on low income customers - rather than being a last resort, it appears to promote the use of termination of low income customers as a tactic to induce payment."[38] Therefore, as opposed to a waiver of the fee, the Straw Proposal recommends that reconnection fees should not be charged to low income customers. No allowance would be made in program costs for waiver of reconnection fees.

[38] Staff Report at 52.

Party Comments

Some parties, including CEC, EE4A, NYC, and UIU strongly supported elimination of reconnection fees. Others, including National Grid and NYSEG/RG&E recommend continuing the practice of waiving of reconnection fees for qualified low income customers, and charging the costs of such waivers as a low income program cost. CH, CEOR, and National Fuel argue that low income customers should pay reconnection fees, and that there should be no waivers. National Fuel denies the Staff finding that utilities use termination aggressively against low income customers.

Discussion

It is beyond dispute that performing service reconnections imposes costs on utilities. Among the fundamental principles of ratemaking is to allocate costs to the customers who impose them. Thus the Commission has authorized reconnection fees for all New York utilities.[39] Staff's findings, based on less than a full year's data, are insufficient to overcome this basic principle. Furthermore, as some utilities noted in their comments, low income customers may sometimes intentionally place themselves at risk for termination, in order to be eligible for and receive Emergency HEAP.

On the other hand, similar to rate discounts, waivers and discounted reconnection fees can ease the burden on low income families. For utilities that currently offer reconnection fee waivers, the budget allocation has been fairly

[39] An equally fundamental ratemaking principle is ensuring that rates are responsive to social needs and social costs, including consideration of low income customers' ability to pay. Resolving the tensions among competing goals is among the fundamental challenges of ratemaking.

low - approximately 1% of total program costs. The waiver programs thus do not appear to be overly costly, and can avoid compounding the difficulties posed on low income families resulting from having service terminated for nonpayment. The Commission therefore continues the practice of allowing reconnection fee waivers as an optional, but not required, feature of low income programs. Similar to the limit for arrears forgiveness, the Commission also establishes a limit of funding for reconnection fee waivers of no more than 1% of the budget. As with arrears forgiveness, budgets for reconnection fee waivers shall be incremental to the rate discount budget, shall not limit funding for rate discounts, and must fit within the budget cap.

In part, the matter of reconnection fees illustrates the lack of information that utilities currently report regarding their low income populations. Improved reporting, as discussed below, will help show whether utilities use termination excessively against low income customers.

Program Reporting/Evaluation

The Straw Proposal notes that a substantial amount of collection activity data is already reported by the utilities for the general body of customers. The Straw Proposal recommends that utilities should begin tracking and reporting the same key collection activity data for the subset of low income customers. The Staff Report also notes that some of the measures tracked in the context of monitoring and evaluating low income programs may also lend themselves to utility incentives, in the context of the REV initiative.[40]

[40] Case 14-M-0101, supra.

Party Comments

A wide variety of parties, including AGREE, CEC, EE4A, MI, and UIU recommended improved collection of information, evaluation, and metrics for gauging the effectiveness of low income programs. AGREE and NLMH argue that utilities should be required to report terminations by zip code or census block, so that termination practices can be monitored for targeting of communities of color. NLMH and PULP recommend that Commission set targets for reducing terminations and arrears.

Discussion

Low income program reports currently filed by utilities do not provide sufficient information to compare different program approaches, identify best practices, or gauge program effectiveness. Some provide no more than the number of participants and dollars expended. Some provide cursory information on participant arrears, and none provide information on how many low income customers are terminated or reconnected, DPA activities involving low income customers, or bad debt attributable to low income customers.

The Commission therefore directs that utilities begin regular, quarterly filing of detailed low income program reports. Such reports shall include all of the information included in the sample report attached to this order as Appendix D. In the filings directed in this Order, the utilities shall provide a timetable for compliance with these reporting requirements.

The Commission concludes that the effort and expense required to track, report and analyze termination data by census block would be substantial. Furthermore, such an exercise would have limited value, and great potential for confusion and mischaracterization. As it would be costly, difficult, and unlikely to provide any real insights into the matter, the Commission declines to order this step.

As noted in the Staff Report, the Commission has approved earnings-based incentives related to reductions in residential terminations and bad debt expense in recent rate cases.[41] As development of new earnings adjustment mechanisms (EAMs) continues in the context of the REV proceeding, some of the measures tracked in the context of monitoring and evaluating low income programs may also lend themselves to EAMs.

Coordination with Other Programs

The Instituting Order noted that low income concerns are being addressed in several proceedings before the Commission, and the Straw Proposal makes recommendations concerning the coordination of the programs providing direct financial assistance that were the primary focus of this proceeding to certain related programs and initiatives. Among other things, such recommendations included the following:

- Recognize Emergency HEAP payments when calculating household energy burden;
- Continue referrals of low income customers to NYSERDA’s Empower-NY program (or any successor program) for low income energy efficiency services, with better utilization of utility bill data to focus and prioritize efficiency services to low income households with high usage; and
- Leverage REV tools to narrow the “affordability gap” that needs to be filled with direct financial assistance.

[41] See Cases 14-E-0318 & 14-G-0319, Central Hudson Electric and Gas Rates; and Cases 14-E-0493 & 14-G-0494, Orange and Rockland Electric and Gas Rates.

Party Comments

A wide variety of parties perceived a need for greater coordination among the various initiatives directed at addressing low income customer needs. AEA, CEOR, EE4A, National Grid, NLMH, and PULP were among those who pointed to the need for better coordination of rate discounts with energy efficiency and weatherization programs.

NYSERDA states that providing bill relief to low income customers is most effective when multiple strategies, including rate discounts and energy efficiency, are pursued simultaneously. It urges the Commission to continue referrals to its Empower-NY program, and to standardize and digitize referral mechanisms for more efficient handling. NYSERDA agrees with the Straw Proposal that energy efficiency services should be prioritized to households with the highest consumption.

In order to achieve greater program coordination, a concept initially advanced by UIU, and endorsed by other parties including AEA and PULP, is "establishment of an Energy Affordability Intergovernmental Task Force administered by and composed of senior management from DPS, OTDA, HCR, NYSERDA, the Long Island Power Authority, the New York Power Authority, the State Office For Aging, the Department of State and other state entities whose work addresses low income customers and affordable energy bills."[42]

EE4A suggested that energy efficiency in low income multi-family housing sector is underserved by current programs. EE4A also encouraged the Commission to take steps to ensure that the benefits of DER are accessible to low and moderate income households. AGREE endorsed a program under consideration in

[42] UIU Comments, page 9, citing its earlier Responses to Questions (filed March 4, 2015), page 7.

California whereby low income discount recipients are allowed to redirect their discounts to certain renewable energy projects.

OTDA opposed the Straw Proposal recommendation to reduce discounts for Emergency HEAP recipients. OTDA also recommended that the Commission lengthen the winter moratorium, currently a two-week period encompassing Christmas and New Year's Day, during which utilities may not terminate service for nonpayment.[43]

Parties including CEC and PULP argue that issues concerning ESCO treatment of low income customers, including marketing practices and pricing, need to be addressed. NLMH urges the Commission to consider various rate design changes, including eliminating customer charges, and adopting inclining block rates for volumetric charges. EE4A argues that the Commission must help develop jobs and training opportunities for low income populations.

Discussion

As previously noted, the Commission concludes that a key to the success of addressing the energy divide facing low income households lies in better coordination between the various Commission initiatives funded by ratepayers, and the numerous other governmental and private agencies that administer programs addressing energy poverty. The Commission therefore directs Staff to work with sister agencies to create an inter-agency task force to achieve greater inter-agency coordination, share information, eliminate duplicative efforts, lower costs and increase effectiveness, and advise in the development of low income energy-related policies and programs.

A need for better coordination of rate discounts with energy efficiency and weatherization services was the most

[43] 16 NYCRR §11.4(a)(4)(ii).

widely given, and least opposed comment. Clearly, this need is perceived by a wide range of parties.

Great progress has been made in improving utility referrals for Empower-NY, but there may be opportunities to better utilize bill data to prioritize referrals for efficiency services to low income households with high usage and high arrears. The Commission recently directed NYSERDA, the utilities, and Staff to update and enhance the current referral process in its recent Clean Energy Fund Framework Order.[44] Other meritorious proposals (e.g., standardizing referral mechanisms and developing more robust multi-family programs) for developing alternative approaches that can improve consumer value are important to addressing the totality of low income needs, and will actively be evaluated through the Clean Energy Advisory Council in order to inform the low to moderate income (LMI) Chapter of NYSERDA's Investment Plan, the utilities' future Energy Efficiency Transition Implementation Plans and budgets and metrics filings, and other clean energy activities.[45]

Facilitating greater access to DER for low income households is of great interest to the Commission. In its Community Net Metering proceeding, the collaborative efforts to remove obstacles to low income participation in Community DG is continuing.[46]

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[44] Case 14-M-0094, supra.

[45] Case 14-M-0094, supra. The Clean Energy Advisory Council is co-chaired by Staff and NYSERDA and includes participation from all utilities offering energy efficiency programs in New York State, NYPA, LIPA, and PSEG, as well as involvement from a broad array of stakeholders.

[46] Case 15-E-0082, supra, Ruling on Extension request (issued April 15, 2016).

As the HEAP recipient data furnished to utilities for HEAP performance measurement will include Emergency HEAP recipients, these customers will be included in the utility low income programs. Unless these customers also receive a utility regular HEAP payment with add-ons, they would receive no more than the lowest tier benefit. Also, as discussed in the Staff Report, utilities may further consider the impact of Emergency HEAP payments on the customer's net energy burden when setting the level of discount for customers who receive Emergency HEAP payments.[47]

An often overlooked tool for helping low income households maintain utility service is increasing energy literacy. Low income energy education, including counseling in household budgeting and financial management, energy savings actions, and information on how to participate in community DG and other DER projects, helps engage and involve the customer in the process, and can have a lasting impact on affordability. Utilities should incorporate educational efforts into their low income programs, and explain their strategies for doing so in their filings.

ESCO matters are being considered in the Commission's Retail Markets case.[48] Rate design matters are being considered in Track Two of the REV proceeding.[49] Other proposals (changes

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[47] As this makes the discount structure more complex, the Commission will allow, but not require utilities to implement this approach.

[48] Case 12-M-0476, supra.

[49] Case 14-M-0101, supra, Staff White Paper on Ratemaking and Utility Business Models (issued July 28, 2015).

to HEFPA, training for low income workers) are beyond the scope of this or any other active Commission proceeding.[50]

CONCLUSION

Access to energy services is essential to the safety and well-being of all residents of the state. Ensuring adequate access for those who face financial difficulties is a public concern, because the utility and societal cost of leaving the economically disadvantaged without such access can be much greater than the cost of maintaining utility service for these customers. Even during the recent trend toward lower commodity prices, especially for natural gas, low income customers continue to have difficulty paying their energy bills and maintaining utility service.

The Commission will continue to work toward facilitating opportunities for all customers, including low and moderate income customers, to invest in clean energy and advanced energy management products, and to enhance demand elasticity and efficiencies. The utilities and third parties should continue to develop and manage programs that provide opportunities for all consumers, regardless of income, to achieve the benefits of REV and clean energy. Partnerships with community groups and other market actors may spur additional investments in DER projects for low and moderate income customers. The CEF will also help lower energy bills for all New Yorkers. **Finally, the Commission's Consumer Advocate will** continue to work with the Consumer Advisory Council, utilities and other interested stakeholders to further develop these programs as part of ongoing REV development. In the meantime,

[50] There is currently no active proceeding to amend the cold weather rules or other provisions of HEFPA, however, parties may petition the Commission to amend HEFPA if they so desire.

the program designs outlined here are a strong and measured response designed to help ensure affordable access to service and optimize the implementation of the utility programs.

Given the phased approach to implementing the Commission's low income policies, utilities will need to file implementation plans that can be updated as needed. Crucially, the plans must include proposals for programs for introduction by utilities in areas that are not being served by markets as part of ongoing REV development, but allow market participants to identify opportunities to serve low income customers. The Commission directs filings by utilities with more than 25,000 customers, to achieve implementation of this framework, including any necessary program modifications, timelines, estimation of costs and proposals for cost recovery, including the details of the reconciliation of actual program costs to amounts reflected in rates. Utilities should utilize their existing low income program cost recovery methods, to the extent practicable, and estimate the cost allocation among the classes resulting from such an approach. Utility filings must propose a path to incorporate these recommendations into ongoing rate plans, as well as cases coming before the Commission in 2016.

The Commission orders:

1. The regulatory policy framework for addressing low income customer needs, as described in the body of this Order, is adopted. Central Hudson Gas & Electric Corp., Consolidated Edison Company of New York, Inc., Orange & Rockland Utilities, Inc., National Fuel Gas Distribution Corp., Brooklyn Union Gas Co. d/b/a National Grid NY, KeySpan Gas East Corp. d/b/a National Grid, Niagara Mohawk Power Corp. d/b/a National Grid, New York State Electric & Gas Corp., and Rochester Gas and Electric Corp. are directed to make the filings described

herein, within 90 days of the Commission's order in this case, for further Commission review and approval.

2. In preparing their respective filings pursuant to Ordering Clause 1, the utilities should utilize their existing low income program cost recovery methods, to the extent practicable, and estimate the cost allocation among the classes resulting from such an approach.

3. The utilities' filings pursuant to Ordering Clause 1 shall discuss the expected timeline for the Office of Temporary and Disability Assistance to begin sharing data on all Home Energy Assistance Program recipients, and for each utility to begin using such data to enroll customers.

4. The utilities' filings pursuant to Ordering Clause 1 shall explain and justify any departure from the default method of calculating discount levels as described herein.

5. The utilities' filings pursuant to Ordering Clause 1 shall propose processes for participating customers to be notified of the option to refuse budget billing, and to exercise such option; and include a detailed description of each utility's budget billing plan, including a description its method for estimating bills when 12 months of billing data are not available.

6. The utilities' filings pursuant to Ordering Clause 1 shall explain their strategies for incorporating educational efforts into their low income programs.

7. The utilities' filings pursuant to Ordering Clause 1 shall provide a timetable for compliance with the reporting requirements included herein.

8. National Grid NY must indicate in its filing whether it intends to utilize a file matching process to enroll eligible customers, and propose a timeline for implementing such a file match.

9. Staff is directed to work with other government agencies to establish an inter-agency task force, to achieve greater program coordination, share information, eliminate duplicative efforts, lower costs and increase effectiveness, and advise in the development of low income energy-related policies and programs.

10. In the Secretary's sole discretion, the deadlines set forth in this order may be extended. Any request for an extension must be in writing, must include a justification for the extension, and must be filed at least one day prior to the affected deadline.

11. This proceeding is continued.

By the Commission,

(SIGNED) KATHLEEN H. BURGESS
Secretary

SUMMARY OF PARTY COMMENTS

Affordability for All

- Composed of nine organization members.
- Individuals voiced their need for additional assistance and the hardships they have faced and continue to face with their energy bills.
- A list of root causes for high energy bills include: old homes, landlord is absent or unwilling to provide building improvements, income levels, and individuals being forced to choose amongst necessities. The solution is to put the surcharge money toward additional weatherization components.
- The program needs to be inclusive and not exclude customers.

Alliance for a Green Economy

- Agree applauds the Commission for initiating this proceeding, but is bitterly disappointed in the Staff Report.
- Agree recommends that the Commission create a comprehensive low income discount program open to all low income households, not just those households who obtain a utility HEAP benefit. Automatic enrollment using Lifeline criteria should be adopted.
- New York needs a statewide implementing agency (as other states have). New York's Office of Temporary and Disability Assistance (OTDA) needs more resources to provide information and file matching for utilities about eligible households.
- Utilities must provide meaningful discounts in the form of rate reductions of approximately 40% for low-income households. This could be accomplished by the following ways: including provision of an affordable block of energy as part of the monthly service charge; creating an across the board discount of 40%; or designing a program that calculates individual households' energy burden and reduces it to 6% of income.
- The program must have a significant increase in funding for utility assistance. Agree calls for a program that provides at least $600 million in assistance. Other states are spending three to four times what we are currently spending per individual customer to ensure affordable service. A more rational and equitable formula for contributions to the low

income program must be devised than charging all customers a fixed annual surcharge of $20 on their electricity bills and $35 on their gas bills for the proposed low income program. The Commission should look at utility profits as a possible source for additional revenues.

- Energy conservation, efficiency, and weatherization services should be part of all low income programs. In general, state and utility programs have funded low hanging opportunities for efficiency at industrial and commercial entities, while low income households have not received proportional benefits, even though they have paid more than their fair share for these statewide programs. Popular education around energy conservation and investments in energy efficiency retrofits are cost effective ways to address the root causes of this crisis for many households and are proven ways to reduce future bill amounts and arrearages.
- The Commission should consider a program like "CleanCARE" being developed by the Interstate Renewable Energy Council, Inc. (IREC) for California. This proposal would allow low-income discount recipients to redirect their discounts into shared renewable energy projects, giving low income people a choice in where their electricity comes from and reducing their utility costs.
- Better data collection is needed for low income communities to understand the barriers to obtaining energy assistance, including for emergencies, the reasons for terminations in service, and how low income residents with unique medical needs are identified and protected. Agree supports the staff's proposal to monitor termination rates among low income customers.
- Utilities must be monitored for racial discrimination and other abuses. The PSC should also collect information needed to document and monitor patterns of racial discrimination in who is being shut off. Utility shutoffs be reported, and analyzed by census block.
- The Commission should use its regulatory authority to prevent shutoffs during the cold period of November through April. More information and evaluations are needed associated with terminations during the cold period of the year. It is appropriate as part of this proceeding for the Commission to consider the relationship to, the Home Energy Fair Practices Act (HEFPA). Procedures taken by utilities to avoid terminations in the cold period should be scrutinized and best practices developed. A full record should be

developed to inform PSC reviews in regular rate cases as well as to identify if there is a need for any amendments to the Home Energy Fair Practices Act, such as a moratorium on shutoffs.

- Customers need protection from utility shutoffs and help with understanding their rights and their options when confronted with threats of service termination. Utility companies should be required to go through a mediation process with customers before terminating service, and customers should have access to independent advocates who speak their language and can help them access assistance.
- Low income people need better representation and influence over utility rates, utility programs, and in PSC proceedings. In the development of the Staff Report, low income individuals or community groups (whose work is embedded in low income neighborhoods) were not systematically consulted. Agree states that it does not believe low income people were consulted at all and questions the legitimacy of the Staff Report. The Commission must approve intervenor funds for community groups to be able to participate in rate cases and policy proceedings.
- The Commission should recommend an Energy Affordability Intergovernmental Agency Task Force (as recommended by the Utility Intervention Unit), to facilitate regular sharing of information about program design, implementation and effectiveness among government providers of services and benefits, be put in place.

AARP

- AARP is generally supportive of the guiding principles from the Straw Proposal, however disagrees with the recommended method for funding the program.
- All commenting parties agree to some type of streamlined approach to be adopted by the Commission, despite varying positions on the best approach. They are concerned with energy affordability for all residential customers and note the very best approach would be to keep energy costs down for everyone.
- AARP generally agrees with 5 principles described in the Straw Proposal: 1) A simple program design; 2) The program is available under the same eligibility guidelines; 3) Automatic enrollment; 4) The program must provide a meaningful bill decrease; 5) The cost of the program should be borne by all classes of customers.

- Eligibility/Enrollment/Benefit Levels – AARP strongly supports eligibility should coordinate with HEAP program as a good starting point which emphasizes a customer's energy burden. However, HEAP as a not catch all for recipients, AARP suggests to utilize Lifeline and direct voucher as additional programs to increase eligibility and to consider Lifeline as criteria for eligibility. AARP suggests the Commission take an aggressive approach to closing the cooperation gap in sharing eligibility data with the Office of Temporary and Disability Assistance (OTDA). AARP agrees that enrollment should be simple and automatic so to include as many customers as possible and keep admin costs down.
- AARP is generally supportive of the benefit level approach, but reiterates that 200% of FPL should be the criteria and a 30-35% discount level be provided. However, in a tiered approach, some minimum discount may be necessary per tier level to ensure that target energy burden is achieved.
- Funding - AARP does not agree with the funding methodology and that exhaustion of and reallocating other sources of funding (Clean Energy Fund, or other NYSERDA funding sources) should be initially utilized and then any remaining funding needed be allocated on the customer usage basis. AARP states that any necessary ratepayer funding be allocated on a usage basis since basing it on per customer produces an unfair burden to the smallest users and for low income customers too.

<u>Association for Energy Affordability -- Initial</u>

- The proposed solution falls short of what is necessary to ensure all New Yorkers can control and pay their energy bills and take advantage of the clean energy economy the Commission seeks to advance. The proceeding is too narrowly focused on discounts and terminations. This focus is insufficient to address affordability and equity, which are a matter of total bills and access to a broad array of energy product and services. In this respect, we consider the domain of this proceeding as necessary but insufficient to ensure energy affordability and equitable access to distributed energy resources for low income consumers. Consumers eligible for rate discounts or other income and means tested programs should be enrolled in energy efficiency and weatherization programs to reduce or eliminate energy waste contributing to higher and unaffordable bills. The draft State

Energy Plan contains a similar goal. Weatherization and energy efficiency measures must accompany rate design approaches and can, over time, reduce or eliminate the need for ongoing subsidies via discount programs.

- Eligibility Determination -- The rationale for not expanding the participant pool seems to rely less on determination that the assistance is unnecessary and more on the cost of providing additional assistance.
- Enlarge the applicable pool of aid recipients, rather than restricting eligibility to HEAP recipients. If eligibility is broadened by a utility on its own but under the Staff Proposal framework, the utility could hit the proposed budget ceiling and be forced to lower its level of support.
- Program Coordination -- We understand ODTA believes constraints make it unable to provide further assistance in identifying low income households, but the Commission should engage with OTDA and other state entities to explore coordination and means of addressing resource constraints that prevent low income households from being offered services in a one-stop-shop approach.
- We recommend that NYS allocate 15% of its HEAP funds directly to the NYS Weatherization Assistance Program and support greater statewide and local collaboration between NYSERDA's direct LMI efforts, New York's WAP, HEAP, and utility low income programs. Upgrading existing housing through weatherization and coordinated energy efficiency treatment can address root causes of unaffordable bills, and when coordinated with HEAP and utility low income discount programs, can provide an effective low income energy assistance strategy statewide. Identifying and enrolling eligible consumers and meeting their individual needs will require coordination with community based organization and social service agencies.
- Determining Affordability -- We believe Ohio's PIPP is a good model for addressing arrearages and ensuring payments are based on a percentage of income. Also, a volumetric approach on pricing is beneficial to low income customers, together with automatic/required enrollment in weatherization and energy efficiency programs.
- Program Budgets -- The proposed budgets are low relative to both the need and overall utility revenues and consumer dollars spent on energy statewide.

AEA -- Reply

- We believe the Commission should act expeditiously to adopt a statewide expanded eligibility guideline for utility low income assistance programs, provide an "affordability block" of energy for low income households, ensure a more holistic and coordinated approach to energy assistance, and proceed with interagency coordination to help implement these approaches to energy affordability for low income households.
- Eligibility for Utility Low Income Programs -- A number of commenters agreed with AEA that "a state-wide approach based on the broader eligibility of receipt of need-based income support would be welcome while a statewide approach restricted to HEAP eligibility would not be progress" and that programs based entirely on HEAP assistance, rather than an expansion to Lifeline as recommended by UIU is insufficient to address affordability and equity.
- The Lifeline criteria would be a more appropriate and effective means of determining program eligibility than HEAP recipients. Adoption of the Lifeline criteria could be accomplished via an application form to be completed by the potential program enrollee
- Block Rate for Energy Affordability -- AEA and a number of other active parties in this proceeding advocated for the first block of energy use to have a lower rate. Tiered pricing for blocks of energy, coupled with automatic/required enrollment in weatherization and energy efficiency programs, would support the Commission's objectives to assist low income consumers, implement demand management, and ensure that low income households are provided with the bill management opportunities envisioned in REV.
- Holistic Approach to Serving Low Income Households –- We recommended that New York allocate 15% of its HEAP funds directly to the NYS Weatherization Assistance Program (WAP), as permitted by both Federal and State legislation, and that there be greater statewide and local collaboration between NYSERDA's direct LMI efforts, New York's WAP, HEAP and utility low income programs
- It is important to use consistent definitions for eligibility for low income programs, ensuring ease of access to program opportunities, providing equitable distribution of utility and NYSERDA program resources and adopting appropriate consumer protection provisions.

- Interagency Coordination -- The Commission should commit to working with other state agencies to implement the State Energy Plan and its commitment to serving low income consumers. We understand OTDA believes constraints make it unable to provide "matching" services to assist utilities in identifying the customers also enrolled in OTDA administered assistance programs. Exploring how to address resource constraints and effectively achieve interagency coordination among OTDA, HCR, NYSERDA and utilities should be a state priority.
- We also support arrears forgiveness programs and a prohibition on reconnection fees for low income program participants. We strongly oppose the position of AARP and PULP that Clean Energy Fund dollars be used for low income discount programs and believe the Clean Energy Fund should only be used for clean energy programs, though including substantial support for energy efficiency for low income households, which provides the necessary complement to utility discount programs.

<u>Central Hudson – Initial</u>

- Central Hudson (CH) provided comments on their existing programs in place and that the Straw Proposal, in particular the 6% energy burden methodology, would negatively impact low-income customers. Changes to their current low income programs would cause incremental costs to CH through additional IT programming, program design and ongoing program resources. CH agrees in continuously making improvements to low income programs as they and other parties have collaborated numerous times to improve their Enhanced Powerful Opportunities Program (EPOP). CH states their current programs provide sufficient benefits at reasonable costs. CH understands the idea of incorporating a standardized low income program and encourages the Commission to maintain and design the most efficient low income program.
- Eligibility/Enrollment – CH agrees an automatic enrollment is a reasonable goal. In addition to HEAP, CH adds the following for eligibility for EPOP: 1) Need to be full service residential customers; 2) Enrolled in budget billing; 3) have $100 in past due 4) electric or gas as primary heating source. CH states they would like to keep their more extensive eligibility criteria since only less than 10% of HEAP eligible customers are enrolled in EPOP which allows for higher benefit amounts to those most in need. CH

suggests new programs should be designed around automatic enrollment, but existing programs should be grandfathered in. CH is also unclear how they will derive the information needed to set up their low income customers in tiers, as well as, information sourcing, program cost, and cost recovery issues should be resolved prior to adopting a new program.

- Benefit Levels/Rate Discount – CH suggest removing Tier 4 customers from calculations since payment for these customers is provided by Department of Social Services.
- Arrearage Forgiveness – CH supports the continuation of an arrears forgiveness program since it has been a success factor in their EPOP program. CH rejects Staff's position that cost savings would be associated with an elimination of an arrears forgiveness program stating it is simply bad debt that is recognized as uncollectible expense through the forgiveness program. If the decision is to adopt a new program, CH suggests that a plan to phase out prior programs would be necessary.

<u>Central Hudson – Reply</u>

- Central Hudson (CH) provides ten principles to help formulate the low income program.
- 1) A nondiscriminatory eligibility process for all low income customers – The eligibility should extend beyond the proposed HEAP criteria since there is a large amount of HEAP eligible customers that do not receive HEAP.
- 2) Automatic enrollment upon meeting criteria – CH comments that all low income customers must assert their eligibility to the proper government agency and upon verification by that agency, the customer should be automatically enrolled in the low income program. Administrative costs would also be reduced in having the agency provide eligible customers.
- 3) Sufficient benefits allowed for customers to effectively manage their bill and avoid termination – CH comments on Staff's method of determining a 6% energy burden level is in part attributed to researching other states programs and thus wishes to correct Staff in regards to Ohio's PIPP program as being under statutory authority. CH proposes that an investigation of a possible partial year program where the provided benefit is sufficient to cover just the heating months, but leveled through budget billing. CH states this would result in a lower monthly benefit, but be sufficient, and therefore not place

additional burden on the rest of the customers. If the benefit provided is sufficient for low income customers to manage their utility bills, then low income customers should not receive a reconnection fee waiver, nor should other customers pay the cost of such waivers.

- 4) Program costs should be as low as possible – CH provides the following suggestions to limit costs: a) partial year heating program; b) adopt a higher benefit for primary heat source, usually gas and then a secondary heat source, typically electric; c) encourage payment plans and disconnection during the non-benefit period to limit arrearages; d) a structured program to provide one benefit to all customers in order to reduce operating costs (6 – 8% target operating costs).
- 5) Mandatory participation in energy efficiency programs - In order to help limit the costs of the program, low income customers must lower their usage. The program should target separately low income homeowners and renters. CH believes the current funding to NYSERDA is sufficient enough to provide such energy efficient programs.
- 6) Simple in design – CH notes the objections received to the four tiered system and believes one consistent benefit is simpler.
- 7) Existing agency should administer eligibility verification and provide eligible lists to the utilities; - CH comments for the program to be administered by an eligibility service provider, such as OTDA. CH states that such organizations utilize the government determined criteria which they require the necessary information from the customer for verification purposes.
- 8) Arrearage forgiveness program should be provided – CH believes an arrearage forgiveness program is important to help a low income customer transition out debt and improve other financial aspects of their lives.
- 9) Statutory requirements – CH agrees with New York City's comments that when designing the structure of such programs need to comply with federal, state, and local laws, and rules and regulations.
- 10) Utilities must receive cost recovery for low income program costs – CH states as the implementation entity of the low income program, the utility should be permitted to recover all costs of the low income program.

- 11) Nobody Leaves Mid-Hudson (NLMH) comments should be disregarded as factually inaccurate – NLMH alleged that inclining block rates and a reduced customer charge will help low income customers. CH states that is not accurate due to the usage of low income customers tends to be more than the average residential customer in which an increased customer charge and declining block rates disproportionately would assist low income customers. Also, NLMH alleged that disconnections may be racially motivated. CH states that is false and should not be tolerated. CH states all customers are treated in the same manner and all are subject to the same rules and regulations set forth by PSC.

<u>Citizens Environmental Coalition – Initial</u>

- A major overhaul of the Low Income program is needed.
- The following are factors contributing to an energy related economic crisis for NY families:
    - Electric prices increased 4% a year from 1970-2011. In states that restructured, prices rose about 220% faster than US electricity prices in the same period.
    - The Great Recession caused massive loss of homes, jobs, and pension, particularly among those at the bottom of the economic ladder.
    - Federal debt increased resulting in funding cuts for low income programs
    - Underemployment
    - Overall energy prices in New York are too high for all customers.
- The following are Commission directives:
    - Conduct an investigation of utility low income programs
    - Evaluate effectiveness of current program designs
    - Identify Improvements that are warranted
    - Identify Best Practices
    - Standardize utility low income programs to reflect best practices
    - Ensure the programs are consistent with statutory and policy objectives
    - Develop a set of Recommendations for how to optimize the Implementation of utility low income programs with more uniformity.

- There were underlying concerns not identified in the Order, such as limited and finite resources available for low income consumers and concern for other ratepayers. We believe this notion of limited resources has harmed the entire proceeding and there are no facts underlying the notion. No matter how large the customer is, the fee is the same. This fee does not have to be so regressive. Large commercial and industrial companies could reasonably contribute 2% of their monthly bill to the Low income fund and this would provide the resources needed to ensure a credible low income program. We recommend that at least $600 million is needed for the low income program. Raising the total costs of a totally inadequate low income program form $136 million to $179 million, as Staff have proposed, is not at all satisfactory.
- Low Income Customers should be provided with a block of low cost electric and gas, as large commercial and industrial customers are provided with a block of low cost electricity.
- In the Staff Report, there was no evaluation of the effectiveness of utilizing the actual receipt of HEAP benefits to determine eligibility. Staff apparently believed they were operating with some sort of strict budget limit and therefore a thorough investigation of the magnitude of low income population needs was precluded. There was no evidence of an investigation or an evaluation of effectiveness of current programs, notably the use of HEAP as a qualifying factor. UIU identified that only 30% of HEAP-eligible customers actually get benefits.
- 25% of the state's population are low income yet only 12% of utility customers are receiving utility low income benefits. This 12% is largely achieved because Con Edison provides benefits to 22% of its customers, but some utilities are proving benefits to only 4-7% of customers. Upstate New Yorkers are not being treated equitably. Further, we are not reducing energy costs to the 6% level (currently).
- We believe Lifeline criteria are essential for a credible low income program.
- The Review of other baseline state programs is needed to be more thorough in identifying the key factors impacting low income customers.
- Best Practices needed to be identified and thoroughly discussed for possible application in NY. We noted that some states with better low income programs had significantly

lower arrears. The tradeoff of spending more on low income programs versus the costs of arrears should be thoroughly considered.

- Staff apparently did not believe it feasible to create uniformity statewide by having a more comprehensive program that covers more low income households statewide, because of financial limitations. It was also unacceptable for NYC and Con Ed to abandon their more comprehensive program.
- Staff did identify some modest improvements and included them in their proposal:
    - We support eliminating reconnection fees.
    - In general we support debt forgiveness associated with deferred payment agreements but strongly recommend providing wide latitude regarding payment due dates and allowance for partial payments.
    - Staff appears open to the idea of affordable block of energy, but this has not been fully developed. This needs to be discussed in a working group
- We strongly disagree with the budget limits proposed by DPS staff.
- We believe the UIU offered the best approach in its initial response to staff questions, by offering a comprehensive Low Income program. We also support a comprehensive program and have ordered our recommendations by their priorities at this point in time:
- Eligibility must be expanded and inequities resolved based on where a family lives so that all households under 60% of the State's median income are able to receive benefits. Automatic enrollment can be facilitated by utilizing the Lifeline criteria. It is likely we need a statewide administrator.
- Establish a Low Income Energy Affordability Intergovernmental Task Force.
- Substantial bill reductions of approximately 50% are essential for Low Income consumers. ESCO issues must be addressed. Significantly reduce costs for a basic block of affordable energy based on a relatively efficient household; high energy users should be referred for energy efficiency services.
- Elimination of the regressive free structure for Low Income program funding, instead charging larger entities more appropriately.
- Arrears Forgiveness
- Recommendation for no terminations during the cold period of year

- An Independent Consumer Advocacy Agency with substantial funding to enable public interest intervention in PSC cases.
- Substantially improved information collection and evaluation metrics for programs. We need more information about how families experience the program and metrics need to be established for evaluating the programs.
- While we would like to address the substance of data collection, we found the abbreviated form provided in the Appendix to the Staff report to be too obscure for us to understand and provide input.

Citizen's Environmental Coalition – Reply

- HEAP is an inadequate means of qualifying eligibility for low income benefits. All low income households must qualify and receive assistance that makes energy bills affordable.
- We recommend DPS consider a phased approach. We note that utilities have identified large numbers of customers who would lose benefits under the Staff proposal.
- Phase I should include:
    - Adoption of Lifeline criteria for determining eligibility for benefits
    - Elimination of reconnection fee
    - Reduced terminations during winter months
    - Statewide arrears forgiveness program. The calculation "Low Income benefits + arrears = total program cost" should be used.
    - If ESCOs cannot offer benefits to customers, they should not be allowed to operate in NY.
- Future Phase(s) should include:
    - -A holistic approach to low income affordability that integrates traditional activities like weatherization and energy efficiency with new programs like community solar. Given multiple new developments associated with REV, it is essential that various involved government agencies coordinate ideas, policies and programs. It should be noted some programs have operated for over a decade, yet have largely been directed to large industrial and commercial entities.

- -A Low Income Energy Affordability Interagency Task Force is necessary to tackle the multiple issues identified in this proceeding. Low Income issues are not being adequately dealt with in other REV proceedings.
- -The Low Income program must be funded in a less regressive way. Rather than charging all customers the same annual fee, larger customers should pay a larger fee to support the program. There are multiple option available, as discussed in the comments.
- -Rate reductions of 40-50% are necessary to make energy affordable for low income consumers. The tiered discount levels proposed by DPS are not a credible way to proceed. Options include:
  - -An affordable block of energy included with the monthly delivery charge.
  - -High usage customers referred for weatherization/energy efficiency services, but rate reductions still are needed for entire bill.
  - -Low cost energy from NYPA similar to the 900 MW in the ReCharge program for industrial and commercial entities.
  - -An Independent Consumer Advocacy Agency with substantial funding to enable public interest interventions in PSC cases.
  - -Substantially improved information collection and evaluation metrics for programs. We need more information about how families experience the program. At the same time metrics need to be established for evaluating the program-not just for addressing a utility's rate case.

<u>Community Service Society</u>

- CSS states the hardship and difficulty paying heating and electric bills especially in households with children. It contends that even though there are assistance programs in place, these programs do not go far enough to ensure that families are not having the lights turned off because they cannot pay the bills. It states that according to a data from their annual Unheard Third survey, around 1 in 7 of both poor (below 100 percent of the federal poverty level) and near poor (between 100 and 200 percent of poverty) New York City residents had services turned off by utilities in the previous year. This shows that the difficulty paying electric bills is not just an issue for the poorest New York City residents, but even those who earn as high as 200 percent of the federal poverty level. Among poor black respondents in the survey, 3 out of 10 had services turned-off in the prior year, the highest figure among the major racial/ethnic groups and more than double the rate of poor respondents overall.

- CSS expressed concern with the eligibility criteria of the Staff Straw Proposal, which it contends will leave many households who desperately need assistance out in the cold. CSS urges that we must ensure that households that are most in need of heating and energy assistance are able to receive it. It points out that just looking at HEAP enrollment to determine eligibility for the proposed program will exclude many households that need assistance.
- Consequently, it states that the Commission should re-examine its eligibility criteria, including the possibility of looking at enrollment in a variety of need-based programs to determine eligibility. In addition, enrollment for eligible households should be simple and straightforward, if not automatic.
- CSS further states that it is important that the new program provide meaningful assistance to families most in need. It expressed the concern that the proposal as currently written will not provide sufficient relief to alleviate the financial burden many low-income households face in trying to pay their energy bills. So, it urges the Commission to rework its proposal so that it will provide meaningful measure of relief to those who need it most.

<u>Con Edison/O&R</u>

- The Commission has purposefully limited this proceeding to considering incentive or discount programs in isolation, rather than on a holistic basis along with type of heating fuel used, customer behavior and usage patterns, rates, and weather. The Companies believe that considering all these factors together in a holistic manner would lead to better outcomes for low income customers, better align with the State's Policy objectives as outlined in the State Energy Plan and REV, and improve the long-term cost-effectiveness of low income programs. The Companies also state that as proposed in the Report, future low income programs would reduce benefits to many current participants in the Companies' programs, cost more to implement, and would introduce volatility in benefits available to customers that rely on them most.

- Low income programs should be utility-specific and funding levels decided in base rate proceedings.
- While Staff was guided by several principles in developing the straw proposal, certain proposals have aspects which are inconsistent with these principles. The first principle cited is that low income programs should be simple to understand, explain, and administer. The second principle cited is that low income programs should automatically enroll customers and be automated to the greatest extent practical. However the Companies feel the proposals in the Report will transform what are currently streamlined, efficient programs with minimal administrative costs into cumbersome programs requiring significant expenses. The Companies also address the principle that low income programs should be available to customers under the same eligibility guidelines as are currently used for New York State Heap recipients, and while they point out that they don't oppose this principle, they feel the implementation and administration is far more complex than the Report acknowledges. The fourth principle mentioned is that low income programs should provide a meaningful discount to participating customers. The Companies point out that the proposed discount levels would lead to many of the Companies' customers who currently participate in their low income programs to receive reduced benefits.
- While the Report recommends that eligibility requirements be primarily based on participation in HEAP, (and that Con Edison should be able to maintain its existing expanded criteria) , the Report only contemplates potentially expanding eligibility requirements to the extent it can be accomplished through automatic enrollment with little administrative burden.
- The Report proposes a discount structure that would apply four tiers of fixed discounts that would vary with customer income, which will be estimated by the number of HEAP add-ons received, or participation in a direct voucher program. However the Companies' current systems only capture that a customer has received a HEAP payment. Therefore the systems will need to be modified to account for multi-tier level discounts and certain assumptions will need to be automated to assign a tier based on the amount of HEAP

dollars passed to customers. The Companies express concern that it is not adequate to rely on these dollar amounts to assign customers to a tier. Furthermore, the Companies point out that it is not uncommon for OTDA to issue supplemental HEAP payments after concluding there are additional dollars remaining in the budget. These supplemental payments could result in a customer migrating into a tier with higher benefits, even though there was no increase in financial need. The Companies therefore feel that should the Commission pursue this approach, OTDA should identify which tier a customer who is a HEAP recipient be placed in. Additionally the Companies point out that although the Report states Con Edison can maintain it program eligibility requirements, it does not specify which tier non-HEAP recipients would be assigned to.

- The report proposes to add an additional category of electric low income customers who are not HEAP eligible to the Con Edison program. The Companies further state that with the addition of this group, there would be an additional 100,000 customers. The Companies believe this additional group should be considered during rate case proceedings. The Companies also state that during the Technical Conference held on July 30, 2015, Staff maintained that Con Edison (and other utilities with additional qualifying programs) put these customers (those who have qualified on a non HEAP basis) into the lowest discount level tier. This would result in more than 85% of Con Edison's low income participants receiving a smaller discount than what they currently receive.
- The Companies believe that the Report overlooks the fact that customers receiving a direct voucher are already having their entire energy bill paid for by social services directly. This gives these people an energy burden of zero. The Companies therefore believe the fourth tier should be eliminated in its entirety and direct voucher customers should be treated like other existing non-HEAP qualifying customers.
- The Companies feel that sixteen different tier discount levels (four proposed tiers, differentiated by heating, non-heating, gas heating, and gas non-heating) runs counter to the Report's guiding principle of simplicity.
- The Companies do not support the budget billing requirement of the Report as they feel this would undermine customer choice, and unfairly discriminate against customers based on income levels. Additionally, only about six percent Con Edison's low income

customers are on budget billing leading the Companies to conclude that customers do not generally value this option.

- The Company sates that while the Report advocates that utility low income programs should set an upper budget limit on program funding, the Report did not provide a justification for its proposed limits. The Companies state they advocate for a volumetric approach to establishing per customer allocations that would assign costs equitably among rate classes and reasonably align contributions with usage.
- The Companies disagree with the Report's proposal that all benefits to non-HEAP low income participants be eliminated and those customers made ineligible for program assistance when the budget cap is exceeded, and that the benefits to remaining customers be reduced. The Companies state that this introduces significant variability in benefits that many customers rely upon and that because energy bills have a high correlation to the weather, this could result in low income programs running out of funding and benefits being reduced when they are most needed. The Companies agree that program costs should be deferred and fully reconcilable. Also, the Companies point out that it is not possible to eliminate non-HEAP qualifying customers from the program if the budget cap is reached, as the Companies are not made aware of which social service program a customer qualified for in order to be in Con Edison's low income program. The Companies believe that changes to qualifying programs to participate in low income programs only be made in the context of utility rate proceedings.
- The Companies do not support an arrears forgiveness program as the program would be challenging, administratively burdensome with high administrative costs. The Companies agree that arrears forgiveness programs should not be mandatory.
- The Companies strongly oppose the proposal to prohibit utilities from collecting reconnection fees from low income customers. The Companies state they terminate service only as a last resort and in compliance with Commission rules and regulations. The Companies feel the Report's proposal disregards what the Companies feel is an ill-conceived requirement (low income customers must receive a disconnect notice to qualify for emergency HEAP) and requests the assistance of the Commission to in working with other State agencies to eliminate this requirement. In addition, the Companies point out that if the utilities can't charge low income customers for

reconnection fees, these costs will have to be recovered from other customers which increases the subsidy by other customers, and reduces the funds available to low income customers.

- The Companies agree that additional tracking and data collection could provide useful information. However, the Companies feel it is premature to develop the tracking proposal and once the Commission adopts new standards for low income programs, tracking mechanism can be developed and designed.
- The Companies do not oppose consideration of earnings-based incentives related to low income programs. The Companies believe such metrics should be developed in the context of utility rate proceedings consistent with similar measures currently being evaluated in Track 2 of REV.
- The Companies state that efforts to improve energy affordability for low income customers should include both discount programs and energy efficiency and demand programs. The focus of this proceeding, per Commission instructions, has been solely on discount programs, but the Companies feel the State can achieve much more for energy affordability if it enhances energy efficiency programs and links them directly to bill discount programs. The Companies go on to say that the right balance of enhanced customer energy use management and traditional low income benefits could be analyzed as part of a statewide study, which could be undertaken to analyze in depth the energy related needs of low income customers across the state.

Energy Democracy Alliance

- EDA seeks urgent action from the Commission to address the suffering of low income families and the unacceptable level of utility shut-offs in the state. The Staff Straw Proposal has been roundly criticized from all quarters because it will leave so many people out, and it does not offer adequate funding or solutions to address crisis.
- EDA therefore, urges the Commission to take immediate actions within the proceeding, such as expanding eligibility criteria and automatic enrollment for utility low-income discount programs and increasing funding available for those programs to ensure affordable energy for all low-income New Yorkers.

- In addition, EDA hopes that the Commission will explore other deeper options for addressing the crisis, for instance, through the use of discount funding to help low-income people weatherize and gain access to low-cost renewables.
- The Commission has the responsibility to ensure that utility companies are not discriminatory in how they handle shut-offs and collections for people of color. It applauds the Commission's recent decision to investigate Central Hudson to examine the possibility of racial discrimination in collection practices. However; EDA contends that discrimination may be a broader problem that extends to shut-offs and to other utilities. It cites the example that, in a 2009 national survey of low-income households by the Federal Energy Information Administration, over twice as many Black families reported having their electricity disconnected in the previous year compared to White families. As a result, EDA urges the Commission to require the reporting of shut-off data by utilities in a format that researchers could use to root out any racial discrimination that may exist.

Energy Efficiency for All – Initial

- Energy Efficiency for All supports efforts in this Proceeding to improve programs for low-income customers and establish a streamlined approach on discounts for use in future rate cases. The Proceeding should not be viewed in isolation from the Reforming the Energy Vision and related proceedings. An integrated approach means uniting the various prongs of REV into a cohesive set of goals and strategies to address equity and affordability.
- An integrated approach will also help achieve a core tenant of REV, namely better leveraging customer, utility and private market funds to find and exploit system wide efficiency, drive markets, create a cleaner, decentralized grid, and ultimately lower costs.
- Solutions to energy burdens are inextricably linked to energy efficiency and other distributed energy resource ("DER") opportunities. The consideration of efficiency and DER within low income assistance programs is ultimately the best way to leverage these funds to the benefits of all New Yorkers, and met this Proceeding's goals and directives.
- Low income consumers must be both empowered and protected throughout New York's Clean Energy Transition. Current low income assistance programs should be deployed as efficiently as possible, with existing budgets protected and ideally, expanded.

- 1) Make coordinated affordability approaches to efficiency and DER a goal or "Principle" of Low Income Assistance Programs. Energy for All generally agrees with the guiding program principles of the Affordability Proceeding: 1) programs be simple to understand, explain, and administer, 2) be generally available to customers under current guidelines used for HEAP, 3) automatically enroll customers, 4) confer a meaningful bill decrease, and 5) be funded by all customer classes. However, Energy for All asks that the goal that low income programs be effectively coordinated with energy efficiency and DER opportunities throughout REV and associated proceedings, and in future rate cases.
- 2) Ensure appropriate coordination between this proceeding and parallel processes, including REV, the BCA and the CEF.
- 3) Energy for All supports the UIU's multi-pronged approach, particularly: 1) extend eligibility to include the Lifeline criteria, 2) increase the discount amount to reach the 6% energy burden standard, 3) implement weatherization and energy efficiency measures for housing in which low income people reside, 4) establish uniform arrears forgiveness in all service territories, 5) consider rate designs that include an "affordability block" that reward low in come customers for using less energy; and 6) implement evaluation metrics, quarterly reports requirements and an annual review by Staff to gauge program effectiveness. Energy for All supports recommendations to ban reconnection fees for low income customers.
- 4) There is significant potential for energy efficiency savings in the low-to-moderate income sector, potentially for over $3 billion in net energy efficiency benefits over the next twenty years.
- 5) It is important that the Commission ensure that DER and its associated benefits be made available to low income communities.

<u>Energy Efficiency for All – Reply</u>

- Stakeholder Alignment on the Importance of an Integrated Strategy to Harness the Benefits of Energy Efficiency for Low-Income Customers and New York as a Whole -- We wish to emphasize the importance of recognizing the following two points: that the consideration of efficiency and DER within low income assistance programs is ultimately the best way to leverage customer funds to the benefit of all New Yorkers and to meet this Proceeding's goals and directives. In order to do so, current low-income assistance programs should be deployed as efficiently as possible, with existing budgets preserved or (ideally) expanded. In furtherance of these goals, and others, areas of consensus among various stakeholders include:

- 1) The need to develop an integrated, comprehensive approach to low-income assistance across REV and related proceedings.
- 2) The importance of prioritizing low-income affordability and reduction in overall energy burdens. In order to best serve low income communities efficiently, the Commission should include a focus on promoting energy efficiency and DER. Indeed, energy efficiency within the multifamily sector (which is predominantly low income) is a largely unaddressed area of need, and has the potential to realize over $3 billion in energy savings over the next 20 years.
- 3) Banning reconnection fees for low-income customers.
- 4) Consider the use of a multi-pronged approach, as recommended by UIU and others. Several parties showed support for the UIU recommendations.6 CEC, New York City, and UIU all showed support for extending eligibility criteria beyond receipt of HEAP benefits. CEC specifically recommended using Lifeline criteria to determine support eligibility, which we agree with. Energy Efficiency for All agrees with these commenters that these UIU recommendations have promise for protecting and serving low-income customers, and urges the Commission to consider these approaches.
- Capture the Co-Benefits of Supporting Good Jobs for Low to Moderate Income New Yorkers Through Energy Efficiency and Income Assistance Programs -- As part of a more holistic approach to alleviating the New York energy burden, Efficiency for All urges the Commission to develop an intentional strategy around the development of training opportunities and jobs for low to moderate income New Yorkers in the context of low income assistance and REV participation.
- Better Engagement of Low Income Voices in the Development of Recommendations -- We urge the Commission to adopt strategies of partnering with local community-based organizations to deepen the engagement of targeted low income communities.
- Energy Efficiency for All believes that REV should power solutions to New York's energy burden, particularly for the most vulnerable. In order to do so, we urge the

Commission to take practical near term steps, like banning reconnection fees for low income customers and utilizing the Lifetime eligibility criteria. We also ask that the commission seek to streamline and enhance processes between agencies when possible. Ultimately, an intentional, holistic and multi-pronged approach to reducing energy burdens should be a result of this proceeding, and a result of REV.

Laundry, Distribution and Food Service Joint Board, Workers United

- HEAP is an inadequate criteria for eligibility.
- The discount should be a percentage of the bill.
- Eligibility should be expanded to up to 175% federal poverty guidelines, and receipt of Lifeline, HEAP, Medicaid, SSI, TANF, and Safety Net Assistance.
- Ideally, the program should have automatic enrollment.

Multiple Intervenors -- Initial

- MI believes the residential low income budgets recommended by Staff are excessive and that it did not consider the order instituting this proceeding, or the proceeding itself to be an invitation to significantly increase the existing budgets for low income programs. MI recommends that the Commission's efforts focus on maximizing the benefits of the existing low income programs (utilizing the existing budgets) rather than increasing the financial burdens that such programs impose on other customers. MI believes that the impacts of increases to residential low income programs should not be evaluated in a vacuum. MI goes on to further state that customers are already funding (or soon will be) numerous other programs and initiatives, such as: System Benefit Charge market transformation programs; Energy Efficiency Portfolio Standard programs and subsidies (including programs and subsidies targeted directly at residential low-income customers that MI states were seemingly were disregarded when calculating the level of assistance provided currently to such customers); Renewable Portfolio Standard programs and subsidies; the capitalization of the New York Green Bank; assessments under Public Service Law section 18-a for the benefit of the State's general fund (which are scheduled to be phased-out in the coming years); certain Reliability Support Services Agreements and at least one refueling contract that previously was approved; plans to increase materially the replacement of leak-prone gas pipe; retail demand response and/or dynamic load programs; and various technology investments and demonstration projects in furtherance of the Reforming the Energy Vision (REV) initiative .

- MI supports Staff's recommended inter-cost allocation method and further states it supports Staff's recommendation that the cost of the residential low income programs be allocated among the classes on a uniform per-customer basis. MI states that, "under no circumstances should residential low income program costs be allocated among the service classes on a per kWh or per therm basis" as " the cost of residential low income programs bears no relationship whatsoever to the amount of electricity and gas delivered to serve all types of customers, including commercial, industrial and municipal customers. Indeed, use of any type of volumetric allocator in this situation not only would violate basic cost-of-service principles, it would grossly over-allocate costs to large non-residential customers that obviously are ineligible to participate in, and receive no direct (as opposed to general, societal) benefits from, residential low-income programs."
- Staff's recommended cost recovery methodology should either be rejected or it should be modified. MI feels that customers already pay too many surcharges, and that there is no justification for the recovery of residential low income program costs from non-residential electric customers through either a per kWh charge or a surcharge. MI further states that in regards to gas customers, recovering of residential low income programs costs from large non-residential customers through per therm charge or surcharges is inconsistent with the manner in which such costs are incurred. MI believes that residential low income program costs allocated to each service class pursuant to Staff's recommended interclass allocation methodology should be recovered through existing rate design structures.

<u>Multiple Intervenors – Reply</u>

- MI objects to the low income program budgets proposed by CEC and PULP, as it finds them to be excessive, and would place an unfair burden on other customers. MI believes the budgets proposed by CEC and PULP ($600 million and $1.15 billion respectively) bear no relation whatsoever to existing funding levels and are not supported by the record. MI believes the Commission first should concentrate on what MI believes to be the main focus of this proceeding- the identification of best practices and the standardization of these practices across the State. MI believes that the potential benefits from existing programs should be maximized before the Commission considers seeking greater funding from customers.

- MI believes that the volumetric cost allocation methodology proposed by AARP and PULP would be highly punitive to large, energy-intensive non residential customers, whom MI believes to be among the State's most price – elastic and energy –efficient customers. MI states that the adoption of Staff's recommended per-customer cost allocation methodology is equitable in this proceeding, and should be adopted.

National Fuel Gas

- NFG administers several different programs that have been uniquely designed to assist these customers in an area of the state which experiences more extreme cold and poverty than other areas. The Company contends that it has been able to run a successful low income program offering an affordable bill in consideration of household income, while at the same time minimizing program administration expense. These types of programs should not be jeopardized in finding a statewide solution in this proceeding.
- The Straw Proposal would fail to provide benefits to the neediest customers while vastly increasing the cost to other ratepayers. The Company is concerned that the current proposal will actually reduce benefits to certain needy customers, and that under the methodology of the Straw Proposal, several utilities, including National Fuel, will exceed the proposed cap from the beginning when the tiers are calculated using actual utility experience rather than the statewide averages. Thus, not all customers will be able to participate.
- Moreover, no funding will be available to allow for continuation of existing low income program components, such as arrearage forgiveness. Customers who are meeting their obligations and are currently receiving debt forgiveness, and almost on their way to a fresh start, will be unable to achieve full arrearage forgiveness if the Straw proposal is adopted and no funding is available for that purpose.
- The overall cost under Straw Proposal as identified in Staff's Appendix D more than doubles the overall cost of National Fuel's low income program. The Company's

programs at current budget level as reflected on Page 1 of 3 of Appendix D is $9,700,000 compared with the Company's Staff proposed programs at 6% Energy burden at the cost of $19,973,556 as reflected on page 2 of 3 of Appendix D. The Company expressed great concern over the proposed increase of over 100%, compared to an overall state increase of 46%.

- The Company further contends that Staff's cost projection on page 2 of Appendix D is likely understated since it uses information on the mix of customers by tier based on information significantly different than that experienced by National Fuel. Based on data specific to the Company, it estimates that Staff's proposed program would have an overall cost of approximately $22,415,179 which exceeds Staff's program budget limit for National Fuel of $20,478,185 found on page 3 of Appendix D in Staff's report.
- NFG contends that while the goal of participation by all low income customers is laudable, it simply cannot be accomplished even with the proposed 46% average increase (or over 100% in the case of National Fuel) in funding and under the current low commodity costs. The Company points out that Staff's report concedes that some utility programs would already exceed the new cap if enacted as proposed on page 43 of Staff's report. The Company states that it would exceed the cap and therefore could not provide sufficient benefits to customers to achieve a 6% energy burden. The company therefore cautions that the program should not be designed to exceed funding limits from initiation; since doing so, would eliminate other current program components, such as arrearage forgiveness, that Staff's report recognizes as providing "additional assistance to the customers that are the most payment-troubled" and which can also encourage them to alter their payment habits.
- The Company states that it has been an industry leader in public education and awareness of HEAP benefits and has been likely more successful in assisting its customers with obtaining HEAP than any other utility in New York State. It states that its efforts have directly assisted those customers in the greatest need. The Company contends that the consequence of this success, given both universal enrollment and the funding allocation methodology of the Straw Proposal, will be to impose even greater costs on the Company's customers. It urges that careful consideration of any additional expense on non-participating customers must be given, especially since National Fuel customers are

already contributing more for low income discounts and weatherization than most other utility customers in the state. The Company contends that because universal enrollment of all HEAP recipients is not achievable, participant selection will need to be based on other factors. The simplest and the least burdensome way it suggests is to require that participation be further limited to those HEAP customers that have received a disconnection notice from the utility in the 12 proceeding months, with an alternative determinant to be customers who have defaulted on a deferred payment agreement.

- NFG argues that not every low income customer receiving HEAP needs additional assistance with their utility bills. Many HEAP recipients budget the annual use of the benefit and make timely payment for all of their utility bills. These customers have not demonstrated any need for additional assistance, so to use Staff's logic here, "the discount is unneeded, and its continued application is inefficient at best and a wasteful application of scarce resources at worst" (Staff Report, fn. 28 at pg.35). In other words, certain low income HEAP recipients on National Fuel's system have demonstrated a need for greater assistance. It is these low income customers that are currently participating on the Company's effective low income customer affordability assistance program (LICAAP) rate. LICAAP customers are payment troubled and consume natural gas in amounts well above that of the average low income customer.
- NFG disagrees with Staff's claim that its existing program does not provide a price signal to conserve on marginal usage. The Company states that its program provides a discounted unit rate. Under the Company's existing low income rate, the more a customer consumes, the greater his or her bill (albeit at a lower discounted rate). Therefore, the customer continues to receive an incentive to use less since it will lower his or her overall bill. The Company contends that its existing low income program provides a greater overall bill reduction for larger volume users, and is consistent with the overall goal to lower the energy burden for specific low income customers. Natural gas usage rises with the number of people in a household. So, by discounting the overall rate, larger low income households will receive a greater overall bill reduction. This use of household size will help to better achieve the percentage of income goal.
- NFG disagrees with Staff's unsubstantiated claim at page 46 of the report regarding the impact of arrearage forgiveness on utility uncollectible. Staff claim assumes that all low

income arrearage would result in an uncollectible expense and are included in utility rate allowances. The Company states that utility uncollectible expenses included in rates have been generally estimated in rate cases as the forecasted write-offs for the rate year net of any forecasted recoveries of previously written off balances. The arrearage balances anticipated in the rate year have never been used as the sole determinant of forecasted bad debt expense. Further, the Company states that Staff's claim that arrearage forgiveness should "only be worth funding to the extent they reduce the amount of arrears that would otherwise be written off as bad debt" completely ignores the significant incentive arrearage forgiveness can provide low income customers in remaining current on their bill payments. The Company opines that arrearage forgiveness programs are an important element in reinforcing good payment practices. Since not all arrearages lead to ultimate termination and bad debt write-offs, and it is impossible to determine ahead of time which low income customers would pay their arrearages and which customers would ultimately have their arrearages written off, the ultimate consequence of an arrearage forgiveness program is higher costs to the utility.

- The Company states that at page 49 of the Staff report, Staff proposes that an arrearage forgiveness program include Tier 1 customers whose bills are by definition affordable. The Company suggests that Tier 1 customers that do not qualify for a rate discount under Staff's proposal should be excluded from the program including the arrearage forgiveness component. Because including Tier 1 customers in the program will add complexity and increase administrative costs, including arrearage forgiveness costs, for services to customers that are deemed to already have an affordable bill.
- NFG contends that under Staff's proposal, the overall costs of a natural gas utility's low income program will be a function of the estimated electric non-heating rate paid by the low income customer. The Company argues that such an assumption will add a contentious issue to stand alone gas rates and is inconsistent with one of the prime objectives of this proceeding which is to streamline the regulatory process. For example, this can be seen from Appendix D where Staff has calculated National Fuel program costs of $19,973,556 based on National Grid's estimated electric bill for low income non-heating electric customers. Electric rate design decisions can have a profound impact on the costs of service to low income electric customers since low income electric customers

tend to use less electricity than other residential electric customers while low income natural gas customers on National Fuel's system tend to use more natural gas than other residential natural gas customers. To demonstrate the impact of electricity bills on natural gas program costs under Staff's proposal, the Company referenced page 3 of exhibit A where Staff calculates the proposed low income program costs on National Fuel from a 25% reduction in low income electricity costs. Further, the Company states that a 25% reduction in electricity costs to low income non-heating customers would reduce the costs of Staff's proposed program on National Fuel to $11,139,001 from Staff's estimate of $19,973,556. The Company expressed interest in determining the appropriate rate design for electric customers in its service territory.

- NFG states that the Straw Proposal calculation of programs at the 6% energy burden increases the disparity in funding to be provided by electric and gas customers. At page 2 of Staff's Appendix D, electric customers are projected to incur an annual cost per customer of $13.47 and gas customers $21.90. Funding for low income customer programs should be equally shared between electric and gas customers. The Company contends that under the Straw Proposal, they are not. For example, a low income customer in Buffalo having electric service from National Grid and natural gas from National Fuel pays an average monthly bill of $98 for each service (Staff's Appendix B). Despite the bills being the same, programs funded at the 6% energy burden would have National Grid customers paying $12.50 annually (a $5.27 increase) while National Fuel customers pay $34.14 annually (a $17.56 increase). This result is unfair and inequitable especially given the fact that the HEAP heating assistance payment is applied to the gas bill. Also, because the low income HEAP customer's $98 monthly gas bill is already reduced by $29 ($350 Regular Benefit/12), there should be reduced need for low income subsidization by gas customers. At minimum, electric and gas customers should equally share the cost of funding low income programs. As described in the example, each should contribute no more than $23.32 toward the respective low income programs.
- The Straw Proposal bases its second and third tiers on a customer's receipt of either one or two add-ons to the base benefit. The current add-on benefit is $25 each for both benefits. i) Household income at or below 130% of the Federal Poverty level; and ii) vulnerable member in the household (under the age of six, age 60, or permanently

disabled). A customer who receives one add-on is placed on Tier 2 and if both add-ons are provided, the customer is in Tier 3. There is a vast disparity in income that exists in using this approach. For example, a household of two adults at the federal poverty level with a monthly income of $1,328 will receive one add-on and be classified as Tier 2. So too will the two-person senior household with a much higher monthly income of $2,935. The Straw Proposal would treat these households the same, despite the fact that their financial situations are much different. In the example, the couple at the federal poverty level has less than half of the available income that the other couple has and is likely living in inferior housing stock and facing higher heating bills.

- The Company proposes that OTDA assign a different and unique dollar amount to the two types of add-ons to differentiate these customers, so as to address OTDA's previous indication that it is not in a position to send tier level information to utilities due to system limitations. For example, the add-on for individuals with household income of up to 130% of Federal Poverty Level could be set at $40 while the add-on for a household with a minor, elderly or disabled resident could be $20 (or $26 and $24, or other unique amounts). This change can be entirely revenue neutral from OTDA's standpoint. In having a distinctly identifiable way to differentiate these two scenarios, utilities are able to subtract the base benefit from the total and be left with a simple means of identifying the different circumstances behind the HEAP benefit.
- NFG urges a rejection of the component of the Straw Proposal which recommends a Tier 4 discount level to those customers who are receiving public assistance through direct voucher. It should be rejected because the proposal does not take into consideration that direct voucher bills are being paid through the state using taxpayer dollars. The direct voucher customer receives a fuel for heating allowance that is intended to pay for his or her heating needs and also has electric bills paid. Further, Staff analysis on an affordable bill for direct voucher participants does not take into account the utility payments that are being made pursuant to social service law and regulation. NFG contends that these government payments provide direct voucher customers with an affordable bill and no further financial assistance is needed. In addition, requiring other utility customers to fund unneeded rate discounts to these customers is inappropriate and will further limit the

funding available to assist other customers in need of assistance. For National Fuel, Staff's addition of a Tier 4 discount level in its proposal adds over $2.5 million in costs.

- In adopting HEFPA in 1981, the State Legislature created a list of proscribed charges that include fees or charges for: late payments (other than as allowed up to 1.5% per month); collection efforts, service disconnections, or deferred payment agreements occasioned by a customer's failure to timely pay for gas or electric service. However, the law did not prohibit the charging of reconnection fees and many utility tariffs still require a utility to do so. These tariff provisions have been approved by the Public Service Commission and recognize the general proposition that those who cause or receive the benefit of a service should be the ones that pay the expense associated with it. There is no support for Staff's suggestion that utilities are terminating low income customers in a more aggressive fashion than other customers; rather, the opposite is true. National Fuel states that it engages in extensive efforts on a daily basis to assist all customers in the payment of utility bills. It offers budget billing and deferred payment agreements to all customers, as well as discounts, free weatherization, and HEAP and other public assistance to its low income customers.
- The act of reconnecting utility service is required and the expense associated with it is both legitimate and necessary. A utility may not be deprived of the opportunity to recover legitimate business expense as such property rights are protected under the Constitution of the United States. For this reason, recovery of legitimate reconnection expense should be unabridged. Moreover, Staff's recommendation denying recovery is inconsistent with Commission policy recognizing that "continuing to spread a utility's revenue requirement across the broadest pool of ratepayers keeps the contribution required of each individual ratepayer as low as possible" (Order Specifying Criteria for Deferral of costs, issued and effective May 15, 2009, p. 8, in Case 08-M-1312).
- NFG states that it is necessary to dispel a misconception about program administration costs by describing how its targeted low income (LICAAP) program is cost efficiently administered. The Company uses a vendor to process application enrollments and procures relevant information on household income and number of residents. The vendor periodically verifies this information and also performs some educational services. This allows the Company to provide a targeted, variable rate discount. The administrations

costs for the program have averaged approximately $155,000 per year over the last seven years for approximately 11,000 program participants. The administrative cost for each of the Company's customers has been just a few pennies a month when spread over the larger customer base, and has allowed the Company to run a targeted assistance program best meeting individual need. Therefore, the Company cautions that program administration expense should not be raised as a basis for eliminating a successful, targeted assistance program.

- NFG cautions that changes that are being considered to simplify and standardize the utility low income offerings should be carefully examined to ensure that effective current programs or program components may continue in the future. The Company contends that Staff's proposal, while attempting to address the requirement to streamline the regulatory process and conserve administrative resources, ignores the needs of some of the most vulnerable low income customers on National Fuel's system. In addition, there is a vast difference in not only rates but customer affluence and weather throughout the state and adopting a one-size fits all program will only serve to hurt those customers that need assistance most.

National Grid

- NG is concerned that there may not be a single comprehensive low income program that will suffice the varying needs of their widespread population individual programs based on the needs of each service territory would be most efficient and cost effective. NG acknowledges and agrees the program should be simple to understand, explain and administer. As NG dug into details with the possibility of a standardized approach, they concluded the challenges they would face would outweigh the benefits and approximately 80,000 current low income customers would lose benefits based on the tiered system in the Straw Proposal.
- Eligibility/Enrollment – It would be optimal for the Office of Temporary and Disability Assistance (OTDA) to administer identifying and classifying customers per the respective tier levels. NG believes the dialogue should continue where OTDA is open to exploring the creation of a file matching system that provides a list of eligible customers to utilities directly; similar to the current system between New York City Human Resources Agency

(HRA) and Consolidated Edison (Con Ed). NG believes the Straw Proposal would likely require additional information to qualify customers in the proper tier and querying internal systems to establish a customer's tier level. Utilizing only a customer's HEAP amount for tiered classification, could lead to inaccuracies. Example provided – A customer who receives regular HEAP with 2 add-on's gets a benefit of $400, the same as a customer who receives a gas only Emergency HEAP in recent years. NG cannot determine type of benefit provided since they only know it is a $400 benefit and both types come from OTDA. Ensuring unique benefit amounts could address this issue. Privacy concerns would also be addressed through OTDA administering the eligibility. Also, OTDA has more extensive amount of information and more mechanisms in place that could more easily perform these operations.

- Aside from HEAP eligibility, KEDNY and KEDLI have relied on other manual processes to identify low income customers who, for whatever reason, did not apply for HEAP payment. According to the National Energy Assistance Directors Association (NEADA), only 20% of eligible HEAP customers actually apply, which values other methods of achieving enrollment. NG notes that during the Technical Conference, utilities opposed the use of only HEAP and that utilities should be using the broadest methods in identifying eligibility, referencing HRA and Con Ed's mechanism as "best practice". Through a manual process of identifying customers from various assistance programs, KEDLI and KEDNY both achieve greater overall participation, 10% and 33% respectively. Of those, many are non-heating who would lose eligibility. NG agrees with Public Utility Law Project (PULP) where additional identifiable methods could be the Senior Citizens Rent Increase Exemption (SCRIE) and Disabled Rent Increase Exemption (DRIE). NG comments as a positive outcome of the discussions, they are developing interactions with HRA to create a similar file sharing mechanism as HRA has with Con Ed. There are still uncertainties and challenges to overcome, however, Con Ed's success with this mechanism suggests significant impacts could be obtained.
- NG supports the proposal to utilize HEAP payments to develop a 2nd and 3rd tier, but direct voucher customers in tier 4 ultimately have zero energy burden since the county assumes financial responsibility for these customers and any low income funds should be provided directly to customers and not a third party.

- Discount Levels – Discrepancies were found in the original data provided and included are the updated numbers to calculate the appropriate discount levels. NG states that a situation could occur where a customer changes tier level due to a change income level and suggests updated customer tier levels should be done on an annual basis.
- NG opposes required budget billing component due to level of difficulty, the required programming and time to implement. NG states that using the budget bill as a limit on the amount provided can have unforeseen impacts from different occurrences. Examples provided are swings in prices (polar vortex) or an increase in usage from medical equipment. These events can cause a lag between budget amount and actual amount of usage. Efficiency measures completed can also produce inconsistencies between budget amount and actual amount used which can lead to over collection from their historic budget bill and significantly reduced budget amounts. These events could render a customer losing benefits where otherwise eligible. NG opposes the budget bill as limit on benefits due to the difficulty in creating and administering a billing system mechanism that utilizes a variable budget cap for each customer and due to the possibility of unforeseen consequences. Also, it would not be easily communicated or understood. NG recommends a uniform discount each month regardless of customer's budget bill, but does agree with Staff Report that customers should not receive cash when benefits outweigh bill amounts and would explore alternative mechanisms for this.
- Program Budget Caps – NG is not prepared to provide an opinion on non-participating burden level since it could vary between territories and should be developed as matter of policy in rate proceedings.
- Arrears Forgiveness – NG recommends arrears forgiveness programs be eliminated due to the higher costs of administering such programs and funds should be allocated to other components of low income program. Through NG's experience few customers actually complete the program and those who do complete it, do not show an improved payment history afterwards. Although difficult or impossible to quantify the avoided uncollectible expense from an arrears forgiveness program, NG suggests it would only be a part of the total saved, thus not in line with the Straw Proposal.
- Reconnection Fee Waivers – NG opposes waivers and requests that utilities be able to recover reconnection fees due to all factors of deploying a vehicle and a service

employee. NG does acknowledge the potential impact of waivers for certain customers and supports the concept, however Commission policy suggests that recovery of costs associated to a specific customer for specific work should be recovered from that customer. Reconnect fees for NMPC are $525K and for KEDNY $90K which NG believes costs should be included in the overall low income program. NG is opposed to the notion that terminations are used as a collection tool since in many cases NG is not aware of the customers' circumstances until after termination occurs. Also, NG does not look at such information prior to termination in order to avoid any discriminatory actions.

- Terminations – NG states low income terminations occur at a higher rates due to their inability to pay and utilities should not impose more stringent collection activities or fees on low income vs. other customers which violates Public Service Law §65 (1)-(2). NG comments there are extensive efforts put forth with all customers to avoid terminations and are committed to assisting most vulnerable customers. The Company's Consumer Advocates provide assistance with payment agreements, enrollment and education services to meet individual needs. The advocates work with other agencies towards avoiding service disruptions and restoration of services. NG notes their Customer Assistance EXPO as a one stop shop service initiative for low income customers.
- Tracking, Reporting and Metrics – NG suggests to continue dialogue with these topics on what's appropriate to measure once the programs have been finalized.
- Additional Avenues to Promote Energy Affordability – NG believes improvements to energy affordability should not only include discounts but also, energy efficiency, fuel conversion programs, and possibility of distributed generation targeted to underserved customers and neighborhoods like the approved REV Demonstration Projects.

<u>NYC – Initial</u>

- City's overarching concern is that the proposed approach could reduce the benefits presently received for hundreds of thousands and could prevent tens of thousands of others low income customers from obtaining benefits.
- Statutory Framework – Extensive discussions have been had amongst the parties in regards to access to information of low income customers, particularly financial status, income levels and identity of those participating in low income programs. The Straw

Proposal creates a discount level for a customer based on the perceived income level of that customer. The City opposes for the following reasons: 1) it could force individuals to disclose personal information to utilities that is not required by other customers and; 2) the proxies used to determine discount are not appropriate, which shows an income based approach cannot work. The City notes there is no legal exception for any social service agency to disclose any client personal information to utilities or the Commission and for a utility to gather information directly from the customer would be administratively burdensome.

- A state-wide one-size-fits-all approach for utility low income programs is not appropriate. A) The proceeding should have originated with a discussion on whether existing programs needed to be changed and the goal of identifying best practices has not been achieved. City notes that Con Ed's current program is running efficiently, capturing most of the low income population in the territory and it is applicable to statutory and policy objectives. City includes the following notable difference of Con Ed's territory to others are: 1) HRA is larger and has more resources to utilize; 2) the low income population is far greater than any other territory; 3) HEAP is a small component of City's low income benefit programs, where HEAP may be the primary component in other areas (roughly 35,000 including KEDNY customers are HEAP recipients compared to 750,000 customers receiving non-utility HEAP benefit). City states that the proposal will cause 95% of current HEAP recipients to become ineligible in Con Ed's and KEDNY's low income programs which is counterproductive. City urges the Commission to consider further development to any changes they may see needed to low income programs and not to adopt changes in the Straw Proposal.
- (B) Recommendations from the Low Income Report that need clarification or modification are as follows: 1) City wishes to clarify that the "matching process" being allowed to continue for Con Ed expressed in the report, if a similar process can be adopted for KEDNY as well. Discussions between KEDNY and HRA have developed to set up a similar "matching process" to the one of Con Ed's. 2) City disagrees with Staff that certain low income customers should be excluded or removed from the utility's program if the costs reached the proposed caps; stating it is not in public interest. 3) City disagrees with using HEAP benefit as method for determining tiered levels. 4) City

interpreted a part of the report as allowing the multiple social services programs to be used for existing utility low income program participants, but that prospective participants would be limited to recipients of HEAP utility heating benefits. This was discussed at the Technical Conference where Staff indicated that no such limitations was intended and City is requesting that it be clearly stated to avoid future disputes.

- The use of a generally applicable low income discount is preferable to multi-level discounts. City has the following concerns with use of energy burden and income level in evaluating the appropriate level of discount: 1) constant fluctuations in income levels can lead to too high or too low of a discount provided; 2) lack of customer income knowledge; 3) administratively burdensome and costly. City believes a uniform discount approach would more appropriate, easier to administer and less costly, and still provide a reasonable benefit to the low income population. Also, City states that the percentage of program participants per the HEAP-based approached is flawed and thus does not accurately reflect the proper number of participants for each tier level. City indicates the proposal on the gas side is unfair to participants in that a high usage customer's relative benefit is substantially smaller than the benefit received for a small usage customer.
- To determine a reasonable discount is subjective and is a judgment based on a the following factors: 1) the totality of the public assistance and other benefits available; 2) general income levels and living expenses; 3) program participation levels and costs; 4) utility costs; 5) impacts on other utility customers.
- The program should be reviewed periodically and adjusted based on financial conditions across the State, program size, cost, and any other important factors. To avoid any hearings or litigation, the Commission could establish guidelines (through a collaborative with interested parties) when determining the reasonableness for any discount level adjustments.
- The proposed four-tiered, HEAP- and income-based discount is not reasonable or appropriate. A) The tier levels do not accurately capture customer needs. The use of affordability blocks based on the customer usage and HEAP benefit received is inaccurate in determining income level of a customer. City states that without verifiable customer information, we cannot determine income level based on HEAP amount. City provided different scenarios where the proposed HEAP methodology would not properly

place a customer in the appropriate tier level. City states that the Adders 1 and 2 do not automatically presume that the customer is in greater financial need nor can the utilities determine which Adder the customer has received (1 or 2), since receiving the second Adder relies solely on a vulnerable individual and not the financial need. B) To accurately achieve an income-based customer energy burden, customer income must be verified and not assumed. Due to federal and state laws no social service agency is permitted to disclose any financial information on any of their customers. So for any income based program to exist, administration of the program would have to be handled by the social service agencies or OTDA. City remains open to further discussions and considerations to the current discount construct. City points out that any changes to the low income program must not: 1) harm current participants; 2) not subject customers to inappropriate disclosure of personal information; 3) provide meaningful and reasonable benefits to eligible individuals; 4) and not unduly burden other customers.

- City supports the elimination of reconnection fee waivers. While City acknowledges that the reconnection fee waivers should be in place to help low income customers from the burden of restoration of service costs, in actuality the costs of the waivers are covered by other customers and included in the total low income program budget, which leaves less funds available for the bill discount portion. City in turns supports the proposal of elimination of reconnection fees for low income customers.
- The design of the proposed arrears forgiveness programs should be modified. City supports the arrears forgiveness portion as it is an important step for many low income customers to be relieved of prior debt as they try to work their way out of poverty. City has concerns with the structure of the program as follows: 1) First, City requires more details of the proposed program. The program should be clearly stated with terms defined, nor should it be left to the discretion of the utility, but a decided structure through this proceeding. 2) City's concerns with the tiered system and the issue that the utility does not have verifiable income information on each customer, a "manageable debt" payment should not be constructed based off the customer's tiered level. 3) A customer who is already struggling to pay their bill should not incur another debt charge. 4) City states that the use of an arrears program to "incentivize" low income customers to pay their utility bills in timely and regular manner is misplaced, in that it is not a lack of

motivation, but rather a choice of what can and can't be paid. 5) City is also concerned with the statement in the proposal that over time "the need for arrearage forgiveness will decline" with the reasoning that the proposed program will make bills more affordable. City believes due to the limitations on eligibility and reduction in participation numbers, the amount of arrears could increase for low income customers. Suggestions from City are as follows for the arrears program. City agrees with a set start date to begin measuring the customer's performance and has no objection to November 1 being the start date each year. A customer should remain consistent with paying current bills to remain in the program. A reset button should be allowed each November 1 for those who do not stay current with paying their bills or an alternative method, restart the program on a rolling window once full payment is received. The "manageable debt" payment amount is a key component to making this work. City suggests that this amount should be similar to that which is required under a deferred payment agreement (minimum of $10 which seems reasonable). City disagrees with using the tier level to determine the length of the arrears forgiveness program for each customer. Alternatively, one set length of time could be used (12 or 18 months) or it could be based on whether the customer receive one or two utility services or a third option could be to base the term on amount of arrears owed (example for every $250 or $500 in arrears that equates to a 12 month term added to the total length of the program). City suggest that a collaborative be set up to continue discussions for the arrears forgiveness program.

- Participation in low income programs should not be restricted because of budgetary reasons. City states that the proposed budget limitations and the method included to avoid exceeding the budget limit is against Commission's longstanding commitment to helping low income customers. To address the balancing of program costs issue and to keep it within a ± 10% of the budget, the utility should adjust the per customer credit by up to 50 cents to remain within the 10% band as the Commission had determined in the 2013 Con Ed rate cases. City states it would be unfair to other low income customers who previously received benefits due to growth of other low income programs. To avoid such action, the first option would be to increase funding (but that will add burden to rest of ratepayers) and second option would be to lessen the benefit levels.

NYC – Reply

- New York City's Low Income Program is operating well and should continue. City points out the broad agreement voiced in the previous comments that the programs in Con Ed and KEDNY territories are functioning well and should continue. Also, that KEDNY is developing a similar file matching process with HRA as similar to Con Ed's. City states there was limited support for a uniform program throughout state due to the differences in territories, differences in the cost of services, and for NYC, the reliance on HEAP is far lower than in other territories. City references a request for clarification from Con Ed's comments in which Staff provided recommendation that Con Ed be able to continue its current low income program, but fails to identify which "tier" non-utility HEAP participants would be considered.
- Benefits provided to low income customers must be weighed and balanced against the costs to other customers. City supports a greater benefit to the low income customer population, however some of the proposed funding levels could have detrimental impacts to moderate income customers, those who struggle to pay utility bills but are just above the eligibility requirements. City provides the following factors in determining a balanced approach: consider the needs of the participants, the size of the discount level, the total cost of the program, and ensuing rate impacts on all customers. City believes the proposal does reach a balance and that a collaborative be set up for future analysis/discussions.
- Arrears Forgiveness and Reconnection Fee Waivers are meritorious proposals and should be adopted. City replies to the utilities that argued these programs do not provide meaningful benefits and are administratively burdensome. City disagrees with these views and supports their place within the overall Low Income Program design (subject to modifications previously provided). The arrears forgiveness component provides the customer an opportunity to gain some financial stability by eliminating prior debt.
- City supports the elimination of reconnection fees for low income customers stating that it will provide a better opportunity to remain as customers and to pay their bills. Also, that these customers have already shown their inability to pay their utility bill and adding another cost to what is already owed creates a larger financial barrier for the customer to overcome. In reply to the fees becoming more of burden to the rest of the customer base,

Con Ed's reconnection fee costs in 2014 were less than one percent of the total low income budget.

- HEAP recipients should not be automatically enrolled in a utility budget billing program. City agrees with OTDA's position that HEAP customers should not be automatically enrolled in budget billing and also against automatic enrollment of low income customers into budget billing. They state that the option of choice should remain consistent across all customers.

<u>NY Communities for Change</u>

- Opposes the Staff Proposal since it does not genuinely help all of those in need.
- Members of NY Communities for Change (NYCC) are primarily people of color who advocate in their neighborhoods for better living and working conditions. Many are retired on fixed income or working low-wage professions where the cost of living leaves them unable to afford their energy bills.
- Since the "Great Recession," almost a decade ago now, members continue to feel the impacts through "lost jobs, reduced wages, bankruptcy, evictions, foreclosures, shutoff threats, late charges, utility disconnections, reconnection charges, and other devastating impacts."
- NYCC acknowledges that current energy assistance programs are available, however, they are inadequate in these hard times and that income levels have not kept up with the skyrocketed costs of living for all necessities.
- The program should not restrict eligibility to HEAP. Many of those who are in desperate need of assistance may not receive HEAP grants due to the inadequate funding of the program.
- In addition, NYCC states that with such a diverse population where a number of different languages are spoken, the application process and calculation of their rate reduction would be difficult to understand and therefore, should not tie program eligibility criteria to HEAP recipients.
- NYCC provided guiding principles for program design, which are as follows: 1) percentage discount of energy bill (30% is adequate); 2) State-wide mandatory rate reduction where the Commission reserves the right to increase reductions in areas as the

Commission feels necessary; 3) eligibility should include households up to 175% of FPL and include recipients of Lifeline, HEAP, Medicaid, and other programs including SSI, TANF, and Safety Net Assistance; 4) an equitable way to spread the costs of the program to other customers and customers classes; 5) automatic enrollment of eligible customers and promote fuller participation for energy efficiency, weatherization, and other customer assistance programs.

NYSEG/RG&E

- 1) Some parts of the Straw Proposal are not simple to administer, explain or understand. In particular explaining and administering the program to customers without a defined benefit and difficult for a customer to understand who may lose the benefit without any changes to their financial situation.
- 2) Tier 1 and 2 customers should not lose benefits and bear the costs of providing benefits to tiers 3 and 4.
- 3) Remove tier 4 since bills are paid for by DSS.
- 4) Budget billing should be optional, however, if participating in the arrears forgiveness program budget billing should be required.
- 5) The Company finds the budget cap per customer and energy burden level reasonable, but the Company does have possible future concerns that it will undermine the simplicity and easy to understand goals.
- 6) The Company can successfully provide a bill discount to customers identified through HEAP, within the proposed cap, and will have sufficient dollars to fund the arrears forgiveness program and budget billing forgiveness program, as proposed in their pending rate cases.
- Eligibility and Enrollment – The Company agrees that HEAP be the criteria since it is the same as their current programs. However, Emergency HEAP should also be included, these customers need to be part of the low income program as well. 5,203 and 1,121 customers from NYSEG and RG&E respectively received emergency HEAP and not regular HEAP.
- Benefit Levels/Discount Levels – The Company supports the tier approach in providing benefits, with modifications. 1) Eliminate tier 4 since DSS pays the utility bills for this

customer group. 2) Guaranteed Payment Plans (GPP) should be included as equivalents of direct voucher customers. 3) OTDA should administer the eligibility since they determine the customer who receives regular, emergency, and add-ons for HEAP. OTDA has the most access to information and would most easily provide up to date tiered levels. 4) HEAP eligible customers should remain eligible for low income program regardless of income for the proposed tiered system.

- Budget Billing – The Company supports the measured use of budget billing to control administrative costs, but do not support the requirement as part of the program nor should it constitute a payment cap. Similar to NG's concerns, the Company states that usage beyond the budget bill amount would lead to decreased benefits.
- Program Budget Caps – The Company agrees the budget caps are sufficient and would fully fund their low income programs, which would include their successful and necessary arrears forgiveness program. Also, utilities should be allowed provide a budget forgiveness program as long as it remains under budget cap.
- Arrears Forgiveness – The Company would like to continue its arrears forgiveness program and not create a uniform program due to successful rates in only certain parts of their territory. Company states roughly 70% of customers who complete arrears program are successful in maintaining service without incurring additional arrears for the next 12 months after completion and 50-60% fail to complete program. The Company has determined the primary reason for customer withdrawal is bill variability and the Company has proposed a Bill Balance Forgiveness component in current rate plan to produce levelized bills for these customers. The Company states that their mature arrears programs have long since been factored into uncollectible expense and no adjustments are necessary unless a new arrears program is introduced. The Company opposed the 10% budget cap since a successful arrears program should not warrant an arbitrary cap and could be restrictive of additional program successes. The Company also opposes the tiered level timeframe of arrears forgiveness which they believe undermines the simplicity concept of the program. Company states it would cause confusion as customers move from tier to tier and that a single timeframe of 24 months should in place.

- Reconnection Fee Waivers – The Company states they take exceptional measures to avoid shut offs and are a minimal component in their program. Terminations occur without bias and sometimes are an incentive for customers seek out resources. The Company believes they should be able to recoup the reconnect fees through the low income program.
- Tracking and Metrics – The Company comments that the low income program should be finalized before determining what efficiency tracking measures should be taken. The Company notes their current rate proceedings and changes implemented should align between both proceedings.

<u>NYSERDA – Initial</u>

- Energy efficiency reduces home energy bills -- NYSERDA recommends the Commission require continued utility referrals of low-income customers for energy efficiency services and establish a standardized referral format protocol and procedure. Energy efficiency promotes positive health impacts and a reduction in utility service costs and arrears
- Improvements in utility referral mechanisms can help accelerate the provision of efficiency services to eligible customers while also advancing the policy outcomes stated in this proceeding. NYSERDA recommends a singular approach to referring customers for NYSERDA energy efficiency services, preferably one that uses an electronic transfer of referral information, as a means to accelerate and improve the referral process and contractor work efforts. NYSERDA also recommends a standardized approach to the frequency of providing referrals for planning and project assignment purposes.
- NYSERDA indicates it is important to institute a program that prioritizes energy efficiency services whenever possible to households with the highest consumption. Also, NYSERDA believes that utility bill information for all customers referred for energy efficiency services should be provided in referrals to assist with the prioritization process. If the utilities and NYSERDA are able to better identify and prioritize energy efficiency services to customers with excessive consumption, the realization of significant reductions in both energy burden and arrearages increases may be possible. To facilitate prioritization, a standard set of utility consumption data provided with each referral is essential.

- NYSERDA recognizes the importance of feedback regarding referrals back to the utilities. NYSERDA supports DPS staff position that a stronger and more comprehensive approach to the design and delivery of low-income programs can ensure services are provided to the most vulnerable customers. NYSERDA believes that the referral of low-income customers for energy efficiency services is an integral part of a comprehensive approach to program design and delivery and will contribute to the meeting the objectives set forth in this proceeding to reduce the energy burden for low-income customers.

NYSERDA – Reply

- Repurposing of Clean Energy Funds to Support Low Income Rate Discounts -- In response to AARP's suggestion of the use of Clean Energy Fund or other NYSERDA funded monies: (from CEF proposal) First, NYSERDA believes an effective means of providing long term, sustained bill savings to consumers can come through participation in energy efficiency programs. Second, the implementation of energy efficiency programs provides system benefits, such as avoided distribution system costs, which can result in the moderation of costs to all consumers, regardless of participation in an energy efficiency project. Third, the CEF proposal takes into account the total ratepayer impacts realized by supporting clean energy activities.
- For low-to-moderate income consumers, multiple strategies will be needed to achieve bill relief, and should be pursued simultaneously. Rate discounts may be able to provide more immediate forms of relief, while energy efficiency activities can provide sustained bill reductions, and will reduce, and in some cases eliminate, the need for future rate discounts. NYSERDA recommends that the Commission not adopt the recommendation to repurpose funds that would otherwise support energy efficiency and other clean energy options for LMI consumers and for energy consumers generally.

Nobody Leaves Mid-Hudson

- NLMH expresses the concern that Staff's proposal reflects the voice of utilities and not the voices of people who are actually low income customers. The organization states that it values the comments by Public Utility Law Project (PULP) and AARP immensely, and shares a great deal of their recommendations. However; NLMH contends that it is critical to also consult the communities that will be most impacted and are truly the experts on utility affordability. Further, it states that the best approach would have been to convene stakeholder meetings and done concerted outreach to a diverse set of low income people to gauge their needs, ideas, and vision for statewide affordability. Clearly this did not happen and this lack of front-end input is reflected in Staff's report.

- NLMH states that given this lack of input, the organization and allies in the Energy Democracy Alliance (EDA) attended the July 30th technical conference to ask questions about the proposal, and provide their technical knowledge of the real world impact of low-income programs. NLMH states that they felt that their voices were not welcomed, their knowledge and questions were treated as non- technical and experiences brushed off. NLMH feels that Staff can do better and that the PSC can be a forum for all stakeholders. Further, it contends that its participation can shape this proposal in a more positive direction and is looking forward to collaborating on this.
- NLMH suggests that a good first step is convening public statement hearings throughout the state, starting with Poughkeepsie, Syracuse, Buffalo and Albany. This will serve as an important opportunity for impacted communities to speak and make their concerns a part of the process. Also, it urges Staff to call on each utility to meet with low-income people and organizations in their respective service territories to develop solutions on a local level that take into account local conditions.
- NLMH states that it has a number of concerns with the proposal. One key concern is about the extremely limited eligibility criteria. It states that utility HEAP recipients represent a fraction of the low-income people who actually need assistance. NLMH gave an example of one of its members who did not get HEAP because enrollment had closed out. This member had been unable to leave her home due to serious medical conditions and the fact that her driveway was frozen over. She explained her circumstance, but was unable to get HEAP for the year. NLMH contends that this member would not benefit from the low-income discount as is being proposed now. If affordability is the goal, eligibility needs to be expanded, and the Lifeline criteria recommended by low-income advocates like PULP should be reconsidered.
- NLMH states that when this eligibility concern was raised during the technical conference, Staff's response was that if eligibility is expanded, it will necessarily narrow

benefits because the pool of money is fixed. NLMH notes that it is fixed at less than 1% of utilities' revenues. Moreover, while ratepayers shoulder the burden of financing low-income programs, utilities are making large profits for their investors. It further notes that the current rate structure is regressive, punishing low-income people for whom a basic service charge makes up a larger portion of their bills.

- NLMH argues that if the purpose of this proceeding is to ensure that low-income customers are not overly burdened with their energy bills, it is necessary to expand eligibility. The use of the Lifeline criteria is one way of reaching more of the low-income people, who are currently very burdened with their energy bills. NLMH points out that many in its group have been shut off, have had to choose between heating and eating or buying medicine, and have had to ask family members to make painful sacrifices just to keep the lights and heat on. It contends that more eligibility is needed, not less, and more benefits, not less.
- NLMH states that the consequences for low eligibility and low benefits are immense. Most of its members have had some experience with shutoffs. No matter how hard they try, there simply are not enough jobs and income in the Hudson Valley to pay high utility bills. Hence, shutoffs are the inevitable result. It described how one of its members lived for over a year without power. She faced the stigma of being known as "the lady without light." She worried for her young family's well-being because they were forced to live by candlelight. There are too many people facing this situation, because the system is broken.
- NLMH opines that if we begin with the premise that utility service is a basic necessity for low-income people, efforts will be made to find ways to increase funding. NLMH points out that the proposal flatly states that "No amount of available funding is likely to meet the total needs of all eligible households." It contends that this is a wrong approach. Instead, it emphasizes that we must start with the vision for meeting low-income people's needs, and then find appropriate ways to finance this effort. Further, NLMH states that it firmly believes that it is Staff's job to be actively searching for financing mechanisms, and that it is not impossible to imagine a significant increase in funding for utility assistance, what is currently lacking is the will power and imagination.

- NLMH states that there are many alternatives that would increase available funds and more equitably distribute the burden. It contends that the proposal did not address the idea of an inclining block rate, which would reduce the burden on low-use ratepayers (including many low-income customers). Also, eliminating basic service charges that disproportionately impact low-income, low-use customers would prevent rate hikes at the expense of the most vulnerable. Another missed opportunity for increasing funding is to charge industrial customers who currently pay as much as an individual customer at an amount that reflects their higher usage and profitability. This would raise hundreds of millions of dollars. Finally, NLMH contends that it is an outrage that utilities are making huge returns for their investors while low-income people are being shut off and choosing whether to heat their homes or feed families. It argues that if utilities' return on investment was directly tied to low-income program funding, it is confident that utilities would find plenty of opportunities to invest in low-income programs.
- NLMH states that the proposal does not set a target for reduced shutoffs or reduced arrearage. It wonders how the success of the program could be measured if there no concrete goals on the most basic impacts of the lack of utility affordability. Once again, while Staff notes that this proceeding stems in part from the 277,000 terminations that took place in New York State in 2014, the proposal begins with the idea that large volume shutoffs are a fact of life. Therefore, a substantive examination and standardization of low-income programs would involve a measurable reduction in this devastating reality. It further contends that the proposal would reflect a very different set of interests if it began with the premise that we need to reduce service termination by half, and addressed this goal with eligibility expansion, financing increases, and recommendations for increased consumer protections.
- NLMH states that it found that shutoffs and utility debt disproportionately impact communities of color in Poughkeepsie and probably other parts of the State. It opines that this is likely due to bad housing stock, a history of residential segregation and disinvestment, and the racial dynamics within the utilities. It contends that it is critical to understand racism as another root cause of affordability crisis. This can be done getting utilities to track the demographics of service terminations by tracking shutoffs based on

census block. With better information, interventions can be developed to address the root causes of unaffordable utility bills and move toward great equity.

- NLMH states that whereas, Staff bracketed the question of energy efficiency as a means to achieve affordability, many of its members living without access to energy efficiency or weatherization, energy efficiency is a root cause of unaffordable utility bills. It states that most of its members are faced with living in houses with outdated appliances and poor insulation in Poughkeepsie because the housing stock has suffered from years of racially motivated disinvestment.
- Finally, NLMH urges Staff to adopt a different approach in the development of proposals about low-income programs. NLMH believes that as people who are directly impacted by these programs, they are the experts and have a great deal of knowledge about what these programs look like in real life. It contends that this knowledge base has not been sufficiently tapped within this proceeding. It hopes that this comment, public statement hearings, and innovative forms of consultation can begin to remedy this omission.

<u>OTDA</u>

- OTDA supports the use of a percentage rate discount rather than a multi-tiered, fixed rate approach. OTDA points out that the percentage rate discount can be uniformly applied, is easier to implement, lessens administrative costs, lessens privacy concerns associated with data exchange necessary for programs that rely on individual income analyses of eligible customers , and can be applied on a monthly basis with a computerized billing system programmed with the rate reduction.
- OTDA supports a longer winter moratorium, while at the same time acknowledging that the Staff Report says this issue is outside of the scope of this motion.
- OTDA opposes the Staff Report proposal that would reduce or eliminate low income utility discounts for emergency HEAP recipients as OTDA believes that the proposal is based on the faulty assumptions that emergency HEAP incentivizes customers to fall into crisis, and that emergency HEAP helps reduce energy burdens.
- Lastly, OTDA objects to the Staff Report's proposal to automatically enroll all HEAP clients into budget billing, and points out that automatically enrolling HEAP recipients into budget billing programs, without their consent, would be a violation of the federal

LIHEAP statue and the HEAP utility vendor agreement, which prohibit being adversely treated based upon the receipt of HEAP assistance.

PSEG

- PSEG commented on their low income program which is comprised of a rate discount, a weatherization component, and advocacy and outreach. Household Assistance Rate (HAR), the rate discount program provides eligibility through HEAP and through other assistance programs. HEAP, Temporary Assistance and SSI recipients are automatically enrolled in HAR. Discounts provided totaled over $1 million in 2014.
- Residential Energy Affordability Program (REAP) is PSEG's energy efficiency program. The program provided for 2,474 households resulting in an average of 995 MWH of energy savings and $2.69 million in expenditures. Savings averaged per household at $95 annually. The consumer advocacy and outreach budget was over $580,000 assisting about 2,000 customers in 2014.
- PSEG LI opposes limiting eligibility to HEAP recipients since it would exclude eligible customers who do not receive HEAP benefits for whatever reason. PSEG LI agrees with grandfathering in existing programs where benefits would decrease from the current low income customers. PSEG LI notes the Energy Affordability Proceeding overlaps with their current rate proceeding.

PULP – Initial

- Design of the Affordability Program -- The Commission should endorse and implement a uniform statewide "Affordability Rate" for essential electric and natural gas service for qualified residential customers. Program should emphasize a significant discount on the entire bill and simply offer a modest fixed monthly bill credit that is not related to the customer's actual bill amount. This is the simplest approach because it reflects the current "best practice" program design for some NY utilities and can be implemented directly by the utilities with relatively minor added administrative costs.
- 1) The Staff has recommended a methodology that, to our knowledge, is not being implemented in any other State and pairs artificially narrowed eligibility criteria with reductions in benefits to some existing recipients based upon a calculation that disregards

their eligibility in favor of keeping costs below an artificial ceiling in a given utility's service area. For example, benefits are not individually calculated.

- Staff's program design is not simple to understand. The utilities in the Technical Conference indicated it would be challenging to implement. The dollar amount of assistance is likely to result in questions and concerns from customers that will require the utilities to expend scarce resources to create a bill presentation that would explain.
- 2) The program design would eliminate bill payment assistance for some low income customers who are currently receiving benefits under the current electric and gas programs. Staff's justification is not reasonable since the Staff assumes that the design of the program to achieve a 6% energy burden is not a reflection of each customer's actual usage and income.
- 3) The program design provides a benefit only for the first usage block of the customer's bill and does not, ensure that the total bill is affordable or that the customer's total bill receives needed assistance.
- 4) The program design purports to create a benefit that assures that participating customers will not pay more than 6% of their household income for essential energy services, but Staff's proposal cannot accomplish this since it is based on average income and usage calculations that do not reflect the customer's actual income and usage characteristics.
- PULP recommends the Commission order electric and gas utilities to implement a total bill discount of sufficient amount to deliver significant assistance, similar to that in CA and MA. This significant rate reduction to customers whose need has been demonstrated to other agencies providing assistance is also consistent with the reference in the 2015 State Energy Plan to California's CARE plan.
- PULP does not agree with limiting the rate reduction to only a portion of the customer's bill. PULP continues to recommend a discount program similar to that of CA and MA that results in a practical rate reduction of 25-30% on the total bill.
- PULP will not endorse a program that eliminates benefits from HEAP eligible customers and is not based on an actual customer-specific analysis of affordability—it is additionally unreasonable to assert Staff's proposals are based on a 6% energy burden analysis when this is in fact demonstrably not the case.

- The objective of this reform must be to ensure that customers receive adequate and reasonable benefits that are designed to impact the affordability of the customers' actual electric and gas bill. Staff's proposal does not result in a program that achieves the intent and purposes of a PIPP program. It is not possible to implement a true PIPP type program at this time due to the lack of cooperation and integration of ODTA and other assistance agencies for implementation in the short terms.
- Eligibility for the Affordability Program -- Reduced rates should be available to those with household income at or below 200% of federal poverty level. At a minimum, programs should use the criteria of the NY telephone Lifeline program. The use of 200% of federal poverty criteria for this program as a catch-all income qualifier would mirror the discount program sin MA and CA.
- PULP suggests, at a minimum, adoption of the program eligibility of the Con Ed gas affordability program, although we believe the public interest would best be served by adoption of the enhanced Lifeline criteria set forth above. Not only has Staff failed to include other means-tested financial assistance programs in its recommendations, but the proposal to rely on HEAP eligibility is significantly defective because it does not even include all electric and natural gas customers who receive HEAP benefits. Staff's proposal would only serve those HEAP customers whose benefits were directed to the natural gas or electric utility even though most of the other households that receive HEAP and who are eliminated in the Staff's proposal also have a gas or electric account. Only 25% of NY's current HEAP recipients received a direct utility benefit and that is the only group of customers that Staff recommends this program apply to. More importantly, HEAP is only available during certain months of the year and it may be difficult for a customer to apply for the plethora of programs available. Further, Staff's proposal does not properly include customers whose HEAP benefit is allocated to a utility that is not a combined gas-electric provider. Staff's focus on eligibility criteria that artificially limit enrollment would result in a program that would serve only about 21% of the NYS households truly in need of utility assistance.
- Categorical Eligibility for the Affordability Program -- The Commission should focus on a program that reaches the greatest number of qualified low income customers in the most cost effective manner. Staff's approach appears more concerned about the costs of a

specific program design than with the identification of a robust program that would actually address the need for universal service and affordability.

- While the Staff apparently relies on a proposal from National Grid with regard to using certain HEAP benefits levels to structure its proposed discount program, National Grid's comment also describe fixed discount approaches, referencing the implementation of the MA 25% discount on the total bill, stating that it is "very successful in terms of cost effectiveness and reaches a large number of low income customers."
- The Utility Project recommends that the Commission should strive to require that the mandated program reach all 1.65 million electricity and gas customers (including the separate electric and gas accounts of customers split between two utilities) that are represented by households subject to the eligibility set forth above, and with:
    - -Income less than 200% of the Federal Poverty Level, and who
    - -Spend more than 30% of their income on housing costs, and
    - -Pay at least one utility (electric and/or gas) bills.
- At the very least the Commission should require that the mandated program reach all HEAP customers with an electric or natural gas account and the Commission should seek to obtain the cooperation of other State Agencies through Gubernatorial or legislative action, if needed to develop the automated communication protocols to reach the same customers who are eligible for the Lifeline Program.
- ODTA or DSS can add a statement to their applications that allows the agency to release the customer's eligibility, at a bare minimum, this should be done for HEAP in NY.
- The Utility Project urges the Commission to communicate with the Governor and with State Agencies that implement means-tested financial assistance programs, to gain the authority and expertise to implement an efficient and effective enrollment method that captures more customers than the relatively small group of HEAP customers that is the focus of Staff's recommendations.
- Arrears Management Programs -- We recommend expenses for arrears management programs be evaluated for costs effectiveness and success in furtherance of universal and continued service objectives.
- The Staff's recommendation appears to suggest rigid payback period for a customer's arrears, but does not include any information to determine if those arrears payback

requirements would be reasonable or achievable by the affected customers. A properly designed cost-benefits analysis of such proposed programs could likely find a balance of cost effectiveness, impact upon the revenue requirements(s), impact upon a customer's financial health, and period, and should be conducted in each such rate case where a program is suggested.

- PULP recommends that the Commission follow the arrears management programs initiated by MA or NJ (described in our March comments), and which have been widely viewed as successful by stakeholders in those areas. The customer is enrolled in a robust bill payment assistance program that reduced the total bill amount either through a significant discount or a customer-specific PIPP calculation. The customer is then solicited to participate in a one-time arrears management program that offers significant relief from old arrears balance in return for a modest payment that is designed to be affordable and ensure success.
- Any arrears owed for longer than 60 days that were created by ESCOs that charged in excess of utility rates, or that "slammed" customers, failed to allow them to cancel service, or otherwise engaged in other violations of the uniform business practices or consumer protection law, the Commission could order the IOUs that forgive such debt.
- Social Services Law -- We recommend scrutiny of existing public aid programs for customers who receive shutoff notices or whose service is shut off for bill collection purposes many customers in financial distress need a "one-shot" grant of utility assistance under Social Services Law §131-s to re-stabilize household budgets. This program has become unreasonably restricted. Removing aid restriction would promote continued service, further public health and welfare, and could lessen some burdens now shifted to all utility customers through uncollectible bills and high collection costs.
- PULP strongly advocates the Commission communicate with the Governor and urge the creation of an inter-agency coordinating council whose purpose would be to identify, obtain and apply to this low-income affordability program all available federal, state and private grant monies that could potentially defray at least in part the impact of this program upon the bills of New York's energy ratepayers.
- Reallocation of Rates for the Affordability Program -- We recommended that the Commission direct utilities to file proposals for low income rate reductions meeting

standards prescribed in this case including their formulae for allocating the revenue impacts of the new program in a reasonable and equitable manner. Such proposals might include repurposing of current surcharges, instead of reducing them. Utilities should be required to file plans for affordable rates in their rate proceedings proposing options for new rate designs and reallocation of revenue so as to achieve the affordability objectives in reasonable ways. There may be different solutions proposed by the utilities that make it wiser for them to propose rate design and revenue reallocation solutions than to prescribe a single methodology at this time.

- The Staff fails to recognize or discuss the potential sources of funding other than reallocating the total costs of its proposed program to the bills of other ratepayers, particularly failing to discuss the recommendations of PULP with respect to repurposing existing Clean Energy Funds. PULP also suggests NYPA "stream" low-cost power to the utilities. PULP also suggests the Commission seek support for that program as a line item in the General Fund portion of the Executive Budget at a 2:1 match to funds raised for the ratepayers.
- PULP's proposal to expand the bill discount and eligible customers will cost more than the Staff's proposal. If the Commission is serious about the need to ensure universal service and affordable essential electric and gas service for low income customers, the scope and scale of the current programs must be reformed and significantly increased.
- Furthermore, if the REV initiatives actually do result in opportunities for lower income customer to experience lower electric bills this outcome will ameliorate the costs of the affordability program as well. However, if this well-intended outcome does not occur, i.e. that the costs of the REV initiatives and REV-mandated investments exceed the benefits in the form of lower electricity rate and bill for low income customers, those most likely to suffer with this result should not bear this risk.
- PULP respectfully requests the Commission's endorsement of the program in these Comments, with immediate (if only interim) steps taken to include all HEAP recipients with a gas or electric bill in their names, until a necessary software interface can be implemented that would allow for the expansion of eligibility to include all Lifeline-conferring programs.

- PULP opposes the Staff's proposed method of cost recovery in rates. Staff's proposal would shield larger commercial and industrial customers from an obligation to fairly contribute to any affordability program because of the recommendation that recovery be assigned on a "per customer" basis. Multiplying the per residential customer budget (per Staff's proposal) by each utility's average number of residential customers, then dividing the product by the actual units of energy sold by each utility in 2014 as reported to the Commission and in this manner, without increasing the allocation to residential ratepayers beyond the budget Staff has proposed, $524 million (45%) of the funding for our recommendation for a broad-based affordability program can be achieved (Appendix 5).
- PULP opposes Staff's proposal to use higher prices charged by ESCOs to calculate the appropriate discount for customers enrolled in the affordability program. Such an approach would reward ESCOs for charging higher prices and adversely impact the costs of the program funded by other ratepayers. Rather, we recommend that any discount be based on the applicable default service price for generation supply service.
- We suggest the following phase-in should be considered regarding the rate reduction we have suggested in these Comments
    - In year 1, the residential customers' allocation should be between 60% and 75% of the amount calculated by PULP in Appendix 5
    - In year 1, the commercial and industrial customs' (C+I) allocation should be 60% of the amount calculated by PULP in Appendix 5.
    - In year 2, both the residential and C+I customers' allocation should be at 100% of the amount calculated by PULP in Appendix 5
    - In year 3, the allocation to other funding sources should be added in at 100% of the amount calculated by PULP in Appendix 5
    - For all years of the program, the PSC should calculate the amount of rate reduction to be conferred by multiplying the total amount of rate reduction by the percentage of penetration of the actual number of enrolled eligible households versus the total number of eligible households.
    - We note this phase-in may be modified in our Reply Comments subject to our analysis of the filings of other parties.

- Terminations and Reconnection of Service -- We urge Staff to address the issue that some utilities follow vastly different policies concerning when termination take place and there is an apparent difference in the volume and timing of residential terminations.
- PULP agrees with the concerns identified by the Staff and the recommendations with respect to the need for utilities to focus on reasonable payment plans as opposed to the reliance on issuing a termination notice and threats of termination. PULP urges the Commission to focus on creating performance standards and specific investigations of this matter in future utility rate cases. PULP supports elimination of the reconnection charge for any low income customer participating in these programs.
- In conclusion, before the parties and staff continue on to the next stages of this proceeding, it is worth taking a moment to reflect upon the irony that the program regarded as the State's broadest based and most effective energy assistance program for low and fixed-income households, HEAP, does not reach all those that are eligible, and that Staff's proposed program based upon HEAP, reaches only a 25% subset of those that succeed in obtaining HEAP in some form. That is why we have advocated forcefully in this proceeding for a robust and uniform statewide program with far wider eligibility than that proposed by staff, and with a far higher benefit.
- The barriers cited by the Staff's Report can be overcome with dedicated and high level coordination, similar to the Commission's implementation of the REV proceeding in which Statewide and Gubernatorial initiatives have enabled the proceeding to move at a sped unseen in many years in the PSC's deliberations.

<u>PULP – Reply</u>

- There are three themes with a very strong consensus among the utilities and consumer organizations:
    - The program design does not meet the requirements announced by the Commission itself for such a program
    - the Staff's eligibility criteria are too narrow, resulting in the exclusion of more than 50% of low-income utility customers, which is unacceptable
    - the budget or funding targets are too low.
- Overall, PULP continues to recommend a program design that:

- Reflects a roughly 30% fixed percentage rate reduction the total bill
- Bases the eligibility for the rate reduction on comprehensive eligibility criteria such as those reflected in NYS's Telephone Lifeline Program (as well as the criteria currently reflected in Con Edison's gas low-income program
- Establishes a funding target to recover the revenue foregone from low-income customers that reflects a meaningful and comprehensive program funded by all customer classes in an equitable manner, including contributions from other funding sources
- defers for future consideration certain aspects of the Staff's proposal with respect to arrears management and budget billing.

- Opposition to the Proposed Program Design -- PULP endorses the shared concerns and comments on the Staff's tiered rate-reduction approach (UIU, ODTA, CEC, the City of NY, and Alliance for a Green Economy). PULP endorses various notations made by some utilities, including National Grid, who indicated "certain tier 1 customers would see their benefit reduced to $0," Con Edison, who indicated "electric discounts will be reduced from $9.50 to $7 per month. For O&R, the reduction is even greater." PULP also agrees that, "More than 85% of Con Edison's low income program participants will receive a smaller discount than they currently receive." Further, PULP supports, "The City respectfully submits that Con Edison's program is functioning well, is administratively efficient and streamlined, and reaching most of the low income population in NYC."
- UIU and OTDA also opposed the tiered rate-reduction approach proposed by Staff. OTDA raised important issues about the absence of a relationship between the HEAP benefits level and the applicant's household income, thus rejecting the rationale of Staff's reliance of those benefit levels to assume a certain household income level used to calculate the Staff's fixed bill credit proposal. Many stakeholders supported PULP's recommendation for a broad-based percentage discount program design.
- PULP recommends that the Commission eschew Staff's complicated multi-tiered rate-reduction approach and focus solely upon a percentage discount applied to the total bill.
- The Need for Robust Eligibility Criteria -- There was widespread rejection by the Parties of the relatively small subset of low-income gas and electric customers who would

receive rate and bill reductions under Staff's proposal. PULP continues to recommend that any affordability program rely not only on HEAP benefits (including those who receive any HEAP benefits is the recipient has a gas or electric account and those who obtain HEAP for a non-utility fuel vendor, a "renters benefits," and "emergency" HEAP), but should also include those who are enrolled in comparable means-tested financial assistance programs, such as those reflected in Con Edison's natural gas program and the criteria used for the New York Telephone Lifeline Program. Such eligibility criteria would deepen the pool of eligible customers.

- Lack of Support for Staff's Arrears Management Program Structure -- Although some parties did not comment on the issue of arrears management, as noted above concerning other aspects of the Staff's proposal, there was little support for the Staff's arrears management program, particularly the required payback requirements. While PULP recommended Staff's proposal for arrears management not be adopted, PULP does not recommend that existing arrears management programs should be entirely eliminated at this time. PULP recommends the design of an effective arrears management program requires first the customer is able to afford and pay the "current" bill (the bill with the low-income rate reduction) prior to entering into a negotiation to establish the reasonableness of payment requirements for an arrears balance.
- Consequently, PULP recommends the Commission at this time focus completely on the priority of developing the rate reduction program, and once that has been allowed to run for some years while being studied, the Commission might consider the statewide guidance on arrears management programs.
- Lack of Support for Mandatory Budget Billing -- A number of stakeholders opposed the Staff's requirement that customers participating in the affordability program must enroll in budget billing. PULP agrees.
- Deficiencies in the Rate Design Recommended By Staff for Reallocation of Foregone Revenue from Low Income Customers -- PULP continues its opposition to the unfair cost allocation methodology proposed in the Staff Report. Consumer advocacy organization, including AARP, UIU, CEC, and Alliance for a Green Economy, rejected the Staff's recommendation for the reallocation of the revenue from low-income customer foregone due to the affordability program. Comments include: "…At least $600 million is needed

for the low income program," "Walmart and Chase Manhattan Bank should not pay the same surcharge as a residential customer," "AARP recommends the Commission initially seek other sources of funding, and then if necessary, allocating and recovering any remaining low income program costs on a usage basis to all customer in all customer classes."

- Insufficiency of the Rate Reduction Level and Funding Requirements -- There was a general opposition to the Staff's proposed total rate reduction limit of roughly $179 million for its proposed affordability program.
- Given REV and this proceeding, it is imperative that substantial progress be made to reform and improve the current New York programs in the near term. PULP urges the Commission to first design a robust program, such as the 30% rate-reduction reflected in its Comments. The program must also address affordability as recommended by most stakeholders to include a significant percentage bill reduction applicable to New York gas and electric customers with incomes at or proximate to 200% of poverty level and who has an electric and/or gas account in their name. The reallocation of revenue foregone from low-income customer can be phased in along with its implementation if necessary. PUKP supports seeking funding from reapportioned NYSEDA funds, the General Fund, and to explore other funding options (such as low cost power from NYPA).
- Inappropriate Use of Terminations as a Bill Collection Measure -- PULP urges the Commission to initiate audits or investigations into how utilities might be misusing the termination option for bill collection in the context of pending and future rate cases, as well as affordability burdens exacerbated by collection of higher ESCO charges and late payment charges, which greatly exceed the utilities' allowed returns on equity and cost of debt. At the very least, utilities should be held to a performance standard to prevent over-reliance on this drastic toll that has significant health and safety impacts on residential customers and their families. Innovations that reward utilities that reduce terminations should be expanded.
- PULP agrees that the primary focus of this proceeding should be the development of a robust and well-funded percentage rate-reduction program to ensure that the resulting energy bill is affordable.

- Opposition to Reconnection Fees -- PULP reiterates its long-standing position concerning reconnection fees and the speed with which reconnections should be effected, and agrees with Staff's recommendation to eliminate the reconnection charge for any low-income customer participating in these programs
- Proposals for Increased Integration of Efficiency Measures and DER into the Proposed Low-Income Program -- PULP supports a more robust low-income affordability program and supports the need for coordination with and expansion of existing efficiency programs, including exploring DER programs for customers who are unlikely to respond to market-based incentives. PULP recommends the Commission focus first and foremost on the development of a robust rate reduction program. In a companion proceeding, or after a statewide rate reduction program has been established, then the Commission might turn its attention to the need for further integration and coordination of other programs that might affect the ability of lower-income customers to make timely payment on their gas and electric bills. PULP is concerned the Commission not rely on future undefined and unevaluated programs to "solve" the affordability gap.
- It appears the Staff program design, eligibility criteria, and funding level and methodology have been broadly rejected. There is a consensus that:
    - Staff design does not meet Commission requirements
    - Customer eligibility criteria is too narrow
    - Staff targets for total bill reductions are too low.
- PULP recommends:
    - A roughly 30% fixed percentage rate reduction on the total bill
    - A rate reduction be available based on comprehensive eligibility such as Lifeline as well as criteria in Con Edison's gas low-income program, with the addition of SCRIE and DRIE enrollment as eligibility criteria
    - Funding target reflects a meaningful and comprehensive program funded by all customer classes in an equitable manner, as well as contributions from other funding sources
    - Certain aspects of the Staff's proposal with respect to arrears management and budget billing be deferred for future consideration and not adopted at this time.

- PULP respectfully requests the Commission issue an interlocutory Order: establishing the parties' agreed-upon robust eligibility criteria as a uniform statewide criterion for low income rate reduction programs, thereby allowing New York's eligible energy consumer to begin signing up for such programs, instructing DPS Staff to begin consulting with OTDA to institute data matches similar to those used to verify eligibility for Lifeline; and seeking such additional authority as may be necessary to institute the data match coordination with OTDA necessary for this program.

Roger Colton

- 1) The costs identified in the Staff report appear to be the difference between bills that are rendered at discounted rates and bills that are rendered at the full standard rate. This difference does not necessarily represent the incremental costs of a low-income affordability program. Gross program costs are not the same as incremental program costs.
- The percentage of low-income accounts in arrears far exceeds the incidence of low-income customers in the residential population and the percentage of low-income dollars in arrears exceeds the percentage of low-income accounts in arrears (indicating that not only are disproportionately more low-income accounts in arrears, but also that they are further in arrears).
- If a utility is not collecting its revenue even if in the absence of a low-income program, to recognize that loss of revenue up-front in a discount does not represent a "cost" attributable to the program.
- 2) Staff gives short-shrift to reasons why customers do not participate in HEAP and populations (if any) who are underrepresented in HEAP.
- 3) No one should assert that low income bill affordability should be delivered "no matter the cost." Expanding income eligibility does not necessarily expand the costs of a low-income bill affordability program. Rate affordability assistance should not be provided to someone simply because they are poor, but instead be in recognition of the inability to pay because of an unaffordable burden.

- What should be considered by PSC: There should be a minimum payment, maximum ceilings on benefits, consider whether certain income-eligible customers should be excluded because they receive public benefits designed to pay their home energy bills, such as people who receive utility allowances while residing in public and assisted housing. (For the same reason HEAP benefits should be netted against a low-income customer's bill.)
- 4) Staff conclusion that ratepayer-provided assistance should not be provided to customers whose bills are included in their rent is appropriate.
- 5) Automatic enrollment cannot be limited to HEAP recipients. HEAP is primarily a heating and cooling program. ODTA should be requested to notify electric utilities of HEAP benefits to customers whose benefits do not go to the electric provider.
- 6) Much of what Staff discusses about home energy burdens is appropriate. But I recommend increasing the proposal use 120-130% of the average as "the affordability block of usage," as there are too many legitimate reasons why a customer might consume somewhat "above average." At minimum, the affordability block of usage should be set at the median. Adoption of a maximum benefit ceiling would aid this.
- 7) Staff appropriately recommends the "household energy cost should be adjusted to account for the HEAP payment received by the customer."
- 8) "Automatic enrollment of participants in the utility's budget billing program" is appropriate (to avoid a low income customer having to "make up" funds not billed during non-heating months). But, HEAP payments are not designed with budget billing in mind, and may also result in a low income customer having to "make up" funds not billed. Conclusion is not to avoid budget billing but that it may be more complicated than it would first appear.
- 9) The Staff's proposal that a utility make an annual budget for the low income program and on an annual basis, even if the utility exceeds its annual budget, there would be no change in benefit levels and participation levels would not be capped, is appropriate. But doing this on an annual basis does not take into account various factor that can affect costs. If more people participant in lower income tiers, this will be more expensive. Staff errs in asserting that the only reason program costs would increase is because of increased participation. Certain limits should be placed on the recommendation (if

spending goes over budget) that the utility should adjust its percentage discount in the following year to reduce discounts until program costs fall within the budget limit.

  - An appropriate spending point to implement this would be 10% over budget. A maximum affordability ceiling of 10% is well-founded. Yes, affordability is a range and not a point. This should only occur if the modification results in a minimum change in the % discount, (1 or 2% should be avoided, should only occur in whole percent points, and if a change would result in a modification of the discount of more than 2%, may be appropriate).
  - Discount level modifications should begin with the highest income tier(s) and then go downward as necessary. Modifications should be made first to the highest income levels, then to increasingly lowest income levels only when needed.

- 10) Staff appropriately notes that an arrearage forgiveness program is an essential part of any bill affordability program. However, bad debt is not the only contribution to a utility's revenue requirement that low income arrears cause, a larger contribution involves the contribution that the level of arrears makes to a utility's working capital. The calculation made by staff that "any administration costs of a properly designed arrearage forgiveness program should produce a net savings in reduced collection costs," is somewhat more involved. The positive impact of an arrearages forgiveness program might result from an increase in the effectiveness and/or efficiency of activity rather than in a reduction in collection activity. Utility collection efforts (thus collection costs) might remain the same, but instead generate a greater return on expenditure because arrears forgiveness would put collection efforts into those who can afford to pay their bills, instead of those who cannot.
- 11. Agrees with Staff that there is not a limit on what a customer can owe to participate in the arrears forgiveness program. While it is Staff recommendation to leave each utility the authority to establish its own approach, utilities should be specifically authorized (not required) to split arrears into increments. Ex. $4,000 in arrears could be split into two increments of $2,000, where the second is frozen and subject to a new program once the first one has been retired. Two benefits from this approach: 1) Customers will make a corresponding larger contribution, over time, toward retiring those arrears since more

months will be required to complete forgiveness plan; 2) Prevents utility arrearage forgiveness budget from being swamped with large unpaid balances.

- 12. The 10% budget limit for an arrearage forgiveness program is likely to be insufficient to address the needs. A chart provided shows from various Pennsylvania Customer Assistance Program (CAP) budgets, a small percent in the last 5 years of 16 companies fall within the proposed 10% budget limit. Similar chart for Maryland Electric Universal Service Program would likely indicate the same result.
- 13. Staff's proposal to adopt a "sliding scale" forgiveness program has merit and should be approved (well suited to meet financial and programmatic objectives). Commenter agrees that only if customer pays bills, then should arrears be forgiven. However, a timeliness requirement in addition to requirement of current bills be paid in full should not be adopted. Arrears credits should be earned as bills are paid over time. The reasoning is that the utility has done their part in providing an affordable bill and it is now the customers turn to do their part in paying that bill. The consequence of the customer failing their part is not a loss of arrears credits, but rather they are placed into the collection cycle, the same as any other customer with an affordable bill.
- From a policy perspective, overlapping layers of "incentives" clouds the fundamental underlying proposition that in recognition of unaffordable burden posed by utility bills at standard rates, the low income customer is allowed to take service under the low-income program. It is then the customer's responsibility to make full and timely payments irrespective of any further "incentive"
- In addition not to impose timely payments for an arrearage program, it is provided from both the New Jersey and Pennsylvania programs, that it is reasonable to expect 90% of bills paid over annual basis in which an occasional bill may be missed or partially paid, however made up the following month.

<u>Senator Kevin S. Parker, 21st District</u>

- We respectfully request the Commission take the opportunity of this proceeding to mandate a statewide affordable energy rate that will apply to every energy utility.
- NY has some of the highest energy prices in the US.
- Existing low income programs are insufficient in light of the Great Recession.

- Affordable energy services for low/moderate/fixed income residential New Yorkers is in the critical public interest and a matter of grave concern that must be addressed without delay.
- The rate should be a percentage reduction of low-income customer's utility bill
- Rate should be mandatory and statewide, uniform percentage, provided the Commission may order areas of extreme average cold or heat conditions can receive high discounts when appropriate.
- Eligibility criteria should include households up to 175% of federal poverty guidelines and should include receipt of Lifeline, HEAP, Medicaid, and other assistance including SSI, TANF, SNAP, and Safety Net Assistance
- Cost should be equitably spread to other customers and customer classes
- To extent possible, utilities should have automatic enrollment and promote programs for energy efficiency, weatherization, and other customer assistance programs
- Commission policy should be to act to avert termination of water or heating.
- Providing a robust low income rate that will ensure that low/moderate/fixed income New Yorkers are neither excluded from the benefits of a 21st century energy grid nor forced to pay a grossly disproportionate percentage of their incomes on energy.

Senator Robert G. Ortt, 62nd District

- Senator Ortt supports the concept of creating a program that helps make utility rates more affordable for low income individuals, as well as, for all individuals. However, he questions the logic behinds placing additional fees on ratepayers to fund the program.
- New York needs to do more to lower energy costs overall, specifically eradicating the 18-a assessments that all ratepayers are forced to pay.
- Western New York is currently experiencing lower energy costs due to passing programs that involve renewable energy (net metering, solar power tax credits, and hopefully in near future geothermal energy tax credit programs).
- The $20 and $35 electric and gas customer charges are high monthly surcharges.

Sierra Club

- This program should be available to all low income citizens of NY at a reasonable threshold of family income. Current inequities based on where a family lives must be resolved. For example, automatic enrollment would ensure that all households under 60% of the state's median income are able to receive utility benefits.
- Program should be adequately funded
- Lower utility bills through winterizations, low cost renewable energy, and home repairs.
- A small fee/percentage on energy bills is fine, but larger entities should be charged more appropriately.
- There should be more research into forgiveness of arrears and proposals made to adjust to a range of circumstances including possibility of debt forgiveness.
- No terminations during cold periods
- There should be an evaluation process in place to determine how this program works, does it meet the needs of customers, are there ways to cut costs.

Solix

- Solix identities itself as a third-party administrator of a range of complex programs, with expertise in complex regulatory program management, eligibility determination, customer care, and program compliance. Solix states it supports the PSC's and Staff's desire to 'balance the interests of participants and non-participants' and to 'maximize benefits and minimize costs'.

o Solix states that a potential approach to take in this proceeding is a centralized system that utilizes uniform eligibility criteria and to the extent possible, automated system solutions for secure eligibility processing and data management. Solix points out that following along this line of thinking, a third-party administrator may be a useful solution. Solix says that an experienced third-party administrator could serve as a partner to the NYS PSC and participating utilities; providing a common operating platform while maintaining flexible program options that can be individualized to each utility and the local community it serves. Solix states that this unified but flexible model would help to ensure that limited funding reaches those most in need while providing consistent decisions and program effectiveness monitoring. Solix states that a third-party administrator can effectively interact with both service providers and subscribers, and is able to provide comprehensive support.

- Solix presents an examination of the LITE-UP Texas program, (referenced in the Staff Report) in order to provide additional details about a current working model. Solix has served as the Texas Low Income Discount Administrator (LIDA) since 2004. Solix discusses Texas's use of a coordinated enrollment process which utilizes a monthly data file e provide by the Texas Health and Human Services Commission. Solix postulates that coordinated enrollment at the state level drives efficiency.

UIU

- The DPS Straw Proposal is under-inclusive because it fails to enroll over half of NYS low income customers (limitation to HEAP recipients). The overarching issue for resolution for the low-income program is enrollment of all eligible customers. UIU recommends a two-phased approach:
  - 1) multi-faceted enrollment, Lifeline eligibility criteria, automated enrollment would expand to include Lifeline customers. The discount during this phase would be based on a uniform broad-based discount.
  - 2) Developing a more sophisticated system to achieve a targeted energy burden for all eligible customers (targeted 6% energy burden).
- Statistics from the Instituting Order indicate a number of customers not receiving a low income discount are struggling to pay the bills as well, perhaps attributable to their preclusion from receiving the discount. Expanding the program to enroll all eligible customers would decrease the amount in arrears, uncollectible accounts, and terminations.
- The initial administrative burden of identifying and including all eligible low income consumers in the utility discount program would be temporary at most. A low income discount with increased administrative costs may also produce offsetting benefits by resulting in 1) fewer terminations, 2) fewer arrears balances, 3) fewer collection and other administrative costs, 4) fewer reconnection fees, 5) less bad debt, 6) increased low-income customer revenue, and 7) increased health and social benefits resulting from energy security. However, even if a net administrative burden is anticipated, this cannot

allow qualifying New York households to receive no discount, while similarly-situated low income counterparts receive a full one.

- DPS' Straw Proposal's statement that "customers seeking a utility HEAP benefit self-select into a program that provides utility bill assistance, demonstrating a relatively stronger need for the utility low income program," is not supported. The bulk of HEAP recipients are automatically enrolled by OTDA when approved for other programs. Also some people may not be able to apply for HEAP during the application process for various reasons. Further, two-thirds of HEAP-eligible rate payers do not receive a HEAP grant due to a deficit in funding.
- Ideally, New York's utility affordability program would feature 1) Lifeline eligibility criteria applied to all gas and electric utility low income discount programs, 2) automated enrollment through matching or other computer software technique, and 3) each customer's discount based upon that customer's family income so as to achieve the targeted 6% energy burden.
- Phase 1 (steps occurring concurrently or consecutively):
- 1) Issue an order to update tariffs to prohibit the assessment of reconnection fees on low income program participants and eligibility will be set to include Lifeline program criteria
- 2) Continue discussions of determining the actual percentage fixed discount based upon each utility's average heat and non-heat residential bills, to be reset annually, and the other recommendation of the DPS Straw Proposal regarding arrears forgiveness and budget billing as well as UIU's interest in improving coordination among utility low income programs and New York's energy efficiency and weatherization programs to make better use of available resources so as to reduce the size of waiting lists.
- 3) Utilities work with DPS Staff, OTDA, UIU and other interested parties to develop a standard utility low income application form (including language allowing applicants to agreeing to their utility learning or verifying their income).
- 4) Utilities work with DPS Staff, OTDA, UIU and other interested parties to develop a statewide public outreach campaign.

- 5) Con Edison, NYC's Human Resources Agency and Westchester Country's DSS continue their semi-annual matching of customer names with people receiving benefits, including criteria not currently included for electricity discount.
- 6) KEDNY and KEDLI work with NYC HRA to institute semi-annual matching. PSEG-LI works with OTDA to institute automatic enrollment of HEAP recipients and other eligible programs.
- 7) Utilities sign MOUs with OTDA/OITS to gain limited access to the state-wide database to confirm low income program applicants' eligibility, such as telephone companies with Lifeline.
- 8) OTDA/OITS make software adjustments to accommodate gas and electric utility access to the state-wide database for the limited purpose to verify eligibility for low income discounts.
- 9) State agencies complete revision of common application form used to apply for a variety of social service programs other than HEAP to include language allowing people to share their status as a recipient of a benefits such as SNAP or SSI and income with their utility.
- Phase 2:
- Develop processes for more sophisticated low income certification and discount for a targeted energy burden. Lifeline customers would be automatically enrolled in utility low income programs. Through software, utilities would learn the income of eligible customers so discounts can be fit to the customer.
- Cooperation between all state agencies that operate low income programs is key, including establishing an Energy Affordability Intergovernmental Task Force (senior management from DPS, HCR, NYSERDA, LIPA, NYPA, State Office for Aging, DOS, and other state entities addressing low income customers and affordable energy).
- With inter-governmental coordination, UIU believes New York can ensure that all ratepayers with family incomes at or below 60% of SMI have the opportunity to participate in utility low income programs designed to achieve an energy burden not greater than 6% through implementation of elements of the Con Edison low income discount program and the lifeline telephone models.

- The Commission must take concrete steps towards enhanced utility evaluation protocols, more rigorous data collection methods, and consistently monitor implementation of the low income program by utilities and all relevant data that may bear upon its success.

<u>Various Individual Comments</u>

- More than 70 public comments were received from individuals who are not affiliated with any organization or group.
- Some were opposed to low income program expansion, which they believe which unfairly adds to the burden of ratepayers who keep up with their obligations; and that there is no incentive for recipients to conserve and to meet the financial obligations.
- Most; however, were supportive of the program, and its expansion. Many were low income utility customers, who described the difficulties they have faced maintaining utility service, and the need to improve energy affordability for the poorest customers.

BENEFIT LEVELS
(all values rounded to nearest whole dollar)

Central Hudson								
Income Level	Electric Heating		Electric Non-Heat		Gas Heating		Gas Non-Heat	
	Current	Revised	Current	Revised	Current	Revised	Current	Revised
Tier 1	$18	$23	$6	$23	$18	$34	$6	$3
Tier 2	$18	$39	$6	$39	$18	$50	$6	$3
Tier 3	$18	$72	$6	$56	$18	$67	$6	$3
Tier 4	$18	$0	$6	$0	$18	$0	$6	$0

Con Edison								
Income Level	Electric Heating		Electric Non-Heat		Gas Heating*		Gas Non-Heat	
	Current	Revised	Current	Revised	Current	Revised	Current	Revised
Tier 1	$10	$10	$10	$10	$50	$50	$2	$3
Tier 2	$10	$10	$10	$10	$50	$50	$2	$3
Tier 3	$10	$22	$10	$14	$50	$50	$2	$3
Tier 4	$10	$0	$10	$0	$50	$0	$2	$0

New York State Electric and Gas								
Income Level	Electric Heating		Electric Non-Heat		Gas Heating		Gas Non-Heat	
	Current	Revised	Current	Revised	Current	Revised	Current	Revised
Tier 1	$19	$3	$10	$3	$13	$3	$7	$3
Tier 2	$19	$11	$10	$11	$13	$18	$7	$3
Tier 3	$19	$28	$10	$28	$13	$34	$7	$3
Tier 4	$19	$0	$10	$0	$13	$0	$7	$0

Niagara Mohawk								
Income Level	Electric Heating		Electric Non-Heat		Gas Heating		Gas Non-Heat	
	Current	Revised	Current	Revised	Current	Revised	Current	Revised
Tier 1	$15	$11	$5	$11	$11	$3	$11	$3
Tier 2	$15	$27	$5	$27	$11	$16	$11	$3
Tier 3	$15	$44	$5	$44	$11	$33	$11	$3
Tier 4	$15	$0	$5	$0	$11	$0	$11	$0

Orange and Rockland								
Income Level	Electric Heating		Electric Non-Heat		Gas Heating		Gas Non-Heat	
	Current	Revised	Current	Revised	Current	Revised	Current	Revised
Tier 1	$27	$56	$18	$56	$17	$35	$6	$3
Tier 2	$27	$72	$18	$72	$17	$51	$6	$3
Tier 3	$27	$91	$18	$88	$17	$68	$6	$3
Tier 4	$27	$0	$18	$0	$17	$0	$6	$0

Rochester Gas and Electric								
Income Level	Electric Heating		Electric Non-Heat		Gas Heating		Gas Non-Heat	
	Current	Revised	Current	Revised	Current	Revised	Current	Revised
Tier 1	$24	$3	$5	$3	$6	$3	$2	$3
Tier 2	$24	$9	$5	$9	$6	$13	$2	$3
Tier 3	$24	$26	$5	$26	$6	$30	$2	$3
Tier 4	$24	$0	$5	$0	$6	$0	$2	$0

Keyspan Long Island								
Income Level	Electric Heating		Electric Non-Heat		Gas Heating		Gas Non-Heat	
	Current	Revised	Current	Revised	Current	Revised	Current	Revised
Tier 1					$18	$41	$4	$3
Tier 2					$18	$57	$4	$3
Tier 3					$18	$74	$4	$3
Tier 4					$18	$0	$4	$0

National Grid NY Gas								
Income Level	Electric Heating		Electric Non-Heat		Gas Heating*		Gas Non-Heat	
	Current	Revised	Current	Revised	Current	Revised	Current	Revised
Tier 1					$17	$17	$3	$3
Tier 2					$17	$17	$3	$3
Tier 3					$17	$30	$3	$3
Tier 4					$17	$0	$3	$0

National Fuel Gas								
Income Level	Electric Heating		Electric Non-Heat		Gas Heating		Gas Non-Heat	
	Current	Revised	Current	Revised	Current	Revised	Current	Revised
Tier 1					$5	$3	$5	$3
Tier 2					$5	$12	$5	$3
Tier 3					$5	$31	$5	$3
Tier 4					$5	$0	$5	$0

***Note: Con Edison Gas and National Grid NY heating discounts include estimated values for volumetric component of discount.**

Low Income Program Budget Summary

	Energy Burden		Current Budget	New Budget	Budget Increase	Percent of Total Revenues	Typical Average Res. Bill Impact	Typical Monthly Res. Bill Increase
Central Hudson	6.00%	Electric	$2,895,000	$8,915,946	207.98%	1.14%	0.99%	$1.12
		Gas	$1,345,000	$3,209,619	138.63%	1.56%	1.36%	$1.31
		Total	$4,240,000	$12,125,565	185.98%	1.22%		
Con Edison	6.00%	Electric	$48,500,000	$57,634,618	18.83%	0.52%	0.10%	$0.17
		Gas	$10,900,000	$11,892,792	9.11%	0.58%	0.05%	$0.06
		Total	$59,400,000	$69,527,410	17.05%	0.53%		
NYSEG	6.00%	Electric	$9,368,425	$13,292,596	41.89%	0.77%	0.28%	$0.23
		Gas	$2,961,097	$6,903,243	133.13%	1.34%	1.18%	$0.88
		Total	$12,329,522	$20,195,839	63.80%	0.90%		
NiMo	6.00%	Electric	$11,850,000	$53,672,258	352.93%	1.40%	1.78%	$1.41
		Gas	$8,345,000	$12,569,997	50.63%	1.35%	0.80%	$0.54
		Total	$20,195,000	$66,242,256	228.01%	1.39%		
O&R	6.00%	Electric	$2,600,000	$14,834,220	470.55%	1.96%	1.94%	$2.65
		Gas	$1,900,000	$5,461,920	187.47%	1.84%	1.71%	$1.78
		Total	$4,500,000	$20,296,140	351.03%	1.93%		
RG&E	6.00%	Electric	$4,179,916	$7,143,587	70.90%	0.86%	0.39%	$0.34
		Gas	$2,724,619	$5,152,757	89.12%	1.17%	0.82%	$0.57
		Total	$6,904,535	$12,296,344	78.09%	0.97%		
BUG	6.00%	Gas	$10,400,000	$23,580,580	126.74%	1.48%	0.75%	$0.73
KEDLI	6.00%	Gas	$4,800,000	$7,297,920	52.04%	0.65%	0.21%	$0.23
NFG	6.82%	Gas	$9,700,000	$16,165,185	66.65%	1.95%	1.17%	$0.84
TOTAL/Average		Electric	$79,393,341	$155,493,224	95.85%	1.16%	0.91%	$0.99
		Gas	$53,075,716	$92,234,014	73.78%	1.33%	0.89%	$0.77
		Total	$132,469,057	$247,727,238	87.01%	1.23%		

QUARTERLY LOW INCOME REPORT

[Company Name]

LOW INCOME PROGRAM

QUARTER ENDING: 3/31/2016

ITEM DESCRIPTION	CUSTOMERS		
	Electric-only	Gas-only	Combination
1a. Rate discount participants -Total			
1b. Tier 1			
1b. Tier 2			
1c. Tier 3			
1d. Tier 4			
1e. New enrollments			
1f. Exited customers			
2a. Arrears forgiveness participants - Total			
2b. New enrollments			
2c. Exited customers			
2d. Completed			
2e. Defaulted			
2f. Cancelled (customer request)			
2g. Other			
4a. Energy efficiency program participant referrals - Total			
4b. EmPower-NY			
4c. Other			
3. Participant reconnnection fees waived - Total			

	DOLLARS	
	Electric	Gas
5a. Rate discounts - Amount expended		
5b. Over/undercollection		
6a. Arrears forgiveness - Amount expended		
6b. Over/undercollection		
7a. Reconnection fee waivers - Total		
7b. Remaining balance		
8. Average bill - Heating		
9. Average bill - Non-heating		
10a. Total Over/Under Collection		
10b. Regulatory Asset/(Liability) Balance-End of Qua		

	COLLECTION DATA	
	Customers	Dollars
11. Participant Arrears - Total		
12. Termination notices sent to participants		
13a. Participants terminated		
13b. Heat-related		
14a. Participants reconnected		
14b. Due to HEAP/DSS		
14c. Due to DPA		
15a. Active Participant DPAs - beginning of period		
15b. DPAs made		
15c. DPAs reinstated		
15d. DPAs defaulted		
15e. DPAs satisfied		
15f. Active Participant DPAs - End of Period		
15g. Participant DPAs in Arrears >60 days		
16. Participant Uncollectibles		
17. Budget Billing Participants		
17a. Credit Reconciliations (overcollection)		
17b. Debit Reconciliations (undercollection)		

Commissioner Diane X. Burman, dissenting:

As reflected in my comments made at the May 19, 2016 session, I dissent on this item.

SOULARDARITY
Organizing for Infrastructure in Highland Park, MI

Comments on MPSC Case No. U-18418 regarding Stakeholder Engagement in the Integrated Resource Planning Process
Submitted Friday October 20th 2017

We, the undersigned, support the comments of the Sierra Club, Earthjustice, Union of Concerned Scientists, Natural Resources Defense Council, Ecology Center, 5Lakes Energy, Environmental Law and Policy Center, EcoWorks, National Housing Trust, Midwest Energy Efficiency Alliance, and NAACP in MPSC Case No. U-18418 regarding the proposed Integrated Resource Planning process. While we support the comment submitted thus far, we believe that more concrete recommendations regarding stakeholder engagement are required.

Soulardarity believes in energy democracy, the concept that people impacted by energy decisions should have a seat at the table in making them. Unfortunately, the history of energy decisions in Michigan epitomizes the well-known saying in our communities: if you aren't at the table, you're on the menu. It has been routinely proven that a combination of efficiency, energy storage, and distributed clean energy would provide more affordable and safe power, but the executives and shareholders who benefit from dirty energy continue to lobby for gas as a primary source of energy generation and to limit public input on these decisions. Meanwhile, Michigan communities struggling with energy poverty, the health impacts of pollution, and diminishing economic opportunity are kept in the dark and out of the conversation.

A dedicated transition to distributed clean energy and efficiency can improve grid reliability, community economic development, and reduce energy costs while creating sustainable employment for Michigan citizens. Without robust stakeholder engagement, we can expect an IRP process that will not take our communities into account. To reach a better future, Michigan citizens - and especially the environmental justice communities most harmed by the current energy system - need the opportunity to advocate for the energy future that we want.

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SOULARDARITY
Organizing for Infrastructure in Highland Park, MI

We believe that an Integrated Resource Planning process must involve robust stakeholder engagement, and that the comments thus far submitted do not go far enough in naming the specific ways this can be achieved. A strong stakeholder engagement process should:

- Have specific focus on demographics most impacted by energy decisions - particularly low-income communities, communities of color impacted by environmental racism, rural communities harmed by resource extraction and energy poverty, and other impacted communities.
- Provide education to stakeholders to understand how the IRP process works and how to make impactful comment by working through community organizations that work directly with impacted communities to ensure culturally appropriate and effective engagement.
- Provide multiple venues, times, and formats for engagement. Multiple sessions should be held directly in impacted communities and intended to reach working people, single parents, and others with high demands on their time and capacity.
- Be accessible. Translation services should be available based on community language needs, location should be easily accessible by public transportation, location should be vetted for disability access, and child care should be provided.
- Ensure that the input from these sessions is directly conveyed to the commission, rather than being synthesized by the utilities.
- Set goals for stakeholder engagement based upon actual participation, rather than just the opportunities provided for it.
- Clearly articulate how stakeholder input will impact the process and set binding requirements around that impact.
- Be ongoing. Communities should have multiple opportunities for input throughout the process, providing feedback and guidance as the IRP evolves.

We implore you to design an engagement process that gives Michigan people the opportunity to work together towards a better energy future.

Signed,

Jackson Koeppel, Executive Director
On Behalf Of Soulardarity

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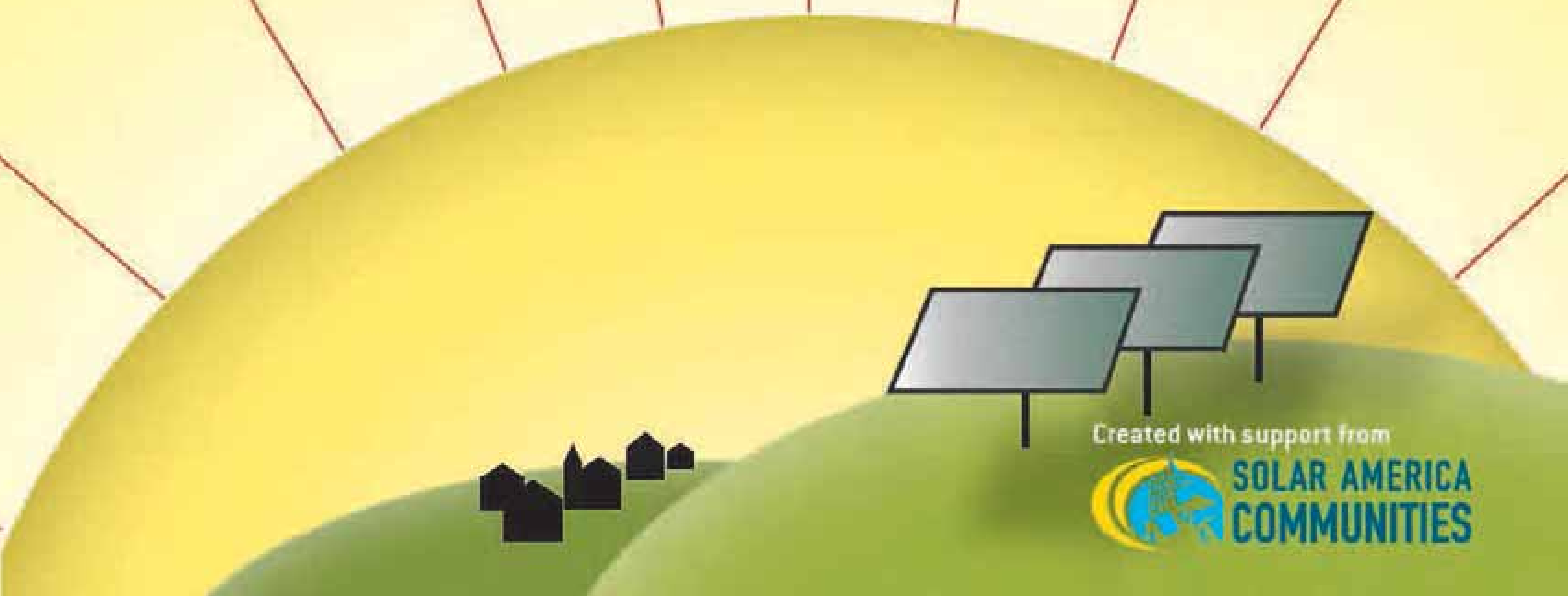
U.S. DEPARTMENT OF
ENERGY
Energy Efficiency &
Renewable Energy

A Guide to Community Solar:

Utility, Private, and Non-profit Project Development



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IREC Interstate Renewable Energy Council

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TABLE OF CONTENTS

Introduction

PURPOSE

In communities across the United States, people are seeking alternatives to conventional energy sources. Whether they aim to increase energy independence, hedge against rising fuel costs, cut carbon emissions, or provide local jobs, they are looking to community-scale renewable energy projects for solutions. Advances in solar technology, an increase in federal and state tax incentives, and creative new financing models have made solar projects including community solar projects, more financially feasible.

This guide is designed as a resource for those who want to develop community solar projects, from community organizers or solar energy advocates to government officials or utility managers. By exploring the range of incentives and policies while providing examples of operational community solar projects, this guide will help communities to plan and implement successful local energy projects. In addition, by highlighting some of the policy best practices, this guide suggests changes in the regulatory landscape that could significantly boost community solar installations across the country.

HOW TO USE THIS GUIDE

The information in this guide is organized around three sponsorship models: utility-sponsored projects, projects sponsored by special purpose entities – businesses formed for the purpose of producing community solar power, and non-profit sponsored projects. The guide addresses issues common to all project models, as well as issues unique to each model.

The guide begins with examples of the three project sponsorship models, discussing the legal and financial implications of each model. This is followed by a discussion of some state policies that encourage community solar – ways for multiple individuals to share in the benefits of a single solar installation. The guide then reviews some of the tax and financing issues that impact community solar projects. While the guide cannot offer legal or tax advice, the authors hope to provide an outline of the legal hurdles and pitfalls that every project organizer should consider. Finally, the "Getting Started" section provides readers with practical tools and tips for planning their own project. The Appendices provide a more detailed comparison of business structures suitable for special purpose entities pursuing solar projects and the Interstate Renewable Energy Council's Model Community Renewables Program Rules.

This guide cannot possibly describe all available incentives or cite all the examples of community solar efforts nationwide. To track the most recent developments, we refer the reader to resources in Section 7.

WHY "COMMUNITY" SOLAR?

For the purpose of this guide, Community Solar is defined as a solar-electric system that, through a voluntary program, provides power and/or financial benefit to, or is owned by, multiple community members. Community Solar advocates are driven by the recognition that the on-site solar market comprises only one part of the total market for solar energy. A 2008 study by the National Renewable Energy Laboratory found that only 22 to 27% of residential rooftop area is suitable for hosting an on-site photovoltaic (PV) system after adjusting for structural, shading, or ownership issues.[i] Clearly, community options are needed to expand access to solar power for renters, those with shaded roofs, and those who choose not to install a residential system on their home for financial or other reasons. Fairness also supports expanding programs in ways that increase options for participation. As a group, ratepayers and/or taxpayers fund solar incentive programs. Accordingly, as a matter of equity, solar energy programs should be designed in a manner that allows all contributors to participate.

This guide focuses on projects designed to increase access to solar energy and to reduce up-front costs for participants. The secondary goals met by many Community Solar projects include:

- Improved economies of scale
- Optimal project siting
- Increased public understanding of solar energy
- Generation of local jobs
- Opportunity to test new models of marketing, project financing and service delivery

Creative mechanisms to foster greater deployment of solar energy projects are not limited to those described in this guide. Readers may be interested in investigating the following efforts that employ some elements of community solar:

- Bulk purchasing efforts in Portland, OR (Solarize Portland!) and nationwide (1BOG)
- Solar services co-ops such as Cooperative Community Energy, CA
- Utility-owned distributed generation on customer rooftops, such as the Arizona Public Service Community Power Project

DEFINITION OF KEY TERMS

The following terms are defined in the context of community solar.

Renewable Energy Credits (RECs, carbon offsets, or green tags): A renewable energy facility produces two distinct products. The first is electricity. The second is the package of environmental benefits resulting from not generating the same electricity– and emissions –from a conventional gas or coal-fired power plant. These environmental benefits can be packaged into a REC and sold separately from the electrical power. A REC represents the collective environmental benefits, such as avoided mercury, CO_2 and other environmentally harmful pollutants, as a result of generating one megawatt-hour (MWh) of renewable energy.

In most cases, RECs are sold on a per MWh basis. However, some project organizers choose to sell all future rights to RECs up front, on a per installed watt basis, effectively capturing an installation rebate and forgoing any future revenue from REC sales.

Net metering: Most on-site renewable energy systems use net metering to account for the value of the electricity produced when production is greater than demand. Net-metering allows customers to bank this excess electric generation on the grid, usually in the form of kilowatt-hour (kWh) credits that can be used as needed during a given period. Essentially, whenever the customer's system is producing more energy than the customer is consuming, the excess energy flows to the grid and the customer's meter runs backwards. Because this "netting of energy" results in the customer purchasing fewer kWhs from the utility, the electricity produced from the renewable energy system can be valued at the retail price of power. Most utilities have a size limit for net metering. Community Solar project organizers should be sure to check before assuming participants in a community solar system can net-meter. It may be that some alternative arrangement, such as group billing or joint ownership, is used to account for the value of the electricity produced by a community solar project.

Tax appetite: Individuals and businesses can reduce the amount of taxes owed by using tax credits. For a tax credit to have any value, though, the individual or business must actually owe taxes. If they are tax-exempt or merely lacking sufficient income to need tax relief, the tax credits have no value. Individuals or businesses that can use tax credits to reduce the amount they owe in taxes are said to have a "tax appetite." For example, public and non-profit organizations are tax-exempt and therefore do not have a tax appetite. In addition, tax-paying entities might be eligible to use tax-based incentives, but have insufficient tax appetite to make full use of them.

Investment Tax Credit (ITC): Section 48 of the Internal Revenue Code defines the federal ITC. The ITC allows commercial, industrial, and utility owners of photovoltaic (PV) systems to take a one-time tax credit equivalent to 30% of qualified installed costs. There is also a federal residential renewable energy tax credit (Internal Revenue Code Section 25D) but the residential tax credit requires that the PV system be installed on a home the taxpayer owns and uses as a residence, thus it would rarely, if ever, be applicable to community solar projects.

Power purchase agreement (PPA): A PPA is an agreement between a wholesale energy producer and a utility under which the utility agrees to purchase power. The PPA includes details such as the rates paid for electricity and the time period during which it will be purchased. Sometimes, the term PPA or "3rd Party PPA" is used to describe the agreement between the system owner and the on-site system host, under which the host purchases power from the system. This arrangement is not explicitly allowed in all states; in some states it may subject the system owner to regulation as a utility. To avoid confusion, in this guide, a PPA refers only to an agreement by a utility to purchase power from the solar system owner.

Solar services agreement (SSA): A solar services agreement is an agreement between the system owner and the system site host, for the provision of solar power and associated services. The system owner designs, installs, and maintains the system (a set of solar services) and signs an agreement with the host to continue to provide maintenance and solar power. The agreement is sometimes referred to as a PPA, but in this guide, we use the term SSA to indicate that the agreement between the system owner and the system site host is more than a power purchase: it is an agreement that the system owner will provide specific services to ensure continued solar power.

Securities: A security is an investment instrument issued by a corporation, government, or other organization that offers evidence of debt or equity. Any transaction that involves an investment of money in an enterprise, with an expectation of profits to be earned through the efforts of someone other than the investor, is a transaction involving a security. Community solar organizers must take care to comply with both state and federal securities regulations, and preferably, to steer clear of inadvertently offering a security. (Further information on securities is provided in Section 4, Tax Policies and Incentives.)

United Power's Sol Partners Installation, Colorado

Community Solar Project Models

People have many reasons for organizing or participating in a community solar project. Just as their motives vary, so do the possible project models, each with a unique set of costs, benefits, responsibilities, and rewards. This section reviews several project models:

- **Utility-Sponsored Model**, in which a utility owns or operates a project that is open to voluntary ratepayer participation.
- **Special Purpose Entity (SPE) Model**, in which individual investors join in a business enterprise to develop a community solar project.
- **Non-Profit "Buy a Brick" Model,** in which donors contribute to a community installation owned by a charitable non-profit corporation.

The authors of this guide hope to illustrate the pros and cons of different sponsorship models, as well as the variations within project models, so that project planners can select the model and variations that best suit their situation and goals. Before selecting a project model, every planner should consider the following issues:

Allocation of Costs and Benefits. Who will pay to plan, construct, and operate the solar system? Who will have rights to benefits, including the electricity produced, RECs, revenue from electricity sales, tax benefits, other incentives, and ownership of the project's assets (such as the solar system itself)? A table at the end of this section summarizes the options for allocating benefits within the structure of each sponsorship model.

Financial and Tax Considerations. Will money be raised through a solar fee on electricity bills, by equity or debt financing of a business entity, through charitable donations, or various other options? What kind of tax implications will there be for participants—e.g., will the project generate taxable income for participants? Will it generate tax credits or deductions for participants?

Other legal issues. How will the project design address securities regulation, utilities regulation, business regulation, and the complexity of agreements between various project participants?

The chart on the following page compares aspects of the three sponsorship models.

COMPARISON OF MODELS

Administered by	Utility	Special Purpose Entity	Non-profit
Owned by	Utility or 3rd party	SPE members	Non-profit
Financed by	Utility, grants, ratepayer subscriptions	Member investments, grants, incentives	Donor contributions, grants
Hosted by	Utility or 3rd party	3rd party	Non-profit
Subscriber Profile	Electric rate payers of the utility	Community investors	Donors
Subscriber Motive	Offset personal electricity use	Return on investment; Offset personal electricity use	Philanthropy
Long-term Strategy of Sponsor	Offer solar options Add solar generation (possibly for Renewable Portfolio Standard)	Sell system to host Retain for electricity production for life of system	Retain for electricity production for life of system
Examples	Sacramento Municipal Utility District – Solar-Shares Program United Power Sol Partners	University Park Community Solar, LLC Clean Energy Collective, LLC	Solar for Sakai

UTILITY-SPONSORED MODEL

For communities desiring to organize a community solar project, the local electric utility is a good place to start. First of all, utilities are likely to have the legal, financial and program management infrastructure to handle organizing and implementing a community solar project. Second, many utilities are actually governed by their member-customers and can be directed to pursue projects on their members' behalf. Fully one-fourth of Americans own their own electric power company, through co-ops, or city- or county-owned utilities.[ii] And, in general, publicly owned utilities have taken the lead in deploying community solar projects. But even when the utility is investor-owned or privately held, it may wish to expand customer choice with an option for community solar power.[iii]

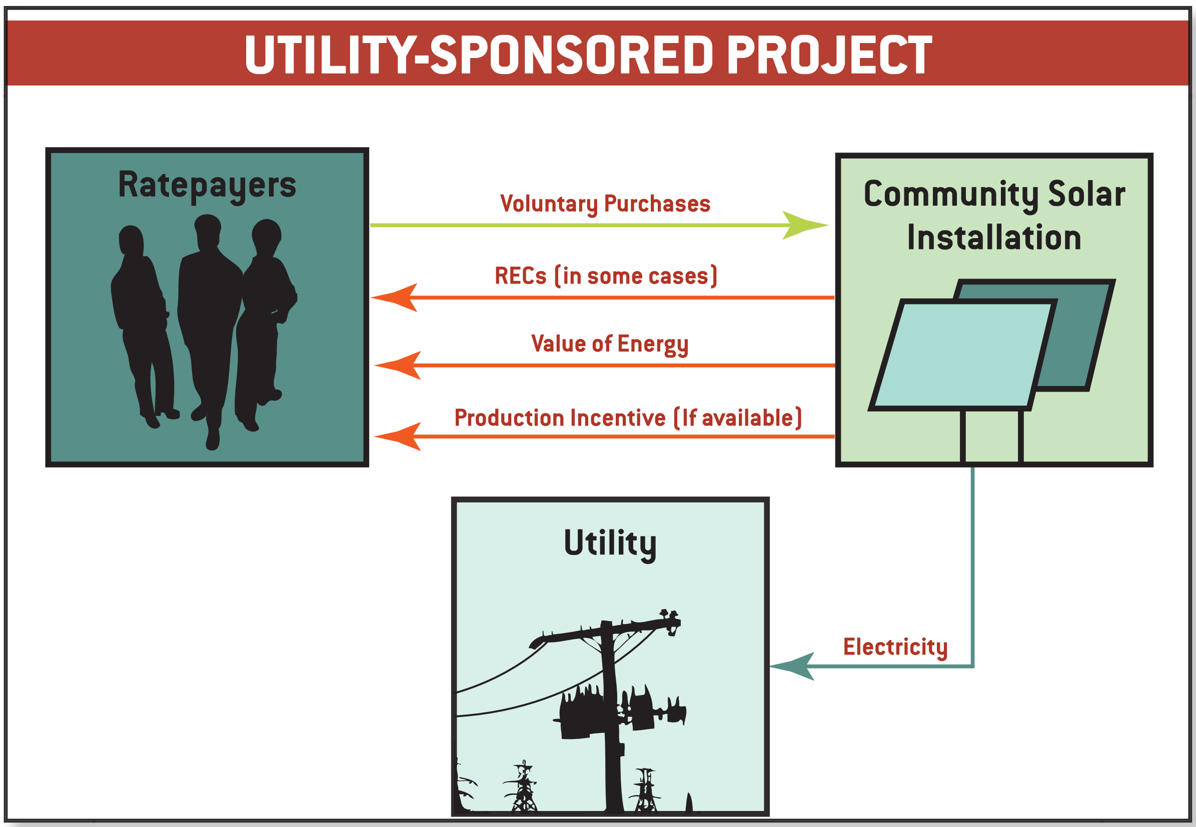
ENROLLMENT OPTIONS

- *Single payment up-front*
- *Payment spread out on Installment Plan*
- *Monthly subscription (no up-front fee)*

OVERVIEW

In most utility-sponsored projects, utility customers participate by contributing either an up-front or ongoing payment to support a solar project. In exchange, customers receive a payment or credit on their electric bills that is proportional to 1) their contribution and 2) how much electricity the solar project produces. Usually, the utility or some identified third party owns the solar system itself. The participating customer has no ownership stake in the solar system. Rather, the customer buys rights to the benefits of the energy produced by the system. Note that utility-sponsored community solar programs are distinct from traditional utility "green power" programs in that "green power" programs sell RECs from a variety of renewable energy resources; utility community solar programs sell energy or rights to energy from a specific solar installation, with or without the RECs.

Utility-sponsored programs can help make solar power more accessible by decreasing the amount of the purchase required, and by enabling customers to purchase solar electricity in monthly increments. Both Sacramento Municipal Utility District's Solar Shares and Tucson Electric Power's upcoming Bright Tucson programs allow customers to participate in community solar on a monthly basis.



TAX AND FINANCE ISSUES FOR UTILITY-SPONSORED PROJECTS

A utility project's ability to use tax incentives will depend on the individual utility's characteristics. Electric co-ops, municipal utilities and public utility districts are exempt from federal income taxes and thus cannot benefit from federal tax incentives, like the ITC and depreciation. However, they can make use of Clean Renewable Energy Bonds (CREBs) that are not available to the for-profit investor-owned or privately held utilities.

Since 2008, investor-owned utilities have been eligible to use the commercial ITC on qualifying public utility property. And as tax-paying entities, they potentially have the tax appetite to make use of them. However, normalization accounting rules limit regulated utilities' flexibility in maximizing the value of these tax benefits compared to other private developers. Normalization rules require regulated utilities to spread the benefits of investment tax credits throughout the useful life of the solar project in their rate-making process. The utility's incentive for investment is the difference between the value it receives from the tax credit up front and the value it passes on to customers over time (i.e. the time value of money). Private developers have the flexibility to pass on the benefits of the ITC sooner, which can give them a price advantage over utility solar projects. [iv]

Other legal issues for utility-sponsored projects include the following:

- **Securities Compliance**. In designing mechanisms for customer participation in solar projects, utilities must be careful to comply with securities regulations. This requires carefully considering what benefit a customer-participant receives in exchange for a financial contribution to the project and how the project is marketed. For example, customer participants may buy ownership stakes in the solar system itself or just the rights to certain benefits from the energy produced (such as credit on their electric bills, RECs, or access to a special electric rate). To avoid any appearance of selling securities, the Sacramento Municipal Utility District (SMUD) chose not to sell actual ownership of panels, but instead to credit customers for an estimated monthly output of solar electricity, specified in advance of enrollment.

- **Allocation of Incentives**. In addition to federal tax incentives, a utility-sponsored project might be eligible for a variety of state incentive programs that provide cash benefits or savings to the project. The utility must consider whether and how these incentives will be passed on to customer participants and the tax implications of how the incentives are handled. For example, in Washington State, participants in a utility-sponsored program are eligible for production incentives. While the state Department of Revenue has ruled that the incentive is not taxable, the IRS has not ruled definitively on whether or not subsidies for solar PV in community solar installations are taxable income, although the precedent is that subsidies for energy conservation measures are not taxable.[v]

- **RECs.** Customer participants in utility-sponsored projects often desire to claim the environmental benefits of using solar energy. They can only make such a claim if they receive RECs or the utility retires the RECs on their behalf. If the utility keeps the RECs for any reason, including Renewable Portfolio Standard compliance, only the utility can make environmental claims related to the solar system. The utility-sponsored project should consider and make explicit how RECs are allocated.

From a participant perspective, the tax implications are minimal.[vi] Bill credits for the value of electricity are not generally taxed; at the same time, participants in a utility-sponsored project are not eligible for the federal investment tax credit. The relative ease of participating in a utility-sponsored project may offset some of the foregone tax incentives available under other community solar ownership models.

EXAMPLES OF UTILITY-SPONSORED PROJECTS

The following examples highlight some of the project options available to those planning a utility-sponsored project.

Sacramento Municipal Utility District (SMUD): SolarShares Program

SMUD has long been a leader in solar energy deployment. The SolarShares program allows customers to purchase output from a solar project on a monthly basis. Rather than own the system, SMUD contracted with a solar developer, enXco, to build, own, and maintain a 1-MW system. enXco sells the power to SMUD under a twenty-year power purchase agreement. The electricity from this system is fed directly into the grid and SMUD uses this solar-generated electricity as the basis for its SolarShares program.


Courtesy of Rachel Huang, Sacramento Municipal Utility District

Customers pay a fixed monthly fee, based on both the amount of PV to which they want to subscribe (from 0.5 to 4 kW) and their average electricity consumption. In order to encourage conservation, SMUD makes the SolarShares less expensive for their customers who use less electricity. Once enrolled, a customer is locked in at the fixed monthly fee, for as long as they wish to participate. They receive monthly kWh credits for the estimated output of their solar subscription. Although customers currently pay a premium for solar energy, the effective rate for solar is locked in when they enroll, which maintains the ability of solar to act as a hedge against future price increases. The program is fully subscribed, with approximately 700 residential SolarShares customers. Customers can join a waiting list, and enroll when current customers drop or move out of the territory. SMUD is making plans for expansion of up to 25 MW over the next few years.

PROGRAM HIGHLIGHTS

- System Owner: enXco, with SMUD purchasing 100% of the output under a 20-year PPA
- Installed Capacity: 1 MW
- Participant Agreement: Customers pay a fixed monthly fee in return for a kWh credit. Credit varies monthly, as solar output varies, so a 12-month consecutive commitment is requested.
- Electricity: The estimated kWh generated by a customer's share is netted against his or her consumption at home, at the full retail rate.
- RECs: Retained by SMUD
- Number of Participants: Approximately 700

FINANCIAL DETAILS

- Installed Cost: NA
- Capital Financing: Handled by 3rd Party, enXco
- Tax Credits: 30% federal Business Investment Tax Credit taken by enXco, MACRS taken by enXco
- Estimated Annual Cost: Varies by customer size & array size; Output from a 0.5-kW share for the small user will cost $129/yr at today's prices.
  As the price for non-solar energy rises, a participant could eventually realize monthly savings on their solar purchase.

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United Power: Sol Partners Cooperative Solar Farm, Colorado

United Power is a rural electric co-op[vii] serving homes and businesses throughout Colorado's northern front range. The Sol Partners Cooperative Solar Farm is located on United Power's property in Brighton. Under a program launched in the summer of 2009, co-op members can license solar panels for a 25-year period and receive credit for all the power generated by their panels. Rather than net the kWh produced by the panels against the customer's personal electricity usage, the utility will bill the customer as usual, but then add a credit at the community solar rate, which is slightly above the full retail rate.

The program will "grow as you go" with new customers providing the funds for future expansion. Although the second phase will be considerably less expensive to build, the customer agreement will be the same for both Phase I and II. Customers may lease multiple panels, up to 10 kW for residential and 25 kilowatts for commercial.

Courtesy of Jerry Marizza, United Power, Inc

PROJECT HIGHLIGHTS

- System Owner: United Power
- Installed Capacity: 10 kW with plans for Phase II
- Participant Agreement: One-time fee to lease a 210-watt panel for 25 years
- Electricity: Customers receive a monthly bill credit for the value of their panel's production at a solar rate, slightly above the retail rate (currently 11 cents per kWh vs. 10.5 cents retail)
- RECs: Retained by United Power
- Number of Participants: 25

FINANCIAL DETAILS

- Total Installed Cost: Phase I: Approximately $10/watt. Phase II: $5.50/watt
- Capital Financing: Utility financed
- Tax Credit: NA (tax-exempt)
- Grants: $50,000 from State Governor's Office for design
- One-time Subscription cost: $1,050
- Value of electricity credits over 25 years: $900 assuming a constant solar credit rate (but this solar credit rate will likely rise, as will the retail rate)

For More Information: Jerry Marizza, newenergy@unitedpower.com, (303) 637-1250, www.unitedpower.com/

OTHER UTILITY-SPONSORED COMMUNITY SOLAR PROJECTS
City of Ellensburg, WA; Florida Keys Electric Co-op, FL; St. George SunSmart, UT; City of Ashland, OR
Coming Soon: *Seattle City Light, WA; Tucson Electric Power, AZ*

SPECIAL PURPOSE ENTITY (SPE) MODELS

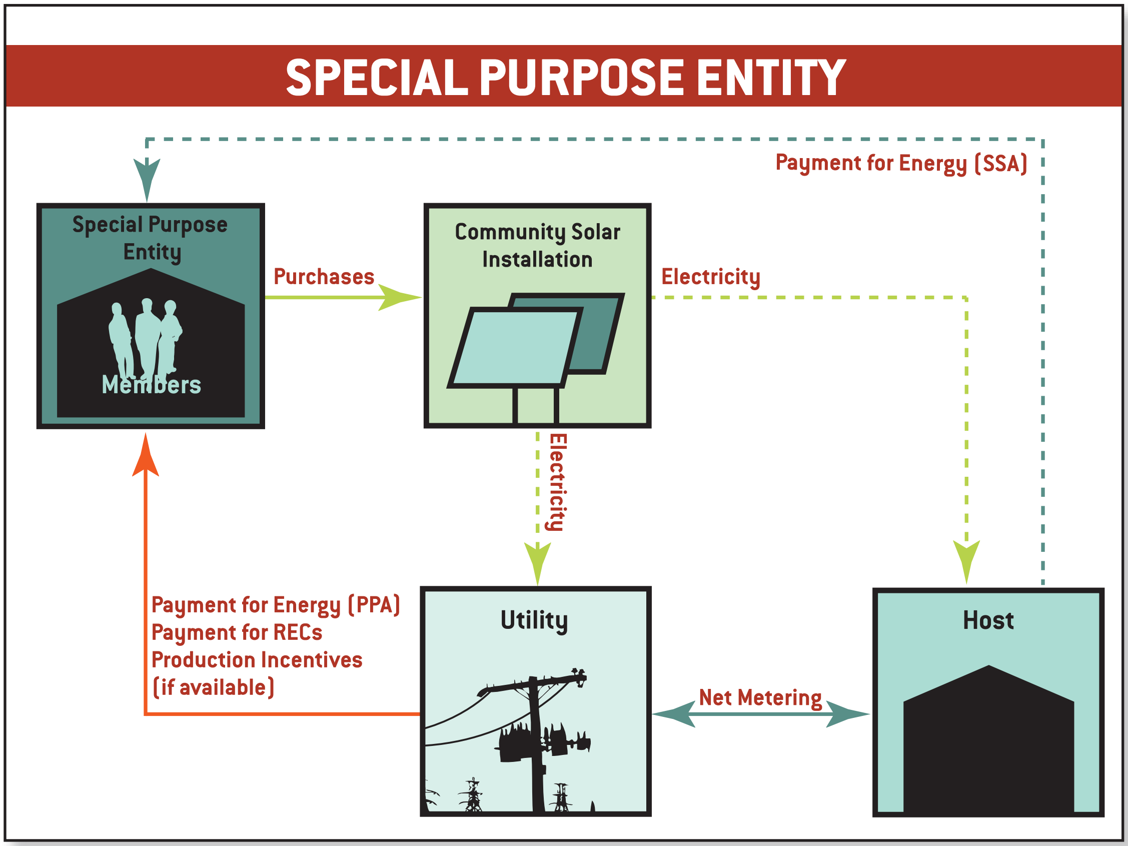
To take advantage of the tax incentives available to commercial solar projects, organizers may choose to structure a project as a business. In most states, there is a range of business entities that could be suitable for a participant-owned community solar project. (Please see Appendix A for more in-depth descriptions of these business entities.) The main challenges in adapting these commercial solar structures for community projects include:

- Fully utilizing available tax benefits when community investors have limited tax appetite, including a lack of passive income.
- Maintaining the community project identity when engaging non-community-based tax-motivated investors.
- Working within limits on the number of unaccredited investors if the project is to be exempt under securities laws.

OVERVIEW

When a group chooses to develop a community solar project as a special purpose entity, they are taking on the significant complexity of forming and running a business. The group must navigate the legal and financial hurdles of setting up a business and raising capital, while possibly having to comply with securities regulation. In addition, they must negotiate contracts between the participant/owners, the site host and the utility; set up the legal and financial processes for sharing benefits; and manage the operation of the business.

Given the complexity of forming a business, it is not surprising that many special purpose entities pursuing community solar are organized by another existing business entity with legal and financial savvy. Solar installation companies such as My Generation Energy in Massachusetts have successfully created LLCs to purchase solar installations funded by a group of investors. Although this expands the market for solar, we have not included this as an example of community solar because the benefits are limited to a small group of tax-motivated investors. In an alternative model, the Clean Energy Collective in Colorado is an LLC that has created a complex business structure that allows for individuals to buy solar panels in a common installation. While the CEC incurred significant legal costs to set up the company structure, they are now able to offer participation to an unlimited number of utility customers.



TAX AND FINANCE ISSUES FOR SPECIAL PURPOSE ENTITY PROJECTS

Federal income tax benefits offer significant value for solar projects, but they can be challenging for community projects to use effectively. Making use of tax credits or losses (from depreciation) requires a taxpayer to have significant taxable income. Moreover, passive investors in a community solar project (investors who do not take an active role in the company or its management) can only apply the ITC to passive income tax liability. As discussed below, most investors in a community solar project will likely be passive investors, and few will have passive income. As a result, most individuals cannot fully utilize federal tax benefits. In this section, we describe the major limitations on using federal tax benefits and outline potential financing structures that accommodate those limitations. However, the descriptions here are general and do not account for the many nuances that might apply to individual projects.

Passive Activity Rules

IRS “passive activity” rules are a major challenge for community-based renewable energy investors trying to use federal tax benefits. In most cases, an individual’s investment in a community solar project will be considered a passive investment. Passive activity rules allow tax credits or losses generated from passive investment to be used to offset only passive income.[viii]

Most individuals primarily have non-passive income, which includes salaries, wages, commissions, self-employment income, taxable social security and other retirement benefits. Non-passive income also includes portfolio income such as interest, dividends, annuities, or royalties not derived in the ordinary course of a business. While portfolio income may seem passive, the IRS specifically excludes it from the category of passive income.

Passive income can only be generated by a passive activity. There are only two sources for passive income: a rental activity or a business in which the taxpayer does not materially participate.

Participation generally means work done in connection with an activity in which the taxpayer owns an interest. To "materially" participate in the trade or business activity (in this case, operation of a solar project) a person must participate on a regular, continuous, and substantial basis in the operations of the activity. This is a high standard that participants likely will not be able to meet. That means most participants will be passive investors, limited to applying federal tax benefits to passive income. The community solar project itself likely will not generate sufficient income to make full use of the ITC or depreciation benefits, at least not in the early years of a project. Therefore a project intending to rely on federal tax benefits will have to seek participation of an investor with a larger tax appetite.

At-Risk Limitations

In addition to passive activity rules, at-risk rules limit the amount of losses one can claim from most activities. Specifically, one can only claim losses equivalent to one's amount of risk in the activity. The "at-risk" amount generally is the amount of cash and property one contributes to the activity. In addition, any amount borrowed for use in the activity is at-risk, so long as the borrower is personally liable for repayment of the loan or the loan is secured with property not used for the activity. Money contributed from a non-recourse loan will not be considered "at-risk."

Securities Regulation

This topic will be explored more fully in the Securities Compliance section below, but is worth mentioning here because securities regulations are a major factor in financing structures for the SPE model. To reduce the burden of securities compliance, many small projects seek a private placement exemption to registration requirements. Qualifying for such an exemption requires limiting who can invest in the project (based on assets or income for individuals) and how such an offering can be conducted. The practical effect is to limit the number of middle-income people who can invest in a community solar project. If a project is designed to produce electricity proportional to the amount used by the participants, securities issues will effectively limit the size of a project. For example, private placement exemption limits the number of "unaccredited" investors to 35 or fewer.[x] A 1-MW solar facility, in contrast, could serve far more participants, perhaps 300-500. Therefore, project developers must carefully consider how to reconcile their financing mechanism with the size of their project, the number of participants, and type of participants.

Potential Financing Structures

Special purpose entities need to plan their financing structure carefully. Structures that effectively use the ITC can be complex and tend to mimic the structures used by larger commercial solar projects. For a community SPE, potential financing structures that maximize federal tax incentives include:

- **Self-financing:** The simplest option for a community SPE is to finance the project with equity invested by community members. However, in order to fully utilize federal tax benefits, the SPE would need to have enough community investors that have sufficient tax appetite to use federal tax incentives. Given the passive loss rules and the at-risk limitations discussed above, this is not a realistic goal for community groups consisting of individuals who lack other sources of passive income. That means, the project organizers will likely have to make the project economically viable without full use of federal tax incentives (difficult without aid from a state or local incentive of similar value), or will have to use one of the more complex structures like a flip or a sale/leaseback described below. This need not take away from the community ownership, if the project can find even one community member with the financial resources and tax appetite to participate as the primary tax investor.

- **Flip Structure:** In this scenario, the community SPE would partner with a tax-motivated investor in a new special purpose entity that would own and operate the project. Initially, most of the equity would come from the tax investor and most of the benefit would flow to the tax investor (as much as 99%). When the tax investor has fully monetized the tax benefits and achieved an agreed upon rate of return, the allocation of benefits and majority ownership (95%) would "flip" to the community SPE (but not within the first five years). After the flip, the community SPE would have the option to buy out all or most of the tax investor's interest in the project at the fair market value of the tax investor's remaining interest. (The numbers provided here reflect IRS guidelines on flip structures issued for wind projects claiming the federal production tax credit; similar rules potentially could apply to solar projects claiming the ITC.)

- **Sale/Leaseback:** In this scenario, the community SPE (as the developer of the project, the site host, or both) would install the PV system, sell it to a tax investor and then lease it back. As the lessee, the community SPE would be responsible for operating and maintaining the solar system as well as have the right to sell or use the power. In exchange for use of the solar system, the community lessee would make lease payments to the tax investor (the lessor). The tax investor would have rights to federal tax benefits generated by the project and the lease payments. The community SPE might have the option to buy back the project at 100% fair market value after the tax benefits are exhausted.

There are numerous complex legal, financial, and tax issues associated with all of these financing structures. These descriptions do not begin to cover them all, but rather present the possible frameworks to work from. For further information on financing structures, see Section 7: Resources.

EXAMPLES OF SPECIAL PURPOSE ENTITY PROJECTS

The following examples represent two possible approaches; a volunteer-led LLC and a business enterprise ready to partner with utilities across the country. Both special purpose entities are structured as LLCs. Although there has been much interest in the possibility of structuring a community solar enterprise as a co-op, in fact, there are no examples of operating solar power co-ops.[xi] Several rural electric co-ops that deliver electricity to their customer/members have started "community solar" programs, but the programs are peripheral to their function as consumer co-ops for the distribution of electricity.

University Park Community Solar LLC, Maryland

The volunteer founders of University Park Community Solar spent more than two years crafting the legal and financial aspects of their business model. With expert consultation, including help from a state Senator to change the Maryland net metering law, they formed a member-managed LLC that will return their investment in five to six years. Within the group, there are both active and passive investors.

Courtesy of David Brosch, University Park Community Solar, LLC

A-22 kW system was installed on the roof of a local church in May 2010. The LLC will pass benefits to its members based on revenue from several sources: electricity sold to the church and grid, the auction of RECs, federal tax incentives, and depreciation. The LLC and the Church have signed a 20-year agreement detailing the provision of electricity, access to the solar array, maintenance, insurance, and other issues. The host has an option to purchase the system before the 20-year term is up.

The founders note that accounting and legal fees could overwhelm any return to members. To assist in establishing the LLC, the group received pro bono help from the Maryland Intellectual Property Legal Resource Center and paid approximately $12,000 for other legal and accounting expertise. Going forward, they plan to handle the accounting and tax paperwork in house as much as possible.

The LLC organizers were careful to obtain legal advice on how to gain an exemption from state and federal SEC filing requirements. They are not all "accredited" investors. In addition, they were required to create lengthy disclosure documents to ensure that investors were fully informed of the risks. Their attorneys advised them to pursue an exemption that restricted them in several aspects, including having fewer than 35 unaccredited investors, keeping the offering private, and limiting membership within the state of Maryland. (See Section 5: Securities Compliance to read more about securities compliance and private placement exemptions.)

PROJECT HIGHLIGHTS

- System Owner: University Park Community Solar LLC
- System Host: Church of the Brethren, University Park, MD
- Installed Capacity: 22 kW
- Participant Agreement: LLC passes net revenues (after expenses) and tax credits to members
- Electricity: LLC sells power to church below retail rate. Rate escalates approx 3.5%/yr. Host net meters. Annual net excess generation is compensated by the utility.
- RECs: LLC is currently negotiating the sale of RECs to the installer
- Number of Participants: 36 LLC Members

FINANCIAL DETAILS

- Installed Cost: $5.90/watt
- Capital Financing: Member financed
- Tax Credits: 30% federal ITC equivalent to $39,000
- Grants: $10,000 from State of MD
- MACRS: Will depreciate 85% of cost over six years
- Estimated Annual Income from Power Sales: $3,600 in year 1, rising 3.5% per year

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Clean Energy Collective, LLC, Colorado

Courtesy of Lauren Martindale, The Clean Energy Collective, LLC

The Clean Energy Collective (CEC) provides a member-owned model that enables individuals to directly own panels in a community solar farm. The CEC works closely with local utilities to create community-scale solar projects that combine the on-bill credits of a utility-owned project with the equivalent tax benefits and rebates of an individually owned solar project. While the 30% investment tax credit is not directly available to individuals who participate in the project, the cost to participate is adjusted to reflect the value of the tax credits. The CEC takes the 1603 Treasury Grant instead of the ITC as the initial owner of the array. Portions of the array are then sold to customers at discounted costs (reducing the cost by the proportioned Treasury Grant discount). Customers must be qualified taxpayers and cannot take a tax credit on their purchase as the grant has been taken by the CEC. Both parties are subject to recapture over the first five years if the resulting system is then sold to a disqualified or non-tax paying entity. Creating this proprietary project model, with ownership, tax and legal considerations, was quite challenging.

When individual owners purchase panels in the solar farm, the utility credits them for the power produced at or above the retail rate (net-metering economics) directly on their electric bill using the CEC's RemoteMeter™ software system. The purchase price is as low as $725, depending on available rebates and RECs. For example, in the first project, CEC sold the rights to all future RECs up-front, on a per watt basis, enabling them to offset a portion of the installed cost. The benefits of ownership are transferable: if an owner moves within the service territory, the bill credits follow them; if they move out of the territory, an owner can resell their ownership to another utility customer or back to the CEC at fair market value or donate the property to a non-profit.

The owners must be customers of the electric utility within which the community array is located and their purchase is limited to the number of panels they need to offset 120% of their yearly electric use. These rules ensure that benefits directly accrue to the local utility customers rather than outside investors. The CEC is the management company representing the community owners and maintaining the solar arrays. In order to provide "utility-grade" long-term power to the utility, a percentage of the monthly power credit value and the initial sale price fund equipment insurance, operations and maintenance escrows.

The first CEC project is a 77.74-kW array in the Holy Cross Energy service territory (western Colorado). The CEC leased the land, sold the project to customers, and negotiated a PPA with Holy Cross Energy. The PPA rate paid by Holy Cross will escalate as regular utility rates increase. CEC's RemoteMeter™ system automatically calculates monthly bill credits for customer accounts and integrates directly with the utility's billing system to apply the credits. The CEC is breaking ground soon on its next community-owned 1-MW solar array at the Garfield County Airport near Rifle, Colorado.

PROJECT HIGHLIGHTS

- System Owner: Individuals in Holy Cross Energy utility territory
- System Host: CEC leases site from the Mid Valley Metropolitan District
- Installed Capacity: 78 kW
- Participant Agreement: Minimum $725 purchase (a single panel after rebates and incentives). Panel owners receive monthly credits for the value of the electricity produced for 50 years.
- Electricity: CEC, as agent for its customers, has a PPA with Holy Cross Energy to purchase the power produced. Customers receive the resulting monetary credit on their monthly electric bill.
- RECs: Holy Cross Energy purchased rights to RECs for $500/kW (paid up-front).
- Number of Participants: 18 customers

FINANCING DETAILS

- Installed Cost: $466,000 or $6/watt (Cost to customers: $3.15/watt, includes all rebates, RECs and credits taken by the CEC)
- Capital Financing: Project built with internal CEC private capital, which is paid back as individuals buy into the project
- Federal Tax Credit: CEC takes the 1603 Treasury Grant and passes the savings to the customer
- Rebates: $1/watt plus $0.50/watt for rights to the RECs from Holy Cross Energy
- Estimated Annual Income from Power Sales: $15,444 ($198/kW), rising as regular rates rise
- Simple Payback: 12.8 years

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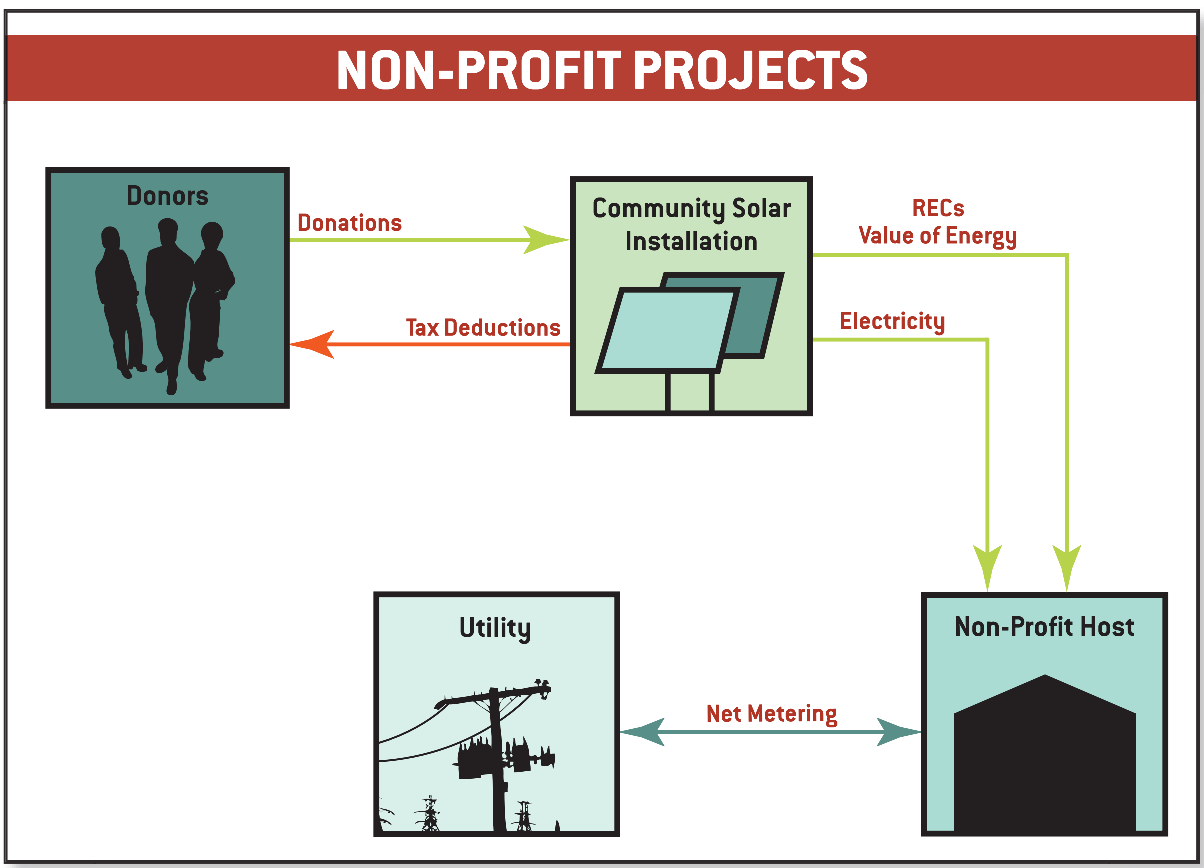
NON PROFIT MODEL

While this is not strictly "community solar" in that the donors do not share directly in the benefits of the solar installation, the donors do share indirectly, by lowering energy costs for their favored non-profit and demonstrating environmental leadership. In addition, with emerging state policies such as virtual net metering and group billing, there may be possibilities for a non-profit project sponsor to share benefits with their donor/members. In a variation on non-profit ownership, a non-profit may partner with a third party for-profit entity, which can own and install the system and take the tax benefits. This model has been deployed successfully in the California Multifamily Affordable Housing program and at other non-profit locations throughout the country. [xii]

If a non-profit were to return some benefit to donors, (for example, a portion of production incentives or a share of electric savings) this would constitute a "quid pro quo" contribution and the donor could not deduct their entire contribution.

OVERVIEW

Non-profit organizations such as schools and churches are partnering with local citizens to develop community solar projects. Under this model, supporters of the non-profit organization help finance the system through tax-deductible donations. While the non-profit is not eligible for the federal commercial ITC, it may be eligible for grants or other sources of foundation funding that would not otherwise be available to a business. An example of this model is the "Solar for Sakai" project on Bainbridge Island, Washington, in which a community non-profit raised donations for a solar installation, and in turn donated the installation to a local school. [xiii]



TAX AND FINANCE ISSUES FOR NON-PROFIT PROJECTS

As non-tax-paying entities, non-profit organizations typically are not eligible for tax incentives. However, donors to a non-profit project can receive a tax benefit in the form of a tax deduction. The IRS allows taxpayers who itemize deductions to deduct verifiable charitable contributions made to qualified organizations. Of course, a tax deduction is much less valuable than a tax credit. For example, a $100 tax credit reduces taxes owed by $100 while a $100 tax deduction reduces taxes owed by $25 for a taxpayer in the 25% federal bracket.

Donors can deduct their contributions to a community solar project if the project sponsor obtains tax-exempt status as a charitable organization under the Internal Revenue Code (26 U.S.C. § 501(c)(3)). Section 501(c)(3) organizations must be organized and operated exclusively for exempt purposes such as charitable, religious, educational, or scientific purposes. Section 501(c)(3) organizations may not be operated for the benefit of private interests and are restricted in how much time they can devote to lobbying activities. The Application for Recognition of Exemption under Section 501(c)(3) is IRS Form 1023.

Solar for Sakai, Bainbridge Island, Washington

Community Energy Solutions, a non-profit organization on Bainbridge Island, Washington, led the effort to raise funds for a solar installation at Sakai Intermediate School. Twenty-six community organizations or individuals made tax-deductible donations to Community Energy Solutions. The school owns the PV system and all of the resulting power and environmental attributes.

Courtesy of Joe Deets, Community Energy Solutions

PROJECT HIGHLIGHTS

- System Owner: Sakai Intermediate School
- Installed Capacity: 5.1 kW
- Electricity: Net metered

FINANCIAL DETAILS

- Installed Cost: $50,000 or $9.80/watt
- Grants: $25,000 from utility (Puget Sound Energy)
- Donations: $30,000 via Community Energy Solutions
- Production Incentive: $0.15/kWh from State of WA

SUMMARY OF BENEFIT ALLOCATION OPTIONS BY MODEL

As evidenced by the examples above, there are many options for allocating the benefits of community solar within each sponsorship model. The following chart summarizes the most common options.

	Utility	Special Purpose Entity	Non-profit
Electricity from Solar System	• Participant receives an estimated or actual kWh credit for their portion of project (virtual net metering) • Participant receives a monetary credit for the value of production for their portion of the project	• SPE sells the electricity to the utility (PPA) • SPE sells the electricity to the system host (SSA) • SPE assigns kWh to utility accounts per agreement with utility (virtual net metering) • Electricity from the system is netted against SPE members' group bill	• Non-profit owner uses on-site and net-meters • Non-profit owner assigns to utility accounts per agreement with utility (virtual net metering) • Electricity from the system is netted against a group bill
Renewable Energy Credits	• Assigned to participants • Retired on participants' behalf • Retained by the utility	• Rights to RECs sold up-front • RECs sold on an on-going basis • Retained for participants	• Rights to RECs sold up-front • RECs sold on an on-going basis • Retained for non-profit
Federal Tax Credits and Deductions	• Neither the commercial ITC nor the residential renewable energy tax credit is available to participants • If the utility has a tax appetite, it may use the commercial ITC • Normalization accounting rules will impact the value of the ITC for regulated utilities	• SPE can pass benefits of Commercial ITC through to participants • Only of use if participants have a tax appetite for passive income offsets	• Project donors can deduct the donation on their taxes • Non-profits are not eligible for federal tax credits
Accelerated Depreciation (MACRS)	• Not available to participants • An investor-owned utility may be able to use MACRS, provided they own the system • To qualify for MACRS, regulated utilities must use normalization accounting	• SPE passes depreciation benefits through to the participants, subject to passive activity rules	• Not useful to non-profits
State and Utility Rebates and Incentives	• Utility may qualify and use rebates/incentives to buy down the project costs;, benefits are indirectly passed on to participants	• SPE may qualify and use rebates/incentives to buy down the project costs or pass through to partici-pants	• Nonprofit may qualify and use rebates/incentives to buy down the project costs

Emerging State Policies to Support Community Solar

Over the last several years, a number of states have expanded their successful on-site solar programs by instituting policies that encourage innovative community solar programs. While each of these state programs varies considerably, a number of themes are emerging. For example, all of the current state-level programs require the solar array and the group members to be located within the same utility service territory. Other requirements to participate in "group" ownership benefits vary, but may include a cap on system size, proof of partial ownership, or limits on the type of ratepayers that can participate. Billing methods also vary; some programs offer one aggregate bill for the entire group; others assign a pro-rated monetary credit on each member's bill.

State-level community solar policies can be grouped based on how the benefits of community solar are distributed. In general, there are three broad categories: group billing, virtual net metering, and joint ownership. Given the importance of these policies to the success of community solar programs, it is worth spending some time on these mechanisms for sharing benefits.

GROUP BILLING

Group billing arrangements operate much like master metering in a multi-unit residential or commercial building. Under master-metering, a landlord receives a single electric bill for all electricity usage within a building, including tenant load. The landlord then determines how to assign energy costs to individual tenants taking into account tenant leases. Group billing for community projects works much the same way except that participants do not need to reside in a single building. First, a utility produces a group bill showing all participants' energy consumption and relevant charges. Then, output from a shared PV system is netted against the group bill. The remaining costs are allocated to participants according to an agreement between the participants. Under this framework, group billing allows multiple participants to receive net-metering credits from a single renewable energy facility.

LOCAL FLAVOR

In Vermont, two well-known residents, Ben and Jerry, decided to share the benefits of one solar installation on a shared electric bill. They hired AllEarthRenewables to build a solar array on Ben's guesthouse and informed their electric utility that the output of the installation should be netted against the combined consumption of both Ben's and Jerry's homes, in one bill. The solar panels offset all of the energy consumption at the guesthouse, and the remainder of the energy is applied toward offsetting the combined use of Ben's and Jerry's homes. They get one electric bill, and split the offset 50/50. They don't have a formal contract, but it works because they are good pals with a life-long history of working together.

A drawback to group billing is that a customer representative must serve as a point of contact and an intermediary between a group of participants and a utility. The customer representative takes on such tasks as billing and dispute resolution that exposes the representative to administrative burdens. This framework may also raise concerns over the creditworthiness of a customer representative.

Vermont has expanded its net metering program to allow group billing for shared systems and this expansion has proven very popular. [xiv] In the service territories of Vermont's two largest utilities, Green Mountain Power and Central Vermont Public Service territory, over 22 groups have formed to share in the output of a renewable energy system with system sizes ranging from 1.5 kilowatts to 199 kilowatts. Vermont's program is not limited to solar energy systems; any eligible renewable energy resource within Vermont's net metering program, including wind, small hydro, biomethane, and solar, can be installed under a group billing arrangement.

VIRTUAL NET METERING

Community renewables programs in Massachusetts, California, and Maine rely on virtual net metering as a means for distributing economic benefits from a shared solar energy system. Similar to group billing, virtual net metering allows net metering credits generated by a renewable system to offset load at multiple retail electric accounts within a utility's service territory. However, under virtual net metering, credits appear on each individual customer's bill the same as they would under traditional net metering.

To date, Massachusetts has implemented the most expansive community solar program using virtual net metering. Massachusetts' program has two avenues of participation: a "neighborhood net metering" program that allows neighborhood-based facilities to serve the energy needs of a group of at least ten residential customers in a neighborhood and an alternative program that allows participating net-metered systems to allocate monthly excess generation to one or more customers within a distribution company's service territory.

Under Massachusetts' "neighborhood net metering" program, a renewable energy system must be behind a participating customer's meter. However, only a minimal amount of load needs to be present on site. In fact, even "parasitic" load needed to run a facility is allowed to count to meet on site load requirements. Kilowatt-hour credits generated by a renewable energy system are allocated to participating customer accounts by participating utilities. Utilities are not required to include the distribution component of participants' applicable retail rate within neighborhood net metering credits.

Under an alternative program, and in a departure from what is typically seen in net metering, Massachusetts allows any customer with a net-metered system to allocate credits associated with monthly excess generation from a system to other customers of the same distribution company. Customers designated by the owner of the net-metered system receive a net metering credit that reflects the host customer's fully bundled retail rate. The net metering credit offered to designated customers is calculated using the retail rate of the host customer ($ per kWh) multiplied by the allocation of kWh for the designated customer. While on-site load must be present where the net-metered system is installed, as with neighborhood net metering rules, parasitic load qualifies as on site load. Taking these rules together, the alternative program is very flexible in who can participate and offers a more financially attractive net metering credit than the neighborhood net metering program.

Under California's Multifamily Affordable Solar Housing (MASH) program, residents of multifamily, low-income complexes such as the SDCHC townhomes in San Diego (see text box) are allowed to receive bill credits from a single on site PV system.[xv] The building owner allocates net metering credits to individual tenants and a building's common load. Virtual net metering allows the building owner to avoid having to build a separate solar energy system with a separate inverter for each tenant, which saves considerable funds. According to a recent program report, issued in the summer of 2010, 179 projects eligible for participation in the MASH program and representing 10 megawatts of solar have been incentivized to date and over 10 megawatts of projects are under review. The California Public Utilities Commission has indicated that it will consider an expansion of the program to allow for participation by other customer groups.

SOLAR FOR ALL

The non-profit San Diego Community Housing Corporation (SDCHC) partnered with a third party, Everyday Energy, to put a 20-kW system on its Hacienda Townhomes property. Everyday Energy installed and owns the system on the 52-unit apartment building, taking advantage of the tax benefits that are not available to the non-profit Housing Corp. SDCHC signed a 20-year Solar Services Agreement with Everyday Energy under which they will pay a flat fee to cover maintenance and electric services from the installation. An electric meter measures the energy flow directly to the grid, and the utility (San Diego Gas & Electric) credits the tenants and common areas as directed in the Virtual Net Metering agreement. It is projected that residents will save 30% on their electric bills.

JOINT OWNERSHIP

Taking a page from successful community wind programs, a few states have begun to explore options for distributing benefits of participation in a community renewables program through frameworks akin to wholesale power sale arrangements. One of the primary motivators of the community wind movement was a desire to promote rural development by expanding opportunities for citizens to invest in renewable energy systems by allowing them to piggyback their projects onto larger wind projects in order to benefit from economies of scale. This history leads to a primary difference between the emergence of community solar and development of community wind insofar as community wind uses a technology that began as utility-scale and is only now moving into smaller scale applications. Community solar is approaching this issue in reverse—moving from on site systems to larger solutions.

Maine's Community-Based Renewable Energy Pilot Program law[xvi] allows "locally owned electricity generating facilities" with at least 51 percent ownership by "qualifying local owners" to elect one of two incentive mechanisms. Under the first, qualifying local owners can enter into a long-term contract to sell output from a facility to a transmission and distribution utility. The contract price for energy may vary over the course of a year, but the average price, weighted based on the expected output of a facility, may not exceed $0.10 per kWh. This price only includes the value of a power sale and does not include a purchase of RECs. A significant downside of this approach is that a payment for power sales to a wholesale or retail purchaser results in taxable income at a federal level and possibly at a state level. Depending on the tax bracket a particular customer faces, the taxation of payments for power sales can significantly decrease the size of benefits available to participating customers.

Under Maine's second incentive option, generation is virtually net-metered to joint owners in proportion to their ownership stake in a system. For example, a 50 percent owner would receive 50 percent of the net metering credits generated by a system via virtual net metering.

Colorado has allowed jointly owned systems for quite some time but has not formulated detailed program rules to support joint ownership.[xviii] Colorado also recently authorized a community renewables program under a subscription-based model.[xix] Implementation of the program is underway at Colorado Public Utilities Commission and it is anticipated that rules concerning community renewables will be in place by the end of 2010.

Washington's community solar rules allow for ownership of community solar projects up to 75 kW that are either jointly owned by individuals, businesses, and non-profits or owned by a utility and voluntarily funded by the utility's ratepayers. Participants receive production incentives based on their proportional share of the output of a project. In addition, in the case of utility-owned projects, participants receive the value of the electricity. Washington's community solar incentives are among the most generous in the world if projects use inverters and modules made in Washington. For such systems, the production incentive is set at $1.08 per kWh through June 2020, but is subject to dilution if incentive payments exceed 0.5% of utility gross revenue in a given year.

St. George SunSmart Program with temporary signs

Tax Policies and Incentives

It has been said that the U.S. makes its energy policy in its tax code. This is certainly true in the solar arena. Federal tax incentives for solar systems are especially valuable and tend to be a primary driver in the design of project structures and financing strategies. This section introduces some of the state and federal tax policies that impact community solar projects, as well as some of the other federal financial incentives in the form of grants, bonds, and loans. Details on tax issues specific to each ownership model can be found in Section 2: Community Solar Project Models.

Receiving any kind of financial benefit or loss from participation in a community solar project could have tax consequences for the participant. In addition, tax incentives can interact in complicated ways, and project organizers should seek professional advice before including tax incentives in a project plan.

Federal tax incentives provide significant support to solar projects, offsetting approximately 56% of the installed cost of a commercially owned PV system[xxi] and 30% of a residential installation. However, community solar project designers should be aware that federal tax incentives were developed with either individually owned PV installations or commercial-scale solar projects in mind. Community-scale projects don't fit squarely into either category, which makes it challenging to design projects that can make use of either the residential or commercial tax credits. For example, the residential Renewable Energy Tax Credit is not available to community solar projects because it only applies to taxpayers who install a solar system on their own residence.

There is proposed legislation at the federal level that could change this. Senator Mark Udall (CO) has proposed the SUN Act 2010 which would allow individuals to claim the residential tax credit when purchasing solar panels in a community solar project. For more information and updates, please consult Senator Udall's website www.markudall.senate.gov/.

Tax incentives vary widely, depending on the status of the project sponsor. For example, investor-owned utilities are eligible for tax incentives that are unavailable to municipal utilities or electric cooperatives. Non-profit projects cannot use solar tax benefits, per se, but donations to them are tax-deductible. Special Purpose Entity business projects have the greatest flexibility for taking advantage of federal tax incentives. As a result, a host of project business structures - some of which are very complicated and require significant legal expertise - have been created in order to maximize federal tax incentives. These structures are discussed in greater detail in Section 2: Community Solar Project Models.

The following federal incentives may be applicable to a community solar installation depending on the details of each project. Additional detail on each of these federal incentives can be found on the Database of State Incentives for Renewables & Efficiency (DSIRE) located at www.dsireusa.org/.

BUSINESS ENERGY INVESTMENT TAX CREDIT ("COMMERCIAL ITC")

The Commercial ITC is among the most valuable incentive available for solar energy. The Commercial ITC allows commercial, industrial, and non-public utility owners of PV systems to take a one-time tax credit equivalent to 30% of qualified installed costs. Under the Commercial ITC, the owner of the PV system for tax purposes can be different from the owner of the host property. As a result, the use of a third party to finance systems has emerged as a leading trend in the solar industry. The tax credit can be used to offset regular tax and alternative minimum tax (AMT). The Commercial ITC is currently available for systems that are placed in service prior to the end of 2016. There is no cap on the amount of the Commercial ITC. Unused credits can be carried forward for up to 20 years. Commercial entities will likely pay income taxes on any up-front rebate or cash incentive they receive. If so, they do not have to reduce the "cost basis" by the amount of the rebate before calculating the Commercial ITC. After January 1, 2017, owners of qualifying solar facilities will be eligible to claim a 10% ITC.

Available to private utilities and SPEs owing federal taxes.

Eligibility and timing issues are complex. For a discussion of these issues, as well as the basis reduction and allocation issues, please see the DSIRE website: www.dsireusa.org/solar/incentives.

U.S. TREASURY RENEWABLE ENERGY GRANT

The American Recovery and Reinvestment Act of 2009 created a cash grant alternative to the Commercial ITC. The owner of a qualified solar facility that is eligible for the ITC can instead elect to receive a grant for approximately the same value. This is especially valuable to tax-paying entities that nevertheless can't take full advantage of the ITC due to lack of tax appetite. Unless extended, the Treasury Grants will be available to new projects for only a short time longer. Projects must "begin construction" by the end of 2010 and be placed in service on or before January 1, 2017 in order to qualify. The Treasury department has issued guidance determining that beginning construction means beginning work of a physical nature or paying or incurring at least 5% of the total cost of the project by the end of 2010. Unless extended, applications for grants must be made by October 1, 2011.

Available to utilities and SPEs eligible for the ITC until December 31, 2010.

Like the ITC, the amount of the grant is equivalent to 30 percent of the tax basis (usually the cost) of the qualifying facility. Also like the ITC, the tax basis of the property is reduced by one-half the amount of the grant. The cash grant is subject to recapture if, within five years of the placed in service date, the project ownership changes hands, the system is shut down permanently, or an interest in the project is transferred to an ineligible owner such as a public entity.

The ITC cannot be claimed for a solar facility for which a cash grant is claimed. Treasury must pay grants within 60 days after the date the project owner applies for payment or the date the facility is placed in service, whichever is later. The grant will not be considered taxable income at the federal level to the recipient, though some states might tax this grant.[xx]

Non-profit organizations and federal, state, and local government entities are ineligible to receive Treasury Grants.

MODIFIED ACCELERATED COST RECOVERY SYSTEM (MACRS)

In addition to grants and tax credits, federal tax policy allows businesses (but not individuals) to depreciate their investments in solar projects on an accelerated basis. Depreciation refers to the concept that over time, assets such as equipment lose value and will eventually need to be replaced. To account for this reduction in asset value, businesses record an expense over a set period of time. For qualified solar projects, this period is five years. Subject to certain restrictions, an owner with other sources of passive income can offset that income with losses generated by accelerated depreciation deductions under the modified accelerated cost recovery system (MACRS). For projects placed in service by the end of 2010, bonus depriciation is avalable which allows the owner to deduct 50% of the adjusted basis of an eligible solar system in the first year.

Available to utilities and SPE's with a tax liability and passive income.

For projects taking the ITC, the depreciable basis must be reduced by half the value of the ITC. For example, if the ITC equals 30% of project costs, then the depreciable basis is reduced by 15%.

The IRS publishes schedules that detail how different asset classes should be depreciated. For additional information, please consult IRS Publication #946. A more detailed discussion of using tax benefits can be found in Section 2, in the discussion of the Special Purpose Entity ownership model.

TAX CREDIT BONDS

Qualified tax credit bonds are a mechanism to lower the cost of debt financing for non-tax-paying entities such as government agencies, municipal utilities and electric cooperatives. Two tax credit bonds in particular – Clean Renewable Energy Bonds (CREBs) and Qualified Energy Conservation Bonds (QECBs) – were created to finance renewable energy projects and programs. However, all available tax credits have been awarded and no additional funding is expected.

Available to non-tax paying entities such as municipal utilities and electric cooperatives.

CLEAN RENEWABLE ENERGY BONDS (CREBS):

CREBs are a tax credit bond which can be used by government entities, municipal utilities and electric cooperatives to finance solar installations and other renewable energy projects. Ashland, Oregon used the proceeds from a CREB to partially finance its Solar Pioneers II community solar project in 2008.

QUALIFIED ENERGY CONSERVATION BONDS (QECBS):

QECBs are tax credit bonds similar to CREBs. The advantage of QECBs is that in addition to using them to finance renewable energy projects, they can also be issued for energy efficiency projects and green community programs, among other things. In addition, up to 30% of a QECB allocation can be used for private sector activities. To date, the authors of this Guide are unaware of a community solar project that has used QECBs.

CREBs and QECBs can be issued in two different ways.

- **Tax credit to the purchaser of the bond:** A qualified entity issues a CREB or a QECB. Rather than receive interest on the bond from the issuer, the purchaser of the bond receives a federal tax credit. To date, the tax credit that the bond purchaser receives has not been sufficient and therefore, the bond issuer also makes a supplemental interest payment (or issues the bond at a discount).

- **Interest rate subsidy to the issuer of the bond:** A qualified entity issues a taxable CREB or QECB. The purchaser of the bond will pay taxes on the interest income. In return for issuing a taxable bond, the issuer will receive an interest rate subsidy from the federal government. For CREBs and QECBs, this subsidy is 70% of a referenced credit rate. This "direct pay subsidy" mechanism can result in a lower cost of financing than a traditional tax-exempt bond or a traditional tax credit bond.

FEDERAL GRANTS

While not necessarily a source of long-term funding, federal grants can be used to bring down the cost of a community solar project. Such grants would lower the cost of the PV system installation and/or subsidize the cost of participation in a community solar project. In 2009-2010, enhanced funding was provided for State Energy Programs and Energy Efficiency and Conservation Block Grant Programs (EECBG). In addition, there have been a number of other stimulus-related funding opportunities for PV projects and some of these funding avenues may still be open. For rural communities, there may be USDA grants and loans available through the Rural Energy for America Program (REAP).

Examples of projects benefiting from federal grant funding are Seattle City Light's new community solar initiative funded under the U.S. Department of Energy's Solar America Cities program, the second phase of St. George, Utah's SunSmart Community Solar program using Energy Efficiency and Conservation Block Grant funding, and APS's Community Power Project using a High Penetration Solar Deployment grant from the DOE's Solar Energy Technologies Program.

STATE AND LOCAL TAX CONSIDERATIONS

Tax issues vary considerably from state-to-state and among localities. However, there are several common issues that project developers should consider when planning and structuring their projects. Taxes in any of the categories below could impose a significant cost on the project. Project developers should determine which taxes will apply to their project and who will be responsible for the cost. Taxation issues can become especially complex when a project involves both taxable and tax-exempt entities.

- **Net Income Tax:** Most states impose a net income tax modeled on the federal system. Thus, any revenue generated by a project will likely be subject to both state and federal income taxes. Some states offer investment tax credits that can be taken in addition to the federal Commercial ITC or other income tax credits and deductions for renewable energy. In Utah, for example, the State's residential income tax credit is available to participants in community solar projects owned by qualifying entities (municipalities, counties, etc.), such as the SunSmart program in St. George. [xxii]

- **Sales and Use Taxes:** Most states impose a sales tax on sales of tangible personal property. Some states also impose a use tax on sales of certain services or a transfer tax on sales of real property. For a solar facility, most state sales taxes will apply to the purchase of solar equipment, but usually not to the sale and use of electricity. Many states offer sales tax incentives for solar facilities in the form of reduced rates, exemptions or rebates.

- **Property Tax:** Nearly all states impose a property tax that is assessed annually, based on the value of real property. Most states also tax tangible personal property that is used for business purposes. For property tax purposes, assessment values might be determined by a central state authority or by a local assessor's office. As with sales taxes, many states offer property tax incentives for solar facilities in the form of exemptions or special assessments.

- **Excise Taxes:** Some states and municipalities impose excise taxes that could potentially apply to a solar facility. An excise tax is special tax imposed on particular goods or activities, such as a gasoline tax or gambling tax.

INTERACTIONS AMONG STATE AND FEDERAL INCENTIVES

Both the Commercial ITC and the Treasury grants are valued at 30% of the tax basis of the solar facility. The "basis" typically means the cost of buying and installing the facility. But certain factors can reduce the basis from which the 30% is taken. Other financial incentives (such as state rebates and grants) will reduce the taxpayer's basis for calculating the ITC or Treasury grant, unless they are considered taxable income to the taxpayer. If the incentive is considered taxable income, then it does not need to be subtracted from the cost basis. These rules avoid "double-dipping" that would come from receiving both a tax-free incentive and a tax credit.


SMUD's SolarShares Installation

Securities Compliance

Community solar projects can be structured to create ownership models that monetize financial incentives, capitalize on favorable government and utility policies, and expand ownership opportunities. When devising a creative business model, though, the project organizer should consider whether or not the model involves the issuance of securities, and, if so, what federal and state securities laws may be involved. A full review of state and federal securities requirements related to small offerings is beyond the scope of this guide, but this discussion is intended to offer a foundation for project organizers to research the issue.

Any entity, no matter how small or large, that attempts to raise capital may be deemed to be issuing securities if it offers or sells stock, membership units, partnership interests or other types of participation interests. If the project is deemed to be offering a security, the project will incur substantially more time and expense in ensuring that it complies with the securities laws. The consequences of failing to comply can be severe and the project, its directors, officers, and employees involved in the offer and sale of the security may be subject to liability for such failure.

The securities laws are intended to protect persons who invest money with an expectation that they will receive profits from the efforts of others, or who invest money in a venture with the expectation of receipt of a valuable benefit when the investor does not have control over the managerial decisions of the venture. Compliance with securities laws requires registering the offering with the Securities Exchange Commission (SEC) and the applicable state regulatory agency or finding a specifically-defined state and federal exemption from the registration requirements. Most states' securities laws have parallels to the federal requirements, but many states require additional filings, even if their exemptions are similar in substance to the federal exemptions.

Registration can be a time-consuming and expensive process that includes filing a formal registration statement with the SEC and preparing extensive disclosure documents called an "offering memorandum." However, even with a registration exemption, filings and the preparation of offering documents may still be required, depending on the participants in the project and many projects will not be able to support the up-front costs of securities compliance.

The definitions of a "security" under federal and state laws include a long list of financial instruments and agreements. Federal and various state definitions are not identical, but commonly include, for example, any note, stock, bond, evidence of indebtedness, certificate of interest or participation in any profit sharing agreement, or investment contract.

A common exemption used by smaller-scale non-utility-owned projects is the private placement exemption which allows a company to raise investment capital from a certain number of investors. All private placement exemptions limit the number of individuals or entities to whom the securities can be offered. The level of the disclosure requirements is triggered according to the net worth or income level of the investor and/or the relationship of the investor to the entity issuing the security (such as acting as the executive officer or director of the entity).

The most relevant test for analyzing whether a contract or an investment is a security under federal law is the "Investment Contract Test." Many states have additional criteria for determining the existence of a security but the basic components are similar to the Investment Contract Test: a security exists if (i) a person invests money or property, (ii) in a common enterprise (i.e. an enterprise in which the benefit to the investor is dependent upon the participation of others), (iii) with an expectation of profits, (iv) solely or primarily from the efforts of someone other than the person providing the money or, in other words, without the right to exercise practical and actual control over the managerial decisions of the enterprise.

It follows that the terminology used to describe participation in a community solar project should avoid references to "shares" or "stock," since those terms are the classic ones used to describe securities issued by a corporation and might create an expectation of profits and other rights customarily associated with stock or shares. All marketing and promotional materials used for the project should refrain from making any statements suggesting that an investment or other opportunity to make money is being offered to participants.

In a utility-owned model, where the utility enters into a contract or arrangement with its retail customer to provide electricity generated by a project, there is a risk that the contract or arrangement could be deemed a security if the customer is required to "invest money" in the project and if the customer has an expectation of getting some kind of profit over and above the value of the electricity it receives.

To the extent that a retail customer agrees to purchase solar power from a utility and to pay a specified, generally applicable rate for the solar power used and the customer is billed periodically based on recent past usage, just like the arrangements for purchasing other power, it is less likely that the customer would be viewed as making an investment of money in the project. By contrast, if the customer is required to make payments in excess of the retail market rate for the solar power, it is more likely that the customer will be viewed as making an investment of money. Therefore, the utility must take care to ensure that the rate charged for the solar power does not contain a charge for the customer's acquisition of an interest in the project. In addition, a payment is more likely to be an investment if the customer pays an amount up front in return for an undetermined amount of solar power over a period of time that may also be undetermined.

In order to reduce the likelihood that the contract is a security, payments made under the contract could be: (1) applicable to a specific, relatively short period of time (e.g. monthly, quarterly); (2) due after solar power is provided; and (3) according to a specified, generally applicable market rate per unit that does not include a component for the purchase by the customer of an interest in the project. The contract, pricing and billing arrangements and related materials, to the extent possible, should resemble a customary consumer purchase of non-solar electricity and should not be marketed to emphasize that the amount of solar power sold to customers depends on the participation of other customers or the success of the utility in obtaining subscribing customers or in operating the project.

Getting Started

As discussed in earlier sections of this guide, there are many legal, financial and project design considerations that need to be thought through to launch a successful community solar project. With so many factors to consider it can be difficult to know where to start. This section is intended to provide insight into "what it takes" to launch a community solar project so that community organizers and project developers can efficiently move concepts to completion.

> *It took us over two years to develop our project structure and only two months to find our members.*
> *- David Brosch, University Park Community Solar*

Like many construction projects, community solar project development can be broken down into phases including: **feasibility, project development, construction, operations and maintenance, and decommissioning.** It's important to note that phases can often overlap and are not necessarily completed in the order listed.

FEASIBILITY ANALYSIS PHASE

The first step is to conduct a comprehensive feasibility analysis. This analysis should determine if there is a good project site with an adequate solar energy resource to justify the project, identify a project team and supporters, prepare an initial financing plan, confirm absence of major obstacles, and gauge the local community and utility's receptivity to a project.

PROJECT DEVELOPMENT PHASE

If the feasibility analysis indicates that there are enough positive elements in place to pursue a community solar project, the project will move into the development phase. At this point, it may be helpful to document the project details in a business plan (which may be required to secure financing) or project charter.

Site selection and Resource Evaluation

Proper siting includes a site analysis for any potential shading, as well as determining optimal tilt of the modules, location of inverters and other system components, wiring distances, foundation or structural support, and security or public access requirements. The project owner must also obtain exclusive rights to build the solar project if they are not the property owner. This is usually negotiated through a land lease agreement with the property owner and/or site host. Careful consideration should be given to site selection, to minimize the environmental footprint and harmonize with existing land uses.

Understanding the amount of solar resource and the effects of climate and latitude on solar energy production is critical to finalizing the system location and obtaining estimates for financial modeling. Typically, project organizers will rely on solar resource maps or solar energy production calculators, such as PV Watts or RETScreen to get an initial assessment of the solar resource.

Financing

In order to obtain financing for a project, a financial pro forma must be created that models the proposed system's costs, revenue (from the production estimates), and the interaction of incentives and financing. This document will reveal the financial viability of the project, and is a necessary component of any project proposal. A very basic sample budget is provided after this discussion to suggest the broad categories of expenses and income that should be considered.

Ownership Structure
The ownership structure of the project will need to be finalized and the business model chosen. The project owner(s) may also need to consult legal and tax professionals to ensure the entity is properly structured to minimize risks to the site host, investors and participants.

Permitting and Environmental Review
The permitting process for a community solar project will depend on the location, size, and type of project. The project will, at minimum, require an electrical permit. A building permit is often necessary, especially if the PV array is a stand-alone structure. The best course of action is to check with the local planning department early on as the permit and environmental compliance requirements may influence the design and siting of the project.

Interconnection and Power Arrangement
The local utility will be involved in interconnecting the system to the electric grid. Utilities generally follow a standard interconnection process and have agreements that must be completed prior to construction. In addition to connecting the system to the distribution system, the arrangements for transferring the power "benefits" must also be accounted for. This is usually negotiated through a power sales agreement between the project owner and the utility or host in the form of a PPA, SSA, net-metering, or other contractual arrangement.

Procurement and Contracting
For projects of this scale, it is common to issue a request for proposals (RFP). The RFP can be fairly broad, allowing solar professionals to offer their recommended system design and specifications; or fairly specific, in order to compare bids on pre-determined project specifications. After identifying solar professionals, or receiving proposals in response to an RFP, it is important to evaluate them as one would evaluate other types of installers and contractors. Professional credentials are one indication of a PV installer's knowledge and qualifications. The North American Board of Certified Energy Practitioners (NABCEP) offers a well-respected voluntary certification program for PV installers.

CONSTRUCTION PHASE
Choosing a solar contractor and/or construction manager is an important decision. In recent years it has become increasingly easy to locate and contact those in the solar field. Tools available to help identify local professionals include www.findsolar.com and the national Solar Energy Industry Association (SEIA.org).

OPERATIONS AND MAINTENANCE PHASE
Operating a community solar project requires ongoing record keeping and timely filing of paperwork. Among other things, a project administrator may have to file tax forms and business license renewals, distribute incentive payments, sell RECs, and keep the insurance, lease and other payments up to date.

Maintenance, though fairly simple for PV systems, is essential to long-term management of a community solar system. Modules may need to be cleaned, but more importantly meters and inverters need to be monitored to make sure that the system is operating as expected. Various monitoring systems are available, offering options from instant email alerts when an inverter malfunctions to on-line daily performance monitoring. A good monitoring system will enable a system manager to minimize down time, protecting the participants' investment. It's important to include a project budget for monitoring, ongoing maintenance costs and parts replacement. In particular, establishing a reserve fund for future inverter replacements may be a good idea, given how expensive it can be to replace it if the warranty has expired.

DECOMMISSIONING OR EXIT STRATEGY

Although solar panels could easily last 25 years or longer, every project must consider the ultimate disposition of the solar installation. Whether the plan is to sell the project to the host, renew a lease, or remove the panels, a solid project plan has defined the options for exiting from the community solar project and potentially restoring the site to its original condition.

COMMUNITY SOLAR PROJECT: SAMPLE BUDGET

The following budget template provides sample categories for a typical community solar project budget.

Note that the budget does not include the cost of labor to organize and develop the project. This could easily be a full time job for a year or two. Depending on how the project is developed (by a utility, an SPE or a non-profit), the developer role could be volunteer or paid.

SITE DEVELOPMENT COSTS	
Design	$
Permits	$
Electrical/Meter Upgrades	$
Fencing/Security	$
Educational Kiosk	$
PROJECT DEVELOPMENT COSTS	
Consulting	$
Legal	$
RFP	$
SYSTEM COSTS	
PV Panels	$
Inverters	$
Ground Mount/Racking System	$
Balance of System Costs	$
TOTAL INSTALLED COST	**$**
MINUS GRANTS AND REBATES	
1603 Treasury Grant	$
Commercial ITC	$
Other Grants and Rebates	$
NET INSTALLED COST	**$**
ANNUAL OPERATING EXPENSES	
Bookkeeping	$
Accounting	$
Legal	$
System Monitoring	$
Insurance	$
Lease	$
Sinking Fund: Inverter Replacement	$
Taxes	$
TOTAL ANNUAL OPERATING EXPENSES	**$**
ANNUAL INCOME	
Sale of Electricity	$
Sale of RECs	$
Production incentive, if available	$

COMMUNITY SOLAR PROJECT DEVELOPMENT WORKSHEET

The following worksheet is meant to suggest the many steps involved in organizing a project but it is not comprehensive. Project organizers will need to create their own list of steps, based on their unique circumstances.

FEASIBILITY ANALYSIS	
Assess site for solar access	
Secure control of property and/or site	
Evaluate the solar resource	
Understand participant motivation	
Conduct market research/focus groups/surveys	
Investigate interconnection options	
Research financing mechanisms	
Gauge community receptivity and support	
PROJECT DEVELOPMENT	
Prepare a financial plan	
Determine ownership structure	
Develop operating agreement between host and project owner (if different)	
Develop participant agreement	
Obtain legal and tax consultation for contracts	
Define system and other technical specifications	
Execute agreement for the sale of power	
Complete permitting and environmental compliance requirements	
Execute interconnection agreement	
Conduct an RFP for design/build	
CONSTRUCTION	
Prepare the site for construction: grading, road improvements, other	
Dig trenches, lay cables, install transformer(s)	
Install fencing and site security features	
Complete inspections and commissioning	
Restore site/surrounding vegetation	
Complete paperwork for incentives	
OPERATIONS & MAINTENANCE	
Schedule and perform panel cleaning	
Save for inverter replacement	
Monitor system output	
Distribute benefits to participants (incentives, tax credits, etc.)	
File tax returns, state production incentive paperwork	
File annual business license requirements	

Resources

This guide to community solar covers a broad array of topics, but does not go into detail on each of them. Communities interested in implementing a project will need a more thorough understanding of many of these topics. The resources listed in this section can provide much of that information.

ORGANIZATIONS & INSTITUTIONS

- Through the U.S. Department of Energy's Solar America Communities partnership,local governments are working to accelerate the adoption of solar energy technologies for a cleaner, more secure energy future. The website offers case studies, policy updates, and news of solar activities across the country. www.solaramericacommunities.energy.gov

- The Database of State Incentives for Renewables and Efficiency (DSIRE) is a comprehensive source of information on state, local, utility, and federal incentives that promote renewable energy and energy efficiency. www.dsireusa.org

- The Office of Energy Efficiency and Renewable Energy (EERE) works to strengthen the United States' energy security, environmental quality, and economic vitality in public-private partnerships. www.eere.energy.gov

- USDA Rural Development provides funding for the development and commercialization of renewable energy technologies in rural communities. The Rural Energy for America Program (REAP) offers grants and loans to help small rural businesses deploy renewable energy projects. www.rurdev.usda.gov/rd/energy

- The Bonneville Environmental Foundation (BEF) supports the development of renewable energy and watershed restoration and empowers people to shrink their carbon footprint. BEF's Project Management Group assists with the funding and construction of solar installations in communities throughout the Northwest. www.b-e-f.org

- Northwest Sustainable Energy for Economic Development (Northwest SEED) empowers community-scale clean energy through targeted technical assistance, education and outreach. Northwest SEED seeks to increase responsible use of clean, renewable energy with maximum local control by providing on-the-ground support to communities in planning and implementing clean energy projects. www.nwseed.org/

- The American Solar Energy Society (ASES) is a nonprofit organization dedicated to increasing the use of solar energy, energy efficiency, and other sustainable technologies in the U.S. This website is a good source for information about solar technology and professionals. www.ases.org/

- The Interstate Renewable Energy Council (IREC) is a non-profit membership-based organization that provides a national forum in which public and private organizations involved with renewable energy may gather, disseminate and exchange information and engage in cooperative efforts. Their website offers the latest policy and practical solutions for tough renewable energy issues. www.irecusa.org/

- The Vote Solar Initiative works at the state, federal and local level to implement programs and policies that allow strong solar markets to grow. www.votesolar.org/

PUBLICATIONS

Solar Powering Your Community: A Guide for Local Governments
U.S. Department of Energy (DOE) 2010
This guide includes case studies and lessons learned from Solar America Cities.
Report: www.solaramericacommunities.energy.gov/resources/guide_for_local_governments

Community Solar Power: Obstacles and Opportunities
John Farrell, Institute for Local Self-Reliance, September 2010.
This report examines nine community solar projects, the policies that made them possible, and the substantial barriers that remain.
Report available from: www.ilsr.org/

Financing Non-Residential Photovoltaic Projects: Options and Implications
Mark Bolinger, Lawrence Berkeley National Laboratory, January 2009.
This report examines the role of financial innovation in PV market penetration. It looks at how financing structures currently being used to support nonresidential PV deployment have, in part, emerged and evolved as a way to extract the most value from a patchwork of federal and state policy initiatives.
Report: eetd.lbl.gov/ea/ems/reports/lbnl-1410e.pdf

Lex Helius: the Law of Solar Energy (2nd Edition)
Stoel Rives, 2009 (See especially, Chapter 7: Financing)
Report: tinyurl.com/25wvwkb

Installing Panels on the Church of the Bretheren, University Park, Maryland

Appendix A

BUSINESS FORMATION AND TYPES: SPECIAL PROJECT ENTITIES FOR COMMUNITY SOLAR PROJECTS

Below are descriptions of the primary business entities suitable for community solar projects, their key characteristics, and the major advantages and disadvantages they might have. Note: We discuss characteristics commonly attributable to these business entities but legal requirements can vary from state to state. State law may also establish default rules that can be changed by agreement among the business owners.

GENERAL PARTNERSHIPS

A general partnership is an association of two or more persons working together in a common business enterprise. There are few formal requirements for establishing a partnership and if the partners fail to enter into a written partnership agreement, the default provisions of the state partnership laws will govern the relationship of the partners. However, most partners choose to enter into a written agreement.

Advantages and Disadvantages of Forming as a General Partnership

The key advantage of organizing as a general partnership is the ease of formation and the flexibility in the inter-partner relationship. General partnerships require little, if any, paperwork for formation or operation. General partnerships also allow for "pass-through" taxation, instead of the "double" taxation that corporations may be subject to. Additionally, most partnership interests will not be treated as securities because all the partners contribute equally to the decision-making processes and participate in management of the business.

General partnerships, however, have several key disadvantages. First, and most important, is that each partner is individually liable for the debts of the partnership. This means that if the partnership cannot pay its debts, the creditors can look to the individual partners to satisfy those debts. Because of the lack of limited liability, general partnerships have fallen in popularity as a business entity in recent years.

Second, the preparation of a partnership agreement requires the assistance of legal counsel and can be expensive, depending on the complexity of the partners' relationships, financial and management.

Third, because of the close personal relationships inherent in a general partnership, partnership interests cannot usually be easily transferred or sold, and unless a partnership agreement so provides, it can be challenging to admit new or substitute partners.

Formalities

As discussed above, in theory there are few, if any, formal requirements for the formation general partnerships. Similarly, there usually are few requirements for operation, but states usually establish some default rules to govern if partners do not enter their own agreement. For example, in the absence of an agreement otherwise, the default rules usually provide that partners have equal control over the business and equal share in profits and losses.

Partnerships are "pass-through" entities, which mean that profits and losses pass through to individual partners. That means the partnership is not a separate tax-paying entity; rather, the partners report profits and losses from the partnership on their individual tax returns.

LIMITED PARTNERSHIPS

A limited partnership is a business entity comprised of two or more partners who operate or manage a business together. In every limited partnership, there are two types of partners: general partners and limited partners. The general partner usually invests significantly less capital than the limited partner(s) and has a significantly smaller ownership stake. Unlike general partnerships, limited partnerships have the ability to limit both the liability risk and the business involvement of certain partners known as "limited partners" but the general partner has unlimited liability. This feature is particularly useful for attracting "passive" investment partners who would like to participate in the profits of the business but not necessarily take on its risks or daily operations.

General partners manage the company's day-to-day operations and are liable for the debts of the partnership. Because they are responsible for any debts or lawsuits incurred by the partnership, general partners often themselves form limited liability entities such as corporations or LLCs (both discussed below) to protect themselves from liability.

Limited partners contribute capital to the partnership but do not (and generally cannot) participate in the daily operations of the company. As an added benefit, they are also shielded from company debts and other liabilities. Limited partnerships are a popular choice for individuals who lack the time or expertise to run a business but would like to share in the profits.

Advantages and Disadvantages of Forming as a Limited Partnership

There are several advantages to the limited partnership entity . The limited partners have limited liability and the limited partnership interests may be able to be sold easily without dissolving the limited partnership as an entity. The option of being a limited partner can attract investors because the investors' liability is limited. However, with certain exceptions, the limited partners have to refrain from dabbling in management; if a limited partner becomes too involved in the partnership's daily operations, the limited partner's status could be altered to that of a general partner, with the attendant loss of limited liability.

While limited partnerships are relatively easy to form, a limited partnership agreement is essential to govern the relationships of the parties, especially the contribution of additional capital and the allocation of profits and losses.

The major disadvantages of the limited partnership are first, that the general partner of a partnership assumes personal liability for the partnership's obligations and debts, and second, the passive nature of the limited partner's involvement carries the risk that the partnership interest will be deemed to be a security.

Formalities

Most states impose more requirements for forming a limited partnership than for a general partnership, such as filing a certificate of formation.

LIMITED LIABILITY COMPANIES (LLC'S)

A limited liability company, usually called an LLC, is a separate and distinct legal entity. An LLCs provides the limited liability protection for its owners (known as members) with the pass-through benefits and flexibility of a partnership. The members of an LLC are not personally liable for its debts and liabilities but also have the benefit of being taxed only once on their profits.

However, LLCs have only been around for 30 years or so and smaller banks may be reluctant to extend credit to LLCs. Further, with such a short history, many legal issues that arise in connection with the LLC format have not been settled.

An LLC may be managed by either (1) the members or (2) one or more managers. If a limited liability company is managed by the members, then the owners are directly responsible for running the company (a "member-managed" LLC).   A "manager" is a person elected by the members to manage the LLC. In this context, a manager is similar to a director of a corporation. A manager can be, but is not required to be, a member. If an LLC is managed by managers, then its members are not directly responsible for running the company and the passive nature of a non-managing member's involvement carries the risk that the membership interest will be deemed to be a security.

LLC ownership can be expressed in two ways: (1) by percentage; and (2) by membership units, which are similar to shares of stock in a corporation. In either case, ownership confers the right to vote and the right to share in profits.

Advantages and Disadvantages of Forming as a Limited Liability Company

The primary advantage of an LLC is that the members are not personally liable for the debts and liabilities of the LLC. The LLC allows individuals to organize with limited liability with fewer restrictions and fewer formalities that were necessary to form "S" or "C" corporations. Also, most limited liability companies can use the cash method of accounting, which means income is not generally taxed until it is received.

An LLC can be taxed either as a "pass-through" entity, like a partnership, or as a regular corporation. A regular corporation pays a corporate tax on its net income (the first tax), and then the stockholders pay income tax on dividends (the second tax) when the corporation distributes profits. With an LLC, the profits "pass through" to the owners who pay taxes at their individual tax rates. Also, the members can deduct the business's operating losses against the member's regular income to the extent permitted by law, which can be helpful if the project anticipates losses in the first few years.

A member may become liable for LLC debts if the member personally guarantees the debts, if personal funds are intermingled with LLC funds, if the LLC has minimal insurance, or if the members do not contribute enough money to the LLC when it is formed. In order to maintain the separate form of the LLC and maintain the liability protection of its members, LLC owners must carefully maintain separate records and keep personal affairs separate from the LLCs business. In particular, the LLCs money should never be intermingled with personal money.

Formalities

Although an LLC requires fewer formalities than a corporation, there is still more paperwork involved than a sole proprietorship or partnership. An LLC agreement is essential to govern the relationships of the members, the financial arrangements and regulation of the transfer of membership interests or admission of a new member; in the absence of an LLC agreement, the state's LLC laws will be applied to the LLC.

In general, the name of an LLC must clearly indicate that is an LLC and end with the words "Limited Liability Company," "LLC," "L.L.C." or "Ltd. Liability Co."

COOPERATIVE

A cooperative is a legal entity owned and democratically controlled by its members. Members often have a close association with the enterprise as producers or consumers of its products or services, or as its employees.

A consumers' cooperative is a business owned by its customers. Employees can also generally become members. Members vote on major decisions, and elect the board of directors from amongst their own number.

Generally, cooperatives are organized as non-capital stock corporations under state-specific cooperative laws. However, they may also be unincorporated associations or business corporations such as limited liability companies or partnerships. Cooperatives often share their earnings with the membership as dividends, which are divided among the members according to their participation in the enterprise, such as patronage, instead of according to the value of their shares. However, irrespective of the amount of a member's contribution to the co-op, each member has one vote only. For tax purposes, most cooperatives are taxed as a separate entity like a corporation, though some are tax-exempt.

Advantages and Disadvantages of Forming as a Cooperative

The democratic nature of cooperatives might appeal to community solar project organizers based on compatible goals of creating a collaborative and accessible structure. But there are significant limitations to cooperative structures that have made them an unpopular choice for renewable energy projects. Traditionally, members have little input into business operations and in certain states, members have to personally benefit from the co-op's products and services (example: REI). In those states, the co-op structure is not designed to bring in outside investment from persons that cannot partake of the co-op's products and services. However, in other states, outside investment is permitted and states are beginning to recognize the value of the co-op structure in a community solar setting.

Formalities

Usually, cooperatives are formed by filing articles of incorporation with the state. It is important to create a comprehensive set of bylaws to govern the members' relationship and the duties and obligations of the board of directors that will operate the business without significant input from the members. If the co-op is to be operated as a non-profit entity, the co-op will need to comply with the formalities for forming such an entity.

A note on the Co-op Model

While solar power production co-ops are popular in Europe, the authors have not found an operating example in the U.S. although the co-op model is currently being pursued by some companies, such as Tangerine Solar. (www.tangerinesolar.com)

One explanation for this discrepancy may be in the differing regulatory regimes. In the U.S., in order to reduce costs from state and federal securities compliance, co-op members would receive limited compensation on capital subscribed as a condition of membership. This makes the co-op model less attractive to investors looking for a monetary return.

FOR-PROFIT CORPORATIONS

A corporation is a separate and distinct legal entity, meaning the corporation does business under its own name. A corporation issues/sells voting common stock and (sometimes) preferred stock which can be voting or non-voting. The owners of the stock are called "stockholders" or "shareholders".

A corporation is managed by a board of directors elected by the shareholders, which is responsible for making major business decisions and overseeing the general affairs of the corporation. The directors appoint officers, who run the day-to-day operations of the corporation. Each corporation must have at least one director. In a small ("close") corporation, the shareholders, the directors and the officers are usually the same three or four people, but in a larger corporation, the shareholders are passive investors and, other than electing directors, have little control over the business operations of the corporation. In that situation, the stock issued to passive shareholders can constitute a security.

Directors and officers (and in some cases, the majority shareholders) of a corporation owe "duties of loyalty and care" to the corporation. Generally, this means the directors must act in good faith, with reasonable care, and in the best interest of the corporation. Directors, officers and majority shareholders must not use their position to gain personally from transactions with the corporation without complying with certain legal formalities.

Advantages and Disadvantages of Forming as a Corporation

The primary advantage of a corporation is that shareholders are not generally liable for corporate debts provided shareholders follow the rules for their particular state regarding formation of the corporate and maintenance of the corporate identity. For example, a shareholder may be liable for corporate debts if the shareholder personally guarantees the debts, if personal funds are intermingled with corporate funds, or if the corporation is undercapitalized (i.e. shareholders do not contribute enough money to the corporation when it is formed). Other actions may affect the liability of the shareholders, so anyone considering this business entity should consult a legal professional to assure that all the proper formalities are followed.

A corporation can elect to be taxed either as a "C corporation" or as an "S corporation." A "C" (or regular) corporation pays a corporate tax on its net income (the first tax), and then the stockholders pay income tax on dividends (the second tax) when the corporation distributes profits. An "S" corporation is like a pass-through entity but there are limitations on the number of shareholders and who may be a shareholder.

FORMALITIES

A corporation is required to hold annual meetings of shareholders to elect directors. In most jurisdictions, meetings can be held in person or by electronic means that allow all persons to hear the proceedings. It is important to maintain the corporation's records scrupulously to prevent creditors making claims against the shareholders. The corporation also must obtain a separate tax identification and separate bank accounts.

The name of a corporation must contain words that identify the company as a limited liability entity, such as "Inc.," "Ltd.," or "Corporation."

NON PROFIT ENTITIES

(Note: The following discussion pertains to non-profit entities that pursue solar projects as part of their core mission. For a discussion of how an existing non-profit may fund a solar project through donations, please see Section 2, Community Solar Project Models: Non-Profit Model.) A non-profit entity can be a corporation, or other form of business entity that is organized to meet specific tax-exempt purposes. Common examples of non-profits include: religious, charitable and political organizations, credit unions and membership clubs such as the Elk's Club. To qualify for non-profit status, the entity must be formed to benefit (1) the public, (2) a specific group of individuals or (3) the membership of the non-profit. If the non-profit has members, they may have the power to vote for directors and approve a sale or merger, but many smaller non-profits do not have members, due to the additional paperwork and required formalities. Even without members, donors may participate as advisors, patrons or contributors, but do not have a vote in the non-profit's operations.

Being a non-profit does not mean the entity cannot make a profit. Non-profits can sell goods or services for money and can pay competitive salaries to officers and employees. The primary limitation is that any profits generated by the non-profit's business operations cannot be distributed to members but must be retained by the non-profit and used to further its purposes and/or run its business. Non-profits are exempt from income, sales and property taxes and allow donors to deduct their donations from their taxes. Absent misuse of the non-profit's resources, directors, officers and members are not liable for the debts of the non-profit.

Although tax-exempt entities such as non-profits are not usually eligible for tax credits, they may be eligible for other grants or other sources of foundation funding that would not otherwise be available to a for-profit entity.

Advantages and Disadvantages of Forming as a Non-Profit Corporation

The largest advantage of organizing as a non-profit is that the entity is exempt from paying taxes on its profits, provided the activities of the entity continue to meet the requirements for exemption. It's important to note that simply forming a non-profit does not automatically qualify the entity for federal and state tax exemption - only an officially recognized non-profit entity can apply for federal and state tax exemption. This application is often referred to as the 501(c)(3) application since that is the IRS code section most commonly applicable to non-profits. In fact, there are more than 20 code sections for non-profit qualification. Another common one is 501(c)(7), which applies to social and recreational clubs.

Formalities

Unless a non-profit corporation files a 501(c)(3) application with the IRS, it will not be exempt from paying federal income taxes. If your non-profit's purpose qualifies under 501(c)(3), then a legal professional can help prepare the application for you. Each state also requires a tax exempt application; however, most states accept the federal tax exempt application in place of their own.

The process for forming the non-profit can take several months – generally the IRS takes three to five months to examine and approve the 501(c)(3) application.

Like any business entity, it is critical to maintain the separate corporate identity of the non-profit. This means setting up a separate bank account, maintaining good corporate records and holding regular board meetings.

SUMMARY TABLE OF BUSINESS TYPES

ENTITY TYPE	LIABILITY FOR OWNERS	TAXATION	PRIMARY ADVANTAGES	PRIMARY DISADVANTAGES
General Partnerships	Personal liability	Pass-through	Ease of formation; pass-through taxation	Personal liability of partners
Limited Partnerships	Personal liability for general partners; limited liability for limited partners	Pass-through	Pass-through taxation; limited liability for limited partners	No liability shield for general partner
Limited Liability Companies	Limited liability	Usually pass-through	Pass-through taxation; fewer formalities to maintain the LLC structure than corporations	Relatively new structure; may be harder to get financing
Cooperatives	Limited Liability	Separate tax entity	Cooperative principles	Inflexible Structure
"S" Corporations Limited liability	Limited Liability	Pass-through	Liability shield; ease of investment; ease of transfer of shares in larger, non-close corporations	Limitations on number and identity of members
"C" Corporation	Limited Liability	Separate tax entity	Liability shield; ease of investment; ease of transfer of shares in larger non-close corporations	Complexity; double taxation
Non- Profit Entities	Limited Liability	Separate tax identity; tax exempt	Tax-exempt; tax deduction for donors	No return for donors; business purposes are limited; no voting rights for donors

Appendix B

INTRODUCTION TO IREC'S COMMUNITY RENEWABLE MODEL PROGRAM RULES

Taking into account the various community solar approaches that have been implemented thus far, the Interstate Renewable Energy Council (IREC) worked closely with The Vote Solar Initiative to develop model rules for community renewable programs that are designed to assist stakeholders in developing programs that meet their diverse needs. The first part of this process was the development of a Community Renewable Power Proposal (Proposal) to generate stakeholder input on best practices in this emerging policy area. Two key principles greatly influenced the development of the Proposal. First, the Proposal was grounded in the belief that participants in a community renewables program should have an experience that is similar to that of customers investing in on-site renewable energy. Second, community renewables should be additive to successful on-site renewable energy programs and not undermine on-site renewable energy programs. It makes little sense to undermine successful on-site programs when seeking to expand options for participation. IREC's Proposal generated significant stakeholder feedback, which was used to develop the Model Program Rules. IREC intends to continue to develop and refine its Model Program Rules.

During discussions with stakeholders on the development of these Model Program Rules, five areas emerged as deserving of special attention:

ALLOCATION OF BENEFITS

Allocating benefits to program participants is a critical element of developing a successful renewables program. In considering the best method for allocating benefits to participating customers, IREC felt it was important to avoid structuring a program as a wholesale program that would result in taxable income. It makes little sense from an economic standpoint for customers to invest in greening their energy supply if benefits of doing so will be siphoned off in taxes. Additionally, many customers are motivated to offset as much of their energy bill as possible and most existing net metering programs accommodate this desire by placing net metering credits on a customer's monthly bill. While the reasons underlying this motivation are complex, bill credits maintain a direct relationship between customers' investments in renewable energy and a reduction in their utility bills. For these reasons, IREC chose virtual net metering as the best method for allocating benefits. This approach maintains a similarity in experience between customers installing on-site systems and those customers who participate in a community renewables program.

PROGRAM ADMINISTRATION

Program administration represents another critical area of program design. Existing community renewables programs have fallen into two camps with regard to who has program administration responsibilities: customer representatives or utilities. IREC believes the best approach is to allow utilities to administer a community renewables program. This framework allows an entity with significant experience in administering complex energy programs to administer the details of a community renewables program. Use of a utility administrator also avoids any concern about creditworthiness of a third-party customer representative.

FINANCING OF COMMUNITY SOLAR

A solar energy system represents a significant investment. Accordingly, an array of local, state, and federal incentives have been developed to incentivize customer investment in solar energy systems. In order to maximize the availability of funding, and to ensure available incentives are used as efficiently as possible, IREC's Model Program Rules support direct ownership, third-party ownership, and utility ownership of community renewable systems. Allowing third-party ownership of a renewable energy system can be critical to tapping into funders who are able to fully utilize available federal tax credits. Thirteen states have explicitly authorized third-party ownership of on-site renewable energy systems and legislation enacting community renewables programs in Colorado, Massachusetts, Delaware and Washington have made clear that third-party owners of community renewable energy systems are not subject to public utility regulation.

An important aspect of allowing utility ownership is a requirement that all system purchase costs, operation and maintenance costs, necessary investment returns, and other costs related to a utility-owned system must be recovered from participants enrolled in a utility program. This requirement is important to maintaining a level playing field between utility offerings and offerings of other parties by ensuring that all costs incurred by a utility to operate a community renewable system are recovered from program participants the same as occurs with other competitive providers.

VALUATION OF THE ENERGY PRODUCED BY THE RENEWABLE SYSTEM

At the heart of a successful community renewables program is the experience participants have as a result of their participation in a community solar project. In general, a threshold decision must be made on whether the net metering credits generated by a project should be transferred to participants as a 1:1 kWh offset on the customer's utility bill or whether the kilowatt-hours should be given a monetary value based on some other rate. Under most states' net metering programs, net metering credits generated by an on-site system are used to directly offset kilowatt-hours delivered by a utility when a customer-generator's consumption exceeds the energy supplied by a renewable energy system. Given most customer-generation is simply used on-site without requiring that a customer's billing meter spin backwards to earn net metering credits, this framework makes intuitive sense. However, the vast majority of participants in community solar projects will not have generation located behind a billing meter, so the link between excess production and 1:1 kWh offsets is not as important. Moreover, credits denominated in dollars and cents are often much easier for utilities to administer and often require fewer billing software changes. Accordingly, for ease of administration by utilities, IREC chose to allow kWh generated by a project to be given a monetary value that can be applied to participants' bills. In determining the appropriate monetary value to assign to kWh credits, three approaches are currently in use for community solar projects: (1) valuing a kWh credit based on the retail rate in effect where the project is located (MA does this), (2) valuing a credit based on a the retail rate in effect for the participant (CA does this), or (3) valuing a credit based on some other approach, such as the wholesale value of power production (ME's approach).

IREC chose the second approach for several reasons. First, valuing the kWh credit at the retail rate in effect for the participant maintains the ability of the project to act as a price hedge against future utility rate increases. Second, valuing the kWh credit at the participant's retail rate maintains an outcome that is as close as possible to the experience participants would have if they installed a solar energy system on-site. Third, transforming the kWh credit into a monetary credit should simplify the calculations required for customers that need to compensate a utility for the use of the distribution system. Finally, transforming kWh credits into a monetary credit allows customers that face demand charges to have their participation in solar generation recognized by valuing their kWh credits at a total aggregate retail rate.

COMPENSATING UTILITIES

One of the thorniest issues with development of community renewables programs is setting an appropriate compensation rate for utilities to administer programs. It should be relatively noncontroversial that utilities should be allowed to recoup their administrative fees. However, the propriety of allowing a utility to recover costs for distribution service is a more controversial topic, and one on which California and Massachusetts have taken different approaches.

In Massachusetts, net metering credits created by a "neighborhood net metered facility" do not contain the distribution portion of a fully bundled retail rate. As a result, participants in a "neighborhood" facility continue to pay distribution charges. However, participants do not pay transmission fees. At this point in time, the Massachusetts approach seems reasonable because neighborhood net-metered facilities are limited to 2 megawatts and participating customers may be located anywhere within a distribution utility's service territory. Although participating systems will be located close to load with no utilization of the transmission system, a utility would only need to be compensated for use of the distribution system.

Colorado's legislation appears to require a similar outcome; however, the Colorado Public Utilities Commission just began implementation of Colorado's program and this and other details are still being addressed. Thus, today it is unclear exactly how the benefits of customer participation in solar energy systems will be valued in Colorado's program.

Unlike Massachusetts, net metering credits are valued at a fully bundled retail rate in California. This outcome appears sensible because, unlike the Massachusetts' program, California's virtual net-metering program is available only to occupants of certain types of multi-tenant buildings. Thus, California participants will be located within the same building on the same distribution circuit and, as a consequence, use of the distribution system will be nonexistent or minimal.

IREC's Model Program rules take a nuanced approach to this issue by specifying that customers on the same distribution circuit as the community solar project will have their kWh credits valued at their full retail rate while also allowing a stakeholder process to determine an appropriate level of compensation for use of a utility's distribution system once a number of factors have been taken into account.

Panels on a Steep Roof, University Park, Maryland

IREC'S COMMUNITY RENEWABLES MODEL PROGRAM RULES

These rules were created by the Interstate Renewable Energy Council and The Vote Solar Initiative to serve as a guide for renewable energy stakeholders to consider during development of a community renewables policy to meet the needs of their state. They provide a framework for building a community renewables program that is additive to successful on-site renewable energy programs and uses solar, wind, hydro, biomass and other renewable energy sources to allow communities to promote local job growth. These program rules are solely the recommendation of the Interstate Renewable Energy Council and The Vote Solar Initiative and do not necessarily reflect the recommendation of the authors, the Department of Energy, or the National Renewable Energy Laboratory.

I. GENERAL PROVISIONS

(a) Subscriptions in a Community Energy Generating Facility may be transferred or assigned to a Subscriber Organization or to any person or entity that qualifies to be a Subscriber under these rules.

(b) New Subscribers may be added at the beginning of each billing cycle. The owner of a Community Energy Generating Facility or its designated agent shall inform the Electricity Provider of the following information concerning the Subscribers to the Community Energy Generating Facility on no more than a monthly basis: (1) a list of individual Subscribers by name, address, account number; (2) the proportional interest of each Subscriber in the Community Energy Generating Facility; and (3) for Subscribers who participate in meter aggregation, the rank order for the additional meters or accounts to which Net Metering credits are to be applied.

(c) A Subscriber may change the individual meters or accounts to which the Community Energy Generating Facility's electricity generation shall be attributed for that Subscriber no more than once quarterly, so long as the individual meters or accounts are eligible to participate.

(d) An Electricity Provider may require that customers participating in a Community Energy Generating Facility have their meters read on the same billing cycle.

(e) If the full electrical output of a stand-alone Community Energy Generating Facility or the excess generation from a hosted Community Energy Generating Facility is not fully allocated to Subscribers, the Electricity Provider shall purchase the unsubscribed energy at a kWh rate that reflects the full value of the generation. Such rate shall include the avoided cost of the energy, including any Locational Benefits of the Community Energy Generating Facility.

(f) If a Subscriber ceases to be a customer within the distribution service territory within which the Community Energy Generating Facility is located, the Subscriber must transfer or assign their Subscription back to their Subscriber Organization or to any person or entity that qualifies to be a Subscriber under these rules.

(g) If the Subscriber ceases to be a customer of the Electricity Provider or switches Electricity Providers, the Electricity Provider is not required to provide compensation to the Subscriber for any unused Net Metering credits.

(h) A Community Energy Generating Facility shall be deemed to be located on the premises of each Subscriber for the purpose of determining eligibility for state incentives.

(i) Neither the owners of, nor the Subscribers to, a Community Energy Generating Facility shall be considered public utilities subject to regulation by the [responsible agency having regulatory oversight] solely as a result of their interest in the Community Energy Generating Facility.

(j) Prices paid for Subscriptions in a Community Energy Generating Facility shall not be subject to regulation by the [responsible agency having regulatory oversight].

(k) A Subscriber owns the Renewable Energy Credits (RECs) associated with the electricity allocated to the

Subscriber's Subscription, unless such RECs were explicitly contracted for through a separate transaction independent of any Net Metering or interconnection tariff or contract. For a Community Energy Generating Facility located behind the meter of a participating Subscriber, the host Subscriber owns the RECs associated with the electricity consumed on-site, unless the RECs were explicitly contracted for through a separate transaction independent of any Net Metering or interconnection tariff or contract.

(l) The dispute resolution procedures available to parties in the Electricity Provider's interconnection tariff shall be available for the purposes of resolving disputes between an Electricity Provider and Subscribers or their designated representative for disputes involving the Electricity Provider's allocation of Net Metering credits to the Subscriber's electricity bill consistent with the allocations provided pursuant to Rule II.b. The Electricity Provider shall not be responsible for resolving disputes related to the agreements between a Subscriber, the owner of a Community Energy Generating Facility, and/or a Subscription Organization or any other party. This provision shall in no way limit any other rights the Subscriber may have related to an Electricity Provider's provision of electric service or other matters as provided by, but not limited to, tariff, decision of [responsible regulatory body or agency], or statute.

II. NET-METERING PROVISIONS

(a) An Electricity Provider shall not limit the cumulative, aggregate generating capacity of Community Energy Generating Facilities. [1]

(b) For a Community Energy Generating Facility, the total amount of electricity expressed in kWh available for allocation to Subscribers, and the total amount of RECs generated by the Community Energy Generating Facility and allocated to Subscribers, shall be determined by a production meter installed and paid for by the owner(s) of the Community Energy Generating Facility. It shall be the Electricity Provider's responsibility to read the production meter.

(c) For a hosted Community Energy Generating Facility, the determination of the quantity of kWh credits available to Subscribers of that facility for Net Metering, including the host Subscriber, shall be based on any energy production of the Community Energy Generating Facility that exceeds the host Subscriber's instantaneous on-site consumption during the applicable billing period and the Subscribers' Subscriptions in that Community Energy Generating Facility.

(d) For a stand-alone Community Energy Generating Facility, the determination of the quantity of kWh credits available to each Subscriber of that Community Energy Generating Facility for Net Metering shall be based on the total exported generation of the Community Energy Generating Facility and each Subscriber's Subscription in that Community Energy Generating Facility.

(e) For Subscribers that host a Community Energy Generating Facility or where participating Subscribers are located on the same distribution feeder as the Community Energy Generating Facility, the value of the kWh credits for the host Subscriber and those Subscribers on the same distribution feeder shall be calculated by multiplying the Subscriber's share of the kWh electricity production from the Community Energy Generating Facility by the retail rate for the Subscriber. For Subscribers on tariffs that contain demand charges, the retail rate for the Subscriber shall be calculated as the Total Aggregate Retail Rate for the Subscriber.

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1. This program rule is based upon IREC's Net Metering Model Rule (b)(2), which specifies that the cumulative, aggregate generating capacity net metered by on-site renewable generation facilities shall not be arbitrarily limited. Some states cap the total amount of aggregate Renewable Energy Generation that can be Net Metered for a particular Electricity Provider. Most commonly, aggregate enrollment caps are expressed as a percentage of an Electricity Provider's peak demand based on the aggregate of nameplate capacity of the generation systems (though it should be noted that capacity calculations are not standardized in their methodology across or even within states). Such percentages can vary from as low as 0.1% to as high as 20%. IREC believes aggregate caps arbitrarily and unnecessarily limit private investment in Renewable Energy Generation and needlessly curtail the flow of benefits that are associated with customer-side Renewable Energy Generation. For states that place an aggregate enrollment cap on net metered generation, that cap should be removed or expanded to ensure that community renewables programs do not undermine successful on-site programs.

(f) For all other Subscribers to a Community Energy Generating Facility, value of the kWh credits allocated to each Subscriber shall be calculated by multiplying the Subscriber's share of the electricity production from the Community Energy Generating Facility by the retail rate as charged to the Subscriber, minus a reasonable charge as determined by the [responsible agency having regulatory oversight] to cover the Electricity Provider's costs of delivering the electricity generated by the community electricity generating facility to the Subscriber's premises after taking into account the Locational Benefits and other benefits[2] provided by the Community Energy Generating Facility. The [responsible agency having regulatory oversight] shall ensure that this charge does not reflect costs that are already recovered by the Electricity Provider from the Subscriber through other charges. In no event, shall the charge, if assessed, be greater than the Subscriber's distribution service charge as determined on a per kWh basis.

(g) The Electricity Provider shall carry over any excess kWh credits earned by a Subscriber and not used in the current billing period to offset the Subscriber's consumption in subsequent billing periods until all credits are used. Any excess kWh credits shall not reduce any fixed monthly customer charges imposed by the Electricity Provider.

III. DEFINITIONS. AS USED WITHIN THESE RULES, UNLESS THE CONTEXT OTHERWISE REQUIRES:

(a) "Biomass" means a power source that is comprised of, but not limited to, combustible residues or gases from forest products manufacturing; waste, byproducts, or products from agricultural and orchard crops; waste or co-products from livestock and poultry operations; waste or byproducts from food processing, urban wood waste, municipal liquid waste treatment operations, and landfill gas.[3]

(b) "Community Energy Generating Facility" means Renewable Energy Generation that is interconnected at the distribution system level and that is located in or near a community served by an Electricity Provider where the electricity generated by the facility is credited to the Subscribers to the facility. A Community Energy Generating Facility may be located either as a stand-alone facility, called herein a stand-alone Community Energy Generating Facility, or behind the meter of a participating Subscriber, called herein a hosted Community Energy Generating Facility. A Community Energy Generating Facility may be no larger than two megawatts (MW). A Community Energy Generating Facility must have at least two Subscribers.

(c) "Electricity Provider" means the jurisdictional entity that is required to offer Net Metering service to Subscribers pursuant to [code section for applicable Net Metering rules].

(d) "Locational Benefits" mean the benefits accruing to the Electricity Provider due to the location of the Community Energy Generating Facility on the distribution grid. Locational Benefits include such benefits as avoided transmission and distribution system upgrades, reduced transmission and distribution level line losses, and ancillary services.

(e) "Net Metering" means a methodology under which electric energy generated by or on behalf of a Subscriber and delivered to the Electricity Provider's local distribution facilities may be used to offset electric energy provided by the Electricity Provider to the Subscriber during the applicable billing period.

(f) "Renewable Energy Credit" means a tradable instrument that includes all renewable and environmental attributes associated with the production of electricity from a Community Energy Generating Facility.

(g) "Renewable Energy Generation" means an electrical energy generation system that uses one or more of the following fuels or energy sources: Biomass, solar energy, geothermal energy, wind energy, ocean energy, hydroelectric power, or hydrogen produced from any of these resources.

2. These benefits can often include capacity payments or energy market payments obtained by the Electricity Provider as provided for under the relevant independent system operator's tariff.
3. The definition of Biomass may need to be adjusted to reflect state renewable portfolio standard definitions.

(h) "Subscriber" means a retail customer of a utility who owns a Subscription and who has identified one or more individual meters or accounts to which the Subscription shall be attributed. Such individual meters or accounts shall be within the same Electricity Provider's distribution service territory as the Community Energy Generating Facility.

(i) "Subscriber Organization" means an organization whose sole purpose is to beneficially own and operate a Community Energy Generating Facility for the Subscribers of the Community Energy Generating Facility. A Subscriber Organization may be any for-profit or non-profit entity permitted by [state] law. The Community Energy Generating Facility may also be built, owned, and operated by a third party under contract with the Subscriber Organization.

(j) "Subscription" means an interest in a Community Energy Generating Facility. Each Subscription shall be sized to represent at least one kilowatt of the Community Energy Generating Facility's generating capacity; provided, however, that the Subscription is sized to produce no more than 120% of the Subscriber's average annual electrical consumption. For Subscribers participating in meter aggregation, 120% of the Subscriber's aggregate electrical consumption may be based on the individual meters or accounts that the Subscriber wishes to aggregate pursuant to these rules. In sizing the Subscription, a deduction for the amount of any existing renewable energy generation at the Subscriber's premises or any Subscriptions owned by the Subscriber in other Community Energy Generating Facilities shall be made.

(k) "Total Aggregate Retail Rate" means the total retail rate that would be charged to a Subscriber if all electric rate components of the Subscriber's electric bill, including any riders or other additional tariffs, except for minimum monthly charges, such as meter reading fees or customer charges, were expressed as per kilowatt-hour (kWh) charges.

End Notes

i. See www.nrel.gov/docs/fy09osti/44073.pdf, p. 4.

ii. Warren, Deborah B; and Steve Dubb. June 2010. TheDemocracy Collaborative at the University of Maryland. Growing a Green Economy for All: From Green Jobs to Green Ownership. p. 22.

iii. It may be that the tax benefits of the ITC are not readily accessible to the for-profit utilities, due to the normalization accounting rules.

iv. Alvarez, Paul and Benjamin Hodges, "Buying Into Solar" Public Utilities Fortnightly, December 2009 p. 57

v. 26 USC 136 states that subsidies from public utilities for energy conservation measures are not taxable. For example, Washington state's production incentive was ruled to be not income. See apps.leg.wa.gov/WAC/default.aspx?cite=458-20-273.

vii. Rural electric co-ops are consumer co-ops, formed for the purpose of delivering electric service to rural communities and financed by federal loans; these are distinct from a special purpose entity cooperative, formed to produce solar power and sell it to a utility. In the case of the rural electric co-op, the member/customers do not provide financing, they merely purchase electricity. In the case of a special purpose entity co-op, the members would provide the capital to build the project and they would not necessarily purchase any of the output.

viii. See www.irs.gov/businesses/small/article/0,,id=146330,00.html for more information on passive income.

ix. To see a list of IRS material participation tests and other details about passive activity and at-risk rules, see IRS Publication 925, available at www.irs.gov/pub/irs-pdf/p925.pdf.

x. For an individual to be considered an accredited investor, he or she must have either: 1) a net worth of more than $1 million or 2) an annual income of $200,000 ($300,000 jointly with a spouse) in each of the most recent two years and a reasonable expectation of having the same income level in the current year.

xi. Tangerine Solar, LLC, based in Washington State has created a legal and business model for a solar power co-op but has not built any projects yet.

xii. The Portland Habilitation Center Northwest, a non-profit organization partnered with U.S. Bancorp Community Development Corporation who will own and finance an 870 kW system to provide energy to the non-profit.

xiiii. Please see the Northwest Community Solar Guide for more information on this project. www.nwseed.org/Educational%20 Resources/publications/default.asp.

xiv. See Vermont Public Service Board Rule 5.100 available at: psb.vermont.gov/sites/psb/files/rules/OfficialAdoptedRules/5100 adoptedrule_2.pdf.

xv. See generally Multifamily Affordable Solar Housing Semiannual Report, January 20, 2010 available at: www.cpuc.ca.gov/ NR/rdonlyres/B3644285-F573-428F-AA0A-A2497A30401B/0/MASHSemiAnnualReport.pdf.

xvi. See www.mainelegislature.org/legis/bills/bills_124th/chapters/PUBLIC329.asp.

xvii. See mpuc.informe.org/easyfile/easyweb.php?func=easyweb_docview&docid= 77134&img_rng=217284&vol_id=2.

xviii. See 4 CCR 723-3 Rule 3652 (c).

xix. See Colorado House Bill 10-1342 available at: www.leg.state.co.us/.

xx. See www.stoel.com/showalert.aspx?Show=6569.

xxi. Bolinger, Mark, Financing Non-Residential Photovoltaic Projects: Options and Implications, LBNL January 2009, eetd.lbl. gov/EA/EMP/reports/lbnl-1410e.pdf.

xxii. See Utah Code 59-7-614.3 www.le.state.ut.us/~code/TITLE59/htm/59_07_061403.htm.

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MICHIGAN

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Michigan utility's gas plant, pipeline plans pose conflict of interest, critics say

Andy Balaskovitz | January 25, 2018

DTE Energy wants to build a natural gas plant near Detroit that could become a customer of a pipeline co-owned by one of its affiliated companies.

Critics of Michigan's DTE Energy say the utility's proposal to build a $1 billion natural gas plant would pose a conflict of interest if the plant becomes a customer of a gas pipeline under construction by one of DTE's affiliated companies.

Nexus Gas Transmission Co. is building the 255-mile NEXUS pipeline (http://www.nexusgastransmission.com/content/project-overview-map) from eastern Ohio to southeastern Michigan. The company is co-owned by DTE and Spectra Energy Partners, a subsidiary of Enbridge. It's expected to be in service later this year.

Meanwhile, DTE is seeking approval from Michigan regulators to build a 1,100-megawatt natural gas plant (http://newsroom.dteenergy.com/2017-08-01-DTE-Energy-seeks-to-build-efficient-natural-gas-plant-in-Michigan#sthash.HVGjOaOF.MP0QNCBZ.dpbs) northeast of Detroit. Company officials say it is seeking proposals for the plant's gas supply. The pipeline's capacity is only about 60 percent subscribed so far, and DTE's gas plant would give it a new customer and help ensure its profitability, said James Clift, policy director for the Michigan Environmental Council.

"When an affiliated company is looking to make money off of a natural gas pipeline, we're worried that this is basically biasing the company in favor of natural gas" over other options, such as renewables, energy efficiency and demand response, Clift said.

The Michigan Environmental Council and Union of Concerned Scientists are among groups (https://mi-psc.force.com/s/case/500t0000008eg3aAAA/in-the-matter-of-the-application-of-dte-electric-company-for-approval-of-certificates-of-necessity-pursuant-to-mcl-4606s-as-amended-in-connection-with-the-addition-of-a-natural-gas-combined-cycle-generating-facility-to-its-generation-fleet-and-for-rela) challenging the proposed gas plant before the Michigan Public Service Commission. The groups filed detailed testimony this month claiming the plant would be significantly more expensive than clean energy options.

"It's sort of the embodiment of a wholesale shift to natural gas," Sam Gomberg, a senior analyst with the Union of Concerned Scientists, said. "It's not about just owning gas plants, it's about having an interest in the extraction and transport as well. I think it's a risky business model."

The company recently issued a competitive bid for the transportation, storage and supply for the proposed power plant in St. Clair County, DTE Electric President Trevor Lauer said. Currently, DTE's electric and gas companies combined account for less than 10 percent of NEXUS' subscribed capacity, he said.

"We're not a significant off-take to the NEXUS pipeline," Lauer said, adding that there are several other gas pipelines near the proposed plant site.

"We have not made a decision. NEXUS and all others are welcome to bid" to supply the proposed plant, Lauer said.

Conflict of interest?

Clift doesn't buy it.

"In the short term they might be doing some competitive bidding, but in the long term they're hanging their hat on the NEXUS pipeline," Clift said.

Multiple regulatory filings suggest DTE is interested in contracting with NEXUS for additional gas supplies, Clift said. The gas plant would more than double the amount DTE would already take from NEXUS, increasing the pipeline's subscribed off-take by 3 percent. The pipeline will have a capacity of 1.5 billion cubic feet per day.

Philip DiDomenico, who testified this month (https://mi-psc.force.com/sfc/servlet.shepherd/version/download/068t0000001eLBO?casenum=18152&submit.x=0&submit.y=0) on behalf of the Michigan Attorney General's Office, said DTE committed to a "maximum daily quantity" of 30,000 decatherms per day at the time of Nexus' in-service date. The company also requested the right to more than double that amount to 75,000 decatherms per day with the addition of the proposed power plant.

Using NEXUS means DTE is "less dependent on marketers and more in control of its own destiny as it increases natural gas-fired electric generation capacity," DiDomenico added.

When asked during testimony if he had concerns about the NEXUS contract in relation to the proposed plant, DiDomenico said, "Yes, I do. While the company does not request approval of the NEXUS contract in this proceeding, it is clear that this contract is a key component of its strategy to support increasing gas-fired generation with firm gas supply service."

Despite the Federal Energy Regulatory Commission's approval of NEXUS (https://www.utilitydive.com/news/ferc-approves-nexus-gas-pipeline-project/503745/) in August, analysts have raised questions about whether its capacity is needed based on the availability in existing pipelines and Michigan's large storage capabilities.

DTE Electric and DTE Gas sought approval from state regulators in 2016 to spread their share of NEXUS costs among ratepayers. Opponents raised concerns (http://energynews.us/2016/04/27/opponents-say-nexus-pipeline-would-be-bad-deal-for-michigan-ratepayers/) about a potential violation of the Public Service Commission's code of conduct rules involving regulated utilities and affiliates.

Because NEXUS had not yet incurred costs for the project, the commission effectively punted on the issue (https://mi-psc.force.com/sfc/servlet.shepherd/version/download/068t0000001UPyo?casenum=17920&submit.x=7&submit.y=12) and declined to issue a warning to the company.

"Costs associated with NEXUS should not be recoverable absent a transparent evidentiary presentation examining the full nature of the NEXUS arrangements," the order said. "The Commission prefers to examine these issues more holistically."

Clift said potential code of conduct violations are still a concern.

"DTE should have the extra burden of showing this contract is in the best interest of ratepayers since clearly it's a conflict of interest on behalf of DTE and its holding company," Clift said.

Lauer said there are clear rules regulated entities like DTE have to follow when doing business with unregulated affiliates. The company competitively bids for resources in the interest of getting the best deal for ratepayers, he said.

"We have no bias at the electric company towards a DTE affiliate," Lauer said.

The cheaper option?

Meanwhile, state utility regulators could decide in April whether to approve DTE's plan for the natural gas plant. The company and its opponents disagree on whether the 1,100 MW plant is the most "reasonable and prudent" option for customers.

Clean energy groups say DTE's modeling is biased to favor gas over renewables, which they claim could save DTE customers hundreds of millions of dollars over the life of the plant. Specifically, the company's models didn't value energy efficiency and renewables enough into the future, they said. Clift and Gomberg also said the company forecasted unreasonably large blocks of renewable energy would have to be purchased at a time, and they underestimated the volume of contracts likely to come in from independent producers under Public Utility Regulatory Policies Act (PURPA) changes that are expected to boost the number of solar projects in Michigan.

"This tends to bias the modeling and analysis towards what they want to do, which is build natural gas plants," Gomberg said. "Do I think DTE has met their burden of proof (that gas is the more cost-effective option)? No."

Renewable and demand-side options also don't rely on fuel prices, making them "much less risky" than natural gas, Clift said.

Paul Proudfoot, director of the Public Service Commission's electric reliability division, said in testimony that DTE showed a need for the new plant but also said that commissioners could still deny it or require "a more robust analysis and presentation."

Meanwhile, industrial energy users say it would be cheaper for DTE to keep three coal plants open (https://www.eenews.net/stories/1060070997) due to anticipated savings under federal tax reform and other federal energy policies favoring coal.

Lauer says the company ran more than 50 different scenarios that relied on varying degrees of natural gas, renewables and demand-side options like efficiency. He said the company will continue to pursue renewable energy as part of a "balanced portfolio."

"The best (scenario) for our customers was to build this 1,100 MW plant, but to continue to build renewables and do energy efficiency," he said. "We reject (claims) this was biased to favor gas generation."

Last year DTE announced plans to reduce carbon emissions by more than 80 percent by 2050, which includes adding 4,000 MW of renewables. The proposed gas plant would help replace 2,000 MW from three aging coal plants in southeastern Michigan the company wants to retire. Lauer added that while the company has been experimenting with battery storage projects that could accompany renewables like wind and solar, "the technology isn't mature enough today."

Critics ultimately hope new statewide energy laws (http://www.michigan.gov/mpsc/0,4639,7-159-80741---,00.html) passed at the end 2016, which require utilities to do detailed forecasting on generation needs and outlines new rules when showing the need for new generation, will act as a stopgap to DTE's proposal as the utility replaces aging coal plants.

Electricity Innovation Lab
ROCKY MOUNTAIN INSTITUTE

A REVIEW OF SOLAR PV BENEFIT & COST STUDIES

2nd Edition

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2nd Edition, published September 2013
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Electricity Innovation Lab
ROCKY MOUNTAIN INSTITUTE

ABOUT THIS DOCUMENT

This report is a 2nd edition released in September 2013. This second edition updates the original with the inclusion of Xcel Energy's May 2013 study,* Costs and Benefits of Distributed Solar Generation on the Public Service Company of Colorado*, as well as clarifies select descriptions and charts.

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OBJECTIVE AND ACKNOWLEDGEMENTS

The objective of this e-Lab discussion document is to assess what is known and unknown about the categorization, methodological best practices, and gaps around the benefits and costs of distributed photovoltaics (DPV), and to begin to establish a clear foundation from which additional work on benefit/cost assessments and pricing structure development can be built.

Building on initial research conducted as part of Rocky Mountain Institute's (RMI) DOE SunShot funded project, Innovative Solar Business Models, this e-Lab work product was prepared by RMI to support e-Lab and industry-wide discussions about distributed energy resource valuation. e-Lab is a joint collaboration, convened by RMI, with participation from stakeholders across the electricity industry. e-Lab is not a consensus organization, and the views expressed in this document do not necessarily represent those of any individual e-Lab member or supporting organizations. Any errors are solely the responsibility of RMI.

e-Lab members and advisors were invited to provide input on this report. The assessment greatly benefited from contributions by the following individuals: Stephen Frantz, Sacramento Municipal Utility District (SMUD); Mason Emnett, Federal Energy Regulatory Commission (FERC); Eran Mahrer, Solar Electric Power Association (SEPA); Sunil Cherian, Spirae; Karl Rabago, Rabago Energy; Tom Brill and Chris Yunker, San Diego Gas & Electric (SDG&E); and Steve Wolford, Sunverge.

WHAT IS e-LAB?

The Electricity Innovation Lab (e-Lab) brings together thought leaders and decision makers from across the U.S. electricity sector to address critical institutional, regulatory, business, economic, and technical barriers to the economic deployment of distributed resources.

In particular, e-Lab works to answer three key questions:

- How can we understand and effectively communicate the costs and benefits of distributed resources as part of the electricity system and create greater grid flexibility?
- How can we harmonize regulatory frameworks, pricing structures, and business models of utilities and distributed resource developers for greatest benefit to customers and society as a whole?
- How can we accelerate the pace of economic distributed resource adoption?

A multi-year program, e-Lab regularly convenes its members to identify, test, and spread practical solutions to the challenges inherent in these questions. e-Lab has three annual meetings, coupled with ongoing project work, all facilitated and supported by Rocky Mountain Institute. e-Lab meetings allow members to share learnings, best practices, and analysis results; collaborate around key issues or needs; and conduct deep-dives into research and analysis findings.

EXECUTIVE SUMMARY

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Electricity Innovation Lab
ROCKY MOUNTAIN INSTITUTE

EXECUTIVE SUMMARY

THE NEED

- The addition of distributed energy resources (DERs) onto the grid creates new opportunities and challenges because of their unique siting, operational, and ownership characteristics compared to conventional centralized resources.

- Today, the increasingly rapid adoption of distributed solar photovoltaics (DPV) in particular is driving a heated debate about whether DPV creates benefits or imposes costs to stakeholders within the electricity system. But the wide variation in analysis approaches and quantitative tools used by different parties in different jurisdictions is inconsistent, confusing, and frequently lacks transparency.

- Without increased understanding of the benefits and costs of DERs, there is little ability to make effective tradeoffs between investments.

OBJECTIVE OF THIS DOCUMENT

- The objective of this e-Lab discussion document is to assess what is known and unknown about the categorization, methodological best practices, and gaps around the benefits and costs of DPV, and to begin to establish a clear foundation from which additional work on benefit/cost assessments and pricing structure design can be built.

- This discussion document reviews 16 DPV benefit/cost studies by utilities, national labs, and other organizations. Completed between 2005 and 2013, these studies reflect a significant range of estimated DPV value.

KEY INSIGHTS

- No study comprehensively evaluated the benefits and costs of DPV, although many acknowledge additional sources of benefit or cost and many agree on the broad categories of benefit and cost. There is broad recognition that some benefits and costs may be difficult or impossible to quantify, and some accrue to different stakeholders.

- There is a significant range of estimated value across studies, driven primarily by differences in local context, input assumptions, and methodological approaches.

    - **Local context**: Electricity system characteristics—generation mix, demand projections, investment plans, market structures—vary across utilities, states, and regions.
    - **Input assumptions**: Input assumptions—natural gas price forecasts, solar power production, power plant heat rates—can vary widely.
    - **Methodologies**: Methodological differences that most significantly affect results include (1) resolution of analysis and granularity of data, (2) assumed cost and benefit categories and stakeholder perspectives considered, and (3) approaches to calculating individual values.

- Because of these differences, comparing results across studies can be informative, but should be done with the understanding that results must be normalized for context, assumptions, or methodology.

- While detailed methodological differences abound, there is general agreement on overall approach to estimating energy value and some philosophical agreement on capacity value, although there remain key differences in capacity methodology. There is significantly less agreement on overall approach to estimating grid support services and currently unmonetized values including financial and security risk, environment, and social value.

EXECUTIVE SUMMARY (CONT'D)

IMPLICATIONS

- Methods for identifying, assessing and quantifying the benefits and costs of DPV and other DERs are advancing rapidly, but important gaps remain to be filled before this type of analysis can provide an adequate foundation for policymakers and regulators engaged in determining levels of incentives, fees, and pricing structures for DPV and other DERs.
- In any benefit/cost study, it is critical to be transparent about assumptions, perspectives, sources and methodologies so that studies can be more readily compared, best practices developed, and drivers of results understood.
- While it may not be feasible to quantify or assess sources of benefit and cost comprehensively, benefit/cost studies must explicitly decide if and how to account for each source of value and state which are included and which are not.
- While individual jurisdictions must adapt approaches based on their local context, standardization of categories, definitions, and methodologies should be possible to some degree and will help ensure accountability and verifiability of benefit and cost estimates that provide a foundation for policymaking.
- The most significant methodological gaps include:
    - **Distribution value:** The benefits or costs that DPV creates in the distribution system are inherently local, so accurately estimating value requires much more analytical granularity and therefore greater difficulty.
    - **Grid support services value:** There continues to be uncertainty around whether and how DPV can provide or require additional grid support services, but this could potentially become an increasingly important value.
    - **Financial, security, environmental, and social values:** These values are largely (though not comprehensively) unmonetized as part of the electricity system and some are very difficult to quantify.

LOOKING AHEAD

- Thus far, studies have made simplifying assumptions that implicitly assume historically low penetrations of DPV. As the penetration of DPV on the electric system increases, more sophisticated, granular analytical approaches will be needed and the total value is likely to change.
- Studies have largely focused on DPV by itself. But a confluence of factors is likely to drive increased adoption of the full spectrum of renewable and distributed resources, requiring a consideration of DPV's benefits and costs in the context of a changing system.
- With better recognition of the costs and benefits that all DERs can create, including DPV, pricing structures and business models can be better aligned, enabling greater economic deployment of these resources and lower overall system costs for ratepayers.

FRAMING THE NEED

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FRAMING THE NEED

- A confluence of factors including rapidly falling solar prices, supportive policies, and new approaches to finance are leading to a steadily increasing solar PV market.
    - In 2012, the US added 2 GW of solar PV to the nation's generation mix, of which approximately 50% were customer-sited solar, net-metered projects.[1]
    - Solar penetrations in certain regions are becoming significant. About 80% of customer-sited PV is concentrated in states with either ample solar resource and/or especially solar-friendly policies: California, New Jersey, Arizona, Hawaii and Massachusetts.[2]
- The addition of DPV onto the grid creates new challenges and opportunities because of its unique siting, operational, and ownership characteristics compared to conventional centralized resources. The value of DPV is temporally, operationally and geographically specific and varies by distribution feeder, transmission line configuration, and composition of the generation fleet.
- Under today's regulatory and pricing structures, multiple misalignments along economic, social and technical dimensions are emerging. For example, in many instances pricing mechanisms are not in place to recognize or reward service that is being provided by either the utility or customer.
- Electricity sector stakeholders around the country are recognizing the importance of properly valuing DPV and the current lack of clarity around the costs and benefits that drive DPV's value, as well as how to calculate them.
- To enable better technical integration and economic optimization, it is critical to better understand the services that DPV can provide and require, and the benefits and costs of those services as a foundation for more accurate pricing and market signals. As the penetration of DPV and other customer-sited resources increases, accurate pricing and market signals can help align stakeholder goals, minimize total system cost, and maximize total net value.

Photo courtesy of Shutterstock

1. Solar Electric Power Association. June 2013. *2012 SEPA Utility Solar Rankings,* Washington, DC.
2. Ibid.

DPV IN THE BROADER CONTEXT OF DISTRIBUTED ENERGY RESOURCES

DISTRIBUTED ENERGY RESOURCES (DERs): demand- and supply-side resources that can be deployed throughout an electric distribution system to meet the energy and reliability needs of the customers served by that system. DERs can be installed on either the customer side or the utility side of the meter.

TYPES OF DERs:

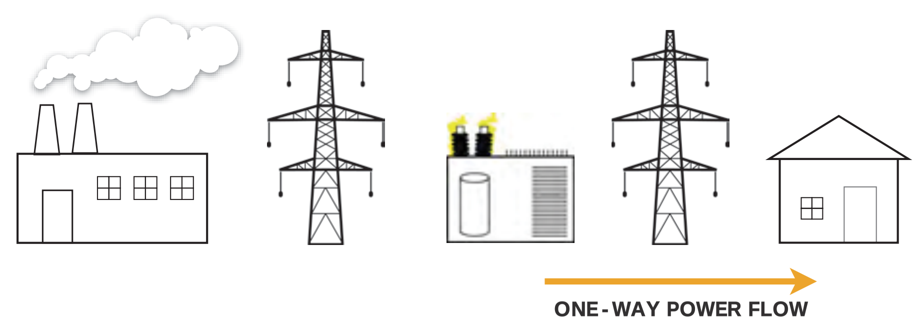
Efficiency
Technologies and behavioral changes that reduce the quantity of energy that customers need to meet all of their energy-related needs.

Distributed generation
Small, self-contained energy sources located near the final point of energy consumption. The main distributed generation sources are:
- Solar PV
- Combined heat & power (CHP)
- Small-scale wind
- Others (i.e., fuel cells)

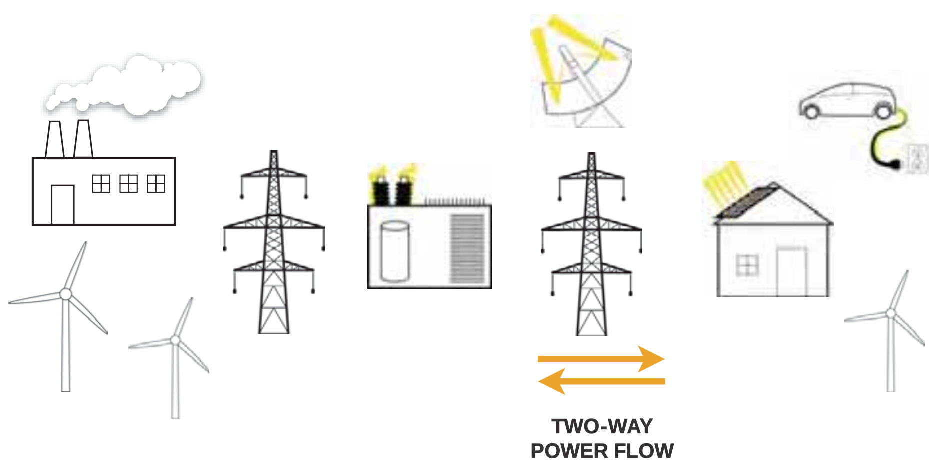
Distributed flexibility & storage
A collection of technologies that allows the overall system to use energy smarter and more efficiently by storing it when supply exceeds demand, and prioritizing need when demand exceeds supply. These technologies include:
- Demand response
- Electric vehicles
- Thermal storage
- Battery storage

Distributed intelligence
Technologies that combine sensory, communication, and control functions to support the electricity system, and magnify the value of DER system integration. Examples include:
- Smart inverters
- Home-area networks
- Microgrids

CURRENT SYSTEM/VALUE CHAIN:



FUTURE SYSTEM/VALUE CONSTELLATION:



WHAT MAKES DERs UNIQUE:

Siting
Smaller, more modular energy resources can be installed by disparate actors outside of the purview of centrally coordinated resource planning.

Operations
Energy resources on the distribution network operate outside of centrally controlled dispatching mechanisms that control the real-time balance of generation and demand.

Ownership
DERs can be financed, installed or owned by the customer or a third party, broadening the typical planning capability and resource integration approach.

STRUCTURAL MISALIGNMENTS

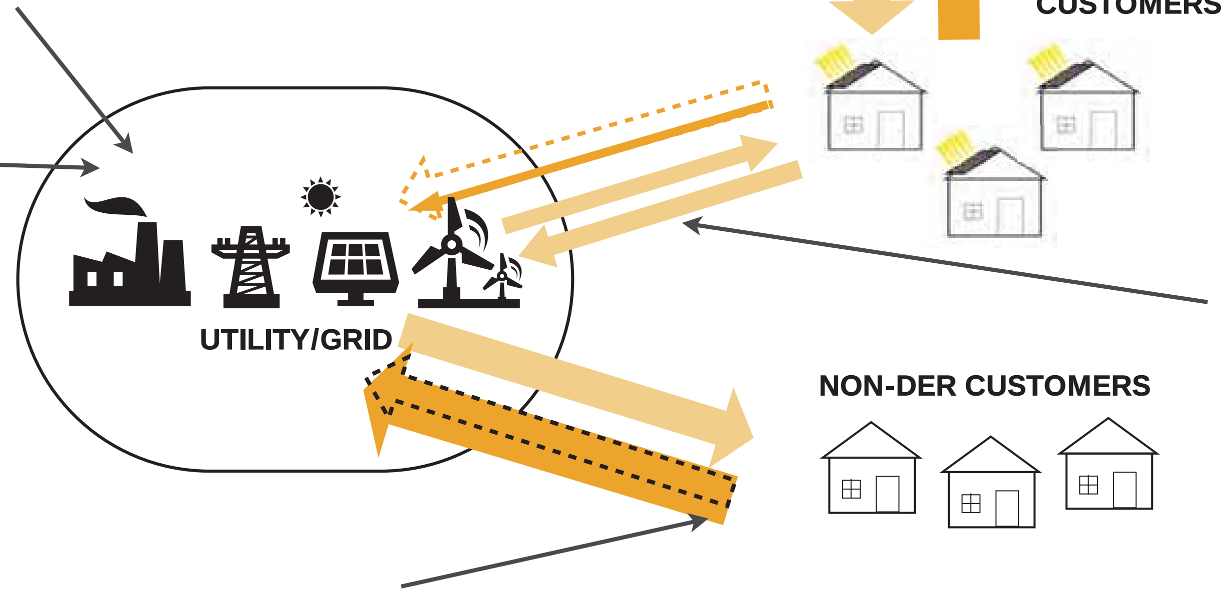
TODAY, OPERATIONAL AND PRICING MECHANISMS DESIGNED FOR AN HISTORICALLY CENTRALIZED ELECTRICITY SYSTEM ARE NOT WELL-ADAPTED TO THE INTEGRATION OF DERS, CAUSING FRICTION AND INEFFICIENCY

FLEXIBILITY & PREDICTABILITY

Providing reliable power requires grid flexibility and predictability. Power from some distributed renewables fluctuate with the weather, adding variability, and require smart integration to best shape their output to the grid. Legacy standards and rules can be restrictive.

LOCATION & TIME

Limited feedback loop to customers that the costs or benefit of any electricity resource, especially DERs, vary by location and time.



BENEFIT AND COST RECOGNITION AND ALLOCATION

Mechanisms are not in place to transparently recognize or compensate service (be it monetized grid services like energy, capacity or balancing supply and demand, or less consistently monetized values, such as carbon emissions savings) provided by the utility or the customer. To the utility, revenue from DER customers may not match the cost to serve those customers. To the customer, bill savings or credit may not match the value provided.

SOCIAL PRIORITIES

Society values the environmental and social benefits that DERs could provide, but those benefits are often externalized and unmonetized.

SOCIAL EQUITY

If costs are incurred by DER customers that are not paid for, those costs would be allocated to the rest of customers. Conversely, DER customers also provide benefits to other customers and to society.

$$ service

Adapted from RMI, Net Energy Metering, Zero Net Energy And The Distributed Energy Resource Future: Adapting Electric Utility Business Models For The 21st Century

STRUCTURAL MISALIGNMENTS IN PRACTICE

THESE STRUCTURAL MISALIGNMENTS ARE LEADING TO IMPORTANT QUESTIONS, DEBATE, AND CONFLICT

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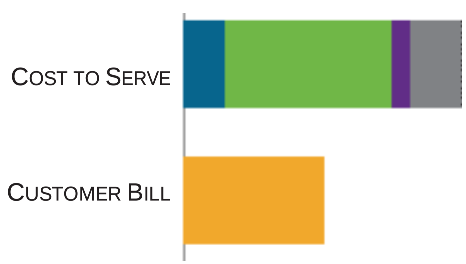
VALUE UNCERTAINTY...

WHAT IF A DPV CUSTOMER DOES NOT PAY FOR THE FULL COST TO SERVE THEIR DEMAND?



WHAT IF A DPV CUSTOMER IS NOT FULLY COMPENSATED FOR THE SERVICE THEY PROVIDE?

Customer Payment
Generation Cost
Distribution Cost
Transmission Cost
Other Costs

...DRIVES HEADLINES...

...RAISING KEY QUESTIONS

- What benefits can customers provide? Is the ability of customers to provide benefits contingent on anything?
- What costs are incurred to support DPV customer needs?
- What are the best practice methodologies to assess benefits and costs?
- How should externalized and unmonetized values, such as environmental and social benefits, be recognized?
- How can benefits and costs be more effectively allocated and priced?

SETTING THE STAGE

02

- defining value
- categories of value
- stakeholder implications

SETTING THE STAGE

- When considering the total value of DPV or any electricity resource, it is critical to consider the types of value, the stakeholder perspective and the flow of benefits and costs–that is, who incurs the costs and who receives the benefits (or avoids the costs).

- For the purposes of this report, value is defined as net value, i.e. benefits minus costs. Depending upon the size of the benefit and the size of the cost, value can be positive or negative.

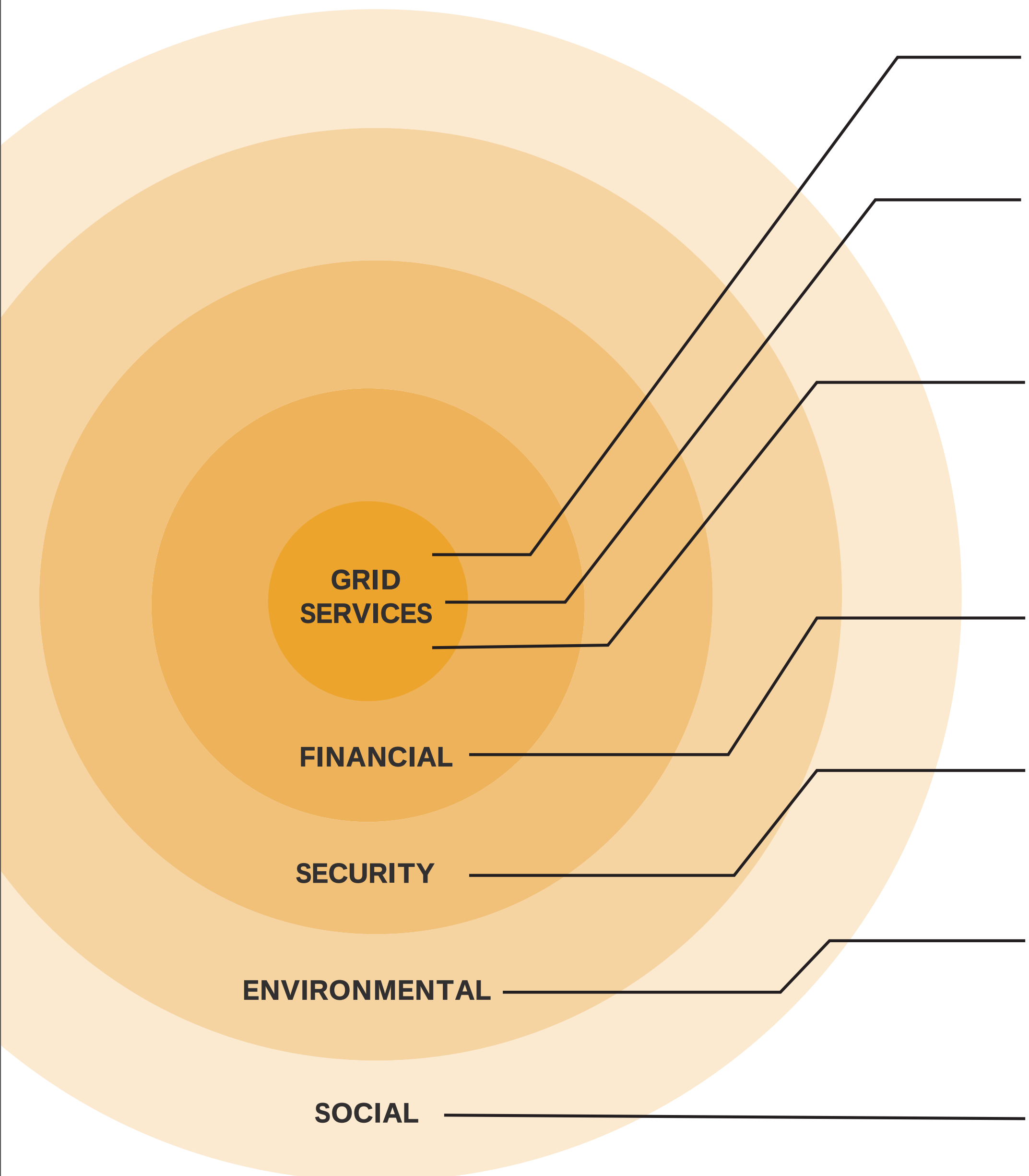
- A variety of categories of benefits or costs of DPV have been considered or acknowledged in evaluating the value of DPV. Broadly, these categories are: energy, system losses, capacity (generation, transmission and distribution), grid support services, financial risk, security risk, environmental and social.

- These categories of costs and benefits differ significantly by the degree to which they are readily quantifiable or there is a generally accepted methodology for doing so. For example, there is general agreement on overall approach to estimating energy value and some philosophical agreement on capacity value, although there remain key differences in capacity methodology. There is significantly less agreement on overall approach to estimating grid support services and currently unmonetized values including financial and security risk, environment, and social value.

- Equally important, the qualification of whether a factor is a benefit or cost also differs depending upon the perspective of the stakeholder. Similar to the basic framing of testing cost effectiveness for energy efficiency, the primary stakeholders in calculating the value of DPV are: the participant (the solar customer); the utility; other customers (also referred to as ratepayers); and society (taxpayers are a subset of society).

BENEFIT & COST CATEGORIES

For the purposes of this report, **value is defined as net value, i.e. benefits minus costs.** Depending upon the size of the benefit and the size of the cost, value can be positive or negative. A variety of categories of benefits or costs of DPV have been considered or acknowledged in evaluating the value of DPV. Broadly, these categories are:



ENERGY
- energy
- system losses

CAPACITY
- generation capacity
- transmission & distribution capacity
- DPV installed capacity

GRID SUPPORT SERVICES
- reactive supply & voltage control
- regulation & frequency response
- energy & generator imbalance
- synchronized & supplemental operating reserves
- scheduling, forecasting, and system control & dispatch

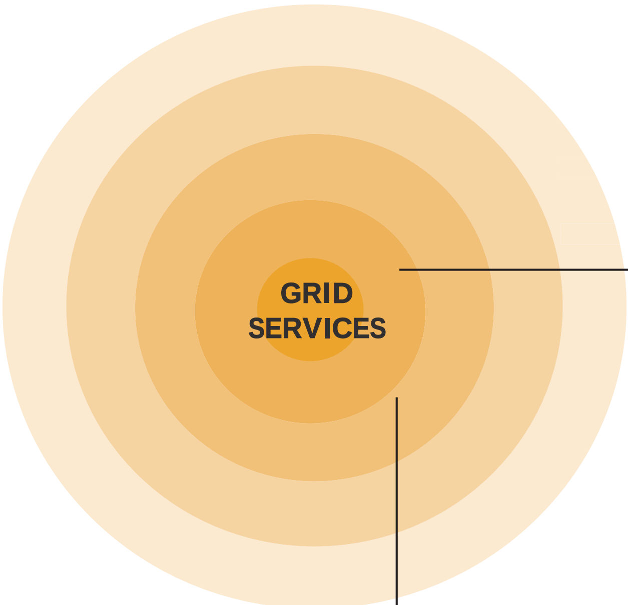
FINANCIAL RISK
- fuel price hedge
- market price response

SECURITY RISK
- reliability & resilience

ENVIRONMENTAL
- carbon emissions (CO_2)
- criteria air pollutants (SO_2, NO_x, PM)
- water
- land

SOCIAL
- economic development (jobs and tax revenues)

BENEFIT & COST CATEGORIES DEFINED



ENERGY

Energy value of DPV is positive when the solar energy generated displaces the need to produce energy from another resource at a net savings. There are two primary components:

- **Avoided Energy** - The cost and amount of energy that would have otherwise been generated to meet customer needs, largely driven by the variable costs of the marginal resource that is displaced. In addition to the coincidence of solar generation with demand and generation, key drivers of avoided energy cost include (1) fuel price forecast, (2) variable operation & maintenance costs, and (3) heat rate.

- **System Losses** - The compounded value of the additional energy generated by central plants that would otherwise be lost due to inherent inefficiencies (electrical resistance) in delivering energy to the customer via the transmission and distribution system. Since DPV generates energy at or near the customer, those losses are avoided. Losses act as a magnifier of value for capacity and environmental benefits, since avoided energy losses result in lower required capacity and lower emissions.

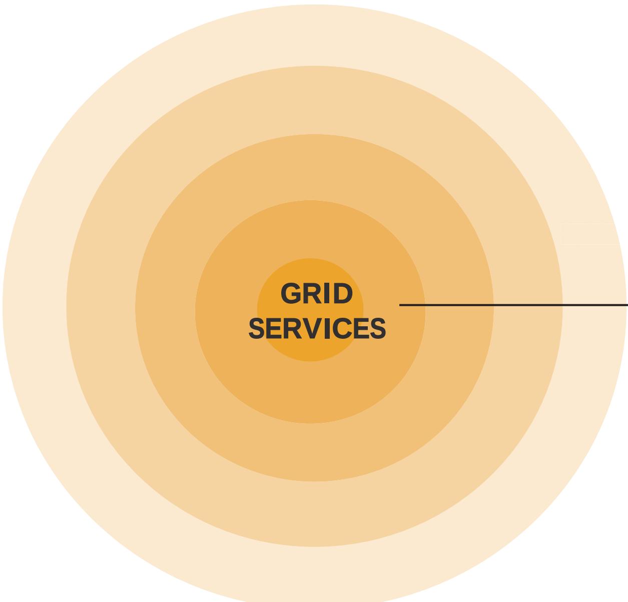
CAPACITY

Capacity value of DPV is positive when the addition of DPV defers or avoids more investment in generation, transmission, and distribution assets than it incurs. There are two primary components:

- **Generation Capacity** - The cost of the amount of central generation capacity that can be deferred or avoided due to the addition of DPV. Key drivers of value include (1) DPV's effective capacity and (2) system capacity needs.

- **Transmission & Distribution Capacity** - The value of the net change in T&D infrastructure investment due to DPV. Benefits occur when DPV is able to meet rising demand locally, relieving capacity constraints upstream and deferring or avoiding T&D upgrades. Costs occur when additional T&D investment is needed to support the addition of DPV.

BENEFIT & COST CATEGORIES DEFINED

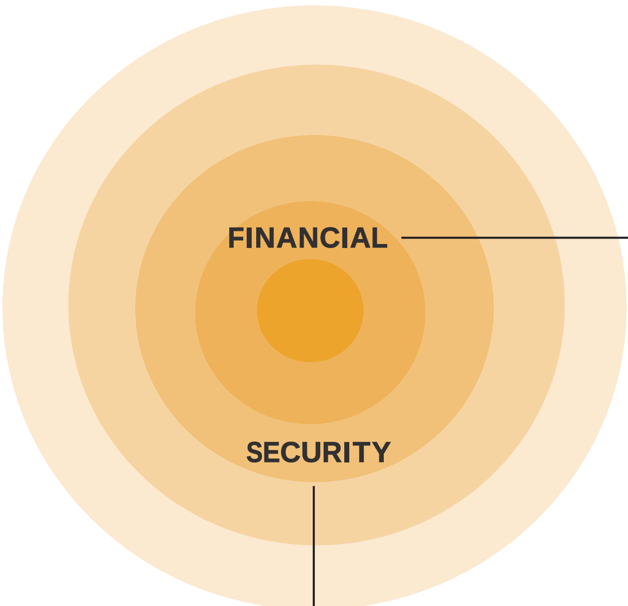


GRID SUPPORT SERVICES

Grid support value of DPV is positive when the net amount and cost of grid support services required to balance supply and demand is less than would otherwise have been required. Grid support services, which encompass more narrowly defined ancillary services (AS), are those services required to enable the reliable operation of interconnected electric grid systems. Grid support services include:

- **Reactive Supply and Voltage Control**— Generation facilities used to supply reactive power and voltage control.
- **Frequency Regulation**—Control equipment and extra generating capacity necessary to (1) maintain frequency by following the moment-to-moment variations in control area load (supplying power to meet any difference in actual and scheduled generation), and (2) to respond automatically to frequency deviations in their networks. While the services provided by regulation service and frequency response service are different, they are complementary services made available using the same equipment and are offered as part of one service.
- **Energy Imbalance**—This service supplies any hourly net mismatch between scheduled energy supply and the actual load served.
- **Operating Reserves**—Spinning reserve is provided by generating units that are on-line and loaded at less than maximum output, and should be located near the load (typically in the same control area). They are available to serve load immediately in an unexpected contingency. Supplemental reserve is generating capacity used to respond to contingency situations that is not available instantaneously, but rather within a short period, and should be located near the load (typically in the same control area).
- **Scheduling/Forecasting**—Interchange schedule confirmation and implementation with other control areas, and actions to ensure operational security during the transaction.

BENEFIT & COST CATEGORIES DEFINED



FINANCIAL RISK

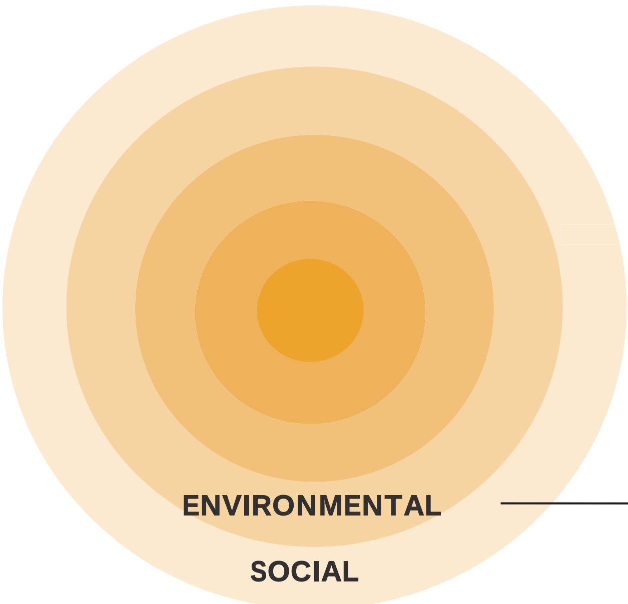
Financial value of DPV is positive when financial risk or overall market price is reduced due to the addition of DPV. Two components considered in the studies reviewed are:

- **Fuel Price Hedge** - The cost that a utility would otherwise incur to guarantee that a portion of electricity supply costs are fixed.
- **Market Price Response** - The price impact as a result of DPV's reducing demand for centrally-supplied electricity and the fuel that powers those generators, thereby lowering electricity prices and potentially commodity prices.

SECURITY RISK

Security value of DPV is positive when grid reliability and resiliency are increased by (1) reducing outages by reducing congestion along the T&D network, (2) reducing large-scale outages by increasing the diversity of the electricity system's generation portfolio with smaller generators that are geographically dispersed, and (3) providing back-up power sources available during outages through the combination of PV, control technologies, inverters and storage.

BENEFIT & COST CATEGORIES DEFINED



ENVIRONMENTAL

Environmental value of DPV is positive when DPV results in the reduction of environmental or health impacts that would otherwise have been created. Key drivers include primarily the environmental impacts of the marginal resource being displaced. There are four components of environmental value:

- **Carbon** - The value from reducing carbon emissions is driven by the emission intensity of displaced marginal resource and the price of emissions.
- **Criteria Air Pollutants** - The value from reducing criteria air pollutant emissions—NO_X, SO_2, and particulate matter—is driven by the cost of abatement technologies, the market value of pollutant reductions, and/or the cost of human health damages.
- **Water** - The value from reducing water use is driven by the differing water consumption patterns associated with different generation technologies, and is sometimes measured by the price paid for water in competing sectors.
- **Land** - The value associated with land is driven by the difference in the land footprint required for energy generation and any change in property value driven by the addition of DPV.
- **Avoided Renewable Portfolio Standard costs (RPS)** - The value derived from meeting electricity demand through DPV, which reduces total demand that would otherwise have to be met and the associated renewable energy that would have to be procured as mandated by an RPS.

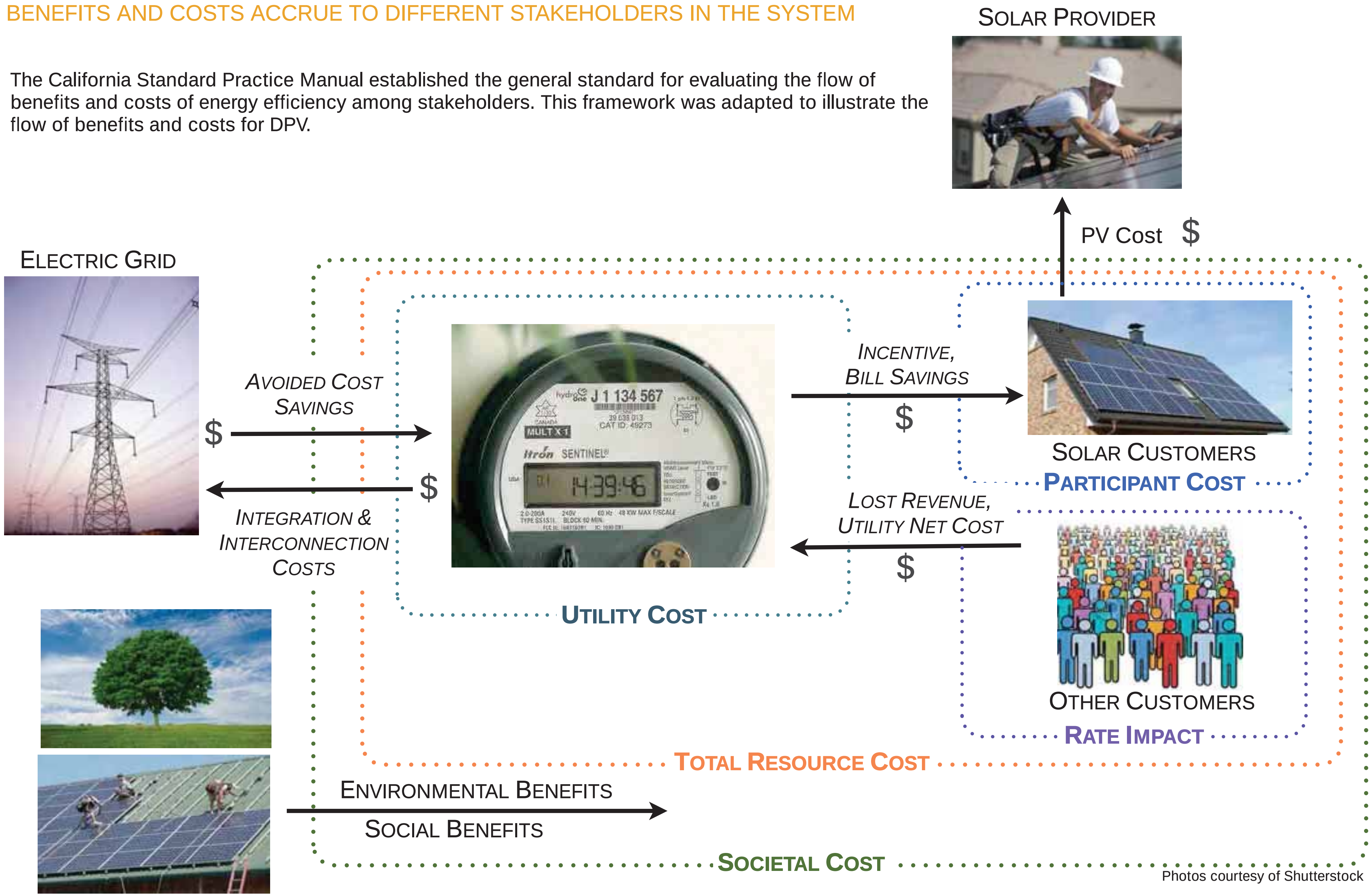
SOCIAL

The studies reviewed in this report defined social value in economic terms. The social value of DPV was positive when DPV resulted in a net increase in jobs and local economic development. Key drivers include the number of jobs created or displaced, as measured by a job multiplier, as well as the value of each job, as measured by average salary and/or tax revenue.

FLOW OF BENEFITS AND COSTS

BENEFITS AND COSTS ACCRUE TO DIFFERENT STAKEHOLDERS IN THE SYSTEM

The California Standard Practice Manual established the general standard for evaluating the flow of benefits and costs of energy efficiency among stakeholders. This framework was adapted to illustrate the flow of benefits and costs for DPV.



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STAKEHOLDER PERSPECTIVES

stakeholder perspective		factors affecting value
PV CUSTOMER 	"I want to have a predictable return on my investment, and I want to be compensated for benefits I provide."	Benefits include the reduction in the customer's utility bill, any incentive paid by the utility or other third parties, and any federal, state, or local tax credit received. Costs include cost of the equipment and materials purchased (inc. tax & installation), ongoing O&M, removal costs, and the customer's time in arranging the installation.
OTHER CUSTOMERS 	"I want reliable power at lowest cost."	Benefits include reduction in transmission, distribution, and generation, capacity costs; energy costs and grid support services. Costs include administrative costs, rebates/ incentives, and decreased utility revenue that is offset by increased rates.
UTILITY 	"I want to serve my customers reliably and safely at the lowest cost, provide shareholder value and meet regulatory requirements."	Benefits include reduction in transmission, distribution, and generation, capacity costs; energy costs and grid support services. Costs include administrative costs, rebates/ incentives, decreased revenue, integration & interconnection costs.
SOCIETY 	"We want improved air/water quality as well as an improved economy."	The sum of the benefits and costs to all stakeholder, plus any additional societal and environmental benefits or costs that accrue to society at large rather than any individual stakeholder.

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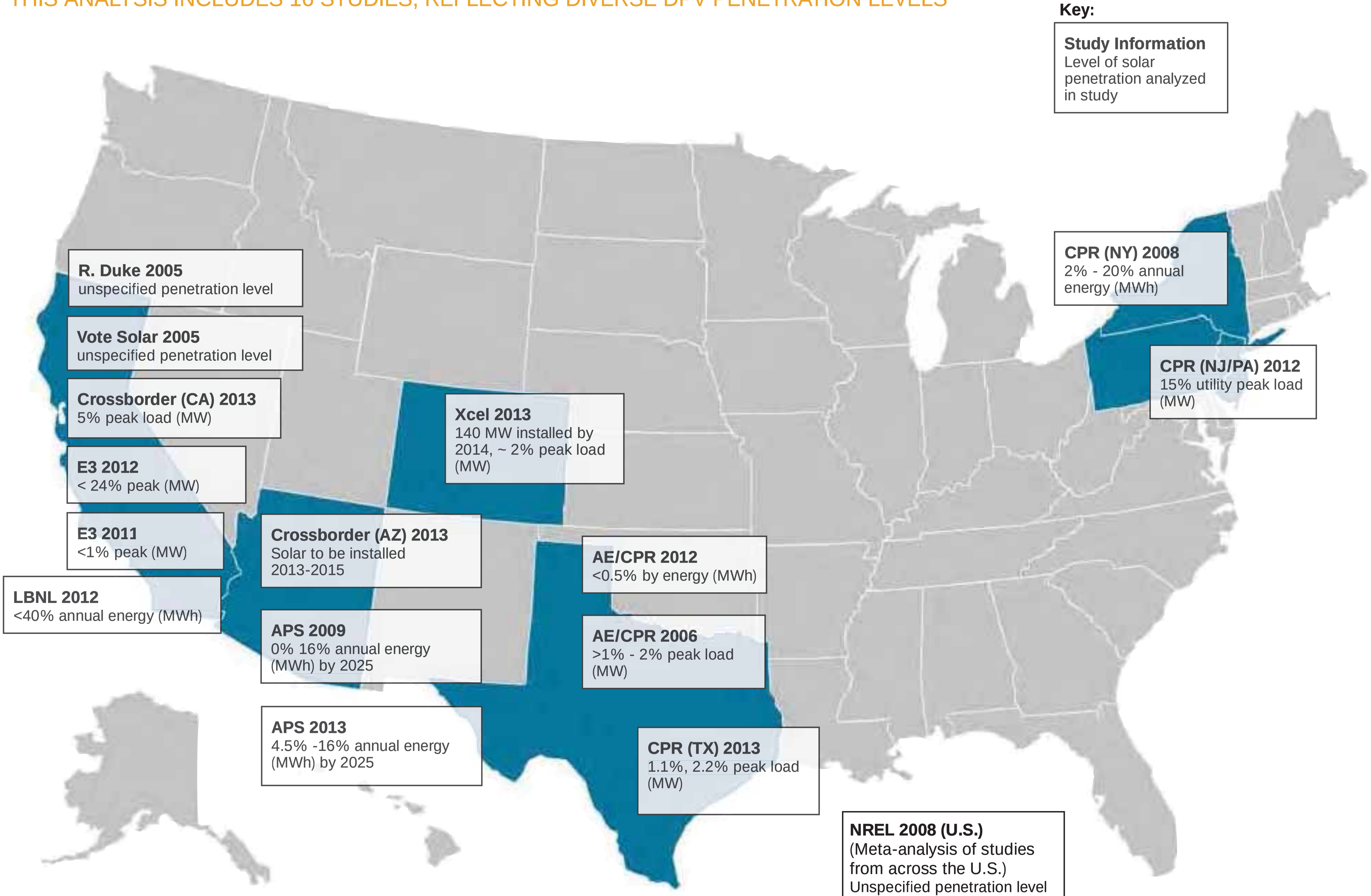
ANALYSIS FINDINGS

03

analysis overview
summary of benefits and costs
detail: categories of benefit and cost

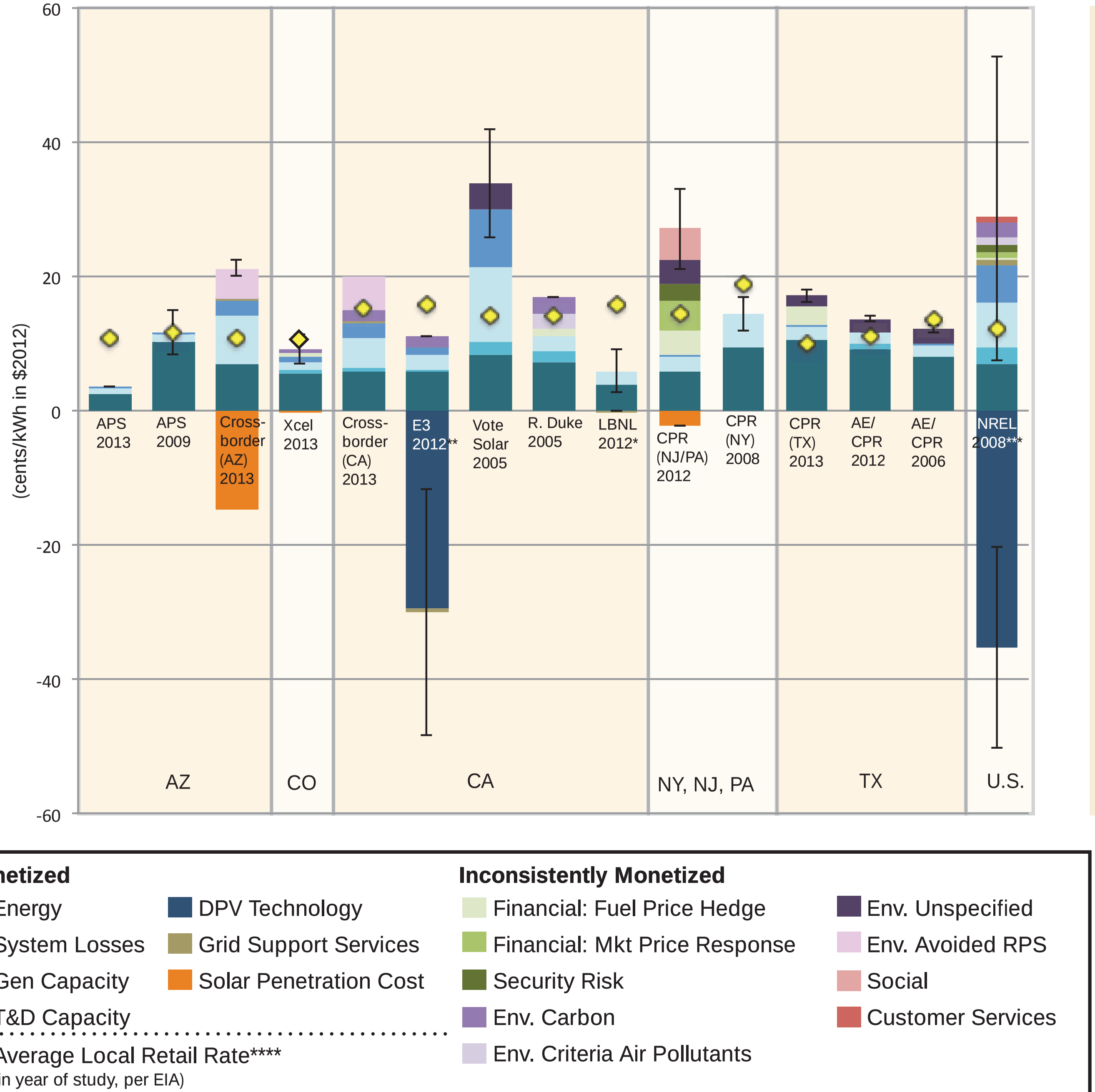
ANALYSIS OVERVIEW

THIS ANALYSIS INCLUDES 16 STUDIES, REFLECTING DIVERSE DPV PENETRATION LEVELS



SUMMARY OF DPV BENEFITS AND COSTS

BENEFITS AND COSTS OF DISTRIBUTED PV BY STUDY



INSIGHTS

- No study comprehensively evaluated the benefits and costs of DPV, although many acknowledge additional sources of benefit or cost and many agree on the broad categories of benefit and cost.
- There is a significant range of estimated value across studies, driven primarily by differences in local context, input assumptions, and methodological approaches.
- Because of these differences, comparing results across studies can be informative, but should be done with the understanding that results must be normalized for context, assumptions, or methodology.
- While detailed methodological differences abound, there is general agreement on overall approach to estimating energy value, although there remain key differences in capacity methodology. There is significantly less agreement on overall approach to estimating grid support services and currently unmonetized values including financial and security risk, environment, and social value.

* The LBNL study only gives the net value for ancillary services
** E3's DPV technology cost includes LCOE + interconnection cost
*** The NREL study is a meta-analysis, not a research study. Customer Services, defined as the value to customer of a green option, was only reflected in the NREL 2008 meta-analysis and not included elsewhere in this report.
****Average retail rate included for reference; it is not appropriate to compare the average retail rate to total benefits presented without also reflecting costs (i.e., net value) and any material differences within rate designs (i.e., not average).
Note: E3 2012 study not included in this chart because that study did not itemize results. See page 47.

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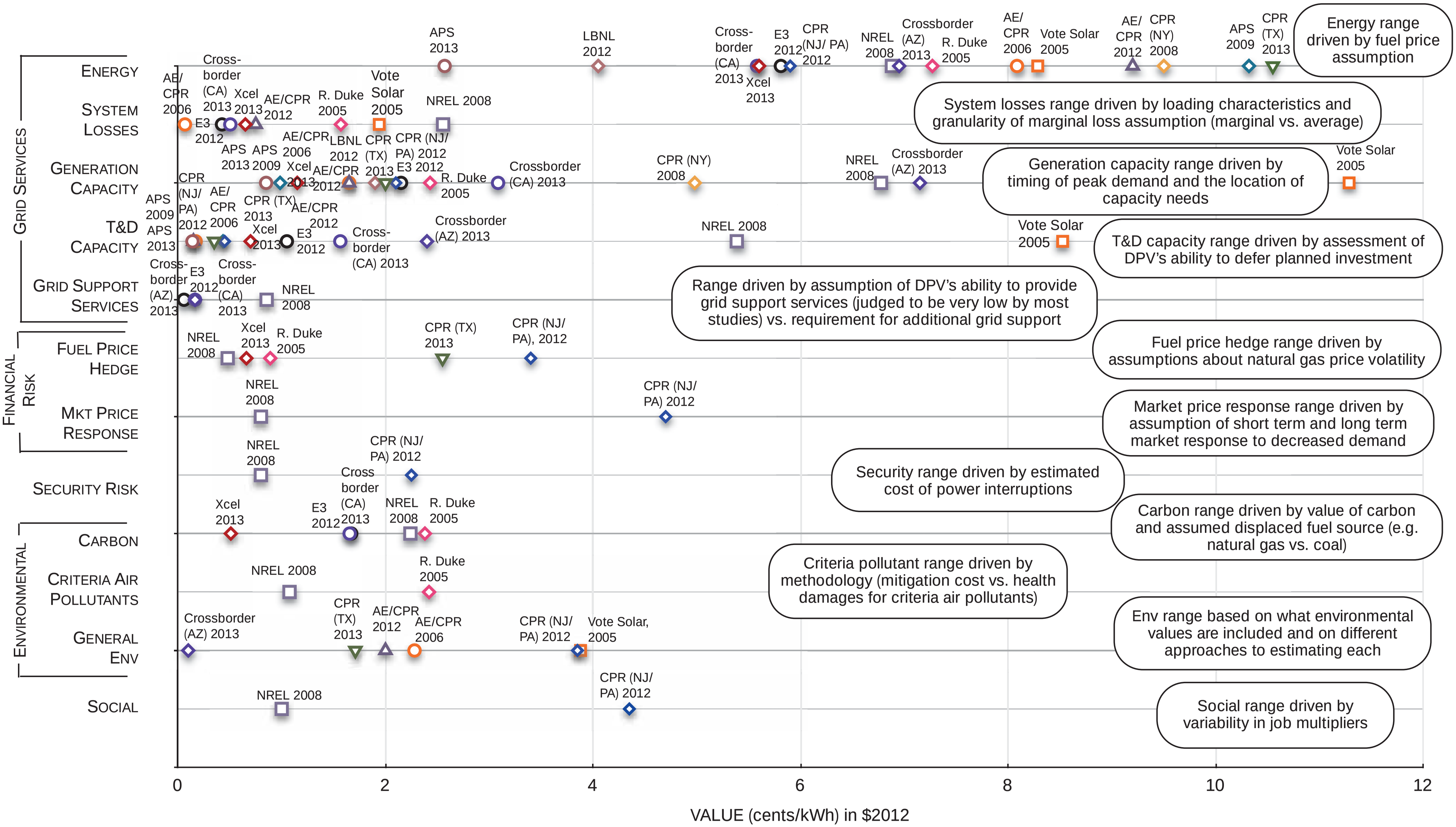
BENEFIT ESTIMATES

THE RANGE IN BENEFIT ESTIMATES ACROSS STUDIES IS DRIVEN BY VARIATION IN SYSTEM CONTEXT, INPUT ASSUMPTIONS, AND METHODOLOGIES

PUBLISHED AVERAGE BENEFIT ESTIMATES*

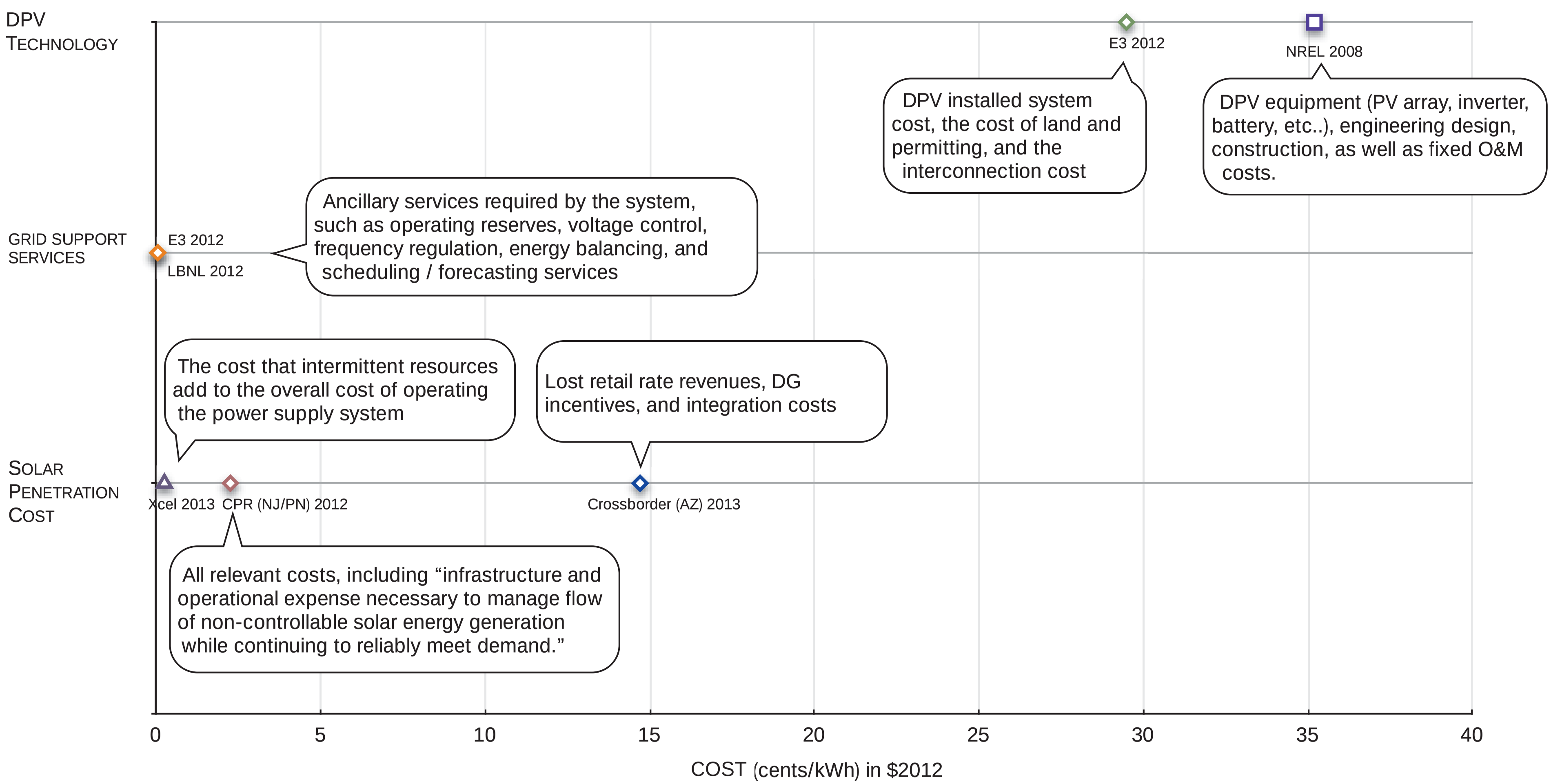


*For the full range of values observed see the individual methodology slides.

COST ESTIMATES

COSTS ASSOCIATED WITH INCREASED DPV DEPLOYMENT ARE NOT ADEQUATELY ASSESSED

PUBLISHED AVERAGE COST VALUES FOR REVIEWED SOURCES



Other studies (for example E3 2011) include costs, but results are not presented individually in the studies and so not included in the chart above. Costs generally include costs of program rebates or incentives paid by the utility, program administration costs, lost revenue to the utility, stranded assets, and costs and inefficiencies associated with throttling down existing plants.

ENERGY

VALUE OVERVIEW

Energy value is created when DPV generates energy (kWh) that displaces the need to produce energy from another resource. There are two components of energy value: the amount of energy that would have been generated equal to the DPV generation, and the additional energy that would have been generated but lost in delivery due to inherent inefficiencies in the transmission and distribution system. This second category of losses is sometimes reflected separately as part of the system losses category.

APPROACH OVERVIEW

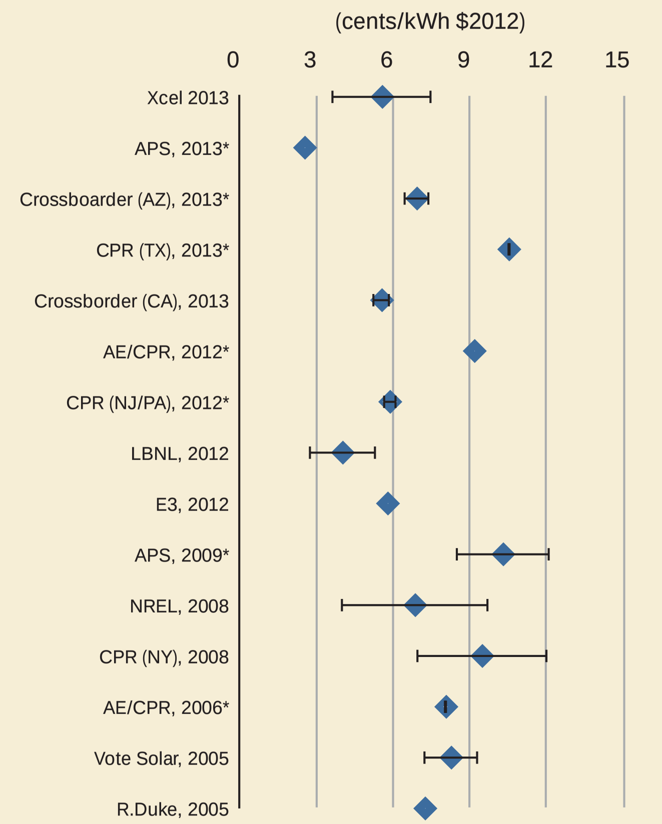
There is broad agreement on the general approach to calculating energy value, although numerous differences in methodological details. Energy is frequently the most significant source of benefit.

- Energy value is the avoided cost of the marginal resource, typically assumed to be natural gas.
- Key assumptions generally include fuel price forecast, operating & maintenance costs, and heat rate, and depending on the study, can include system losses and a carbon price.

WHY AND HOW VALUES DIFFER

- **System Context:**
  - **Market structure** - Some Independent System Operators (ISOs) and states value capacity and energy separately, whereas some ISOs only have energy markets without capacity markets. ISOs with only energy markets may reflect capacity value in the energy price.
  - **Marginal resource characterization** - Studies in regions with ISOs may calculate the marginal price based on wholesale market prices, rather than on the cost of the marginal power plant; different resources may be on the margin in different regions or with different solar penetrations.
- **Input Assumptions:**
  - **Fuel price forecast** - Since natural gas is usually on the margin, most studies focus on natural gas prices. Studies most often base natural gas prices on the New York Mercantile Exchange (NYMEX) forward market and then extrapolate to some future date (varied approaches to this extrapolation), but some take a different approach to forecasting, for example, based on Energy Information Administration projections.
  - **Power plant efficiency** - The efficiency of the marginal resource significantly impacts energy value; studies show a wide range of assumed natural gas plant heat rates.
  - **Variable operating & maintenance costs** - While there is some difference in values assumed by studies, variable O&M costs are generally low.
  - **Carbon price** - Some studies include an estimated carbon price in energy value, others account for it separately, and others do not include it at all.
- **Methodologies:**
  - **Study window** - Some studies (for example, APS 2013) calculate energy value in a sample year, whereas others (for example, Crossborder (AZ) 2013) calculate energy value as a levelized cost over 20 years.
  - **Marginal resource characterization** - Studies take one of three general approaches: (1) DPV displaces energy from a gas plant, generally a combined cycle, (2) DPV displaces energy from one type of plant (generally a combined cycle) off-peak and a different type of plant (generally a combustion turbine) on-peak, (3) DPV displaces the resource on the margin during every hour of the year, based on a dispatch analysis.

ENERGY BENEFIT AND COST ESTIMATES AS REPORTED BY REVIEWED STUDIES



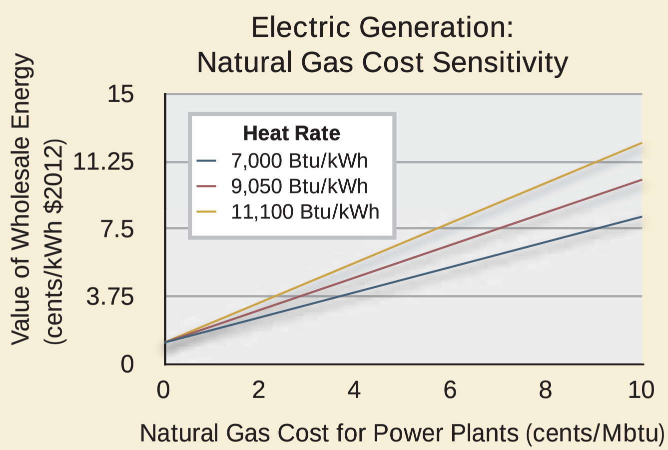
* = value energy savings that result from avoided energy losses

Note: Benefits and costs are reflected separately in chart. If only benefits are shown, study did not represent costs.

ENERGY (CONT'D)

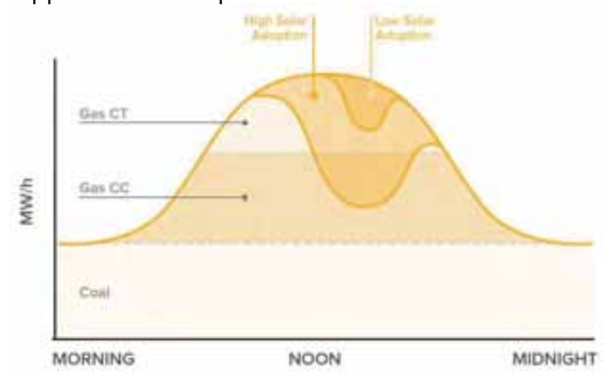
SENSITIVITIES TO KEY INPUT ASSUMPTIONS

Electric Generation: Natural Gas Cost Sensitivity



INSIGHTS & IMPLICATIONS

- Accurately defining the marginal resource that DPV displaces requires an increasingly sophisticated approach as DPV penetration increases.



The resources that DPV displaces depends on the dispatch order of other resources, when the solar is generated, and how much is generated.

More accurate, more complex ↓

Marginal Resource Characterization	Pros	Cons
Single power plant assumed to be on the margin (typically gas CC)	Simple; often sufficiently accurate at low solar penetrations	Not necessarily accurate at higher penetrations or in all jurisdictions
Plant on the margin on-peak/plant on the margin off-peak	More accurately captures differences in energy value reflected in merit-order dispatch	Not necessarily accurate at higher penetrations or in all jurisdictions
Hourly dispatch or market assessment to determine marginal resource in every hour	Most accurate, especially with increasing penetration	More complex analysis required; solar shape and load shape must be from same years

- Taking a more granular approach to determining energy value also requires a more detailed characterization of DPV's generation profile. It's also critical to use solar and load profiles from the same year(s), to accurately reflect weather drivers and therefore generation and demand correlation.

- In cases where DPV is displacing natural gas, the NYMEX natural gas forward market is a reasonable basis for a natural gas price forecast, adjusted appropriately for delivery to the region in question. It is not apparent from studies reviewed what the most effective method is for escalating prices beyond the year in which the NYMEX market ends.

LOOKING FORWARD

As renewable and distributed resource (not just DPV) penetration increases, those resources will start to impact the underlying load shape differently, requiring more granular analysis to determine energy value.

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SYSTEM LOSSES

VALUE OVERVIEW

System losses are a derivation of energy losses, the value of the additional energy generated by central plants that is lost due to inherent inefficiencies (electrical resistance) in delivering energy to the customer via the transmission and distribution system. Since DPV generates energy at or near the customer, that additional energy is not lost. Energy losses act as a magnifier of value for capacity and environmental benefits, since avoided energy losses result in lower required capacity and lower emissions.

APPROACH OVERVIEW

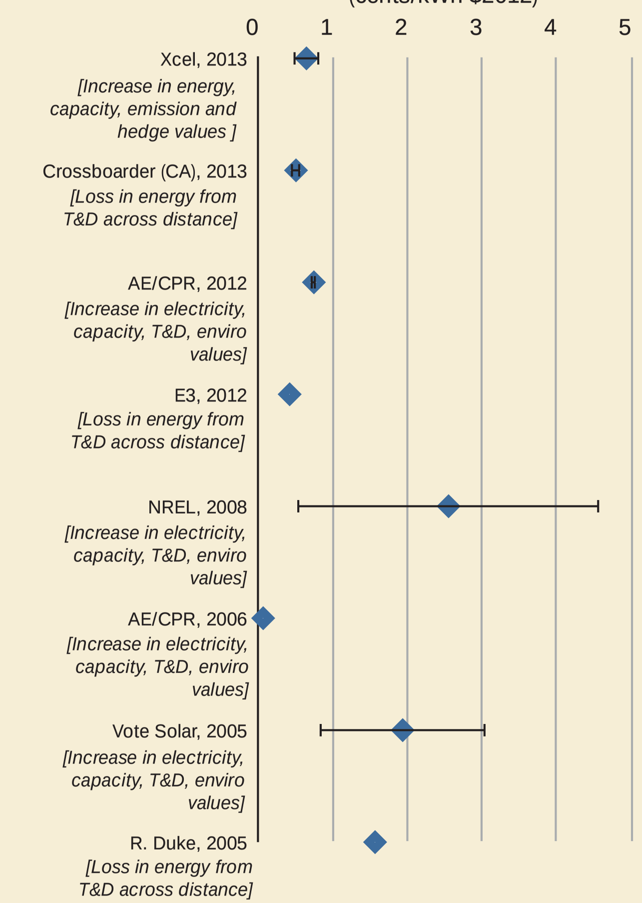
Losses are generally recognized as a value, although there is significant variation around what type of losses are included and how they are assessed. Losses usually represent a small but not insignificant source of value, although some studies report comparatively high values.

- Energy lost in delivery magnifies the value of other benefits, including capacity and environment.
- Calculate loss factor(s) (amount of loss per unit of energy delivered) based on modeled or observed data.

WHY AND HOW VALUES DIFFER

- **System Context:**
  - **Congestion** - Because energy losses are proportional to the inverse of current squared, the higher the utilization of the transmission & distribution system, the greater the energy losses.
  - **Solar characterization**—The timing, quantity, and geographic location of DPV, and therefore its coincidence with delivery system utilization, impacts losses.
- **Input Assumptions:**
  - **Losses** - Some studies estimate losses by applying loss factors based on actual observation, others develop theoretical loss factors based on system modeling. Further, some utility systems have higher losses than others.
- **Methodologies:**
  - **Types of losses recognized** - Most studies recognize energy losses, some recognize capacity losses, and a few recognize environmental losses.
  - **Adder vs. stand-alone value** - There is no common approach to whether losses are represented as stand-alone values (for example, NREL 2008 and E3 2012) or as adders to energy, capacity, and environmental value (for example, Crossborder (AZ) 2013 and APS 2013), complicating comparison across studies.
  - **Temporal & geographic characterization** - Some studies apply an average loss factor to all energy generated by DPV, others apply peak/off-peak factors, and others conduct hourly analysis. Some studies also reflect geographically-varying losses.

SYSTEM LOSSES BENEFIT AND COST ESTIMATES AS REPORTED BY REVIEWED STUDIES

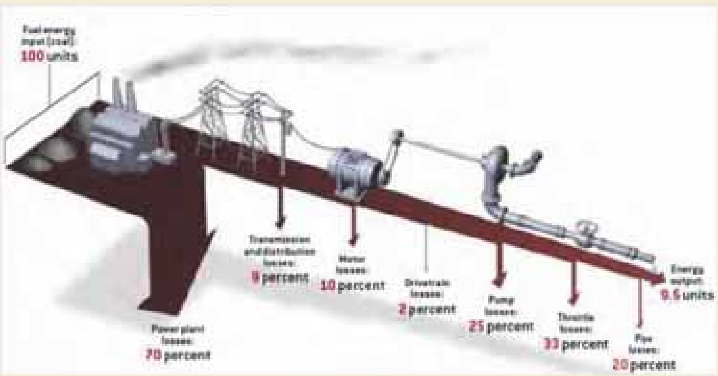


Note: Benefits and costs are reflected separately in chart. If only benefits are shown, study did not represent costs.

SYSTEM LOSSES (CONT'D)

WHAT ARE SYSTEM LOSSES?

Some energy generated at a power plant is lost as it travels through the transmission and distribution system to the customer. As shown in the graphic below, more than 90% of primary energy input into a power plant is lost before it reaches the end use, or stated in reverse, for every one unit of energy saved or generated close to where it is needed, 10 units of primary energy are saved.



For the purposes of this discussion document, relevant losses are those driven by inherent inefficiencies (electrical resistance) in the transmission and distribution system, not those in the power plant or customer equipment. Energy losses are proportional to the square of current, and associated capacity benefit is proportional to the square of reduced load.

INSIGHTS & IMPLICATIONS

- All relevant system losses—energy, capacity, and environment—should be assessed.
- Because losses are driven by the square of current, losses are significantly higher during peak periods. Therefore, when calculating losses, it's critical to reflect marginal losses, not just average losses.
- Whether or not losses are ultimately represented as an adder to an underlying value or as a stand-alone value, they are generally calculated separately. Studies should distinguish these values from the underlying value for transparency and to drive consistency of methodology.

LOOKING FORWARD

Losses will change over time as the loading on transmission and distribution lines changes due to a combination of changing customer demand and DPV generation.

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GENERATION CAPACITY

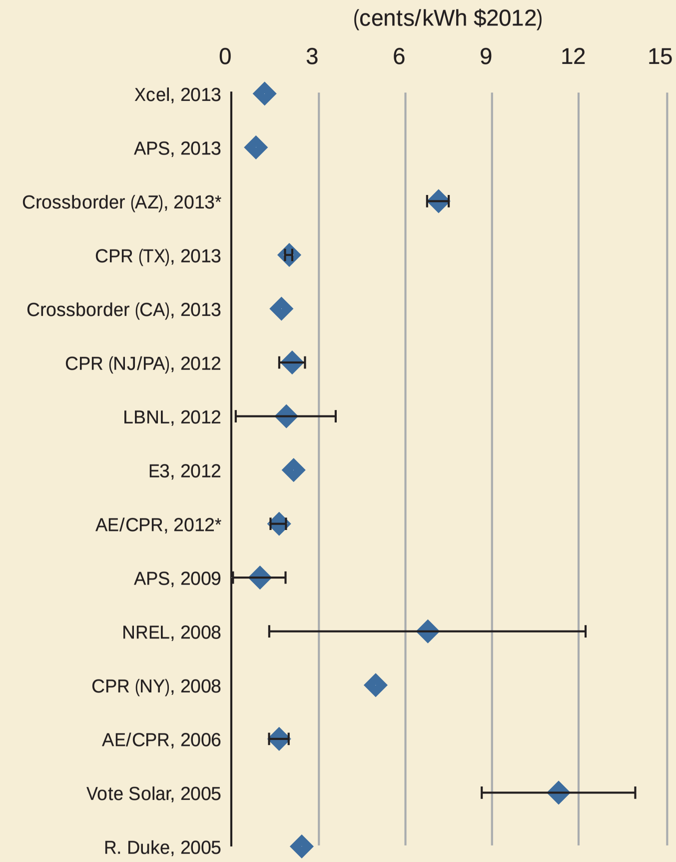
VALUE OVERVIEW
Generation capacity value is the amount of central generation capacity that can be deferred or avoided due to the installation of DPV. Key drivers of value include (1) DPV's effective capacity and (2) system capacity needs.

APPROACH OVERVIEW
Generation capacity value is the avoided cost of the marginal capacity resource, most frequently assumed to be a gas combustion turbine, and based on a calculation of DPV effective capacity, most commonly based on effective load carrying capability (ELCC).

WHY AND HOW VALUES DIFFER

- **System Context:**
  - **Load growth/generation capacity investment plan** - The ability to avoid or defer generation capacity depends on underlying load growth and how much additional capacity will be needed, at what time.
  - **Solar characteristics** - The timing, quantity, and geographic location of DPV, and therefore its coincidence with system peak, impacts DPV's effective capacity.
  - **Market structure** - Some ISOs and states value capacity and energy separately, whereas some ISOs only have energy markets but no capacity markets. ISOs with only energy markets may reflect capacity value as part of the energy price. For California, E3 2012 calculates capacity value based on "net capacity cost"—the annual fixed cost of the marginal unit minus the gross margins captured in the energy and ancillary service market.
- **Input Assumptions:**
  - **Marginal resource** - Most studies assume that a gas combustion turbine, or occasionally a gas combined cycle, is the generation capacity resource that could be deferred. What this resource is and its associated capital and fixed O&M costs are a primary determinant of capacity value.
- **Methodologies:**
  - **Formulation of DPV effective capacity** - There is broad agreement that DPV's effective capacity is most accurately determined using an ELCC approach, which measures the amount of additional load that can be met with the same level of reliability after adding DPV. There is some variation across studies in ELCC results, likely driven by a combination of underlying solar resource profile and ELCC calculation methodology. The approach to effective capacity is sometimes different when considering T&D capacity.
  - **Minimum DPV required to defer capacity** - Some studies (for example, Crossborder (AZ) 2013) credit every unit of effective DPV capacity with capacity value, whereas others (for example, APS 2009) require a certain minimum amount of solar be installed to defer an actual planned resource before capacity value is credited.
  - **Inclusion of losses** - Some studies include capacity losses as an adder to capacity value rather than as a stand-alone benefit.

GENERATION CAPACITY BENEFIT AND COST ESTIMATES AS REPORTED BY REVIEWED STUDIES



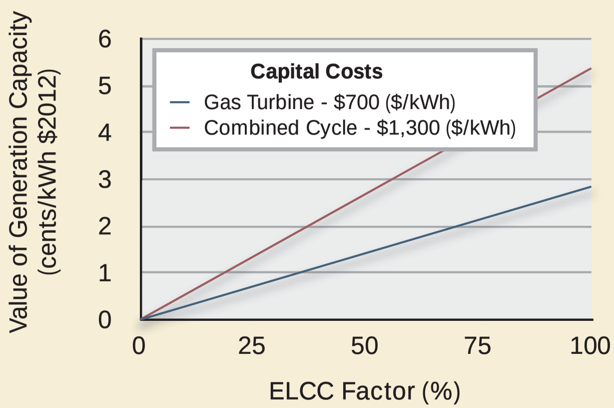
* = value includes generation capacity savings that result from avoided energy losses

Note: Benefits and costs are reflected separately in chart. If only benefits are shown, study did not represent costs.

GENERATION CAPACITY (CONT'D)

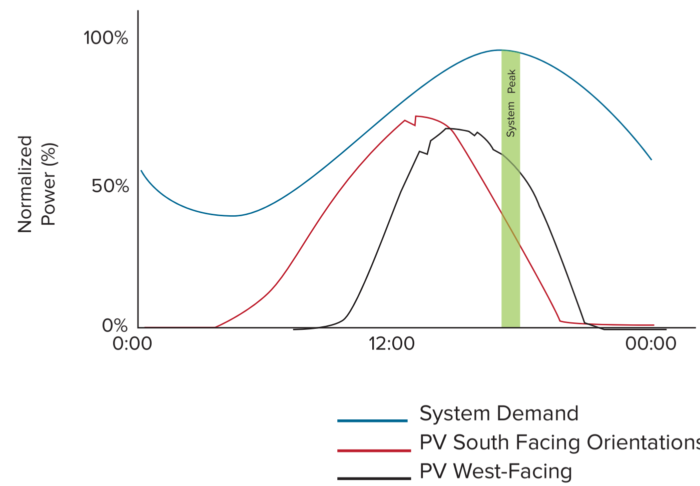
SENSITIVITIES TO KEY INPUT ASSUMPTIONS

Sensitivity of Generation Capacity Value to the ELCC Factor



INSIGHTS & IMPLICATIONS

- Generation capacity value is highly dependent on the correlation of DPV generation to load, so it's critical to accurately assess that correlation using an ELCC approach, as all studies reviewed do. However, varying results indicate possible different formulations of ELCC.



While effective load carrying capacity (ELCC) assesses DPV's contribution to reliability throughout the year, generation capacity value will generally be higher if DPV output is more coincident with peak.

- The value also depends on whether new capacity is needed on the system, and therefore whether DPV defers new capacity. It's important to assess what capacity would have been needed without any additional, expected, or planned DPV.

- Generation capacity value is likely to change significantly as more DPV, and more renewable and distributed resources of all kinds are added to the system. Some amount of DPV can displace the most costly resources in the capacity stack, but increasing amounts of DPV could begin to displace less costly resources. Similarly, the underlying load shape, and therefore even the concept of a peak could begin to shift.

LOOKING FORWARD

Generation capacity is one of the values most likely to change, most quickly, with increasing DPV penetration. Key reasons for this are (1) increasing DPV penetration could have the effect of pushing the peak to later in the day, when DPV generation is lower, and (2) increasing DPV penetration will displace expensive peaking resources, but once those resources are displaced, the cost of the next resource may be lower. Beyond DPV, it's important to note that a shift towards more renewables could change the underlying concept of a daily or seasonal peak.

TRANSMISSION & DISTRIBUTION CAPACITY

VALUE OVERVIEW

The transmission and distribution (T&D) capacity value is a measure of the net change in T&D infrastructure as a result of the addition of DPV. Benefits occur when DPV is able to meet rising demand locally, relieving capacity constraints upstream and deferring or avoiding transmission or distribution upgrades. Costs are incurred when additional transmission or distribution investment are necessary to support the addition of DPV, which could occur when the amount of solar energy exceeds the demand in the local area and increases needed line capacity.

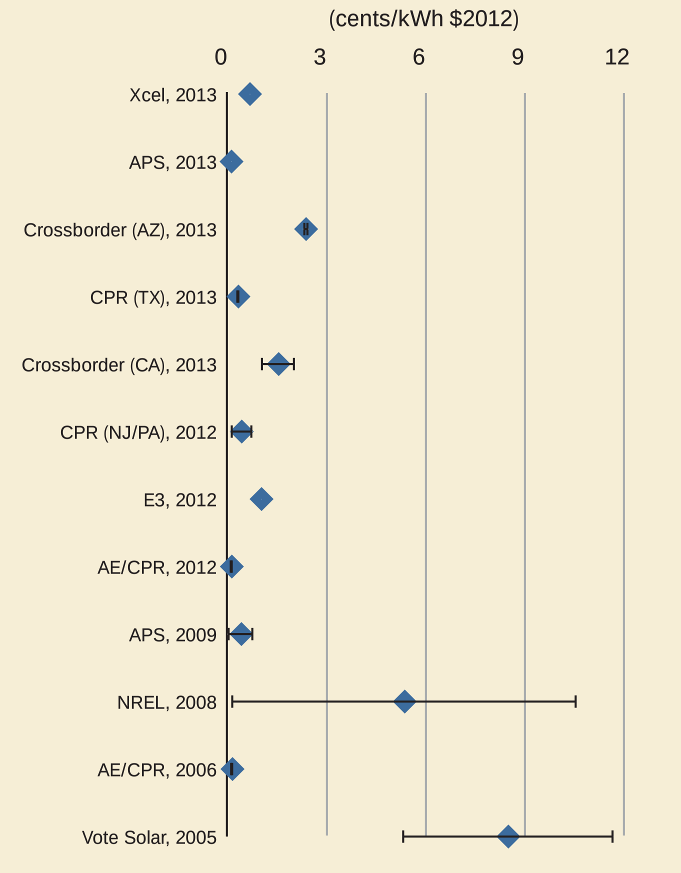
APPROACH OVERVIEW

The net value of deferring or avoiding T&D investments is driven by rate of load growth, DPV configuration and energy production, peak coincidence and effective capacity. Given the site specific nature of T&D, especially distribution, there can be significant range in the calculated value of DPV. Historically low penetrations of DPV has meant that studies have primarily focused on analyzing the ability of DPV to defer transmission or distribution upgrades and have not focused on potential costs, which would likely not arise until greater levels of penetration. Studies typically determine the T&D capacity value based on the capital costs of planned expansion projects in the region of interest. However, the granularity of analysis differs.

WHY AND HOW VALUES DIFFER

- **System Context:**
  - **Locational characteristics** - Transmission and distribution infrastructure projects are inherently site-specific and their age, service life, and use can vary significantly. Thus, the need, size and cost of upgrades, replacement or expansion correspondingly vary.
  - **Projected load growth/T&D capacity investment plan** - Expected rate of demand growth affects the need, scale and cost of T&D upgrades and the ability of DPV to defer or offset anticipated T&D expansions. The rate of growth of DPV would need to keep pace with the growth in demand, both by order of magnitude and speed.
  - **Solar characteristics** - The timing of energy production from DPV and its coincidence with system peaks (transmission) and local peaks (distribution) drive the ability of DPV to contribute as effective capacity that could defer or displace a transmission or distribution capacity upgrade.
  - **The length of time the investment is deferred** -The length of time that T&D can be deferred by the installation of DPV varies by the rate of load growth, the assumed effective capacity of the DPV, and DPV's correlation with peak. The cost of capital saved will increase with the length of deferment.
- **Input Assumptions:**
  - **T&D investment plan characteristics -** Depending upon data available and depth of analysis, studies vary by the level of granularity in which T&D investment plans were assessed–project by project or broader generalizations across service territories.
- **Methodologies:**
  - **Accrual of capacity value to DPV** - One of the most significant methodological differences is whether DPV has incremental T&D capacity value in the face of "lumpy" T&D investments (see implications and insights).
  - **Losses -** Some studies include the magnified benefit of deferred T&D capacity due to avoided losses within the calculation of T&D value, while others itemize line losses separately.

T&D CAPACITY BENEFIT AND COST ESTIMATES AS REPORTED BY REVIEWED STUDIES



* = value includes T&D capacity savings that result from avoided energy losses

Note: Benefits and costs are reflected separately in chart. If only benefits are shown, study did not represent costs.

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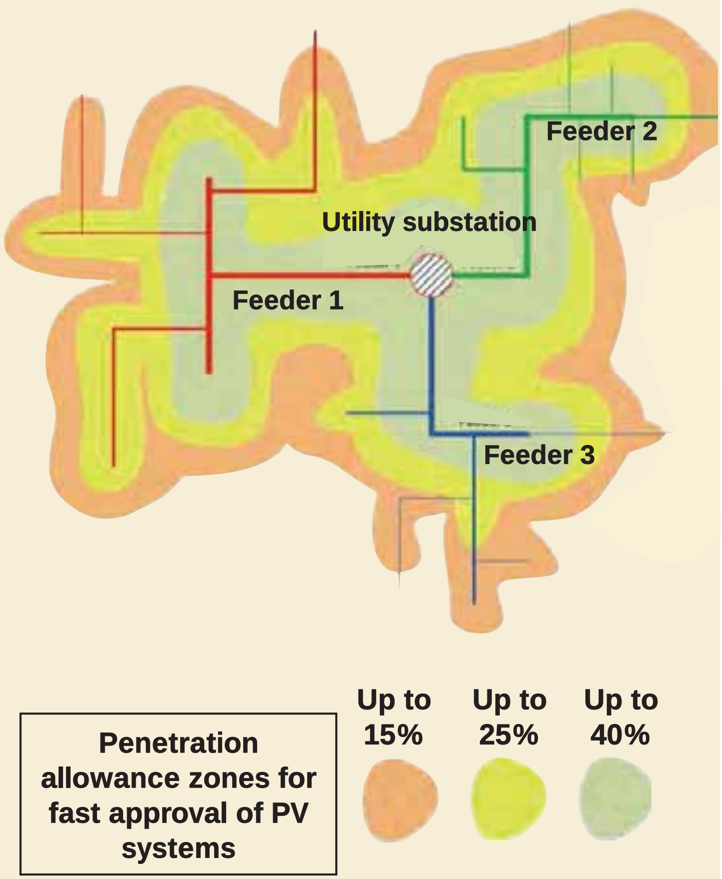
TRANSMISSION & DISTRIBUTION CAPACITY (CONT'D)

LOCATIONAL CONSIDERATIONS AT THE DISTRIBUTION LEVEL



Adapted from Coddington, M. et al, *Updating Interconnection Screens for PV System Integration*

INSIGHTS & IMPLICATIONS

- Strategically targeted DPV deployment can relieve T&D capacity constraints by providing power close to demand and potentially deferring capacity investments, but dispersed deployment has been found to provide less benefit. Thus, the ability to access DPV's T&D deferral value will require proactive distribution planning that incorporates distributed energy resources, such as DPV, into the evaluation.
- The values of T&D are often grouped together, but they are unique when considering the potential costs and benefits that result from DPV.
  - While the ability to defer or avoid transmission is still locational dependent, it is less so than distribution. Transmission aggregates disparate distribution areas and the effects of additional DPV at the distribution level typically require less granular data and analysis.
  - The distribution system requires more geographically specific data that reflects the site specific characteristics such as local hourly PV production and correlation with local load.
- There are significantly differing approaches on the ability of DPV to accrue T&D capacity deferment or avoidance value that require resolution:
  - How should DPV's capacity deferral value be estimated in the face of "lumpy" T&D investments? While APS 2009 and APS 2013 posit that a minimum amount of solar must be installed to defer capacity before credit is warranted, Crossborder (AZ) 2013 credits every unit of reliable capacity with capacity value.
  - What standard should be applied to estimate PV's ability to defer a specific distribution expansion project? While most studies use ELCC to determine effective capacity, APS 2009 and APS 2013 use the level at which there is a 90% confidence of that amount of generation.

LOOKING FORWARD

Any distributed resources, not just DPV, that can be installed near the end user to reduce use of, and congestion along, the T&D network could potentially provide T&D value. This includes technologies that allow energy to be used more efficiently or at different times, reducing the quantity of electricity traveling through the T&D network (especially during peak hours).

GRID SUPPORT SERVICES

VALUE OVERVIEW

Grid support services, also commonly referred to as ancillary services (AS) in wholesale energy markets, are required to enable the reliable operation of interconnected electric grid systems, including operating reserves, reactive supply and voltage control; frequency regulation; energy imbalance; and scheduling.

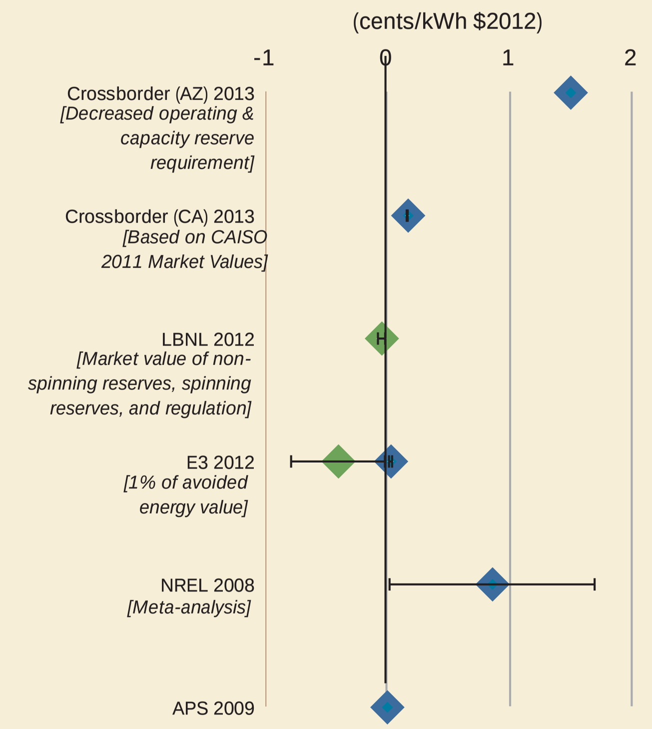
APPROACH OVERVIEW

There is significant variation across studies on the impact DPV will have on the addition or reduction in the need for grid support services and the associated cost or benefit. Most studies focus on the cost DPV could incur in requiring additional grid support services, while a minority evaluate the value DPV could provide by reducing load and required reserves or the AS that DPV could provide when coupled with other technologies. While methodologies are inconsistent, the approaches generally focus on methods for calculating changes in necessary operating reserves, and less precision or rules of thumb are applied to the remainder of AS, such as voltage regulation. Operating reserves are typically estimated by determining the reliable capacity for which DPV can be counted on to provide capacity when demanded over the year.

WHY AND HOW VALUES DIFFER

- **System Context:**
  - **Reliability standards and market rules** - The standards and rules for reliability that govern the requirements for grid support services and reserve margins differ. These standards directly impact the potential net value of adding DPV to the system.
  - **Availability of ancillary services market** - Where wholesale electricity markets exist, the estimated value is correlated to the market prices of AS.
  - **Solar characteristics** - The timing of energy production from DPV and it's coincidence with system peaks differs locationally.
  - **Penetration of DPV** - As PV penetrations increase, the value of its reliable capacity decreases and, under standard reliability planning approaches, would increase the amount of system reserves necessary to maintain reliable operations.
  - **System generation mix** - The performance characteristics of the existing generation mix, including the generators ability to respond quickly by increasing or decreasing production, can significantly change the supply value of ancillary services and the value.
- **Methodologies:**
  - **Effective capacity of DPV** - The degree that DPV can be depended on to provide capacity when demanded has a direct effect on the amount of operating reserves that the rest of the system must supply. The higher the "effective capacity," the less operating reserves necessary.
  - **Correlating reduced load with reduced ancillary service needs** - Crossborder (AZ) 2013 calculated a net benefit of DPV based on 1) load reduction & reduced operating reserve requirements; 2) peak demand reduction and utility capacity requirements.
  - **Potential of DPV to provide grid support with technology coupling** - While the primary focus across studies was the impact DPV would have on the need for additional AS, NREL 2008 & AE/CPR 2006 both noted that DPV could provide voltage regulation with smart inverters were installed.

GRID SUPPORT SERVICES BENEFIT AND COST ESTIMATES AS REPORTED BY REVIEWED STUDIES



Note: Benefits and costs are reflected separately in chart. If only benefits are shown, study did not represent costs.

GRID SUPPORT SERVICES (CONT'D)

Grid Support Services	The potential for DPV to provide grid support services (with technology modifications)
REACTIVE SUPPLY AND VOLTAGE CONTROL	(+/-) PV with an advanced inverter can inject/consume VARs, adjusting to control voltage
FREQUENCY REGULATION	(+/-) Advanced inverters can adjust output frequency; standard inverters may
ENERGY IMBALANCE	(+/-) If PV output < expected, imbalance service is required. Advanced inverters could adjust output to provide imbalance
OPERATING RESERVES	(+/-) Additional variability and uncertainty from large penetrations of DPV may introduce operations forecast error and increase the need for certain types of reserves; however, DPV may also reduce the amount of load served by central generation, thus, reducing needed reserves.
SCHEDULING / FORECASTING	(-) The variability of the solar resource requires additional forecasting to reduce uncertainty

INSIGHTS & IMPLICATIONS

- As with large scale renewable integration, there is still controversy over determining the net change in "ancillary services due to variable generation and much more controversy regarding how to allocate those costs between specific generators or loads." (LBNL 2012)
- Areas with wholesale AS markets enable easier quantification of the provision of AS. Regions without markets have less standard methodologies for quantifying the value of AS.
- One of the most significant differences in reviewed methodological approaches is whether the necessary amount of operating reserves, as specified by required reserve margin, decreases by DPV's capacity value (as determined by ELCC, for example). Crossborder (CA) 2013, E3 2012 and Vote Solar 2005 note that the addition of DPV reduces load served by central generation, thus allowing utilities to reduce procured reserves. Additional analysis is needed to determine whether the required level of reserves should be adjusted in the face of a changing system.
- Studies varied in their assessments of grid support services. APS 2009 did not expect DPV would contribute significantly to spinning or operating reserves, but predicted regulation reserves could be affected at high penetration levels.

LOOKING FORWARD

Increasing levels of distributed energy resources and variable renewable generation will begin to shift both the need for grid support services as well as the types of assets that can and need to provide them. The ability of DPV to provide grid support requires technology modifications or additions, such as advanced inverters or storage, which incur additional costs. However, it is likely that the net value proposition will increase as technology costs decrease and the opportunity (or requirements) to provide these services increase with penetration.

FINANCIAL: FUEL PRICE HEDGE

VALUE OVERVIEW

DPV produces roughly constant-cost power compared to fossil fuel generation, which is tied to potentially volatile fuel prices. DPV can provide a "hedge" against price volatility, reducing risk exposure to utilities and customers.

APPROACH OVERVIEW

More than half the studies reviewed acknowledge DPV's fuel price hedge benefit, although fewer quantify it and those that do take different, although conceptually similar, approaches.

- In future years when natural gas futures market prices are available, using those NYMEX prices to develop a natural gas price forecast should include the value of volatility.
- In future years beyond when natural gas futures market prices are available, estimate natural gas price and volatility value separately. Differing approaches include:
  - Escalating NYMEX prices at a constant rate, under the assumption that doing so would continue to reflect hedge value (Crossborder (AZ) 2013); or
  - Estimating volatility hedge value separately as the value or an option/swap, or as the actual price adder the utility is incurring now to hedge gas prices (CPR (NJ/PA 2012), NREL 2008).

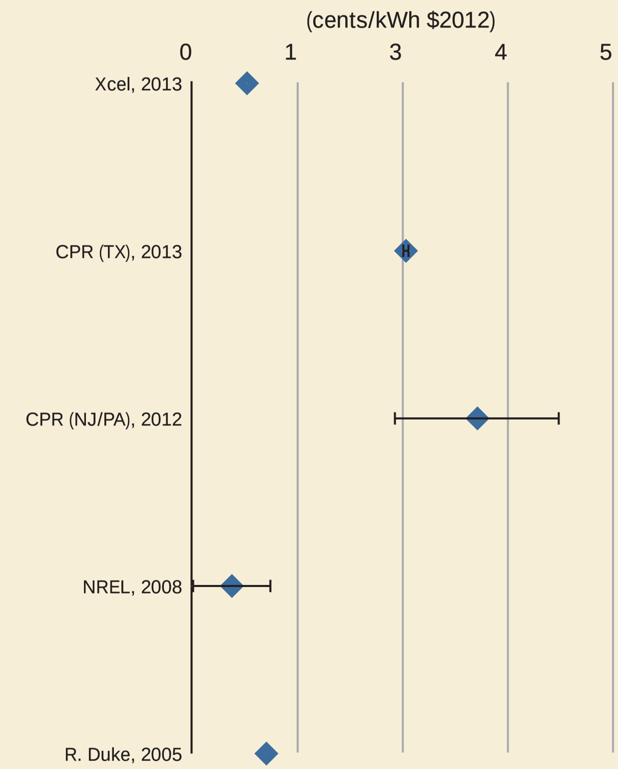
WHY AND HOW VALUES DIFFER

- **System Context:**
  - **Marginal resource characterization** - What resource is on the margin, and therefore how much fuel is displaced varies.
  - **Exposure to fuel price volatility** - Most utilities already hedge some portion of their natural gas purchases for some period of time in the future.
- **Methodologies:**
  - **Approach to estimating value** - While most studies agree that NYMEX futures prices are an adequate reflection of volatility, there is no largely agreed upon approach to estimating volatility beyond when those prices are available.

INSIGHTS & IMPLICATIONS

- NYMEX futures market prices are an adequate reflection of volatility in the years in which it operates.
- Beyond that, volatility should be estimated, although there is no obvious best practice. Further work is required to develop an approach that accurately measures hedge value.

FUEL PRICE HEDGE BENEFIT AND COST ESTIMATES AS REPORTED BY REVIEWED STUDIES



Note: Benefits and costs are reflected separately in chart. If only benefits are shown, study did not represent costs.

FINANCIAL: MARKET PRICE RESPONSE

VALUE OVERVIEW

The addition of DPV, especially at higher penetrations, can affect the market price of electricity in a particular market or service territory. These market price effects span energy and capacity values in the short term and long term, all of which are interrelated. Benefits can occur as DPV provides electricity close to demand, reducing the demand for centrally-supplied electricity and the fuel powering those generators, thereby lowering electricity prices and potentially fuel commodity prices. A related benefit is derived from the effect of DPV's contribution at higher penetrations to reshaping the load profile that central generators need to meet. Depending upon the correlation of DPV production and load, the peak demand could be reduced and the marginal generator could be more efficient and less costly, reducing total electricity cost. However, these benefits could potentially be reduced in the longer term as energy prices decline, which could result in higher demand. Additionally, depressed prices in the energy market could have a feedback effect by raising capacity prices.

APPROACH OVERVIEW

While several studies evaluate a market price response of DPV, distinct approaches were employed by E3 2012, CPR (NJ/PN) 2012, and NREL 2008.

WHY AND HOW VALUES DIFFER

- **Methodologies:**
  - **Considering market price effects of DPV in the context of other renewable technologies** - E3 2012 incorporated market price effect in its high penetration case by adjusting downward the marginal value of energy that DPV would displace. However, for the purposes of the study, E3 2012 did not add this as a benefit to the avoided cost because they "assume the market price effect would also occur with alternative approaches to meeting [CA's] RPS."
  - **Incorporating capacity effects** -
    - E3 2012 represented a potential feedback effect between the energy and capacity by assuming an energy market calibration factor. That is, it assumes that, in the long run, the CCGT's energy market revenues plus the capacity payment equal the fixed and variable costs of the CCGT. Therefore, a CCGT would collect more revenue through the capacity and energy markets than is needed to cover its costs, and a decrease in energy costs would result in a relative increase in capacity costs.
    - CPR (NJ/PA) 2012 incorporates market price effect "by reducing demand during the high priced hours [resulting in] a cost savings realized by all consumers." They note "that further investigation of the methods may be warranted in light of two arguments...that the methodology does address induced increase in demand due to price reductions, and that it only addresses short-run effects (ignoring the impact on capacity markets)."

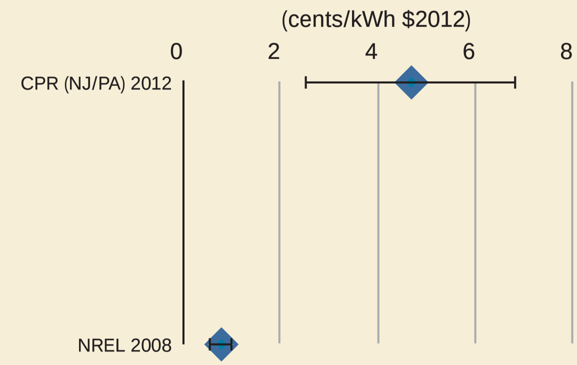
INSIGHTS & IMPLICATIONS

- The market price reduction value only assesses the initial market reaction of reduced price, not subsequent market dynamics (e.g. increased demand in response to price reductions, or the impact on the capacity market), which has to be studied and considered, especially in light of higher penetrations of DPV.

LOOKING FORWARD

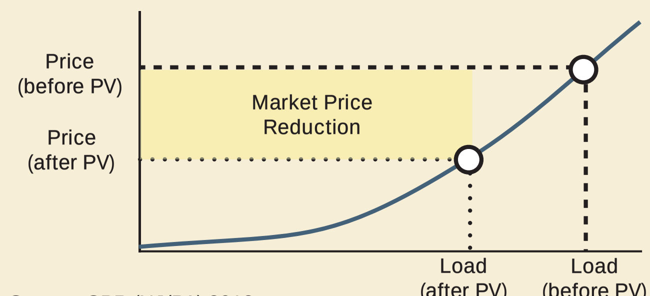
Technologies powered by risk-free fuel sources (such as wind) and technologies that increase the efficiency of energy use and decrease consumption would also have similar effects.

MARKET PRICE RESPONSE BENEFIT AND COST ESTIMATES AS REPORTED BY REVIEWED STUDIES



Note: Benefits and costs are reflected separately in chart. If only benefits are shown, study did not represent costs. Also, E3 2012 is not included in this chart because this study did not provide an itemized value for market price response,

MARKET PRICE VS. LOAD



Source: CPR (NJ/PA) 2012

SECURITY: RELIABILITY AND RESILIENCY

VALUE OVERVIEW

The grid security value that DPV could provide is attributable to three primary factors, the last of which would require coupling DPV with other technologies to achieve the benefit:

1) The potential to reduce outages by reducing congestion along the T&D network. Power outages and rolling blackouts are more likely when demand is high and the T&D system is stressed.
2) The ability to reduce large-scale outages by increasing the diversity of the electricity system's generation portfolio with smaller generators that are geographically dispersed.
3) The benefit to customers to provide back-up power sources available during outages through the combination of PV, control technologies, inverters and storage.

APPROACH OVERVIEW

While there is general agreement across studies that integrating DPV near the point of use will decrease stress on the broader T&D system, most studies do not calculate a benefit due to the difficulty of quantification. CPR 2012 and 2011 did represent the value as the value of avoided outages based on the total cost of power outages to the U.S. each year, and the perceived ability of DPV to decrease the incidence of outages.

INSIGHTS & IMPLICATIONS

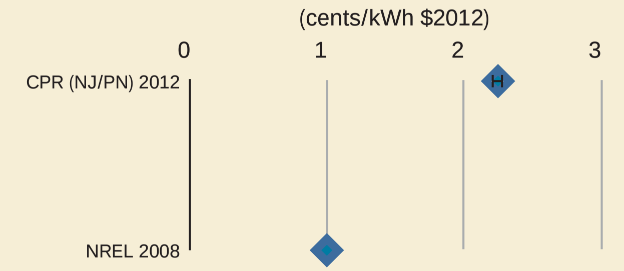
- The value of increased reliability is significant, but there is a need to quantify and demonstrate how much value can be provided by DPV. Rules-of-thumb assumptions and calculations for security impacts require significant analysis and review.

- Opportunities to leverage combinations of distributed technologies to increase customer reliability are starting to be tested. The value of DPV in increasing suppling power during outages can only be realized if DPV is coupled with storage and equipped with the capability to island itself from the grid, which come at additional capital cost.

LOOKING FORWARD

Any distributed resources that can be installed near the end user to reduce use of, and congestion along, the T&D network could potentially reduce transmission stress. This includes technologies that allow energy to be used more efficiently or at different times, reducing the quantity of electricity traveling through the T&D network (especially during peak hours). Any distributed technologies with the capability to be islanded from the grid could also play a role.

RELIABILITY AND RESILIENCY BENEFIT AND COST ESTIMATES AS REPORTED BY REVIEWED STUDIES



Note: Benefits and costs are reflected separately in chart. If only benefits are shown, study did not represent costs.

Disruption Value* Range by Sector
(cents/kWh $2012)

Sector	Min	Max
Residential	0.028	0.41
Commercial	11.77	14.40
Industrial	0.4	1.99

Source: The National Research Council, 2010

*Disruption value is a measure of the damages from outages and power-quality events based on the increased probability of these events occurring with increasing electricity consumption.

ENVIRONMENT: CARBON DIOXIDE

VALUE OVERVIEW
The benefits of reducing carbon emissions include (1) reducing future compliance costs, carbon taxes, or other fees, and (2) mitigating the heath and ecosystem damages potentially caused by climate change.

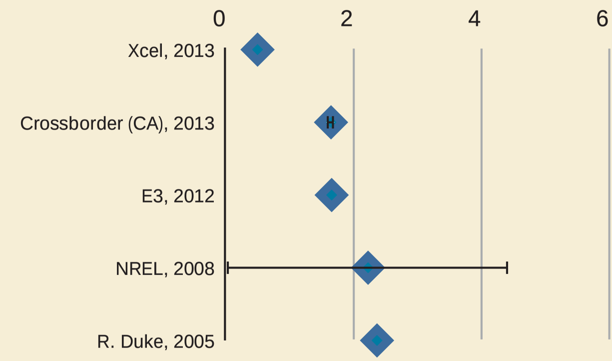
APPROACH OVERVIEW
By and large, studies that addressed carbon focused on the compliance costs or fees associated with future carbon emissions, and conclude that carbon reduction can increase DPV's value by more than two cents per kilowatt-hour, depending heavily on the price placed on carbon. While there is some agreement that carbon reduction provides value and on the general formulation of carbon value, there are widely varying assumptions, and not all studies include carbon value.

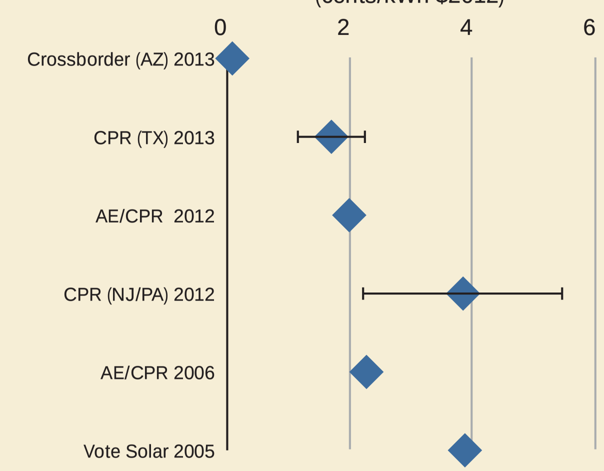
Carbon reduction benefit is the amount of carbon displaced times the price of reducing a ton of carbon. The amount of carbon displaced is directly linked to the amount of energy displaced, when it is displaced, and the carbon intensity of the resource being displaced.

WHY AND HOW VALUES DIFFER

- **System Context:**
  - **Marginal resource characterization** - Different resources may be on the margin in different regions or with different solar penetrations. Carbon reduction is significantly different if energy is displaced from coal, gas combined cycles, or gas combustion turbines.
- **Input Assumptions:**
  - **Value of carbon reduction** - Studies have widely varying assumptions about the price or carbon. Some studies base price on reported prices in European markets, others on forecasts based on policy expectations, others on a combination. The increased uncertainty around U.S. Federal carbon legislation has made price estimates more difficult.
  - **Heat rates of marginal resources** - The assumed efficiency of the marginal power plant is directly correlated to amount of carbon displaced by DPV.
- **Methodologies:**
  - **Adder vs. stand-alone value** - There is no common approach to whether carbon is represented as a stand-alone value (for example, NREL 2008 and E3 2012) or as an adder to energy value (for example, APS 2013).
  - **Marginal resource characterization** - Just as with energy (which is directly linked to carbon reduction), studies take one of three general approaches: (1) DPV displaces energy from a gas plant, generally a combined cycle, (2) DPV displaces energy from one type of plant (generally a combined cycle) off-peak and a different type of plant (generally a combustion turbine) on-peak, (3) DPV displaces whatever resource is on the margin during every hour of the year, based on a dispatch analysis.

ENVIRONMENTAL BENEFIT AND COST ESTIMATES AS REPORTED BY REVIEWED STUDIES

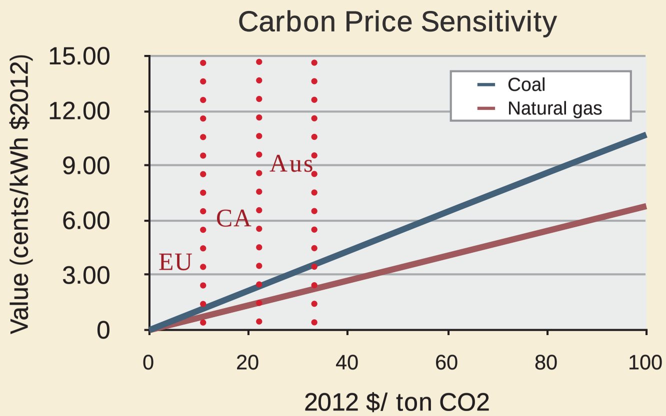


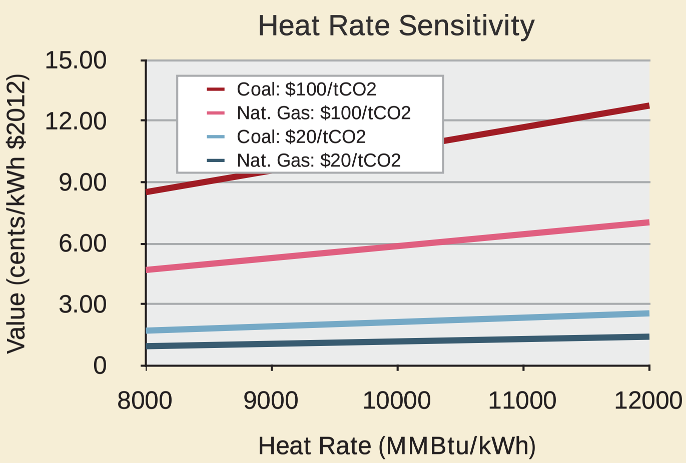


Note: Benefits and costs are reflected separately in chart. If only benefits are shown, study did not represent costs.

ENVIRONMENT: CARBON DIOXIDE
(CONT'D)

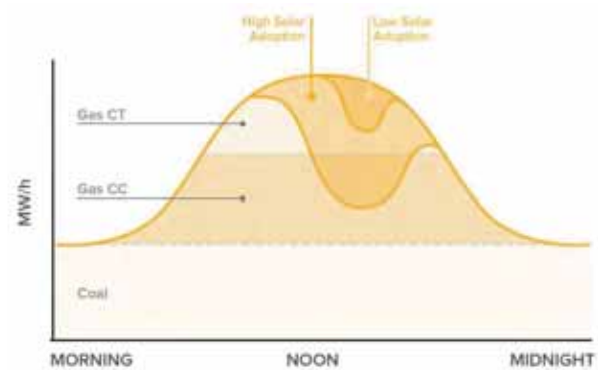
SENSITIVITY TO KEY INPUT ASSUMPTIONS





INSIGHTS & IMPLICATIONS

- Just as with energy value, carbon value depends heavily on what the marginal resource is that is being displaced. The same determination of the marginal resource should be used to drive both energy and carbon values.



The amount of carbon DPV displaces depends on the dispatch order of other resources, when the solar is generated, and how much is generated.

- While there is little agreement on what the $/ton price of carbon is or should be, it is likely non-zero.

LOOKING FORWARD

While there has been no federal action on climate over the last few years, leading to greater uncertainty about potential future prices, many states and utilities continue to value carbon as a reflection of assumed benefit. There appears to be increasing likelihood that the U.S. Environmental Protection Agency will take action to limit emissions from coal plants, potentially providing a more concrete indicator of price.

ENVIRONMENT: OTHER FACTORS

In addition to carbon, DPV has several other environmental benefits (or potentially costs) that, while commonly acknowledged, are included in only a few of the studies reviewed here. That said, there is a significant body of thought for each outside the realm of DPV cost/benefit valuation, some of which is referenced below.

CRITERIA AIR POLLUTANTS

SUMMARY: Criteria air pollutants (NO_X, SO_2, and particulate matter) released from the burning of fossil fuels can produce both health and ecosystem damages. The economic cost of these pollutants is generally estimated as:

1. The compliance costs of reducing pollutant emissions from power plants, or the added compliance costs to further decrease emissions beyond some baseline standard; and/or

2. The estimated cost of damages, such as medical expenses for asthma patients or the value of mortality risk, which attempts to measure willingness to pay for a small reduction in risk of dying due to air pollution.

VALUE: Crossborder (AZ) 2013 estimated the value of criteria air pollutant reductions, based on APS's Integrated Resource Plan, as $0.365/MWh, and NREL 2008 as $0.2-14/MWh (2012$). CPR (NJ/PA) 2012 and AE/CPR 2012 also acknowledged criteria air pollutants, but estimate cost based on a combined environmental value.

RESOURCES:

Epstein, P., Buonocore, J., Eckerle, K. et al., *Full Cost Accounting for the Life Cycle of Coal*, 2011.

Muller, N., Mendelsohn, R., Nordhaus, W., *Environmental Accounting for Pollution in the US Economy.* American Economic Review 101, Aug. 2011. pp. 1649 - 1675.

National Research Council. *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use*, 2010.

AVOIDED RENEWABLE PORTFOLIO STANDARD (RPS)

SUMMARY: Investments in DPV can help the utility meet a state Renewable Portfolio Standards (RPS) / Renewable Energy Standards (RES) in two ways:

1. As DPV is installed and energy use from central generation correspondingly decreases, the amount of renewable energy the utility is required to purchase to meet an RPS/RES decreases.

2. Depending on the RPS/RES requirements, customer investment in DPV can translate into direct investments in renewables that utilities do have to make if they are able to receive credit, such as through Renewable Energy Certificates (RECs).

VALUE: Crossborder (AZ) 2013 estimated the avoided RPS cost, based on the difference between the revenue requirements for a base scenario and a high renewables scenario in APS's Integrated Resource Plan, as $45/MWh. Crossborder (CA) estimated the avoided RPS cost, based on the cost difference forecast between RPS-eligible resources and the wholesale market prices, at $50/MWh.

RESOURCES:

Beach, R., McGuire, P., *The Benefits and Costs of Solar Distributed Generation for Arizona Public Service.* Crossborder Energy May, 2013.

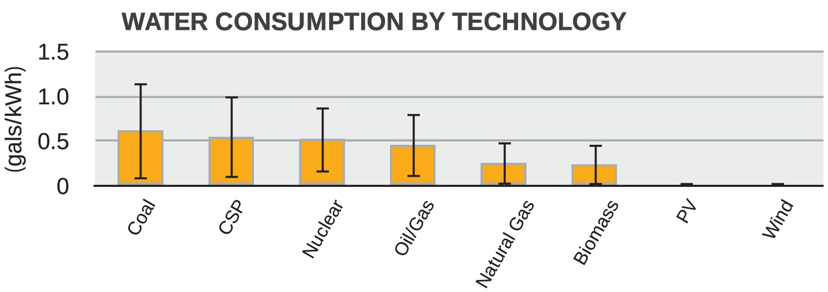
Beach, R., McGuire, P., *Evaluating the Benefits and Costs of Net Energy Metering for Residential Customers in California.* Crossborder Energy, Jan. 2013.

ENVIRONMENT: OTHER FACTORS

In addition to carbon, DPV has several other environmental benefits (or potentially costs) that, while commonly acknowledged, are included in only a few of the studies reviewed here. That said, there is a significant body of thought for each outside the realm of DPV cost/benefit valuation, some of which is referenced below.

WATER

SUMMARY: Coal and natural gas power plants withdraw and consume water primarily for cooling. Approaches to valuing reduced water usage have focused on the cost or value of water in competing sectors, potentially including municipal, agricultural, and environmental/recreational uses.



Source: Fthenakis

VALUE: The only study reviewed that explicitly values water reduction is Crossborder (AZ) 2013, which estimates a $1.084/MWh value based on APS's Integrated Resource Plan.

RESOURCES:

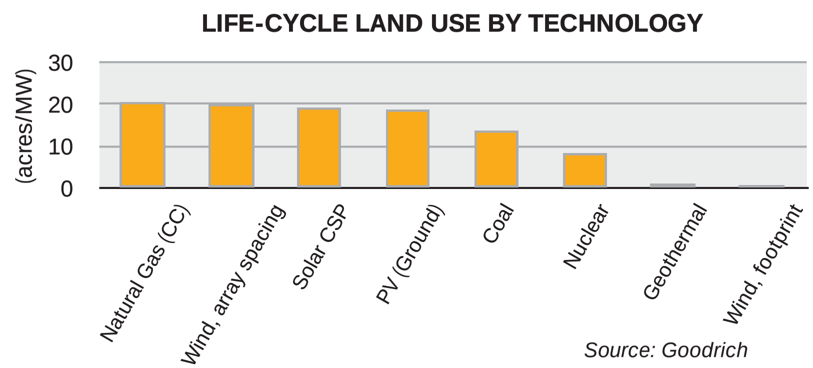
Tellinghulsen, S., *Every Drop Counts.* Western Resources Advocates, Jan. 2011.

Fthenakis, V., Hyungl, C., *Life-cycle Use of Water in U.S. Electricity Generation.* Renewable and Sustainable Energy Review 14, Sept. 2010. pp.2039-2048.

LAND

SUMMARY: DPV can impact land in three ways:

1) Change in property value with the addition of DPV,
2) Land requirement for DPV installation, or
3) Ecosystem impacts of DPV installation.



Source: Goodrich

VALUE: None of the studies reviewed explicitly estimate land impacts.

RESOURCES:

Goodrich et al. Residential, Commercial, and Utility Scale Photovoltaic (V) System Prices in the United States: Current Drivers and Cost-Reduction Opportunities. NREL. February 2012. Pages 14, 23—28

SOCIAL: ECONOMIC DEVELOPMENT

VALUE OVERVIEW

The assumed social value from DPV is based on any job and economic growth benefits that DPV brings to the economy, including jobs and higher tax revenue. The value of economic development depends on number of jobs created or displaced, as measured by a job multiplier, as well as the value of each job, as measured by average salary and/or tax revenue.

APPROACH OVERVIEW

Very few studies reviewed quantify employment and tax revenue value, although a number of them acknowledge the value. CPR (NJ/PN) 2012 calculated job impact based on enhanced tax revenues associated with the net job creation for solar vs conventional power resources. The 2011 study included increased tax revenue, decreased unemployment, and increased confidence for business development economic growth benefits, but only quantified the tax revenue benefit.

IMPLICATIONS AND INSIGHTS

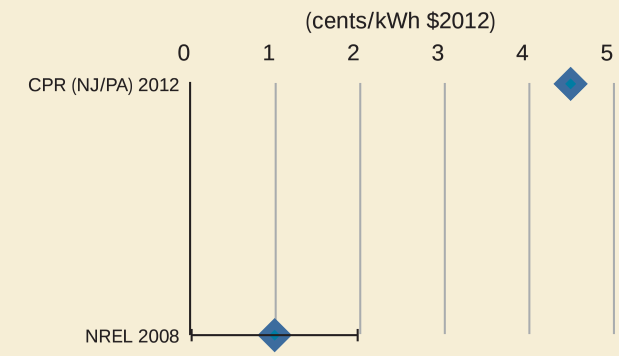
- There is significant variability in the range of job multipliers.
- Many of the jobs created from PV, particularly those associated with installation, are local, so there can be value to society and local communities from growth in quantity and quality of jobs available. The locations where jobs are created are likely not the same as where jobs are lost. While there could be a net benefit to society, some regions could bear a net cost from the transition in the job market.
- While employment and tax revenues have not generally been quantified in studies reviewed, E3 2011 recommends an input-output modeling approach as an adequate representation of this value.

RESOURCES:

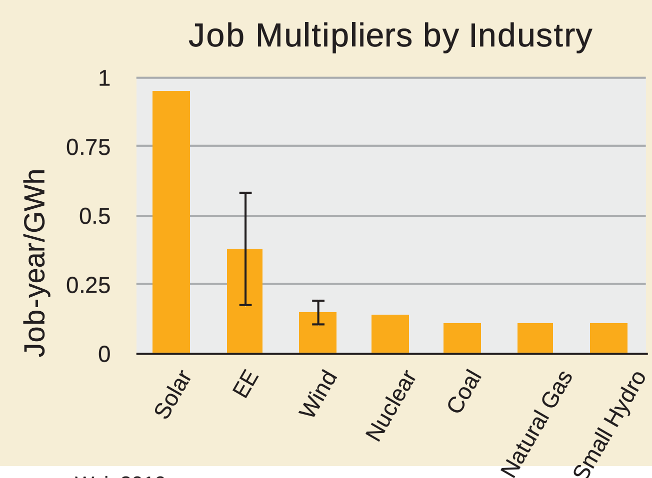
Wei, M., Patadia, S., and Kammen, D., Putting Renewables and Energy Efficiency to Work: How Many Jobs Can the Energy Industry Generate in the US? Energy Policy 38, 2010. pp. 919-931.

Brookings Institute, Sizing the Clean Economy: A National and Regional Green Jobs Assessment, 2011.

ECONOMIC DEVELOPMENT BENEFIT AND COST ESTIMATES AS REPORTED BY REVIEWED STUDIES



Note: Benefits and costs are reflected separately in chart. If only benefits are shown, study did not represent costs.



Sources: Wei, 2010

STUDY OVERVIEWS

04

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SECTION STRUCTURE

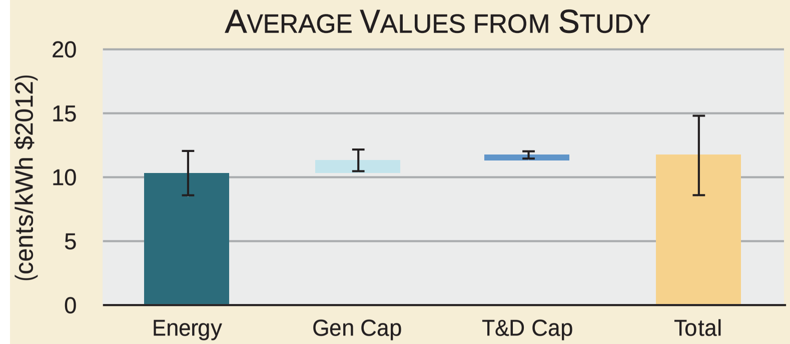
KEY COMPONENTS INCLUDED IN EACH STUDY OVERVIEW

STUDY CHARACTERISTICS	
STUDY OBJECTIVE	*A brief overview of the stated purpose of the study*
GEOGRAPHIC FOCUS	*Geographic region analyzed*
SYSTEM CONTEXT	*Relevant characteristics of the electricity system analyzed*
LEVEL OF SOLAR ANALYZED	*Solar penetrations analyzed, by energy or capacity*
STAKEHOLDER PERSPECTIVE	*Stakeholder perspectives analyzed (e.g., participant, ratepayer, society)*
GRANULARITY OF ANALYSIS	*Level of granularity reflected in the analysis as defined by:* • *Solar characterization - How the solar generation profile is established (e.g., actual insolation data v. modeled, time correlated to load)* • *Marginal resource/losses characterization - Whether the marginal resources and losses are calculated on a marginal hourly basis v. average* • *Geographic granularity - Approach to estimating locationally-dependent benefits or costs (e.g., distribution feeders)*
TOOLS USED	*Key modeling tools used in the analysis*

Highlights

The Highlights section includes key observations about the study's approach, key drivers of results, and findings.

OVERVIEW OF VALUE CATEGORIES



The chart above depicts the average values by category explored in each study.

The Overview of Value Categories section includes brief assessments of the study's approach, relevant assumptions, and findings for each value category included.

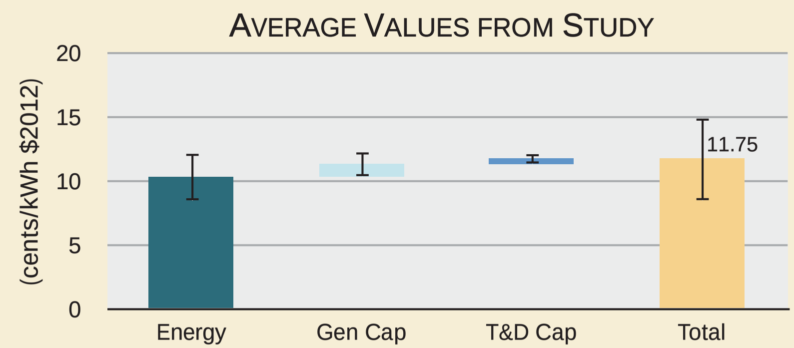
RW Beck for Arizona Public Service, 2009
Distributed Renewable Energy Operating Impacts & Valuation Study

Study Characteristics	
Study Objective	To determine the potential value of DPV for Arizona Public Service, and to understand the likely operating impacts.
Geographic Focus	Arizona Public Service territory
System Context	Vertically integrated IOU, 15% RPS by 2025 with 30% distributed resource carveout
Level of Solar Analyzed	0-16% by 2025 (by energy)
Stakeholder Perspective	Ratepayers
Granularity of Analysis	• Solar characterization - Hourly TMY data, determined to be good approximation of calendar year data in a comparison • Marginal resource/losses characterization - Calculated based on hourly PROMOD simulation; theoretical hourly loss analysis; actual APS investment plan • Geographic granularity - Screening analysis of specific feeders; example constrained area and greenfield area analyzed
Tools Used	SAM 2.0; ABB's Feeder-All; EPRI's Distribution System Simulator; PROMOD

Highlights

- Value was measured incrementally in 2010, 2015, and 2025. The study approach combined system modeling, empirical testing, and information review, and represents one of the more technically rigorous approaches of reviewed studies.
- A key methodological assumption in the study is that generation, transmission, and distribution capacity value can only be given to DPV when it actually defers or avoids a planned investment. The implications are that a certain minimum amount of DPV must be installed in a certain time period (and in a certain location for distribution capacity) to create value.
- The study determines that total value decreases over time, primarily driven by decreasing capacity value. Increasing levels of DPV effectively pushes the system peak to later hours.
- The study acknowledged but did not quantify a number of other values including job creation, a more sustainable environment, carbon reduction, and increased worker productivity.

Overview of Value Categories



*this chart represents the present value of 2025 incremental value, not a levelized cost

Energy: Energy provides the largest source of value to the APS system. Value is calculated based on a PROMOD hourly commitment and dispatch simulation. DPV reduces fuel, purchased power requirements, line losses, and fixed O&M. The natural gas price forecast is based on NYMEX forward prices with adjustment for delivery to APS's system.

Generation Capacity: There is little, but some, generation capacity value. Generation capacity value does not differ based on the geographic location of solar, but generation capacity investments are "lumpy", so a significant amount of solar is needed to displace it.

Capacity value includes benefits from reduced losses. Capacity value is determined by comparing DPV's dependable capacity (determined as the ELCC) to APS's generation investment plan.

T&D Capacity: There is very little distribution capacity value, and what value exists comes from targeting specific feeders. Solar generation peaks earlier in the day than the system's peak load, DPV only has value if it is on a feeder that is facing an overloaded condition, and DPV's dependable capacity diminishes as solar penetration increases. Distribution value includes capacity, extension of service life, reduction in equipment sizing, and system performance issues.

There is little, but some, transmission capacity value since value does not differ based on the geographic location of solar, but transmission investments are "lumpy", so a significant amount of solar is needed to displaced it. Transmission value includes capacity and potential detrimental impacts to transient stability and spinning resources (i.e., ancillary services).

T&D capacity value includes benefits from reduced losses, modeled with a combination of hourly system-wide and feeder-specific modeling. T&D capacity value is determined by comparing DPV's dependable capacity to APS's T&D investment plan. For T&D, as compared to generation, dependable capacity is determined as the level of solar output that will occur with 90% confidence during the daily five hours of peak during summer months.

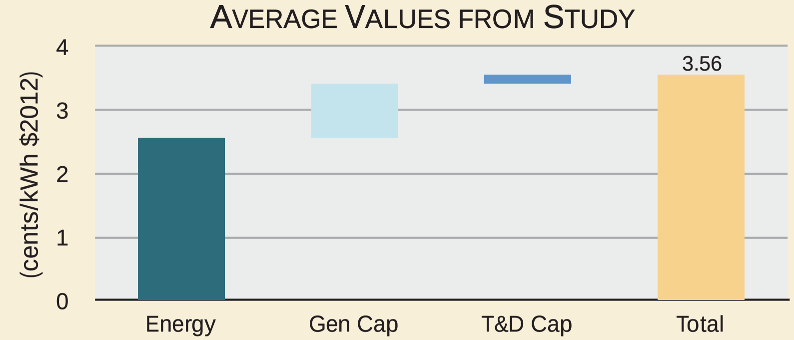
SAIC for Arizona Public Service, 2013
2013 Updated Solar PV Value Report

Study Characteristics	
Study Objective	To update the valuation of future DPV systems in the Arizona Public Service (APS) territory installed after 2012.
Geographic Focus	Arizona Public Service territory
System Context	Vertically integrated IOU, 15% RPS by 2025 with 30% distributed resource carve out, peak extends past sunset
Level of Solar Analyzed	4.5-16% by 2025 (by energy)
Stakeholder Perspective	Ratepayers
Granularity of Analysis	• Solar characterization - Hourly 30-year TMY data; coupled with production characteristics of actual installed systems • Marginal resource/losses characterization - Calculated based on hourly PROMOD simulation and APS investment plan as in 2009 study; average energy loss and system peak demand loss factors as recorded by APS • Geographic granularity - Screening analysis of existing feeders with >10% PV; based on that, determination of number of feeders where PV could reduce peak load from above 90% to below 90%
Tools Used	PVWatts; EPRI's DSS Distribution Feeder Model; PROMOD

Highlights

- Value was measured incrementally in 2015, 2020, and 2025.
- DPV provides less value than in APS's 2009 study, due to changing power market and system conditions. Energy generation and wholesale purchase costs have decreased due to lower natural gas prices. Expected CO_2 costs are significantly lower due to decreased likelihood of federal legislation. Load forecasts are lower, meaning reduced generation, distribution and transmission capacity requirements.
- The study notes the potential for increased value (primarily in T&D capacity) if DPV can be geographically targeted in sufficient quantities. However, it notes that actual deployment since the 2009 study does not show significant clustering or targeting.
- Like the 2009 study, capacity value is assumed to be based on DPV's ability to defer planned investments, rather than assuming every installed unit of DPV defers capacity.

Overview of Value Categories



this chart represents the present value of 2025 incremental value, not a levelized cost

Energy: Energy provides the largest source of value to the APS system. Value is calculated based on a PROMOD hourly commitment and dispatch simulation. DPV reduces fuel, purchased power requirements, line losses, and fixed O&M. The natural gas price forecast is based on NYMEX forward prices with adjustment for delivery to APS's system. Energy losses are included as part of energy value, and unlike the 2009 report, are based on a recorded average energy loss.

Generation Capacity: Generation capacity value is highly dependent on DPV's dependable capacity during peak. Generation capacity value is based on PROMOD simulations, and results in the deferral of combustion turbines. Benefits from avoided energy losses are included as part of capacity value, and unlike the 2009 report, are based on a recorded peak demand loss. Like the 2009 study, generation capacity value is based on an ELCC calculation.

T&D Capacity: The study concludes that there are an insufficient number of feeders that can defer capacity upgrades based on non-targeted solar PV installations to determine measurable capacity savings. Distribution capacity savings can only be realized if distributed solar systems are installed at adequate penetration levels and located on specific feeders to relieve congestion or delay specific projects, but solar adoption has been geographically dispersed. Distribution value includes reduced losses, capacity, extended service life, and reduced equipment sizing.

Transmission capacity value is highly dependent on DPV's dependable capacity during peak. No transmission projects can be deferred more than one year, and none past the target years. As with the 2009 study, DPV dependable capacity for the purposes of T&D benefits is calculated based on a 90% confidence of generation during peak summer hours. Benefits from avoided energy losses are included.

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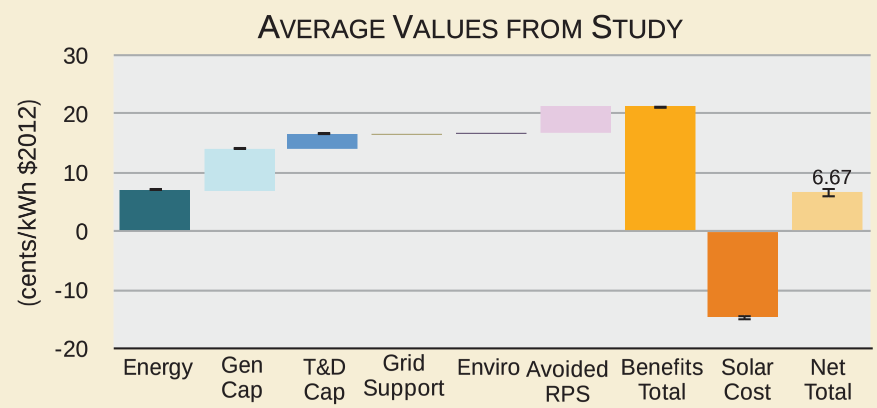
CROSSBORDER ENERGY, 2013
THE BENEFITS AND COSTS OF SOLAR DISTRIBUTED GENERATION FOR ARIZONA PUBLIC SERVICE

STUDY CHARACTERISTICS	
STUDY OBJECTIVE	To determine how demand-side solar will impact APS's ratepayers; a response to the APS 2013 study.
GEOGRAPHIC FOCUS	Arizona Public Service territory
SYSTEM CONTEXT	Vertically integrated IOU, 15% RPS by 2025
LEVEL OF SOLAR ANALYZED	DPV likely to be installed between 2013-2015; estimated here to be approximately 1.5%
STAKEHOLDER PERSPECTIVE	Ratepayers
GRANULARITY OF ANALYSIS	• Solar characterization - Not stated • Marginal resource/losses characterization - For energy, expected operating cost of a CT in peak months and CC in non-peak months; for capacity, fixed costs of a CT; marginal line loss factor from APS 2009 • Geographic granularity - Assumption that distribution investment can be deferred on 50% of feeders, based on APS 2009 conclusion that 50% of feeders show potential for reducing peak demand
TOOLS USED	Secondary analysis based on SAIC and APS detailed modeling

Highlights

- The benefits of DPV on the APS system exceed the cost by more than 50%. Key methodological differences between this study and the APS 2009 and 2013 studies include:
  - Determining value levelized over 20 years, as compared to incremental value in test years.
  - Crediting capacity value to every unit of solar DG installed, rather than requiring solar DG to be installed in "lumpy" increments.
  - Using ELCC to determine dependable capacity for generation, transmission, and distribution capacity values, as compared to using ELCC for generation capacity and a 90% confidence during peak summer hours for T&D capacity.
  - Focusing on solar installed over next few years years, rather than examining whether there is diminishing value with increasing penetration.
- The study notes that DPV must be considered in the context of efficiency and demand response—together they defer generation, transmission, and distribution capacity until 2017.

OVERVIEW OF VALUE CATEGORIES



Energy: Avoided energy costs are the most significant source of value. APS's long-term marginal resource is assumed to be a combustion turbine in peak months and a combined cycle in off-peak months, and avoided energy is based on these resources. The natural gas price forecast is based on NYMEX forward market gas prices, and the study determines that it adequately captures the fuel price hedge benefit. Key assumptions: $15/ton carbon adder, 12.1% line losses included in the energy value.

Generation Capacity: Generation capacity value is calculated as DPV dependable capacity (based on DPV's near-term ELCC from APS's 2012 IRP) times the fixed costs of a gas combustion turbine. Every installed unit of DPV receives that capacity value, based on the assumption that, when coupled with efficiency and demand response, capacity would have otherwise been needed before APS's planned investment.

T&D Capacity: T&D capacity value is calculated as DPV dependable capacity (ELCC) times APS's reported costs of T&D investments. Like generation capacity, every installed unit is credited with T&D capacity, with the assumption that 50% of distribution feeders can see deferral benefit. The study notes that APS could take a proactive approach to targeting DPV deployment, thereby increasing distribution value.

Grid Support (Ancillary Services): DPV in effect reduces load and therefore reduces the need for ancillary services that would otherwise be required, including spinning, non-spinning, and capacity reserves.

Environmental: DPV effectively reduces load and therefore reduces environmental impacts that would otherwise be incurred. Lower load means reduced criteria air pollutant emissions and lower water use (carbon is included as an adder to energy value).

Renewable Value: DPV helps APS meet its Renewable Energy Standard, thereby lowering APS's compliance costs.

Solar Cost: Since the study takes a ratepayer perspective, costs included are lost retail rate revenues, incentive payments, and integration costs.

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XCEL ENERGY FOR PUBLIC SERVICE COMPANY OF COLORADO, 2013
COSTS AND BENEFITS OF DISTRIBUTED SOLAR GENERATION ON THE PUBLIC SERVICE COMPANY OF COLORADO SYSTEM

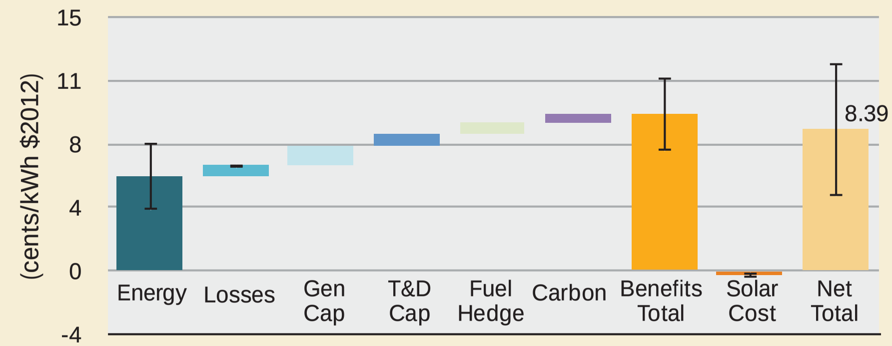
STUDY CHARACTERISTICS	
STUDY OBJECTIVE	To determine the costs and benefits of DPV on the Public Service Company of Colorado's electric power supply system at current penetration levels and projections for near-term penetration levels.
GEOGRAPHIC FOCUS	Public Service Company of Colorado's territory
SYSTEM CONTEXT	Vertically integrated IOU, 30% RPS by 2020 (includes DG standard)
LEVEL OF SOLAR ANALYZED	2012 DPV solar capacity: 59 MW; Est penetration in 2014: 140 MW installed by 2014
STAKEHOLDER PERSPECTIVE	System (excludes participant expenses (PV cost), solar program administration costs, or program incentive payments)
GRANULARITY OF ANALYSIS	• Solar characterization - Single TMY2 hourly generation profile weighted to represent entire 59 MW of DPV on PSCO's system used to calculate avoided energy costs & certain components of distribution system analysis; Historical meter data from 9 PV systems in 2009, 14 systems in 2010 (each >250 kW) used to estimate DPV capacity credit • Marginal resource/losses characterization - Calculated based on hourly PROMOD simulation; theoretical hourly loss analysis • Geographic granularity - Hourly feeder level data from small subset of feeders extrapolated to system
TOOLS USED	ProSym; NREL's TMY2 data sets using PV Watts

Highlights

- The study concludes that the most significant avoided cost from DPV (>90%) is from avoided energy costs.
- Energy value was calculated by comparing ProSym simulations with and without DPV, and the results were highly sensitive to assumed natural gas price forecasts. To estimate annual avoided energy costs, ProSym modeling used a single TMY2 generation profile (weighted by distribution of PV across PSCO's system), which was non-serially correlated with system load data.
- For the study, Xcel updated its ELCC calculations that are used to estimate capacity credit for DPV. In comparison to its previous 2009 ELCC study, the updated capacity credit for DPV across the four solar zones used is roughly 30% lower. The capacity credits range from 27%-32% for fixed installations and 40%-46% for tracking PV.

OVERVIEW OF VALUE CATEGORIES

AVERAGE VALUES FROM STUDY



Energy: Costs are calculated on a marginal basis using ProSym hourly commitment and dispatch simulation using the TMY2 data set. The variable costs include fuel, variable O&M, and generation unit start costs. ProSym simulation implies DPV tends to primarily displace generation that is blend of an efficient CC unit (7 MMBtu/MWh) and a less efficient CT (10 MMBtu/MWh) through 2035. It is noted that, through 2017, DPV displaces a mix of gas-fired and coal-fired generation (before coal is retired in 2017).

System Losses: Avoided T&D lines losses were assumed to achieve savings in energy, emissions, fuel hedge value and generation capacity. Distribution line losses were estimated using actual hourly feeder load data for the 58 feeders that represent 55% of DPV generation, and using an estimated value for the remainder. Average distribution losses were used to estimate savings from energy, emission & hedge value, and on a peak basis for generation capacity. Transmission line losses, based on annual, DPV generation-weighted values, were used to calculate energy, emissions, and hedge value, whereas avoided generation capacity was based on losses incurred across top 50 load hours.

Generation Capacity: Avoided generation capacity costs are based on the market price of capacity until 2017, and after that (because of incremental need) based on the economic carrying charge of a generic CT's capital and fixed O&M costs. The avoided generation capacity cost is credited to DPV based on a ELCC study (historical system load and solar generation patterns for 2009 and 2010).

T&D Capacity: DPV is assumed to defer distribution feeder capital investment by 1 to 2 years only if the existing feeder's peak load is at or near the feeder's capacity and the feeder's peak load is decreased by ~10%.

Fuel Price Hedge Value: While the study notes the approach taken in other benefit/ cost studies to estimate fuel price hedge value from NYMEX fuel price forecasts, it is not explicitly stated how the fuel price hedge was ultimately estimated.

Carbon: Annual tons of CO_2 emissions avoided by DPV as calculated by the ProSym avoided cost case simulations. Change in marginal emissions over time driven by planned changes in generation fleet (primarily retirement of 1,300 MW coal in 2017).

Solar Cost: Defined as "Integration Costs," or "costs that DPV adds to the overall cost of operating the Public Service power supply system based on inefficiencies that arise when the actual net load differs from the day-ahead forecasted net load." These costs are composed of electricity production costs levelized over 20 years.

ENERGY AND ENVIRONMENTAL ECONOMICS, INC. (E3), 2011
CALIFORNIA SOLAR INITIATIVE COST-EFFECTIVENESS EVALUATION

STUDY CHARACTERISTICS	
STUDY OBJECTIVE	"To perform a cost-effectiveness evaluation of the California Solar Initiative (CSI) in accordance with the CSI Program Evaluation Plan."
GEOGRAPHIC FOCUS	California
SYSTEM CONTEXT	Study: CSI program, retail net metering CA: 33% RPS, ISO market
LEVEL OF SOLAR ANALYZED	1,940 MW program goal (<1% of 2016 peak load)
STAKEHOLDER PERSPECTIVE	Participants (DPV customers), Ratepayers, Program Administrator, Total Resource, Society
GRANULARITY OF ANALYSIS	• Solar characterization - Hourly PV output profiles based on metered and simulated PV output data • Marginal resource/losses characterization - Energy: historical hourly day-ahead market price shapes (CAISO); Capacity: fixed cost of a new CT less net energy, AS revenues (see Overview box); Energy loss factors by TOU period, season; Capacity loss factors at peak periods • Geographic granularity - Major climate zones for each IOU; costs from utility rate case filings used as proxy for long-run marginal cost T&D investment avoided
TOOLS USED	E3 Avoided Cost Calculator (2011)

Highlights

- The study concludes that DPV is not expected to be cost-effective from a total resource or rate impact perspective during the study period, but that participant economics will not hinder CSI adoption goals. Program incentives support participant economics in the short-run, but DPV is expected to be cost-effective for many residential customers without program incentives by 2017. The study suggests that the value of non-economic benefits of DPV should be explored to determine if and how they provide value to California.

- The study focuses on seven benefits including energy, line losses, generation capacity, T&D capacity, emissions, ancillary services, and avoided RPS purchases. It focuses on costs including net energy metering bill credits, rebates/incentives, utility interconnection, costs of the DG system, net metering costs, and program administration.

- The study assesses hourly avoided costs in each of California's 16 climate zones to reflect varying costs in those zones, and calculates benefits and costs as 20-year levelized values. It uses E3's avoided cost model.

OVERVIEW OF VALUE CATEGORIES

This study assesses overall cost-effectiveness based on five cost tests (participant cost test, ratepayer impact measure, program administrator cost, total resource cost, and societal cost) as defined in the California Standard Practices Manual, and presents total rather than itemized results. Therefore, individual results are not shown here in a chart.

Energy: Hourly wholesale value of energy measured at the point of wholesale energy transaction. Natural gas price is based on NYMEX forward market and then on a long-run forecast of natural gas prices.

System Losses: Losses between the delivery location and the point of wholesale energy transaction. Losses scale with energy value, and reflect changing losses at peak periods.

Generation Capacity: Value of avoiding new generation capacity (assumed to be a gas combustion turbine) to meet system peak loads, including additional capacity avoided due to decreased energy losses. DPV receives the full value of avoided capacity after the resource balance year. Value is less in the short-run (before the resource balance year) because of CAISO's substantial planning reserve margin.

T&D Capacity: Value of deferring T&D capacity to meet peak loads.

Grid Support Services (Ancillary Services): Value based on historical ancillary services market prices, scaled with the price of natural gas. Individual ancillary services included are regulation up, regulation down, spinning reserves, and non-spinning reserves, and value is based on how a load reduction affects the procurement of each AS.

Avoided RPS: Value is the incremental avoided cost of purchasing renewable resources to meet California's RPS.

Environmental: Value of CO_2 reduction, with $/ton price based on a meta-analysis of forecasts. Unpriced externalities (primarily health effects) were valued at $0.01-0.03/kWh based on secondary sources.

Social: The study acknowledges that customers who install DPV may also install more energy efficiency, but does not attempt to quantify that value. The study also acknowledges potential benefits associated with employment and tax revenues and suggests that an input-output model would be an appropriate approach, although these benefits are not quantified in this study.

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ENERGY AND ENVIRONMENTAL ECONOMICS, INC. (E3), 2012

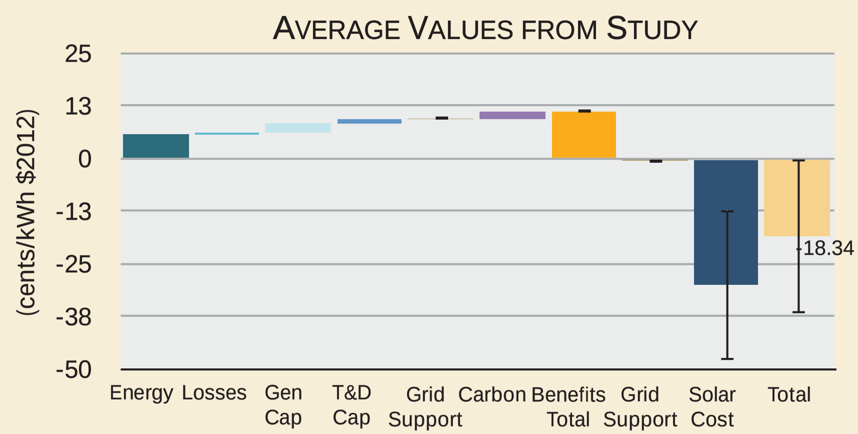
TECHNICAL POTENTIAL FOR LOCAL DISTRIBUTED PHOTOVOLTAICS IN CALIFORNIA

STUDY CHARACTERISTICS	
STUDY OBJECTIVE	To estimate the technical potential of local DPV in California, and the associated costs and benefits.
GEOGRAPHIC FOCUS	California
SYSTEM CONTEXT	California's 3 investor-owned utilities (IOU): PG&E, SDG&E, SCE
LEVEL OF SOLAR ANALYZED	< 24% system peak load
STAKEHOLDER PERSPECTIVE	Total resource cost (TRC)
GRANULARITY OF ANALYSIS	• Solar characterization - Simulated hourly PV output for each configuration (horizontal, fixed tilt, tracking) for each substation based on 2010 weather • Marginal resource/losses characterization - Energy: historical hourly day-ahead market price shapes (CAISO); Capacity: fixed cost of a new CT less net energy, AS revenues (see Overview box); Energy loss factors by TOU period, season; Capacity loss factors at peak periods • Geographic granularity - Compared hourly load at the individual substation level to potential PV generation at the same location at 1,800 substations
TOOLS USED	E3 Avoided Cost Calculator

Highlights

- Local DPV is defined as PV sized such that its output will be consumed by load on the feeder or substation where it is interconnected. Specifically, the generation cannot backflow from the distribution system onto the transmission system.
- The process for identifying sites included using GIS data to identify sites surrounding each of approximately 1,800 substations in PG&E, SDG&E and SCE. The study compared hourly load that the individual substation level to potential DPV generation at the same location.
- Cost of local distributed DPV increases significantly with Investment Tax Credit (ITC) expiration in 2017.
- When DPV is procured on a least net cost basis, opportunities may exist to locate in areas with high avoided costs. In 2012, a least net cost procurement approach results in net costs that are approximately $65 million lower assuming avoided transmission and distribution costs can be realized. These benefits carry through to 2016 for the most part, but disappear by 2020, when all potential has been realized regardless of cost.

OVERVIEW OF VALUE CATEGORIES



Energy: Estimate of hourly wholesale value of energy adjusted for losses between the point of wholesale transaction and delivery. Annual forecast based on market forwards that transition to annual average market price needed to cover the fixed and operating costs of a new CCGT, less net revenue from day-ahead energy, ancillary service, and capacity markets. Hourly forecast derived based on historical hourly day-ahead market price shapes from CAISO's MRTU system.

System Losses: Losses between the delivery location and the point of wholesale energy transaction. Losses scale with energy value, and reflect changing losses at peak periods.

Generation Capacity: In the long-run (after the resource balance year), generation capacity value is based on the fixed cost of a new CT less expected revenues from real-time energy and ancillary services markets. Prior to resource balance, value is based on a resource adequacy value.

T&D Capacity: Value is based on the "present worth" approach to calculate deferment value, incorporating investment plans as reported by utilities.

Grid Support Services (Ancillary Services): Value based on the value of avoided reserves, scaling with energy.

Carbon: Value of CO_2 emissions, based on an estimate of the marginal resource and a meta-analysis of forecasted carbon prices.

Solar Cost -The installed system cost, the cost of land and permitting, and the interconnection cost

*E3's components of electricity avoided costs include generation energy, line losses, system capacity, ancillary services, T&D capacity, environment.

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CROSSBORDER ENERGY FOR VOTE SOLAR INITIATIVE, 2013

EVALUATING THE BENEFITS AND COSTS OF NET ENERGY METERING IN CALIFORNIA

STUDY CHARACTERISTICS	
STUDY OBJECTIVE	"To explore recent claims from California's investor-owner utilities that the state's NEM policy causes substantial cost shifts between energy customers with Solar PV systems and non-solar customers, particularly in the residential market."
GEOGRAPHIC FOCUS	California
SYSTEM CONTEXT	33% RPS, retail net metering, increasing solar penetration, ISO market
LEVEL OF SOLAR ANALYZED	Up to 5% of peak (by capacity)
STAKEHOLDER PERSPECTIVE	Ratepayers
GRANULARITY OF ANALYSIS	• Solar characterization - Used PVWatts to produce hourly PV outputs at representative locations • Marginal resource/losses characterization - Based on E3 avoided cost model (Sept 2011), which determines hourly energy market values and capacity based on CT (since resource balance year not used in this study) • Geographic granularity - Major climate zones for each IOU; costs from utility rate case filings used as proxy for long-run marginal cost T&D investment avoided
TOOLS USED	E3 Avoided Cost Calculator (2011), PVWatts

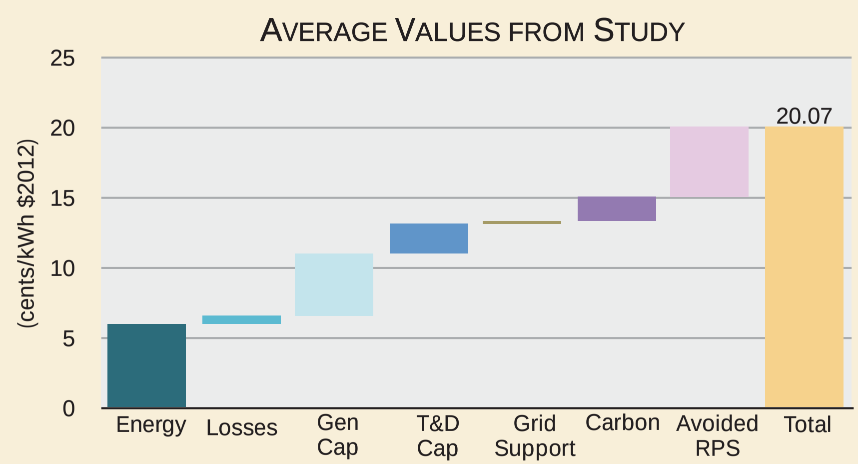
Highlights

- The study concludes that "on average over the residential markets of the state's three big IOUs, NEM does not impose costs on non-participating ratepayers, and instead creates a small net benefit." This conclusion is driven by "recent significant changes that the CPUC has adopted in IOUs' residential rate designs" plus "recognition that [DPV]...avoid other purchases or renewable power, resulting in a significant improvement in the economics of NEM compared to the CPUC's 2009 E3 NEM Study."

- The study focused on seven benefits: avoided energy, avoided generation capacity, reduced cost for ancillary services, lower line losses, reduced T&D investments, avoided RPS purchases, and avoided emissions. The study's analysis reflects costs to other customers (ratepayers) from "bill credits that the utility provides to solar customers as compensation for NEM exports, plus any incremental utility costs to meter and bill NEM customers." These costs are not quantified and levelized individually in the report, so they are not reflected in the chart to the right.

- The study bases its DPV value assessment on E3's avoided cost model and approach. It updates key assumptions including natural gas price forecast, greenhouse gas allowance prices, and ancillary services revenues, and excludes the resource balance year approach (the year in which avoided costs change from short-run to long-run). The study views the resource balance year as inconsistent with the modular, short lead-time nature of DPV. The study only considered the value of the exports to the grid under the utility's NEM program.

OVERVIEW OF VALUE CATEGORIES



Energy: Wholesale value of energy adjusted for losses between the point of the wholesale transaction and the point of delivery. Crossborder adjusted natural gas price forecast and greenhouse gas price forecast.

System Losses: The loss in energy from transmission and distribution across distance.

Generation Capacity: The cost of building new generation capacity to meet system peak loads. Crossborder does not use E3's "resource balance year" approach, which means that generation capacity value is based on long-run avoided capacity costs.

T&D Capacity: The costs of expanding transmission and distribution capacity to meet peak loads.

Grid Support Services (Ancillary Services): The marginal cost of providing system operations and reserves for electricity grid reliability. Crossborder updated assumed ancillary services revenues.

Carbon: The cost of carbon dioxide emissions associated with the marginal generating resource.

Avoided RPS: The avoided net cost of procuring renewable resources to meet an RPS Portfolio that is a percentage of total retail sales due to a reduction in retail loads.

VOTE SOLAR INITIATIVE, 2005
QUANTIFYING THE BENEFITS OF SOLAR POWER FOR CALIFORNIA

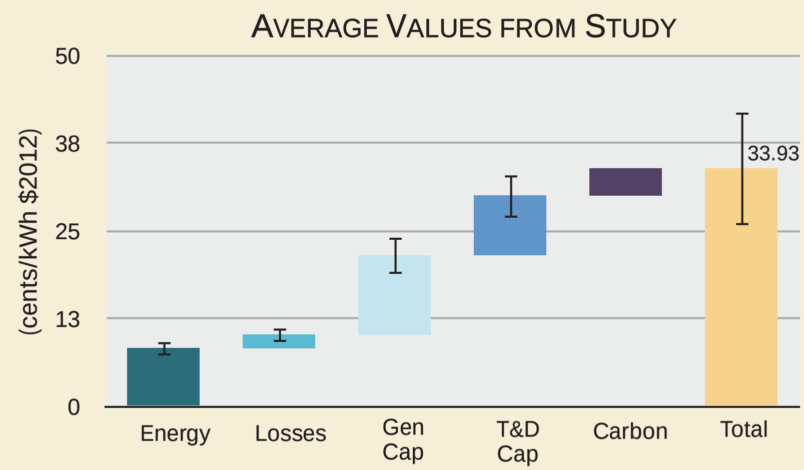
Electricity Innovation Lab
ROCKY MOUNTAIN INSTITUTE

STUDY CHARACTERISTICS	
STUDY OBJECTIVE	To provide a quantitative analysis of key benefits of solar energy for California.
GEOGRAPHIC FOCUS	California
SYSTEM CONTEXT	California's 3 investor-owned utilities (IOU): PG&E, SDG&E, SCE
LEVEL OF SOLAR ANALYZED	Unspecified
STAKEHOLDER PERSPECTIVE	Utility, ratepayer, participant, society
GRANULARITY OF ANALYSIS	• Solar characterization - Assumed average solar PV ELCC to be 50% from range of 36%-70% derived from NREL study[1] • Marginal resource/losses characterization - Assumed natural gas generation plant on margin both for peak demand and non-peak periods • Geographic granularity - Not considered in this study
TOOLS USED	Spreadsheet analysis

Highlights

- The study concluded that the value of on-peak solar energy in 2005 ranged from $0.23 - 0.35 /kWh.
- The analysis looks at avoided costs under two alternative scenarios for the year 2005. The two scenarios vary the cost of developing new power plants and the price of natural gas.
  - Scenario 1 assumed new peaking generation will be built by the electric utility at a cost of capital of 9.5% with cost recovery over a 20 year period; the price of natural gas is based on the 2005 summer market price (average gas price)
  - Scenario 2 assumed new peaking generation will be built by a merchant power plant developer at a cost of capital of 15% with cost recovery over a 10 year period; the price of natural gas is based on the average gas price in California for the period of May 2000 through June 2001 (high gas price – 24% higher)
- While numerous unquantifiable benefits were noted, five benefits were quantified:
  1) Deferral of investments in new peaking power capacity
  2) Avoided purchase of natural gas used to produce electricity
  3) Avoided emissions of CO_2 and NO_x that impact global climate and local air quality
  4) Reduction in transmission and distribution system power losses
  5) Deferral of transmission and distribution investments that would be needed to meet growing loads.
- The study assumed that, "in California, natural gas is the fuel used by power plants on the margin both for peak demand periods and non-peak periods. Therefore it is reasonable to assume the solar electric facilities will displace the burning of natural gas in all hours that they produce electricity."

OVERVIEW OF VALUE CATEGORIES



Energy: Avoided fuel and variable O&M. Natural gas fuel price multiplied by assumed heat rate of peaking power plant (9360 MMBtu/kWh). Assumed value of consumables such as water and ammonia to be approximately 0.5 cents/kWh. For non-peak, average heat rates of existing fleet of natural gas plants were used for each electric utility's service area. Assumed heat rates: PG&E: 8740 MMBtu/kWh, SCE - 9690 MMBtu/kWh, SDG&E – 9720 MMbtu/kWh.

System Losses: Solar assumed to be delivered at secondary voltage. The summer peak and the summer shoulder loss factors are used to calculate the additional benefit derived from solar power systems because of their location at load.

Generation Capacity: Cost of installing a simple cycle gas turbine peaking plant multiplied by DPV's ELCC and a capital recovery factor, converted into costs per kilowatt hour by expected hours of on-peak operation.

T&D Capacity: One study area was selected for each utility to calculate the value of solar electricity in avoiding T&D upgrades. To simplify the analysis the need for T&D upgrades was assumed to be driven by growth in demand during 5% of the hours in a year. The 50% ELCC was used used in calculating the value of avoided T&D upgrades.

Carbon: Assumed to be the avoided air emissions, CO_2 and NOx, created from marginal generator (natural gas). CO_2 = $100/ton; NOx = $.014/kWh

1 "Solar Resource-Utility Load-Matching Assessment," Richard Perez, National Renewable Energy Laboratory, 1994

RICHARD DUKE, ENERGY POLICY, 2005

ACCELERATING RESIDENTIAL PV EXPANSION: DEMAND ANALYSIS FOR COMPETITIVE ELECTRICITY MARKETS

STUDY CHARACTERISTICS	
STUDY OBJECTIVE	To quantify the potential market for grid-connected, residential PV electricity integrated into new houses built in the US.
GEOGRAPHIC FOCUS	California and Illinois
SYSTEM CONTEXT	California: 33% RPS, mostly gas generation; Illinois: mostly coal generation
LEVEL OF SOLAR ANALYZED	not stated; assumed low
STAKEHOLDER PERSPECTIVE	System
GRANULARITY OF ANALYSIS	• Solar characterization - Single estimated insolation for two states analyzed • Marginal resource/losses characterization - For energy, marginal resource is a natural gas plant in California and a cola plant in Illinois. For capacity, marginal resource is a gas turbine in both states. Losses based on average and peak loss factors estimated in secondary sources. • Geographic granularity - Transmission and distribution system impacts not accounted for since they are site specific
TOOLS USED	High level, largely based on secondary analysis

Highlights

- Total value varies significantly between the two regions studied largely driven by what the off-peak marginal resource is (gas vs coal). Coal has significantly higher air pollution costs, although lower fuel costs.
- The study notes that true value varies dramatically with local conditions, so precise calculations at a high-level analysis level are impossible. As such, transmission and distribution impacts were acknowledged but not included.

OVERVIEW OF VALUE CATEGORIES

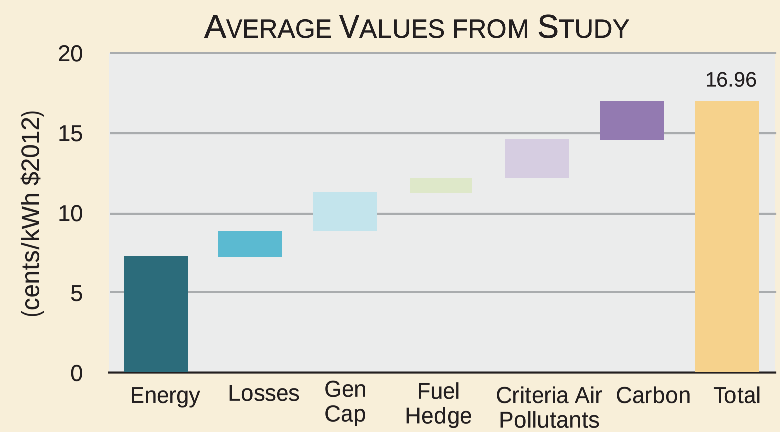


**Chart data only reflects California assessment for comparison*

Energy: Energy value is based on the marginal resource on-peak (gas combustion turbine) and off-peak (inefficient gas in California, and coal in Illinois). Fuel prices are based on Energy Information Administration projections, and levelized.

System Losses: Energy losses are assumed to be 7-8% off-peak, and up to twice that on-peak. Losses are only included as energy losses.

Generation Capacity: Generation capacity value is based on the assumption that the marginal resource is always a gas combustion turbine. Effective capacity is based on an ELCC estimate from secondary sources.

Fuel Price Hedge Value: Hedge value is estimated based on the market value to utilities of a fixed natural gas price for up to 10 years based on market swap data. The hedge is assumed to be additive since EIA gas prices were used rather than NYMEX futures market.

Criteria Air Pollutants: Criteria air pollutant reduction value is based on avoided costs of health impacts, estimated by secondary sources.

Carbon: Carbon value is the price of carbon (estimated based on European market projections) times the amount of carbon displaced.

Lawrence Berkeley National Lab, 2012

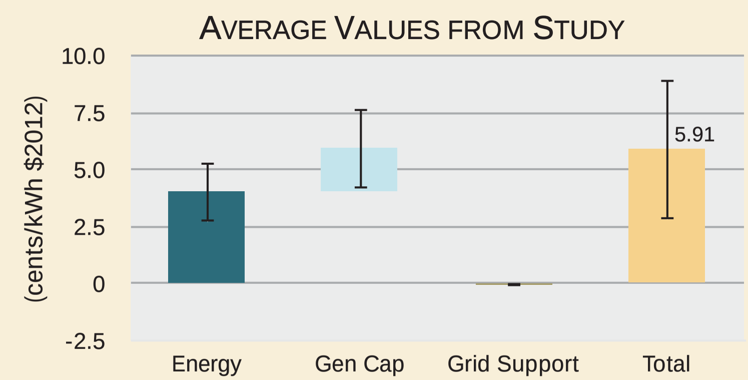
Changes in the Economic Value of Variable Generation at High Penetration Levels: A Pilot Case Study of California

Study Characteristics	
Study Objective	To quantify the change in value for a subset of economic benefits (energy, capacity, ancillary services, DA forecasting error) that results from using renewable generation technologies (wind, PV, CSP, & Thermal Energy Storage) at different penetration levels.
Geographic Focus	Loosely based on California
System Context	33% RPS, ISO market
Level of Solar Analyzed	Up to 40% (by energy)
Stakeholder Perspective	System
Granularity of Analysis	• Solar characterization - Hourly satellite derived insolation data from National Solar Research Database, 10 km x 10 km granularity, NREL SAM model • Marginal resource/losses characterization - For energy and capacity, modeled hourly market prices, reflecting day-ahead, real-time, and ancillary services • Geographic granularity - Not considered in this study
Tools Used	Customized model that evaluates long-run investment decisions and short-term dispatch and operations

Highlights

- The marginal economic value of solar exceeds the value of flat block power at low penetration levels, largely attributable to generation capacity value and solar coincidence with peak.
- The marginal value of DPV drops considerably as the penetration of solar increases, initially, driven by a decrease in capacity value with increasing solar generation. At the highest renewable penetrations considered, there is also a decrease in energy value as DPV displaces lower cost resources.
- The study notes that it is critical to use an analysis framework that addresses long-term investment decisions as well as short-term dispatch and operational constraints.
- Several costs and impacts are not considered in the study, including environmental impacts, transmission and distribution costs or benefits, effects related to the lumpiness and irreversibility of investment decisions, uncertainty in future fuel and investment capital costs, and DPV's capital cost.

Overview of Value Categories



Energy: Energy value decreases at high penetrations because the marginal resource that DPV displaces changes as the system moves down the dispatch stack to a lower cost generator. Energy value is based on the short-run profit earned in non-scarcity hours (those hours where market prices are under $500/MWh), and generally displaces energy from a gas combined cycle. Fuel costs are based on Energy Information Administration projections.

Generation Capacity: Generation capacity value is based on the portion of short-run profit earned during hours with scarcity prices (those hours where market price equals or exceeds $500/MWh). Effective DPV capacity is based on an implied capacity credit as a result of the model's investment decisions, rather than a detailed reliability or ELCC analysis.

Grid Support (Ancillary Services): Ancillary services value is the net earnings from selling ancillary services in the market as well as paying for increased ancillary services due to increased short-term variability and uncertainty.

Electricity Innovation Lab
ROCKY MOUNTAIN INSTITUTE

CLEAN POWER RESEARCH, 2012

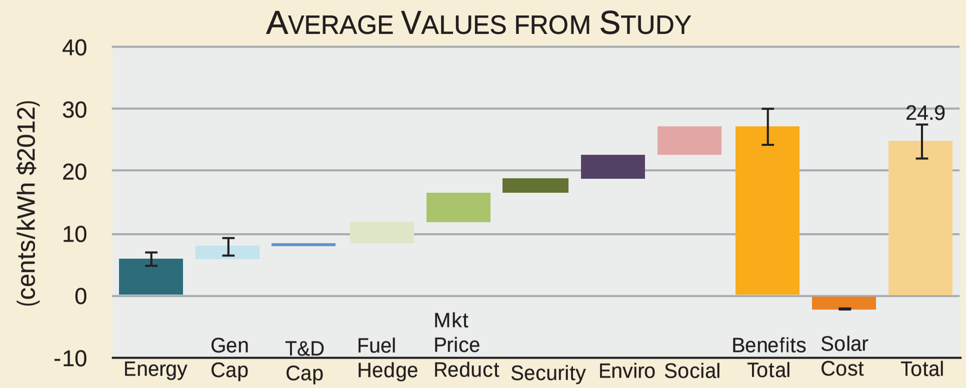
THE VALUE OF DISTRIBUTED SOLAR ELECTRIC GENERATION TO NEW JERSEY AND PENNSYLVANIA

STUDY CHARACTERISTICS	
STUDY OBJECTIVE	To quantify the cost and value components provided to utilities, ratepayers, and taxpayers by grid-connected, DPV in Pennsylvania and New Jersey.
GEOGRAPHIC FOCUS	7 cities across PA and NJ
SYSTEM CONTEXT	PJM ISO
LEVEL OF SOLAR ANALYZED	15% of system peak load, totaling 7 GW across the 7 utility hubs
STAKEHOLDER PERSPECTIVE	Utility, ratepayers, taxpayer
GRANULARITY OF ANALYSIS	• Solar characterization - Hourly estimates based on SolarAnywhere (satellite-derived irradiance data and simulation model with a 10 km x 10 km pixel resolution) • Marginal resource/losses characterization - For energy and capacity, marginal resource assumed to be CT; Marginal loss savings calculated, although methodology unclear • Geographic granularity - Locational marginal price node
TOOLS USED	Clean Power Research's Distributed PV Value Calculator; Solar Anywhere, 2012

Highlights

- The study evaluated 10 benefits and 1 cost. Evaluated benefits included: Fuel cost savings, O&M cost savings, security enhancement, long term societal benefit, fuel price hedge, generation capacity, T&D capacity, market price reduction, environmental benefit, economic development benefit. The cost evaluated was the solar penetration cost.
- The analysis represents the value of PV for a "fleet" of PV systems, evaluated in 4 orientations, each at 7 locations (Pittsburgh, PA; Harrisburg, PA; Scranton, PA; Philadelphia, PA; Jamesburg, NJ; Newark, NJ; and Atlantic City, NJ), spanning 6 utility service territories, each differing by: cost of capital, hourly loads, T&D loss factors, distribution expansion costs, and growth rate.
- The total value ranged from $256 to $318/MWh. Of this, the highest value components were the Market Price Reduction (avg $55/MWh) and Economic Development Value (avg $44/MWh).
- The moderate generation capacity value is driven by a moderate match between DPV output and utility system load. The effective capacity ranges from 28% to 45% of rated output (in line with the assigned PJM value of 38% for solar resources).
- Loss savings were not treated as a stand-alone benefit under the convention used in this methodology. Rather, the loss savings effect is included separately for each value component.

OVERVIEW OF VALUE CATEGORIES



Energy: Fuel and O&M cost savings. PV output plus loss savings times marginal energy cost, summed for all hrs of the year, discounted over PV life (30 years). Marginal energy costs are based on fuel and O&M costs of the generator most likely operating on the margin (assumed to be a combined cycle gas turbine). Assumed natural gas price forecast: NYMEX futures years 0-12; NYMEX futures price for year 12 x 2.33% escalation factor. Escalation rate assumed to be the same as the rate of wellhead price escalation from 1981-2011.

Generation Capacity: Capital cost of displace generation times PV's effective load carrying capability (ELCC), taking into account loss savings.

T&D Capacity: Expected long-term T&D system capacity upgrade cost, divided by load growth, times financial term, times a factor that represents match between PV system output (adjusted for losses) and T&D system load. In this study, T&D values were based on utility-wide average loads, which may obscure higher value areas.

Fuel Price Hedge Value: Cost to eliminate the fuel price uncertainty associated with natural gas generation through procurement of commodity futures. The value is directly related to the utility's cost of capital.

Market Price Reduction: Value to customers of the reduced cost of wholesale energy as a result of PV installation decreasing the demand for wholesale energy. Quantified through an analysis of the supply curve and reduction in demand, and the accompanying new market clearing price.

Security Enhancement Value: Annual cost of power outages in the U.S. times the percent (5%) that are high-demand stress type that can be effectively mitigated by DPV at a capacity penetration of 15%.

Social (Economic Development Value): Value of tax revenues associated with net job creation for solar vs conventional power generation. PV hard and soft cost /kW times portion of each attributed to local jobs, divided by annual PV system energy produced, minus CCGT cost/kW times portion attributed to local jobs divided by annual energy produced. Levelized over the 30 year lifetime of PV system, adjusted for lost utility jobs, multiplied by tax rate of a $75K salary, multiplied by indirect job multiplier.

Environmental: Environmental cost of a displaced conventional generation technology times the portion of this technology in the energy generation mix, repeated and summed for each conventional generation sources displaced by PV. Environmental cost for each generation source based on costs of GHG, SOx / NOx emissions, mining degradations, ground-water contamination, toxic releases and wastes. etc...as calculated in several environmental health studies.

Electricity Innovation Lab
ROCKY MOUNTAIN INSTITUTE

CLEAN POWER RESEARCH & SOLAR SAN ANTONIO, 2013

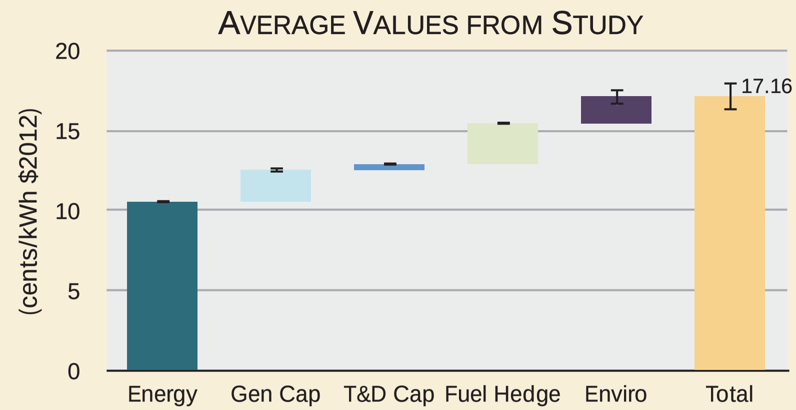
THE VALUE OF DISTRIBUTED SOLAR ELECTRIC GENERATION TO SAN ANTONIO

STUDY CHARACTERISTICS	
STUDY OBJECTIVE	To quantify the value provided by grid-connected, DPV in San Antonio from a utility perspective.
GEOGRAPHIC FOCUS	CPS Energy territory
SYSTEM CONTEXT	Municipal utility
LEVEL OF SOLAR ANALYZED	1.1-2.2% of peak load (by capacity)
STAKEHOLDER PERSPECTIVE	Utility
GRANULARITY OF ANALYSIS	• Solar characterization - Hourly estimates based on SolarAnywhere (satellite-derived irradiance data and simulation model with a 10 km x 10 km pixel resolution) to provide time- and location-correlated PV output with utility loads • Marginal resource/losses characterization - For energy and capacity, marginal resource assumed to be an "advanced gas turbine"; losses calculated on marginal basis • Geographic granularity - Not specified
TOOLS USED	Clean Power Research's SolarAnywhere, PVSimulator, DGValuator

Highlights

- The study concludes that DPV provides significant value to CPS Energy, primarily driven by energy, generation capacity deferment, and fuel price hedge value. The study is based solely on publicly-available data; it notes that results would be more representative with actual financial and operating data. Value is a levelized over 30 years.
- The study notes that value likely decreases with increasing penetration, although higher penetration levels needed to estimate this decrease were not analyzed.
- The study acknowledged but did not quantify a number of other values including climate change mitigation, environmental mitigation, and economic development.

OVERVIEW OF VALUE CATEGORIES



Energy: The study shows high energy value compared to other studies, driven by using EIA's "advanced gas turbine" with a high heat rate as the marginal resource. The natural gas price forecast is based on NYMEX forward market gas prices, then escalated at a constant rate. Energy losses are included in energy value, and are calculated on an hourly marginal basis.

Generation Capacity: Generation capacity value is DPV's effective capacity times the fixed costs of an "advanced gas turbine", assumed to be the marginal resource. Effective capacity based on ELCC; the reported ELCC is significantly higher than other studies. Every installed unit of DPV is given generation capacity value.

T&D Capacity: The study takes a two step approach: first, an economic screening to determine expansion plan costs and load growth expectations by geographic area, and second, an assessment of the correlation of DPV and load in the most promising locations.

Fuel Price Hedge: The study estimates hedge value as a combination of two financial instruments, risk-free zero-coupon bonds and a set of natural gas futures contracts, to represent the avoided cost of reducing fuel price volatility risk.

Environmental: The study quantified environmental value, as shown in the chart above, but did not include it in its final assessment of benefit since the study was from the utility perspective.

Electricity Innovation Lab
ROCKY MOUNTAIN INSTITUTE

AUSTIN ENERGY & CLEAN POWER RESEARCH, 2006

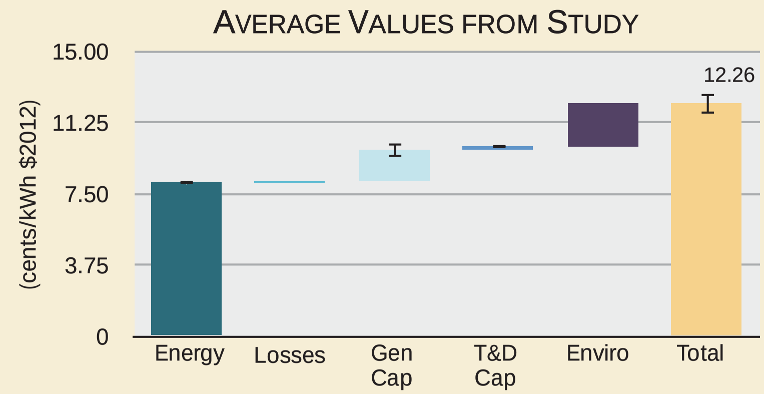
THE VALUE OF DISTRIBUTED PHOTOVOLTAICS IN AUSTIN ENERGY AND THE CITY OF AUSTIN

STUDY CHARACTERISTICS	
STUDY OBJECTIVE	To quantify the comprehensive value of DPV to Austin Energy (AE) in 2006 and document methodologies to assist AE in performing analysis as conditions change and, to apply to other technologies
GEOGRAPHIC FOCUS	Austin, TX
SYSTEM CONTEXT	Municipal utility
LEVEL OF SOLAR ANALYZED	>1% - 2%* system peak load
STAKEHOLDER PERSPECTIVE	Utility, ratepayer, participant, society
GRANULARITY OF ANALYSIS	• Solar characterization - Hourly PV output simulated for select PV configurations using irradiance data from hourly geostationary satellites; Validated using ground data from several climatically distinct locations including Austin, TX • Marginal resource/losses characterization - Energy: based on internal marginal energy cost provided by AE; • Geographic granularity - PV capacity value (ELCC) estimated system wide; Informed distribution avoided costs with area-specific distribution expansion plans "broken down by location and by the expenditure category"
TOOLS USED	Clean Power Research internal analysis; satellite solar data; PVFORM 4.0 for solar simulation; AE's load flow analysis for T&D losses

Highlights

- The study evaluated 7 benefits–energy production, line losses, generation capacity, T&D capacity, reactive power control (*grid support*), environment, natural gas price hedge (*financial*), and disaster recovery (*security*).
- The analysis assumed a 15 MW system in 7 PV system orientations, including 5 fixed and 2 single-axis.
- Avoided energy costs are the most significant source of value (about two-thirds of the total value), which is highly sensitive to the price of natural gas.
- Distribution capacity deferral value was relatively minimal. AE personnel estimated that 15% of the distribution capacity expansion plans have the potential to be deferred after the first ten years (assuming growth rates remain constant). Therefore, the study assumed that currently budgeted distribution projects were not deferrable, but the addition of PV could possibly defer distribution projects in the 11th year of the study period.
- Two studied values were excluded from the final results:
  - While reactive power benefits was estimated, the value ($0-$20/kW) was assumed not to justify the cost of the inverter that would be required to access the benefit (estimated cost not included).
  - The value of disaster recovery could be significant, but more work is needed before this value can be explicitly captured.

OVERVIEW OF VALUE CATEGORIES



Energy: PV output plus loss savings times marginal energy cost. Marginal energy costs are based on fuel and O&M costs of the generator most likely operating on the margin (typically, a combined cycle gas turbine).

System Losses: Computed differently depending upon benefit category. For all categories, loss savings are calculated hourly on the margin.

Generation Capacity: Cost of capacity times PV's effective load carrying capability (ELCC), taking into account loss savings.

Fuel price Hedge: Cost to eliminate the fuel price uncertainty associated with natural gas generation through procurement of commodity futures. Fuel price hedge value is included in the energy value.

T&D Capacity: Expected long-term T&D system capacity upgrade cost, divided by load growth, times financial term, times a factor that represents match between PV system output (adjusted for losses) and T&D system load.

Environmental: PV output times REC price—the incremental cost of offsetting a unit of conventional generation.

*ELCC was evaluated from 0%-20%; however, the ELCC estimate for 2% penetration was used in final value.

AUSTIN ENERGY & CLEAN POWER RESEARCH, 2012

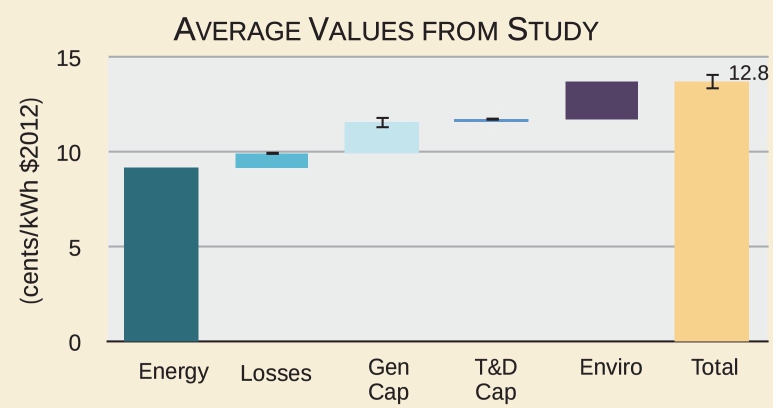
DESIGNING AUSTIN ENERGY'S SOLAR TARIFF USING A DISTRIBUTED PV CALCULATOR

STUDY CHARACTERISTICS	
STUDY OBJECTIVE	To design a residential solar tariff based on the value of solar energy generated from DPV systems to Austin Energy
GEOGRAPHIC FOCUS	Austin, TX
SYSTEM CONTEXT	Municipal utility with access to ISO (ERCOT)
LEVEL OF SOLAR ANALYZED	Assumed to be 2012 levels of penetration (5 MW)[1] < 0.5% penetration by energy[2]
STAKEHOLDER PERSPECTIVE	Utility
GRANULARITY OF ANALYSIS	Assumed to replicate granularity of AE/CPR 2006 study
TOOLS USED	Clean Power Research's Distributed PV Value Calculator; Solar Anywhere, 2012

Highlights

- The study focused on 6 benefits–energy, generation capacity, fuel price hedge value (included in energy savings), T&D capacity, and environmental benefits–which represent "a 'break-even' value...at which the utility is economically neutral to whether it supplies such a unit of energy or obtains it from the customer." The approach, which builds on the 2006 CPR study, is "an avoided cost calculation at heart, but improves on [an avoided cost calculation]... by calculating a unique, annually adjusted value for distributed solar energy."
- The fixed, south-facing PV system with a 30-degree tilt, the most common configuration and orientation in AE's service territory of approximately 1,500 DPV systems, was used as the reference system.
- As with the AE/CPR 2006 study, avoided energy costs are the most significant source of value, which is very sensitive to natural gas price assumptions.
- The levelized value of solar was calculated to total $12.8/kWh.
- Two separate calculation approaches were used to estimate the near term and long term value, combined to represent the "total benefits of DPV to Austin Energy" over the life time of a DPV system.
  - For the the near term (2 years) value of DPV energy, A PV output weighted nodal price was used to try to capture the relatively good correlation between PV output and electricity demand (and high price) that is not captured in the average nodal price.
  - To value the DPV energy produced during the mid and long term–through the rest of the 30-year assumed life of solar PV systems–the typical value calculator methodology was used.

OVERVIEW OF VALUE CATEGORIES



Energy: DPV output plus loss savings times marginal energy cost. Marginal energy costs are based on fuel and O&M costs of the generator most likely operating on the margin (typically, a combined cycle gas turbine).

System Losses: Computed differently depending upon benefit category. For all categories, loss savings are calculated hourly on the margin.

Generation Capacity: Cost of capacity times PV's effective load carrying capability (ELCC), taking into account loss savings.

Fuel Price Hedge Value: Cost to eliminate the fuel price uncertainty associated with natural gas generation through procurement of commodity futures. Fuel price hedge value is included in the energy value.

T&D Capacity: Expected long-term T&D system capacity upgrade cost, divided by load growth, times financial term, times a factor that represents match between PV system output (adjusted for losses) and T&D system load.

Environmental: PV output times Renewable Energy Credit (REC) price—the incremental cost of offsetting a unit of conventional generation.

Sources:
1) http://www.austinenergy.com/About%20Us/Newsroom/Reports/solarGoalsUpdate.pdf
2) http://www.austinenergy.com/About%20Us/Newsroom/Reports/2012AnnualPerformanceReportDRAFT.pdf

NAVIGANT CONSULTING FOR NREL, 2008
PHOTOVOLTAICS VALUE ANALYSIS

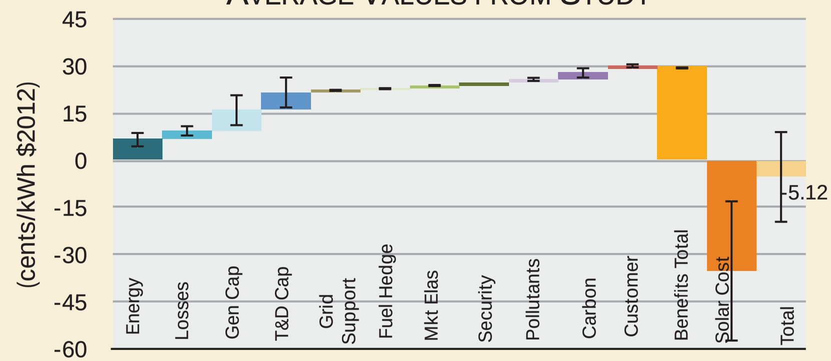
STUDY CHARACTERISTICS	
STUDY OBJECTIVE	To summarize and describe the methodologies and range of values for the costs and values of 19 services provided or needed by DPV from existing studies.
GEOGRAPHIC FOCUS	Studies reviewed reflected varying geographies; case studies from TX, CA, MN, WI, MD, NY, MA, and WA
SYSTEM CONTEXT	n/a
LEVEL OF SOLAR ANALYZED	n/a
STAKEHOLDER PERSPECTIVE	Participating customers, utilities, ratepayers, society
GRANULARITY OF ANALYSIS	This study is a meta-analysis, so reflects a range of levels of granularity.
TOOLS USED	Custom-designed Excel tool to compare results and sensitivities

Highlights

- There are 19 key values of distributed PV, but the study concludes that only 6 have significant benefits (energy, generation capacity, T&D costs, GHG emissions, criteria air pollutant emissions, and implicit value of PV).
- Deployment location and solar output profile are the most significant drivers of DPV value.
- Several values require additional R&D to establish a standardized quantification methodology.
- Value can be proactively increased.

OVERVIEW OF VALUE CATEGORIES

AVERAGE VALUES FROM STUDY



Energy: Energy value is fuel cost times the heat rate plus O&M costs for the marginal power plant, generally assumed to be natural gas.

System Losses: Avoided loss value is the amount of loss associated with energy, generation capacity, T&D capacity, and environmental impact, times the cost of that loss.

Generation Capacity: Generation capacity value is the capital cost of the marginal power plant times the effective capacity (ELCC) of DPV.

T&D Capacity: T&D capacity value is T&D investment plan costs times the value of money times the effective capacity, divided by load growth, levelized.

Grid Support Services (Ancillary Services): Ancillary services include VAR support, load following, operating reserves, and dispatch and scheduling. DPV is unlikely to be able to provide all of these.

Financial (Fuel Price Hedge, Market Price Response): Hedge value is the cost to guarantee a portion of electricity costs are fixed. Reduced demand for electricity decreases the price of electricity for all customers and creates a customer surplus.

Security: Customer reliability in the form of increased outage support can be realized, but only when DPV is coupled with storage.

Environment (Criteria Air Pollutants, Carbon): Value is either the market value of penalties or costs, or the value of avoided health costs and shortened lifetimes. Carbon value is the emission intensity of the marginal resource times the value of emissions.

Customer: Value to customer of having green option, as indicate by their willingness to pay.

Solar cost: Costs include capital cost of equipment plus fixed operating and maintenance costs.

SOURCES

05

Electricity Innovation Lab
ROCKY MOUNTAIN INSTITUTE

STUDIES REVIEWED IN ANALYSIS

Study	Funded / Commissioned by	Prepared by
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Electricity Innovation Lab
ROCKY MOUNTAIN INSTITUTE

ACRONYMS

AE - Austin Energy
APS - Arizona Public Service
AS - Ancillary Services
CCGT - Combined Cycle Gas Turbine
CHP - Combined Heat and Power
CPR - Clean Power Research
CT - Combustion Turbine
DER - Distributed Energy Resource
DPV - Distributed Photovoltaics
E3 - Energy + Environmental Economics
eLab - Electricity Innovation Lab
ELCC - Effective Load Carrying Capacity
FERC - Federal Energy Regulatory Commission
ISO - Independent System Operator
LBNL - Lawrence Berkeley National Laboratory
NREL - National Renewable Energy Laboratory
NYMEX - New York Mercantile Exchange
PV - Photovoltaic
RMI - Rocky Mountain Institute
SDG&E - San Diego Gas & Electric
SEPA - Solar Electric Power Association
SMUD - Sacramento Municipal Utility District
T&D - Transmission & Distribution
TOU - Time of Use

Michigan Public Service Commission

Staff Report

U-20169

August 10, 2018

Sally A. Talberg, Chairman
Norman J. Saari, Commissioner
Rachael A. Eubanks, Commissioner

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Contents

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Executive Summary

On May 17, 2018, the Michigan Public Service Commission (Commission) issued an order in MPSC Docket No. U-20169 after a severe wind storm swept through southeastern lower-Michigan and the thumb area beginning May 4, 2018. High wind speeds, with gusts approaching 70 mph, resulted in several hundred downed wires, thousands of customer outages, and a confirmed electrocution fatality due to a downed wire on May 7, 2018. The Commission order was issued based on the concern that areas of DTE's electric distribution system are not able to provide safe and reliable service; therefore, the order was issued with a focus on safety to determine if system maintenance is contributing to safety hazards. DTE and, later, the Michigan Public Service Commission Staff (Staff) were directed to file reports. Staff was specifically directed to:

> "… file an evaluation of DTE Electric's report. The Staff shall carefully examine the factual basis for assertions in the report, and the strength of the analysis and information provided by the company. The Staff's report shall include an analysis and recommendations, where necessary, regarding: (1) potential violations; (2) improvements to DTE Electric's method of transmitting and supplying electricity; (3) the strength and effectiveness of DTE Electric's procedures addressing downed wires (both regulatory and internal); and (4) the degree of adherence to the program of inspection required under the Commission's rules."

Overall, Staff believes that the DTE Electric report provided a fair review of what the Commission asked the Company to address. However, Staff does believe that there were areas within the Company's report that lacked detail and thus failed to address what the Commission order requested. Staff was not satisfied with how the Company addressed the Commission's concern "that parts of DTE Electric's distribution system are exhibiting an inability to routinely provide the level of safe and reliable service that is required by law" and the concern "with the operation of the 4.8 kV system and the question of whether it presents unique hazards." Staff issued a total of 68 questions and initiated meetings from July to early August to address areas of concern raised in the Commission's order that Staff believed the Company's report failed to address.

Staff's investigation included a review of the Company's distribution system, wire down procedures, and inspection program and identified potential violations. After reviewing the vegetation density results, the number of wire downs and outages, and the operations and maintenance (O&M) tree-trim spend amounts on the 4.8 kV system in the City of Detroit as part of the investigation, Staff has determined that there are areas within DTE Electric's distribution system that have experienced variable levels of tree-trim maintenance on an overhead circuit basis. Staff also finds that prior to 2015 "equipment" was used as the default cause for "unknown" outage causes to the customer's secondary service lines which leads Staff to believe that some of the outages caused by equipment in the 2013-2015 timeframe may not have been related to equipment. Staff is concerned with the 4.8 kV system as a whole given the fact that it is an ungrounded system and although the system is equipped with some ground alarm capabilities, single-phased downed wires may not produce fault currents large enough to engage safety devices and remain energized. Staff believes that the system also presents unique hazards in the City of Detroit due to the amount of rear-lot construction, which significantly impacts accessibility to the entire system and the ability to perform maintenance, emergency response, and remediation efforts.

As a result of its investigation, Staff makes nine recommendations to the Company and recommendations to the Commission.

Introduction

On May 17, 2018, the Michigan Public Service Commission (Commission) issued an order in MPSC Docket No. U-20169 after a severe wind storm swept through southeastern lower-Michigan and the thumb area beginning May 4, 2018. High wind speeds, with gusts approaching 70 mph, resulted in several hundred downed wires, thousands of customer outages, and a confirmed electrocution fatality due to a downed wire on May 7, 2018. The Commission order was issued based on the concern that areas of DTE's electric distribution system are not able to provide safe and reliable service; therefore, the order was issued with a focus on safety to determine if system maintenance is contributing to safety hazards. DTE and, later, the Michigan Public Service Commission Staff (Staff) were directed to file reports. Staff was specifically directed to:

> "… file an evaluation of DTE Electric's report. The Staff shall carefully examine the factual basis for assertions in the report, and the strength of the analysis and information provided by the company. The Staff's report shall include an analysis and recommendations, where necessary, regarding: (1) potential violations; (2) improvements to DTE Electric's method of transmitting and supplying electricity; (3) the strength and effectiveness of DTE Electric's procedures addressing downed wires (both regulatory and internal); and (4) the degree of adherence to the program of inspection required under the Commission's rules."

Incident Reporting – R 460.3804[1]

Staff performed a five-year review and analysis of incidents[2] reported by DTE Electric in accordance with Michigan Administrative Rule 460.3804 from June 30, 2013 through June 30, 2018. The review, summarized in Figure 1 below, reflects a total of 20 reported incidents associated with DTE Electric's facilities within three distribution categories: 1) the 4.8 kV system in the City of Detroit, 2) the 4.8 kV system outside of the City of Detroit, and 3) the rest of the distribution system which is mostly comprised of the 8.3 kV and 13.2 kV systems[3]. Figure 1 shows that the 4.8 kV system in the City of Detroit had eight reported incidents versus six in each of the two remaining categories. Additionally, the data shows that over half of the total incidents reported on the 4.8 kV system were due to downed wires. Of the total downed wire incidents,

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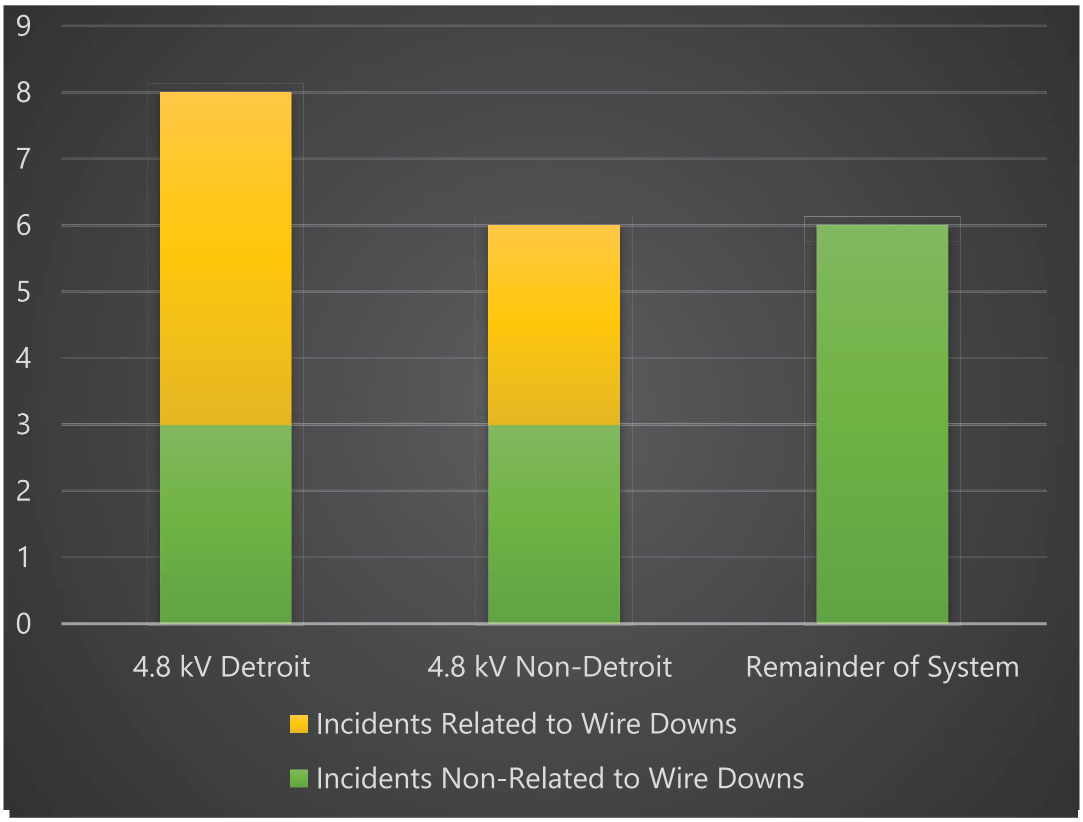
[1] Administrative Rule 460.3804 entitled "Accidents; notice to commission" states that "[e]ach utility shall promptly notify the commission of fatalities and serious injuries that are substantially related to the facilities or operations of the facilities."

[2] The locations and health status associated with the incidents was determined based on the information that was initially reported to Staff. Subsequent updates related to location or health status may not be reflected in the analysis.

[3] Staff chose to display the data under these three categories to not only show how the 4.8 kV system compares to the rest of the system, but to also compare areas within the 4.8 kV system.

over 87% were related to storm events. The review also included an analysis of the percentage of incidents which resulted in fatal injury. For the 4.8 kV system in the City of Detroit, 100% of incidents resulted in fatal injury. For the 4.8 kV system outside the City of Detroit, approximately 83% of incidents resulted in fatal injury, and approximately 33% of incidents resulted in fatal injury for the remainder of the system.

Figure 1: DTE Incidents Reported Under R 460.3804 (June 30, 2013 - June 30, 2018)



DTE Report Evaluation

The Commission order directed DTE to file a report in MPSC Docket No. U-20169. The Commission's directive was made with a focus on safety to inform the Commission and address concerns "that parts of DTE Electric's distribution system are exhibiting an inability to routinely provide the level of safe and reliable service that is required by law" and "the operation of the 4.8 kV system and the question of whether it presents unique hazards" as provided below:

> "The report shall detail the performance of DTE Electric's system during and after the May 4 windstorm event, including why outages occurred, how the utility responded, and whether changes should be implemented to reduce the potential for massive power outages, injury, or death. The report shall also provide a detailed examination of the utility's ongoing efforts to ensure compliance with the regulations listed above. The

> report shall also include a description of DTE Electric's internal safety protocols, and an analysis of compliance with those protocols. The Commission is particularly interested in whether DTE Electric is in compliance with these rules and protocols on a daily basis, and whether the utility experiences a comparable degree of compliance across all geographic areas of its distribution system."

Overall, Staff believes that the DTE Electric report provided a fair review of what the Commission asked the Company to address. DTE provided an overview of the May 4th wind storm's intensity showing areas of the lower-peninsula that saw the highest impacts from the storm. The Company also provided an adequate overview of the impacts the May 4th storm had on its distribution system, providing the number of wire downs, customer outages, broken poles, and amount of wire replaced. Along with the storm analysis, the Company provided its response to the storm by explaining the staging and preparation to support restoration efforts, providing details on the specific numbers of restoration resources, mutual assistance contact timing, and restoration plan in order to meet Commission Rule requirements. The Company's internal protocols were summarized and demonstrated that the Company does have internal procedures to protect the public in a wire down event designed to reduce potential hazards that may endanger life or property. The Company also provided an overview of compliance with the regulations outlined by individually addressing each of the Commission Rules specified in the Commission order. Finally, Staff appreciated the fact that the Company acknowledges that there are areas for improvement by outlining three areas in detail; prevention of downed wires through maintenance and upgrades, further education and communication regarding downed wires, and responsiveness to reported downed wires during major storms.

However, Staff does believe that there were areas within the Company's report that lacked detail and thus failed to address what the Commission order requested. Staff was not satisfied with how the Company addressed the Commission's concern "that parts of DTE Electric's distribution system are exhibiting an inability to routinely provide the level of safe and reliable service that is required by law" and the concern "with the operation of the 4.8 kV system and the question of whether it presents unique hazards." The areas Staff believed to lack detail and analysis are:

- Analysis of why the large number of customer outages occurred, aside from the fact that the May 4th wind storm appeared to have been concentrated on DTE Electric's service territory.
- Analysis of compliance with internal safety protocols.
- Analysis of compliance across all geographic service distribution areas, as they relate to preventative maintenance programs.

Staff Investigation

Staff sought more information from the Company in its investigation through meetings and multiple questions and requests for clarification to further its analysis after DTE Electric's report was issued. Staff's questions were designed to address areas of concern raised in the Commission's order that Staff believed the Company's report failed to address. The dates for each communication[4] were as follows:

- July 9, 2018 – Questions 1-56 issued to the Company
- July 16, 2018 – Call to discuss Questions 1-56 issued to the Company
- July 20, 2018 – Responses to 1-56 (excluding 19) received from the Company
- July 24, 2018 – Questions 57-68 issued to the Company
- July 25, 2018 – Response to Questions 19, 57, 60-61, 63, 65, and 67-68 received from the Company
- July 27, 2018 – Remaining responses received from the Company
- August 2, 2018 – Meeting to review the downed wire procedures with the Company

Distribution System Investigation

Staff has a good understanding of how DTE Electric's distribution system supplies electricity to its customers, but looked more deeply at specific characteristics of the distribution system. In addition to what has already been conveyed through the Company's Distribution Operations Five-Year (2018-2022) Investment and Maintenance Plan in MPSC Docket No. U-18014, it was determined that the 4.8 kV system in the City of Detroit is mostly comprised of an ungrounded ringed system and is equipped with ground alarm capabilities at some substations within the city that provide the ability to send alarms if there is an equipment failure or a grounded downed wire situation to improve safety. On a per overhead circuit mile basis, it was determined that the 4.8 kV system in the City of Detroit has 80% rear-lot construction, which is approximately 20% more than the 4.8 kV system outside of the City of Detroit and the rest of the distribution system[5]. The rear-lot construction on the 4.8 kV system in the City of Detroit is often near alleyways, which are no longer maintained by the City of Detroit, making it difficult for DTE Electric to access the entire right-of-way to perform maintenance, emergency response, and remediation functions. Adding to the accessibility issue, city residents have encroached the right-of-way with additions such as sheds and fences. Staff has made site reviews to assist in its analysis as to what exists in the city.

DTE Electric's 4.8 kV system in the City of Detroit shows a higher-level of tree density per overhead line mile, as compared to the 4.8 kV system outside of the City of Detroit and the rest of the distribution system. This information was provided by an outside consultant (ECI). The vegetation management consultant's survey outlines that starting in 2017, the estimated tree density on the

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[4] See Appendix A for a full list of Staff questions and Company responses.
[5] See Appendix A response to Question #2.

4.8 kV system in the City of Detroit is 297 trees per mile as compared to 172 trees per mile on the 4.8 kV system outside of the City of Detroit and 180 trees per mile on the rest of the distribution system[6]. Staff believes that the vegetation densities are generally proportional to the increased number of wire down and outage events in a given area. As a result, the 4.8 kV system in the City of Detroit experiences greater levels of wire down and outage events on an overhead circuit mile basis, compared to the remainder of the distribution system. Based on Staff's review of the O&M tree-trim spend over the past five-years[7], it is evident that the 4.8 kV system has received a lower-level of spend on an overhead circuit mile basis compared to the rest of the distribution system. Staff is aware that the Company had to make a decision on its tree-trim cycle and spend based on its O&M dollar funding, but until recently the Company did not raise an issue of high tree densities in the City of Detroit until sometime late in 2017. It appears that the 4.8 kV system in the City of Detroit consists of approximately 8.5% of DTE's total electric system on an overhead line mile basis, but the 4.8 kV system has not received more than 8.5% of total tree trimming yearly funding in four of the past five-years. See response to Question #10 of Appendix A on past O&M tree-trim spend amounts. DTE Electric states it is currently able to achieve an 8.5-year effective tree-trim cycle based on the current funding levels as outlined on page 18 of DTE Electric's report in MPSC Docket No. U-20169.

Additionally, Staff also observed that the number of outage events caused by equipment failures on the 4.8 kV system saw a significant reduction beginning in 2015, specifically on equipment where one customer was interrupted[8]. The reduction in number of outage events caused by equipment is because DTE Electric began recording the default cause as "unknown" rather than "equipment" in 2015 which leads Staff to believe that some of the outages caused by equipment in the 2013-2015 timeframe may not have been related to equipment. The single-outage equipment causes are typically related to overhead service lines on the secondary system.

Furthermore, certain areas of DTE Electric's distribution system unexpectedly experience more outages than the rest of the system and require an immediate large amount of money to fix the problem. Plymouth and Ann Arbor areas are two examples. In the Plymouth area, DTE Electric met with the public to work on a plan to improve the reliability that was determined to require one million dollars to be spent. Additional reliability issues occurred within two months prompting the Company to change their mind and increased the anticipated spend amount to five million dollars to improve reliability. If further meetings with the public occur on reliability issues in this area or other areas of DTE Electric's service area, Staff should be invited.

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[6] See Appendix A response to Question #4.
[7] See Appendix A response to Question #10
[8] See Appendix A response to Question #6.

Wire Down Procedure Investigation

DTE Electric provided a summary of the wire down response process on pages 11-15 of DTE's report filed in MPSC Docket No. U-20169. As previously mentioned, Staff also met with the Company on August 2, 2018, to review DTE Electric's downed wire procedures as directed in the Commission order. During the meeting, multiple documents were reviewed and presented to Staff including informational packets, a memorandum, a training presentation, and guidelines. The Company made the appropriate personnel available to explain the Company's internal wire down response process in detail for both storm and normal "blue-sky-day" operations. Multiple questions were asked by Staff including, but not limited to, staffing and procedural details as they relate to wire down response. The purpose of a procedure is to establish a framework to ensure that there is a level of consistency regarding a specific task or function. Staff concluded that there is no definitive procedure which outlines the entire wire down response function of the Company to ensure consistent response by all employees to reduce the safety hazards posed from a downed wire. Given the critical importance of wire down response and remediation, Staff believes it would be difficult to maintain a level of consistency in response by all employees across the system if the Company is relying on multiple documents to support the wire down response safety function. DTE also shared during the meeting that they have limited the use of wire guard personnel due to recent changes to procedures. In Staff's opinion, this policy fails to provide adequate protections to the general public's safety during severe weather situations. In the Commission's December 4, 2014 order in MPSC Docket No. U-17542 regarding the 2013 Ice Storm, the Commission encouraged the utilities to meet the goal of 2,500 trained wire down personnel. The intent of this goal was undeniably to improve the public safety during wire down events. DTE's current approach of training and maintaining the 2,500 wire guards while minimizing their deployment fails to promote the intended protection to the public at large from the order.

Inspection Program Investigation

DTE provided a maintenance overview and explained each of the maintenance programs related to the Company's electric distribution system in the report filed in MPSC Docket No. U-20169. Staff also requested further details related to the inspection programs to determine the Company's level of compliance with internal inspection programs related to each electric distribution equipment category. Staff was informed that the Company currently has a 14% critical asset inspection backlog, which has improved since 2014[9], and the Company may intentionally defer inspections if there is planned decommissioning or replacement work in the near future for that equipment.

[9] See Appendix A response to Question #19

Potential Violations

The Commission's authority to make and prescribe regulations is granted through Act 419 of 1919.

MCL 460.55 states in part that:

> The commission shall also have authority to make and prescribe regulations for the conducting of the business of public utilities, subject to the jurisdiction thereof, and it shall be the duty of every corporation, joint stock company, association or individual owning, managing or operating any such utility to obey such rules and regulations. Any such corporation, joint stock company, association or individual refusing or neglecting so to do, or refusing or neglecting to make any report required hereunder, shall be liable to a penalty of not less than 100 dollars nor more than 1,000 dollars…

Administrative Rules entitled "Technical Standards of Electric Service"[10] and "Service Quality and Reliability Standards for Electric Distribution Systems"[11] provide the Michigan Public Service Commission the authority to enforce operations and maintenance rules to ensure public safety. As a result of the investigation, Staff has identified the following violations.

<u>R 460.3801</u>

R 460.3801 entitled "Protective measures." states that:

> Each utility shall exercise reasonable care to reduce the hazards to which its employees, its customers, and the general public may be subjected.

In its investigation, Staff determined that DTE Electric has failed to develop wire down procedures which clearly outline the Company's internal wire down response and remediation functions to ensure consistency across all employees and to reduce the hazards to which its employees, its customers, and the general public may be subjected. Staff determined that the internal wire down response process, as described to Staff on August 2, 2018, was not adequately supported by the Company's documents. Multiple documents are used to inform the employees of the appropriate steps in the response process makes it difficult to carry out consistent response for wire downs across the entire system. Staff determined that there is no definitive standalone procedure which outlines the entire wire down response function of the Company to ensure consistent response by all employees to reduce the safety hazards posed from a downed wire.

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[10] Authority granted through Public Act (PA) 3 of 1939 (MCL 460.4 and MCL 460.6), PA 106 of 1909 (MCL 460.557), and PA 419 of 1919 (MCL 460.55).

[11] Authority granted through PA 3 of 1939 (MCL 460.4 and MCL 460.6), PA 106 of 1909 (MCL 460.557), PA 141 of 2000 (MCL 460.10p) PA 380 of 1965 (MCL 16.103, MCL 16.109 and MCL 16.331), and PA 419 of 1919 (MCL 460.55).

R 460.3501

R 460.3501 entitled "Electric plant; construction, installation, maintenance, and operation pursuant to good engineering practice required." states that:

> The electric plant of the utility shall be constructed, installed, maintained, and operated pursuant to accepted good engineering practice in the electric industry to assure, as far as reasonably possible, continuity of service, uniformity in the quality of service furnished, and the safety of persons and property.

R 460.3504 entitled "Electric plant inspection program." states that:

> Each utility shall adopt a program of inspection of its electric plant to ensure safe and reliable operation. The frequency of the various inspections shall be based on the utility's experience and accepted good practice. Each utility shall keep sufficient records to verify compliance with its inspection program.

In its investigation, Staff determined that DTE Electric has established electric equipment preventative maintenance inspection frequencies[12] to ensure safe and reliable operation based on the utility's experience. DTE Electric currently has a 14% critical asset inspection backlog and has failed to adhere to the Company's preventative maintenance program for assets since 2014. This backlog started at 29% in 2014 and is currently on pace to be eliminated by approximately 2022. At the current rate, it is possible that critical assets in the distribution system could be eight-years past the Company's preventative maintenance inspection cycle dates.

R 460.3505

R 460.3505 entitled "Utility line clearance program." states in part that:

> Each utility shall adopt a program of maintaining adequate line clearance through the use of industry-recognized guidelines. A line clearance program shall recognize the national electric safety code standards that are adopted by reference in R 460.811 et seq.

R 460.813 entitled "Standards of good practice, adoption by reference." states in part that:

> Parts 1, 2, and 3 and sections 1, 2, 3, and 9 of the national electrical safety code, 2017 edition (ANSI-C2-2017), are adopted by reference in these rules as standards of accepted good practice.

[12] Exhibit 6.2.1 within DTE Electric's Five-Year Investment and Maintenance Plan filed in MPSC Docket No. U-18014 shows the established inspection frequency for each asset in the distribution system.

Part 2, Section 21 of the National Electric Safety Code (NESC) entitled "General requirements" states in part that:

> 218. Vegetation management
>
> A. General
>
> > 1. Vegetation management should be performed around supply and communication lines as experience has shown to be necessary. Vegetation that may damage ungrounded supply conductors should be pruned or removed.

In its investigation, Staff relied on the Company's consultant (ECI) to demonstrate that the 4.8 kV system in the City of Detroit has an estimated vegetation density of 297 trees per mile. The Company states it has experienced a higher level of wire downs and outages on a per overhead circuit miles basis over the past five-years. Staff determined from its review that over the past five-years the 4.8 kV system, as a whole, has received a lower level of O&M tree-trim funding on an overhead circuit basis compared to the rest of the distribution system. DTE Electric prioritizes circuits for trimming based on reliability impacts, wire down reductions, number of years since the last tree-trim, and alignment with construction and capital programs[13]. However, the causes of wire down events are not tracked, nor was the Company able to provide average tree-trim cycles broken down into the three distribution categories -the 4.8 kV system in the City of Detroit, the 4.8 kV system outside of the City of Detroit, and the rest of the distribution system. Staff believes that the historic average tree-trim cycles could have been provided at a circuit level had the Company appropriately maintained the information needed to support the tree-trim prioritization criteria previously mentioned. Based on the tree densities on the 4.8 kV system in the City of Detroit and the fact that approximately 49% of circuit miles on the 4.8 kV system in the City of Detroit are beyond the Company's five-year targeted tree-trim cycle, it is evident that the current tree trimming maintenance program has failed to allow the Company to maintain adequate clearance around the distribution and service lines as experience has shown to be necessary.

R 460.723(1) and R 460.723(2)

R 460. 721 entitled "Duty to plan to avoid unacceptable levels of performance" states that:

> An electric utility shall plan to operate and maintain its distribution system in a manner that will permit it to provide service to its customers without experiencing an unacceptable level of performance as defined by these rules.

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[13] See Appendix A response to Question #10.

R 460.723 entitled "Wire down relief requests." states that:

> 1) It is an unacceptable level of performance for an electric utility to fail to respond to a request for relief of a non-utility employee guarded downed wire at a location in a metropolitan statistical area within 240 minutes after notification at least 90% of the time under all conditions.
> (2) It is an unacceptable level of performance for an electric utility to fail to respond to a request for relief of a non-utility employee guarded downed wire at a location in a non-metropolitan statistical area within 360 minutes after notification at least 90% of the time under all conditions.

In its investigation, Staff determined that DTE Electric has failed to comply with the wire down relief requirements in metropolitan and non-metropolitan areas in calendar year 2017 and from January 1, 2018 through June 30, 2018. Figure 2[14] below outlines the achieved percentages from 2017 and the first half of 2018.

Figure 2: DTE R 460.723 Compliance

	2017	January 1, 2018 - June 30, 2018
R 460.723(1)	84%	86%
R 460.723(2)	76%	61%

Staff Findings and Recommendations

After reviewing the vegetation density results, the number of wire downs and outages, and the O&M tree-trim spend amounts on the 4.8 kV system in the City of Detroit, Staff has determined that there are areas within DTE Electric's distribution system that have experienced variable levels of tree-trim maintenance on an overhead circuit basis. Staff also finds that prior to 2015 "equipment" was used as the default cause for "unknown" outage causes to the customer's secondary service lines which leads Staff to believe that some of the outages caused by equipment in the 2013-2015 timeframe may not have been related to equipment. Staff is concerned with the 4.8 kV system as a whole given the fact that it is an ungrounded system and although the system is equipped with some ground alarm capabilities, single-phased downed wires may not produce fault currents large enough to engage safety devices and remain energized. Staff believes that the system also presents unique hazards in the City of Detroit due to the amount of rear-lot

[14] DTE files annual reports in MPSC Docket No. U-12270 to update Staff on compliance under the service quality and reliability standards. The 2017 percentages are outlined in the 2017 annual report and the 2018 percentages were provided in the Company's response to Question #54.

construction, which significantly impacts accessibility to the entire system and the ability to perform maintenance, emergency response, and remediation efforts.

As a result of its investigation, Staff makes the following recommendations.

Company Recommendations

1) Staff recommends that DTE Electric track the causes of wire down events and number of years since the last tree-trim at a circuit level in to more effectively prioritize tree-trim circuits within the distribution system. Responses to Staff's questions revealed that the Company does not track the causes of wire downs, nor was the Company able to provide the average tree-trim cycle broken down into the three distribution categories - 4.8 kV Detroit, 4.8 kV Not-Detroit, and the rest of the distribution service territory.

2) Staff recommends that DTE Electric consider an O&M tree-trim spend on a risk-based analysis for its distribution circuits, not on a mile basis. The 4.8 kV system in the City of Detroit should be receiving over 8.5% of the tree-trim spending budget until the outages or number of tree related events is significantly reduced. Responses to Staff's questions also revealed that approximately 49% of the circuits on the 4.8 kV system within the City of Detroit are beyond the five-year trim cycle.

3) Staff recommends that DTE Electric establish a procedure to permit quicker reporting of incidents to Staff in accordance with R 460.3804 identifying at a minimum the location, size of distribution system, when the incident occurred, and health status. DTE reported the May 7, 2018, fatal injury to Staff on May 17, 2018. The 10-day time period is not considered by Staff to be prompt notification of a fatality. Staff realizes that all of the pertinent details may not be available soon after the incident, but Staff should be notified once the Company is aware of the incident by telephone or email and a detailed report can be filed at a later date.

4) Staff recommends that DTE Electric continue to aggressively perform inspections including infrared surveys, foot patrols, and pole top maintenance inspections to identify equipment failures in order to strengthen circuits and improve safety, reliability, and resiliency.

5) Staff recommends that DTE Electric consider alternatives to rear-lot construction on the 4.8 kV system in the City of Detroit and work to make the now encroached alleyways accessible for maintenance, emergency response, and remediation efforts. The results of the ECI survey demonstrate that the 4.8 kV system in the City of Detroit is comprised of 80% rear-lot construction which has also experienced encroachment from city residents after the City of Detroit has ceased maintenance of the alleys. The combination of rear-lot construction, the City ceasing maintenance on of alleyways, and encroachment issues make it challenging for DTE Electric to operate and maintain the electric distribution system.

6) Staff recommends that DTE Electric participate in an initiative involving multiple electric utilities to improve the downed wire response process and timing. Over half of DTE Electric's incidents reported in accordance with R 460.3804 on the 4.8 kV system have been related to downed wires,

and Company responses to Staff's questions revealed that the wire down response times from the time the Company is notified to the time the Company's employee arrives to the site are long. Staff acknowledges that the Company has committed to re-evaluating the downed wire response protocols and has started a benchmarking initiative as outlined on page 28 of DTE Electric's report filed in MPSC Docket No. U-20169 that Staff is willing to participate in to improve the downed wire response process.

7) Staff recommends that DTE Electric develop a single wire down response procedure to ensure consistency in response efforts thought the Company. DTE's wire down response protocol consisted of multiple documents making it difficult for employees to establish consistency throughout the company as it relates to wire down response efforts.

8) Staff recommends that DTE track the wire down response times during outages of more than 75,000 customers using the information available through the OMS system identifying at a minimum the initial response time to make safe, time the work is completed, and amount of time the employee was on standby at the site.

9) Staff recommends that DTE Electric expedite the elimination of the 2018 inspection backlog for critical assets that have exceeded the Company's established maintenance cycle. DTE Electric had a 29% inspection backlog in 2014 for critical assets within the electric distribution system and has reduced the backlog to 14% in 2018. Although the backlog is improving, DTE is on pace to eliminate the critical asset inspection backlog by approximately 2022, which would total eight-years to eliminate the backlog.

Commission Recommendations

1) **Potential Violations:** Staff recommends four areas of potential violation to the Commission identified under Administrative Rules 460.3801, 460.3501, 460.3505, and 460.723 related to the wire down response procedures, adherence to the Company's preventative maintenance program, vegetation management, and wire down relief requests. The details for each identified issue are described in the Potential Violations section of the report.

2) **Improvements to DTE Electric's Method of Transmitting and Supplying Electricity:** Staff recommends the Commission require DTE to review the multiple alternatives to decrease or even eliminate the level of rear-lot construction on the 4.8 kV system in the City of Detroit due to the accessibility challenges and obstacles of abandoned and encroached alleyways which were once accessible. The review should also include a feasibility analysis.

3) **Strength and Effectiveness of DTE Electric's Procedures Addressing Downed Wires:** Staff has identified the potential violation under R 460.3801 related to the downed wire response procedures. Staff believes the procedures need to be strengthened by providing further detail. The wire down response process was described to Staff, but the procedures did not always reflect the level of detail as described. Staff also believes the procedures would become more effective

and improve consistency across all response employees if the multiple documents were combined to establish one standalone procedure outlining the entire protocol.

4) **Degree of Adherence to the Program of Inspection Required Under the Commission Rules:** Staff has identified the potential violation under R 460.3501 related to the lack of adherence to the Company's preventative maintenance program. Staff determined that DTE Electric currently has a 14% critical asset inspection backlog that is on pace to be eliminated by approximately 2022.

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Appendix A – Staff Questions and DTE Electric Responses

DTE Electric Company **Auditor:** **T. Becker**
Case No. U-20169 **Request No:TJB-1.1** **Page: 1 of 1**

Request:

1. Exhibit 3.4 on page 27 of DTE's five-year distribution plan outlines that DTEE Distribution has a total of 28,459 overhead circuit miles. Please confirm the total overhead miles in each category.

   a. 4.8 kV Detroit
   b. 4.8 kV non-Detroit
   c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

The primary overhead miles for each category is provided in the table below.

Category	Primary Overhead Miles
4.8 Detroit	2,412
4.8 non-Detroit	14,372
8.3 & 13.2	11,675
Total	28,459

DTE Electric Company		**Auditor:**	**T. Becker**
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Request:

2. Please confirm the percentage of overhead circuit miles which are rear-lot construction into the following categories.

   a. 4.8 kV Detroit
   b. 4.8 kV non-Detroit
   c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

Through the Company's system density assessment, the Company had the vegetation management consultant, ECI, sample the percentage of rear-lot versus roadway accessible circuit miles. Through this assessment the Company estimates rear-lot construction as follows:

a. 4.8 kV Detroit – 80%
b. 4.8 kV non-Detroit – 63%
c. Rest of distribution service territory (8.3 kV and 13.2 kV) – 60%

DTE Electric Company
Case No. U-20169

Auditor: **T. Becker**
Request No: **TJB-1.3**
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Request:

3. Please compare the cause of outages/trouble events over the past five years on the APPOL1346 circuit on the 4.8 kV system in the City of Detroit and the BUNRT8404 circuit on the 4.8 kV system in Warren (both of which had tree trimming in 2013 and 2014 respectively).

Response:

DTE records the cause of outage events, but not the cause of trouble (non-outage) events. For each of the two circuits, the numbers of outage events by cause and the total number of trouble events for the previous five years are listed in tables below.

Note: Both circuits were trimmed per the legacy clearance circle practice. Reviewing pre- and post-trimming data indicates the legacy clearance circle practice did not improve the reliability performance of these two circuits.

	Number of Outage and Trouble Events by Year						
Circuit	Outage Cause/Trouble	2013	2014	2015	2016	2017	Avg
APPOL1346	Cause = Trees	5	12	16	11	25	14
APPOL1346	Cause = Equipment	27	32	16	12	15	20
APPOL1346	Cause = All Other	4	5	3	4	2	4
APPOL1346	Cause = Unknown	1	0	11	14	20	9
APPOL1346	Total Outage	37	49	46	41	62	47
APPOL1346	Total Trouble	119	139	129	135	164	137
APPOL1346	Total Outage & Trouble	156	188	175	176	226	184

	Number of Outage and Trouble Events by Year						
Circuit	Outage Cause/Trouble	2013	2014	2015	2016	2017	Avg
BUNRT8404	Cause = Trees	1	3	1	1	3	2
BUNRT8404	Cause = Equipment	14	13	9	15	6	11
BUNRT8404	Cause = All Other	7	3	6	3	12	6

DTE Electric Company **Auditor:** **T. Becker**
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BUNRT8404	Cause = Unknown	1	1	3	8	5	4
BUNRT8404	Total Outage	23	20	19	27	26	23
BUNRT8404	Total Trouble	55	127	82	78	95	87
BUNRT8404	Total Outage & Trouble	78	147	101	105	121	110

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.4**
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Request:

4. Please describe the overall vegetation density based on vegetation density surveys performed over the past 12 months in the following categories. Please describe how these surveys are documented, how long the records are retained, what information is captured, and planned remediation timeframe if deficiencies are discovered.

    a. 4.8 kV Detroit
    b. 4.8 kV non-Detroit
    c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

The Company performed an approximate 10% tree density assessment on approximately 23,000 miles since September 2017 to better forecast the scope of work and associated costs for the annual tree trimming plan. The Company's vegetation management consultant, ECI, surveyed the identified circuits, capturing estimates for the following information: Number of trims, number of removals, area of brush, the property type, accessibility, potential crew types to conduct the work, location of construction, and wire configurations.

The data was captured electronically and analyzed using Excel. The records will be retained for seven years, per the Company's records retention policy.

Through this density assessment, the Company estimates the following tree densities:

a. 4.8 kV Detroit – 297 trees/mile
b. 4.8 kV non-Detroit – 172 trees/mile
c. Rest of distribution service territory (8.3 kV and 13.2 kV) -180 trees/mile

DTE Electric Company **Auditor:** **T. Becker**
Case No. U-20169 **Request No:** **TJB-1.5**
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Request:

5. In DTE Electric's testimony in Case Number U-18255, Mr. Whitman's testimony states 46% of customers are served by 4.8 kV and 53% of customers are served by 13.2 kV lines. (Whitman pg. 8). The five-year distribution shows on page 153 that DTE Electric's 4.8 kV system has experienced 55% of Trouble events and 62% of Wire downs events. For the last five years, please provide the number of trouble events and wire down events broken down into the following categories.

   a. 4.8 kV Detroit
   b. 4.8 kV non-Detroit
   c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

The numbers of trouble events and wire down events for the last five years are provided in the tables below. These numbers reflect the initial trouble call data and are not verified or modified after-the-fact. DTE responds to all wire down events regardless of the ownership of the wire.

	Number of Trouble Events (Includes Wire Down Events)				
Year	4.8 kV Detroit	4.8 kV Non-Detroit	4.8 kV System	8.3 & 13.2 kV System	Distribution System
2013	62,343	72,263	134,606	115,844	250,450
2014	72,707	82,854	155,561	123,081	278,642
2015	63,257	72,774	136,031	106,930	242,961
2016	60,530	74,532	135,062	111,718	246,780
2017	79,203	91,517	170,720	135,961	306,681
Average	67,608	78,788	146,396	118,707	265,103

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	Number of Wire Down Events				
Year	4.8 kV Detroit	4.8 kV Non-Detroit	4.8 kV System	8.3 & 13.2 kV System	Distribution System
2013	6,378	6,426	12,804	9,624	22,428
2014	8,537	8,238	16,775	10,285	27,060
2015	5,816	5,603	11,419	6,019	17,438
2016	4,997	5,393	10,390	6,334	16,724
2017	8,470	8,777	17,247	10,824	28,071
Average	6,840	6,887	13,727	8,617	22,344

DTE Electric Company		**Auditor:**	**T. Becker**
Case No. U-20169		**Request No:**	**TJB-1.6**
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Request:

6. Please provide information on the causes of the wire down events and trouble events on the 4.8 kV system in the City of Detroit compared to the rest of the 4.8 kV system over the past five years.

Response:

DTE records the cause of outage events, but not the cause of wire down events or non-outage trouble events in the Outage Management System. The numbers of outage events by cause are provided in the table below.

Beginning in 2015, single customer outage events began being recorded with a default "unknown" cause code instead of "equipment". This explains the decline in single customer equipment outage events and increase in outage events with the cause of unknown.

		Outage Events by Cause		
Cause	Year	4.8 kV Detroit	4.8 kV Non-Detroit	4.8 kV Total
Trees	2013	5,135	4,722	9,857
	2014	6,339	5,765	12,104
	2015	4,988	4,695	9,683
	2016	4,601	4,518	9,119
	2017	6,606	6,488	13,094
	Average	5,534	5,238	10,771
Equipment [Events where Customers Interrupted > 1]	2013	317	718	1,035
	2014	348	697	1,045
	2015	399	970	1,369
	2016	449	1,306	1,755
	2017	534	1,288	1,822
	Average	409	996	1,405
Equipment [Events where Customers Interrupted = 1]	2013	8,010	6,415	14,425
	2014	8,497	6,630	15,127
	2015	4,451	4,239	8,690
	2016	2,549	2,761	5,310
	2017	1,766	2,076	3,842
	Average	5,055	4,424	9,479

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Unknown	2013	418	572	990
	2014	211	344	555
	2015	1,690	1,393	3,083
	2016	2,095	2,705	4,800
	2017	3,401	3,825	7,226
	Average	1,563	1,768	3,331
All Other	2013	2,672	2,552	5,224
	2014	2,459	2,560	5,019
	2015	2,015	2,389	4,404
	2016	1,910	2,032	3,942
	2017	977	1,597	2,574
	Average	2,007	2,226	4,233
Total	2013	16,552	14,979	31,531
	2014	17,854	15,996	33,850
	2015	13,543	13,686	27,229
	2016	11,604	13,322	24,926
	2017	13,284	15,274	28,558
	Average	14,567	14,651	29,219

DTE Electric Company **Auditor:** **T. Becker**
Case No. U-20169 **Request No:** **TJB-1.7**
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Request:

7. The five-year distribution report states that one-third of the outage events are caused by trees. For each of the last five years, provide the number of outages caused by tree interference in the following categories.

   a. 4.8 kV Detroit
   b. 4.8 kV non-Detroit
   c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

The numbers of outage events caused by tree interference in three categories of the system are provided in the table below:

Outage Events by Trees				
Year	4.8 kV Detroit	4.8 kV Non-Detroit	4.8 kV Total	8.3 & 13.2 kV Total
2013	5,135	4,722	9,857	8,230
2014	6,339	5,765	12,104	8,048
2015	4,988	4,695	9,683	6,746
2016	4,601	4,518	9,119	7,088
2017	6,606	6,488	13,094	10,707
Average	5,534	5,238	10,771	8,164

DTE Electric Company	**Auditor:**	**T. Becker**
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Request:

8. For each of the last five years, provide the number of times a line crew was dispatched in the following categories.

   a. 4.8 kV Detroit
   b. 4.8 kV non-Detroit
   c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

The numbers of times that an overhead line crew and/or a tree trimming crew was dispatched to an event on the 4.8 kV system in the City of Detroit, the rest of the 4.8 kV system, and the rest of distribution system for the last five years are provided in the table below.

	Number of Events Line Crews were Dispatched (Overhead and/or Tree Trim Crew)				
Year	4.8 kV Detroit	4.8 kV Non-Detroit	4.8 kV System	8.3 & 13.2 kV System	Distribution System
2013	50,551	56,420	106,971	87,718	194,689
2014	57,070	62,906	119,976	91,919	211,895
2015	51,689	58,154	109,843	80,807	190,650
2016	49,640	59,630	109,270	84,984	194,254
2017	61,353	70,721	132,074	103,048	235,122
Average	54,061	61,566	115,627	89,695	205,322

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Auditor: **T. Becker**
Request No: **TJB-1.9**
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Request:

9. Please describe the tree trimming programs in the following categories over the past five years including the tree trim specification(s) used.

   a. 4.8 kV Detroit
   b. 4.8 kV non-Detroit
   c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

Tree trimming specifications have been applied consistently throughout the Company's service territory. The Company currently trims circuits to maintain clearance for one five-year cycle worth of growth, which, on average, necessitates ten feet of clearance to the outermost conductor. The required clearance is species-specific.

DTE Electric Company | **Auditor:** | **T. Becker**
Case No. U-20169 | **Request No:** | **TJB-1.10**
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Request:

10. Please provide the O&M tree trimming dollars spent in the following categories in each of the past five years. These amounts shall include O&M spending only and not include capital projects. If the O&M spend was decreased as compared to previous years on the 4.8 kV in the City of Detroit, please explain.

 a. 4.8 kV Detroit
 b. 4.8 kV non-Detroit
 c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

	Tree Trimming Maintenance O&M Spend ($ Million)		
Year	4.8 kV Detroit	4.8 kV Non-Detroit	Rest of the Distribution System
2013	2.2	13.3	23.5
2014	2.8	5.6	21.4
2015	2.8	13.6	33.5
2016	4.1	9.3	37.3
2017	1.6	10.8	44.2

The Company does not select circuits for tree trimming based upon municipality, and the resultant decrease in spend in the City of Detroit between 2016 and 2017 is simply the outcome of the Company's prioritization methodolgy. The Company prioritizes circuits for trimming based on reliability impacts, wire down reductions, the number of years that have passed since the last trim, and alignment with constrution/capital programs. Resource balancing across the service territory is also considered to ensure resources are available to respond to unplanned events in a timely manner.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.11**
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Request:

11. Please describe the overall results of any infrared surveys performed over the past 12 months in the following categories. Please describe how these surveys are documented, how long the records are retained, what information is captured, and planned remediation timeframe if deficiencies are discovered.

    a. 4.8 kV Detroit
    b. 4.8 kV non-Detroit
    c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

A database is maintained that documents each circuit that received an infrared survey and a record of each hot spot or other defective condition identified. For each hot spot or defect, data is collected regarding the location, equipment description, temperature rise above ambient and an infrared photo. The database currently has records for at least ten years.

Upon identification of a significant hotspot or defect, the situation is immediately called into general supervisors in service centers to follow up and address. For minor hotspots or defects, the work is held until other planned work (e.g. PTM or capital work) is scheduled for the circuit.

Infrared Patrols – 12 Months Ending June 30, 2018		
Category	Number of Circuits with Infrared Patrols	Number of Hotspots or Defects Identified
4.8 kV Detroit	38	16
4.8 kV non-Detroit	74	9
8.3 & 13.2 kV	11	1
Total	123	26

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Auditor: **T. Becker**
Request No: **TJB-1.12**
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Request:

12. Please provide the number of circuits which have been trimmed to the ETTP specification since 2015 in the following categories.

   a. 4.8 kV Detroit
   b. 4.8 kV non-Detroit
   c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

Since 2015, the company has trimmed 346 circuits as part of the ETTP. The following chart shows the number of circuits trimmed on the 4.8 kV in the City of Detroit, the remainder 4.8 kV system that is not in Detroit, and the remainder of the distribution system:

	Number of Circuits Trimmed as Part of the ETTP		
Year	4.8 kV Detroit	4.8 kV Non-Detroit	Remaining Distribution System
2015	10	13	4
2016	9	57	83
2017	15	70	85

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.13**
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Request:

13. Please provide the current average tree trimming cycle for circuits in the following categories.

    a. 4.8 kV Detroit
    b. 4.8 kV non-Detroit
    c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

Average trimming cycles are not seperable for the three categories requested. In 2017, the Company cleared 3,601 miles which equates to an eight and a half-year cycle. Based on funding and miles trimmed in 2015-2017 the system is on a nine-year cycle.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.14**
	Page:	**1 of 1**

Request:

14. Pages 24 and 25 of DTE's report filed on June 29, 2018, state "[a] subset of the poles is further tested based on a schedule determined by pole age, type, treatment, and location. Based on the inspection and testing results, poles that do not have the required strength remaining are flagged for either replacement or reinforcement." Please describe how the "schedule" is determined and how DTE ensures that the testing is evenly distributed throughout the entire system.

Response:

The Pole and Pole Top Hardware Program selects circuits for inspection each year based on time since last inspection. Circuits with longest time since last inspection are prioritized for inspection program.

Poles selected for the Pole and Pole Top Hardware Program are either visually inspected or further tested. The criteria for further pole testing is predominantly by pole age. For instance, poles in service for 19 years or less have a low probability of failure and are mostly visually inspected. In addition, a small number of poles may not be tested due to factors such as pole type, treatment, or environmental conditions (aka location).

- Pole Type: Steel or concrete poles are only visually inspected.
- Treatment: All cellon treated poles (average age of 48 years) are replaced without further testing. The Company's analysis and industry benchmark indicate cellon treated poles experience scattered decay and ground-line testing is not a reliable indicator of overall decay.
- Environmental conditions (aka location): Poles that are not readily accessible for ground-line testing because they are surrounded by a wall or in water are visually inspected and replaced when poles reach expected end-of-life – the industry standard life expectancy of a pole is 40 years for pine and 50 years for cedar.

Poles are inspected and tested based on criteria discussed above, regardless the service centers or communities they serve.

DTE Electric Company | **Auditor:** | **T. Becker**
Case No. U-20169 | **Request No:** | **TJB-1.15**
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Request:

15. Please provide the average PTM cycle for circuits in the following categories.

a. 4.8 kV Detroit
b. 4.8 kV non-Detroit
c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

The average PTM cycle (based on the last five years of inspections) for each category is shown in the table below.

	4.8 kV Detroit	4.8 kV non-Detroit	8.3 & 13.2 kV
Average Pole Inspection Cycle	9	11	11

DTE Electric Company
Case No. U-20169

Auditor: **T. Becker**
Request No: **TJB-1.16**
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Request:

16. DTE Energy Electric 2017 Pole Inspection report filed on March 23, 2018 identified poles visually inspected through the PTM program (33,976), poles inspected through the PTM program with additional pole testing (29,254), poles inspected through the joint use process (39,226), and poles replaced on trouble (4,112). For each of the categories mentioned above, please classify the percentage of inspections/tests into the following categories.

a. 4.8 kV Detroit
b. 4.8 kV non-Detroit
c. Rest of distribution service territory (8.3 kV and 13.2 kV)
d. Other

Response:

The pole inspections by type and category for 2017 are shown in the table below. Please note that 2017 inspection data only is not representative of how pole inspections have been distributed among different parts of the DTE system.

	Poles Inspected in 2017	Percent of Poles Inspected in each Category		
Inspection Type		4.8 kV Detroit	4.8 kV non-Detroit	8.3 & 13.2 kV
PTM Visual Inspections	33,976	4%	50%	46%
PTM Testing	29,254	4%	56%	40%
Joint Use Inspections	39,226	7%	28%	65%
Poles Replaced on Trouble	4,112	19%	31%	50%
Total	106,568	6%	43%	51%

DTE Electric Company | **Auditor:** **T. Becker**
Case No. U-20169 | **Request No:** **TJB-1.17**
Page: **1 of 1**

Request:

17. The May 4th wind storm resulted in 542 broken poles. Please provide the number of broken poles into the following categories and identify the number of poles in each category which exceeded the 10-12 year inspection frequency.

a. 4.8 kV Detroit
b. 4.8 kV non-Detroit
c. Rest of distribution service territory (8.3 kV and 13.2 kV)
d. Other

Response:

The estimated broken pole distribution in the three categories during May 4th wind storm is shown in the table below. DTE was not able to identify the number of poles in each category which exceeded the 10-12-year inspection frequency.

Approximately 13% of DTE poles are located in 4.8 kV Detroit area, 31% located in 4.8 kV non-Detroit area and 56% located in the rest of system.

	4.8 kV Detroit	4.8 kV non-Detroit	8.3 & 13.2 kV
Percentage of Broken Poles	14%	40%	46%

DTE Electric Company
Case No. U-20169

Auditor: **T. Becker**
Request No: **TJB-1.18**
Page: **1 of 1**

Request:

18. Please identify the number of broken poles during the April 15, 2018 ice storm, and provide the number of broken poles into the following categories identify the number of poles in each category which exceeded the 10-12 year inspection frequency.

a. 4.8 kV Detroit
b. 4.8 kV non-Detroit
c. Rest of distribution service territory (8.3 kV and 13.2 kV)
d. Other

Response:

The April 15th ice storm resulted in approximately 112 broken poles. The estimated broken pole distribution in the three categories during April 15th ice storm is shown in the table below. DTE was not able to identify the number of poles in each category which exceeded the 10-12-year inspection frequency. Approximately 13% of DTE poles are located in 4.8 kV Detroit area, 31% located in 4.8 kV non-Detroit area and 56% located in the rest of system.

	4.8 kV Detroit	4.8 kV non-Detroit	8.3 & 13.2 kV
Percentage of Broken Poles	21%	33%	46%

DTE Electric Company
Case No. U-20169

Auditor:	**T. Becker**
Request No:	**TJB-1.19**
Respondent:	**Yujia Zhou**
Page:	**1 of 1**

Request:

19 .Exhibit 6.2.1 in DTE's five-year distribution plan outlines general inspection cycles for substation and distribution system categories. Prior to May 4, 2018, please provide the percentage of inspections which exceeded the general inspection cycle (since the most recent inspection) for each asset in the following categories. Please include all assets in the exhibit that apply.

a. 4.8 kV Detroit
b. 4.8 kV non-Detroit
c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

The table below contains the percentage of units by distribution electrical equipment type that exceeds the stated inspection cycle (or inspection backlog) based on the completion of the 2018 preventative maintenance program. Asset inspections are generally done to adhere to inspection cycles regardless of asset geographical locations. Assets may have inspections intentionally deferred/canceled due to planned work in the near-term where the assets will be decommissioned or replaced. Assets may also have inspections intentionally deviate from time-based inspection cycles due to results from Predictive Maintenance Program (e.g., Substation Regulators, Single Tap Substations).

DTE has made significant strides in reducing the inspection backlog. For critical assets, the current backlog is 14% compared to 29% in 2014. Assets with highest criticality to the electrical system are prioritized for backlog reduction.

Note that "n/a" is not applicable, meaning the assets do not exist in the referenced categories.

	Percent of Distribution Electrical Assets Exceeding Inspection Cycle			
Asset	Inspection Cycle (Years)	4.8 kV Detroit	4.8 kV non-Detroit	8.3 & 13.2 kV
Distribution Breakers	3/10/12	3%	2%	3%
Substation Predictive Maintenance Inspections (SPdM)	3	0%	0%	0%
Substation Regulators	10	18%	26%	n/a
Single Tap Substations	10	n/a	45%	10%

Network Banks	5	0%	12%	n/a
13.2 kV Enclosed Capacitor Banks	1	n/a	n/a	0%
Relays	5/7/10	13%	21%	28%
Substation Batteries	1	0%	0%	0%
Transformers & Regulators (Dissolved Gas Analysis)	1	0%	0%	0%
Overhead Distribution SCADA Reclosers and Pole Top Switches	4/8	0%	1%	24%
Primary Switch Cabinets	5/10/15	1%	0%	7%
DTE Equipment in High Rise Structure	20	0%	0%	0%
Overhead Capacitor & Regulator Controls	1	4%	3%	2%
Overhead Distribution Device (SCADA) Batteries	4	0%	1%	24%
Voltage Controls	1	0%	0%	0%

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.20**
	Page:	**1 of 1**

Request:

20. Exhibit 6.2.1 in DTE's five-year distribution plan outlines general inspection cycles for substation and distribution system categories. For each of the assets, please describe how the inspections are documented, how long these documents are retained, what information is captured, and planned remediation timeframe if deficiencies are discovered.

Response:

Each asset class has an inspection form that lists the required electrical and mechanical tests and measurements for the asset. Most of the inspection forms are paper, but a few are electronic.

As part of the inspection process, any identified abnormalities are resolved. Some repairs are made at the time of the inspection; others are scheduled for future repair if the parts or resources are not immediately available. If parts are no longer available or the repair costs are excessive, the asset will be scheduled for replacement.

The inspection form is completed by the field crew. Engineering reviews the completed form and verifies the inspection/repairs. A record of the inspection is entered into the work management system (Maximo). The inspection forms are retained for 11 years per DTE's Corporate Policy OP6 for Electric Transmission & Distribution records.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.21**
	Page:	**1 of 1**

Request:

21. Please identify the number of circuits which are not compliant with current DTE Electric design standards in the following categories.

a. 4.8 kV Detroit
b. 4.8 kV non-Detroit
c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

DTE Electric design standards evolve over time. Any asset or circuit installation is compliant with the design standards at the time of the construction.DTE Electric Company Auditor: T. Becker

Case No. U-20169	**Request No:**	**TJB-1.22**
	Page:	**1 of 1**

Request:

22. For the 4.8 kV hardening program and demand failures work on the 4.8 kV system in Detroit are all poles, conductors, insulators, and cross-arms installed to meet the current DTE Electric design standards? Are these standards to the 13.2 kV design?

Response:

All new assets installed today are based on the current DTE design standards. The current DTE design standards for distribution system are for 13.2 kV design (see the response to question #21). Poles, conductors, insulations and cross-arms installed today as part of the 4.8 kV hardening program or any other projects/programs meet the current DTE's design standards.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.23**
	Page:	**1 of 1**

Request:

23. Please provide DTE's wire down response procedure for blue sky and storm events outlining what is required from the time a wire down is reported until the wire down is resolved including documentation requirements associated with the responses.

Response:

As outlined on DTE's U-20169 Response submitted to the commission on June 29 2018, the Company responds to downed wires reported by the public via mobile app, web or phone, substation ground alarms, and reports by Police and Fire departments.

For wires reported by the public or Police and Fire, the first part of the process is creating a wire down event in the system of record (InService). This event is generated by Customer Service if reported by phone call or automatically generated if reported by the app, web or the Company's interactive voice response (IVR) system. The generated event includes a unique identification number, the timestamp of creation, the type of event, the system details (circuit, service center, region, etc.)

In Blue Sky, generally the resource dispatched is an overhead crew, which confirm the hazard and remediate it (either by repair or cutting the wire in the clear). The crew is dispatched, arrives at the site and marks the job as complete in InService. Each of these actions generates a time stamp in InService.

In Storm, when the volume of reported downed wires is higher, the first available resource dispatched when overhead crews are not immediately available is either an Electric Field Operations (EFO) resource or a Public Safety (Secure First) resource. Their role is to identify the hazard, secure the site by taping and alerting the neighboring residents, relieving the Police and Fire on site (in the case of wires reported by Police and Fire departments), and standing-by if the wire meets stand-by criteria. After the EFO or Secure First team has secured the area, the hazard is then removed by the first available overhead crew. Similarly to what happens in Blue Sky, all crews are dispatched, arrive at the site and mark the job as complete in InService.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.24**
	Page:	**1 of 1**

Request:

24. Please provide DTE's procedure for remediating a wire down (if not captured in the previous question's request) including the targeted response time to remediate the wire down and documentation requirements.

Response:

See question 23 for remediation of downed wires.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.25**
	Page:	**1 of 1**

Request:

25. Page 15 of DTE's report filed on June 29, 2018 indicates that "[c]andidates are required to pass a test and to perform 50 hours of supervised field experience paired with a qualified mentor in order to become fully qualified." Please describe how these records are documented, how long the records are retained, and what information is captured.

Response:

Each candidate attending the training is required to sign an attendance sheet which is then collected by the instructor. The list of names is then cross-referenced with the results of the tests in order to track who successfully completed the training. The attendance and the successful completion of the test is maintained in the Company's training system.

Hours worked in the field (up to a total of 50) are manually tracked by Distribution Operation Emergency Preparedness and Response Team utilizing an Excel spreadsheet.

The Company generally retains training records for 70 years.

DTE Electric Company **Auditor:** **T. Becker**
Case No. U-20169 **Request No:** **TJB-1.26**
Page: **1 of 1**

Request:

26. Please provide the average wire down response times (from notification to dispatch) for the April 15th and May 4th storms in 2018 in the following categories.

a. 4.8 kV Detroit
b. 4.8 kV non-Detroit
c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

The average response time (time to dispatch) for the two storms was as follows:

			Time to Dispatch Confirmed Downed Wires	
	Reported Downed Wires Apr 15 / May 4	Confirmed Downed Wires Apr 15 / May 4	April 15th storm	May 4th storm
4.8kV Detroit	1,772 / 668	959 / 419	246 minutes	94 minutes
4.8kV non-Detroit	1,478 / 1039	970 / 613	190 minutes	141 minutes
Rest of territory	931 / 1,173	611 / 728	94 minutes	176 minutes
Total	4,181 / 2,880	2,540 / 1,760		

Note that reported downed wires along with confirmed downed wires in the above table do not exactly match other reports. The differences are made up by miscellaneous downed wire events that are not associated with the above categores (e.g., City of Detroit PLD wires, subtransmission, etc.)

DTE Electric Company **Auditor:** **T. Becker**
Case No. U-20169 **Request No:** **TJB-1.27**
Page: **1 of 1**

Request:

27. Please provide the average wire down response times (from dispatch to arrival) for the April 15th and May 4th storms in 2018 in the following categories.

a. 4.8 kV Detroit
b. 4.8 kV non-Detroit
c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

The average response time (time to arrive) for the two storms was as follows:

			Time to Arrive to Confirmed Downed Wires	
	Reported Downed Wires Apr 15 / May 4	**Confirmed Downed Wires Apr 15 / May 4**	**April 15th storm**	**May 4th storm**
4.8kV Detroit	1,772 / 668	959 / 419	58 minutes	31 minutes
4.8kV non-Detroit	1,478 / 1,039	970 / 613	54 minutes	47 minutes
Rest of territory	931 / 1,173	611 / 728	30 minutes	58 minutes
Total	4,181 / 2,880	2,540 / 1,760		

Note that reported downed wires along with confirmed downed wires in the above table do not exactly match other reports. The differences are made up by miscellaneous downed wire events that are not associated with the above categores (e.g., City of Detroit PLD wires, subtransmission, etc.)

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.28**
	Page:	**1 of 1**

Request:

28. Please describe the pre-storm preparation and first responder stationing in an effort to ensure that employees are able to respond efficiently to wire downs and trouble events during the storm. Does increased trouble calls change the stationing for the response employees?

Response:

As illustrated in the U-20169 response, first responders include EFO as well as Secure First resources.

Given the hazard represented by strong winds, we do not station employees in the field as the weather event moves across the territory.

EFO is comprised of Field Employees which are dispatched to the event closest to their location utilizing geotagging capability of the Company's mapping system.

Secure First resources are generally non-field employees. The Company's Public Protection dispatch function dispatches employees to their closest event, utilizing an app that employees are required to download on their mobile device.

DTE Electric Company		**Auditor:**	**T. Becker**
Case No. U-20169		**Request No:**	**TJB-1.29**
		Page:	**1 of 1**

Request:

29. Page 14 of DTE's report filed on June 29, 2018, states that "[i]f the downed wire cannot be identified within 4 hours of dispatch, the substation breaker is opened to de-energize the entire circuit." Of the 3,016 wire down reports during the May 4, 2018 wind storm, please identify how many were not identified within four hours and confirm that all circuits were de-energized if the downed wire was not identified within four hours. Please describe why circuits were not de-energized that met the aforementioned criteria.

Response:

Note that the Company policy for de-energizing circuits (i.e., intentionally opening the breaker after four hours of unsuccessful patrollingfor the wire) only applies when a ground alarm is detected.

In total 37 circuits were intentionally de-energized.

DTE Electric Company		**Auditor:**	**T. Becker**
Case No. U-20169		**Request No:**	**TJB-1.30**
		Page:	**1 of 1**

Request:

30. Page 14 of DTE's report filed on June 29, 2018, states that "[i]f the downed wire cannot be identified within 4 hours of dispatch, the substation breaker is opened to de-energize the entire circuit." Please confirm the number of wire down reports for the April 15, 2018 ice storm, and identify how many were not identified within four hours and confirm that all circuits were de-energized if the downed wire was not identified within four hours. Please describe why circuits were not de-energized that met the aforementioned criteria.

Response:

4,269 downed wire reports in the April 15th storm.

In total 45 circuits were de-energized due to not being able to find the downed wire on the system.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.31**
	Page:	**1 of 1**

Request:

31. Page 8 of DTE's report filed on June 29, 2018, indicates that the May 4th wind storm resulted in 1,811 confirmed wire downs. Please break down the causes of these wire downs in the percent of the total.

Response:

DTE does not track cause codes for non-outage events, this includes downed wire cases.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.32**
	Page:	**1 of 1**

Request:

32. Please provide the number of confirmed wire downs during the April 15, 2018 ice storm and break down the causes of these wire downs in the percent of the total.

Response:

The April 15th, 2018 ice storm resulted in 2,620 confirmed downed wires.

DTE does not track cause codes for wire down events.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.33**
	Page:	**1 of 1**

Request:

33. Page 8 of DTE's report filed on June 29, 2018, indicates that the May 4th wind storm resulted in 1,811 confirmed wire downs. Please provide the number of wire downs in the following categories with percent of total.

    a. 4.8 kV Detroit
    b. 4.8 kV non-Detroit
    c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

This question is answered in DTE's response to questions #26 and #27.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.34**
	Page:	**1 of 1**

Request:

34. Please provide the total confirmed wire downs during the April 15, 2018 ice storm and provide percentages in the following categories.

    a. 4.8 kV Detroit
    b. 4.8 kV non-Detroit
    c. Rest of distribution service territory (8.3 kV and 13.2 kV)
    d. Other

Response:

This question is answered in DTE's response to questions #26 and #27.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.35**
	Page:	**1 of 1**

Request:

35. Of the 1,811 confirmed wire downs during the May 4, 2018 wind storm, please compare the number of wire downs which met the “stand-by criteria” with the number of wire downs which actually received stand-by assistance (wire guard) in accordance with the stand-by criteria. Please identify the percentage of wire downs which met the “stand-by criteria that did not receive a wire guard in accordance with the procedures.

Response:

As outlined in DTE’s U-20169 response, our current process has been enhanced to address wire downs that meet stand-by criteria by either performing the repair or cutting the wire in the clear. This is done by sending the nearest overhead crew and if necessary pulling them from an outage to go remediate the downed wire. No wire guards were used during the May 4, 2018 storm.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.36**
	Page:	**1 of 1**

Request:

36. Please provide the number of confirmed wire downs during the April 15, 2018 ice storm, please compare the number of wire downs which met the "stand-by criteria" with the number of wire downs which actually received stand-by assistance (wire guard) in accordance with the stand-by criteria. Please identify the percentage of wire downs which met the "stand-by criteria that did not receive a wire guard in accordance with the procedures.

Response:

As outlined in DTE's U-20169 response, our current process has been enhanced to address wire downs that meet stand-by criteria by either performing the repair or cutting the wire in the clear. This is done by sending the nearest overhead crew and if necessary pulling them from an outage to go remediate the downed wire. No wire guards were used during the April 15, 2018 storm.

DTE Electric Company
Case No. U-20169

Auditor: **T. Becker**
Request No: **TJB-1.37**
Page: **1 of 1**

Request:

37. Page 8 of DTE's report filed on June 29, 2018, indicates that the May 4th wind storm resulted in 1,811 confirmed wire downs out of 3,016 reported in the field. Please explain the approximately 40% of the reported wire downs being false alarms and how that was confirmed by DTE.

Response:

The approximately 40% of false alarms is a result of multiple issues: duplicate reports by multiple people, non-DTE wires, misreported by customers and other miscellaneous reasons. DTE investigates each of the reported downed wires by sending a field resource or first responder.

DTE Electric Company
Case No. U-20169

Auditor: **T. Becker**
Request No: **TJB-1.38**
Page: **1 of 1**

Request:

38. Based on after outage even review, please explain what DTE has done to improve wire down relief and response efforts since the April 2018 ice storm and the May 2018 wind storm.

Response:

As outlined in DTE's response to U-20169 the Company has undertaken to evaluate areas for improvement. Those areas are:

a. Prevention of downed wires and outages is best accomplished through the solutions detailed in the Five-Year Plan. Continuing to execute and accelerate this plan around tree trimming and infrastructure improvements will provide for much improved safety and reliability

b. Further education and communication to all stakeholders regarding the dangers of downed wires.

c. Advance, through the use of new technologies, the responsiveness of the public protection program to even more quickly address reported downed wires especially during major storms.

DTE Electric Company		**Auditor:**	**T. Becker**
Case No. U-20169		**Request No:**	**TJB-1.39**
		Page:	**1 of 1**

Request:

39. Page 12 of DTE's report filed on June 29, 2018, states that "[w]ire down reports are received by DTE Electric's Central Dispatch, which assigns and dispatches the appropriate crews." Please confirm that all outage reports (i.e. phone, online, AMI, etc.) are dispatched through Central Dispatch. Please also confirm that Central Dispatch is the only dispatch location within the state for DTE.

Response:

All outage reports are dispatched through Central Dispatch, which is the only dispatch location for outages in the state for DTE.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.40**
	Page:	**1 of 1**

Request:

40. Please explain DTE's internal wire down relief targets (in minutes) in metropolitan and non-metropolitan areas and explain how blue sky days and catastrophic conditions may change this target.

Response:

DTE's internal wire down relief targets are aligned with the Commission targets to respond to a request for relief of a non-utility employee guarded downed wire at a location in a metropolitan statistical area within 240 minutes and within 360 minutes in a non-metropolitan area after notification at least 90% of the times.

DTE Electric Company
Case No. U-20169

Auditor: T. Becker
Request No: TJB-1.41
Page: 1 of 1

Request:

41. Please provide a breakdown for SAIFI and SAIDI information for 2017 and 2018 for the following categories with MED's days.

a. 4.8 kV Detroit
b. 4.8 kV non-Detroit
c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

The following tables show the breakdown for reliability indices for 2017 and 2018 YTD June 30 for the three categories with MED's days. These tables also contain information requested in question 43.

	2017 All Conditions (including MEDs)			2018 YTD June 30 All Conditions (including MEDs)		
Metric	4.8 kV Detroit	4.8 kV non-Detroit	8.3 & 13.2 kV	4.8 kV Detroit	4.8 kV non-Detroit	8.3 & 13.2 kV
SAIFI	0.23	0.33	0.83	0.15	0.19	0.43
SAIDI minutes	272	338	452	99	123	142
CAIDI minutes	1,205	1,024	542	655	648	327

DTE Electric Company
Case No. U-20169

Auditor: T. Becker
Request No: TJB-1.42
Page: 2 of 1

Request:

42. Please provide a breakdown for SAIFI and SAIDI information for 2017 and 2018 for the following categories without MED's days.

a. 4.8 kV Detroit
b. 4.8 kV non-Detroit
c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

The following tables show the breakdown for reliability indices for 2017 and 2018 YTD June 30 for the three categories without MED's days. These tables also contain information requested in question 44.

	2017 Excluding MEDs			2018 YTD June 30 Excluding MEDs		
Metric	4.8 kV Detroit	4.8 kV non-Detroit	8.3 & 13.2 kV	4.8 kV Detroit	4.8 kV non-Detroit	8.3 & 13.2 kV
SAIFI	0.14	0.20	0.65	0.09	0.11	0.33
SAIDI minutes	40	50	106	17	22	46
CAIDI minutes	295	246	163	186	202	139

DTE Electric Company | **Auditor:** | **T. Becker**
Case No. U-20169 | **Request No:** | **TJB-1.43**
Page: | **1 of 1**

Request:

43. Page 2 of DTE's reliability and power quality report issued on March 29, 2018 in U-16065 identifies SAIFI, SAIDI, and CAIDI reliability performance over the past 10 years for all weather. Year 2017 had the worst performance in the past 10 years in all categories. Please provide the 2017 SAIFI, SAIDI, and CAIDI performance broken down into the following categories.

   a. 4.8 kV Detroit
   b. 4.8 kV non-Detroit
   c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

See the response to question #41.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.44**
	Page:	**1 of 1**

Request:

44. Page 4 of DTE's reliability and power quality report issued on March 29, 2018 in U-16065 identifies SAIFI, SAIDI, and CAIDI reliability performance over the past 10 years excluding MEDs. Please provide the 2017 SAIFI, SAIDI, and CAIDI performance broken down into the following categories.

    a. 4.8 kV Detroit
    b. 4.8 kV non-Detroit
    c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

See the response to question #42.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.45**
	Page:	**1 of 1**

Request:

45. For each of the past five years, what amount of capital and O&M spending was made in the following categories?

    a. 4.8 kV Detroit
    b. 4.8 kV non-Detroit
    c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

Generally, capital and O&M spend is not tracked on a circuit basis and therefore DTE Electric cannot provide response to this question.

DTE Electric Company **Auditor:** **T. Becker**
Case No. U-20169 **Request No:** **TJB-1.46**
Page: **1 of 1**

Request:

46. Page 7 of DTE's report filed on June 29, 2018, shows that there were 254,867 actual customer outages. Of these outages, how many customers were not restored within 60 hours? Please provide the number of customers not restored within 60 hours into the following categories.

a. 4.8 kV Detroit
b. 4.8 kV non-Detroit
c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

The number of customers restored and not restored within 60 hours for the May 4, 2018 wind storm are shown in the table below. The data show that DTE met the MPSC Service Quality and Reliability Standard of restoring 90% or more of customers within 60 hours under catastrophic conditions in each category.

May 4, 2018 Wind Storm – Number of Customers Restored									
	Within 60 Hours			Beyond 60 Hours			Total		
Bus kV	Detroit	Non-Detroit	Total	Detroit	Non-Detroit	Total	Detroit	Non-Detroit	Total
4.8	52,900	82,430	135,330	8	6	14	52,908	82,436	135,344
8.3 & 13.2	355	119,154	119,509	0	14	14	355	119,168	119,523
Total	53,255	201,584	254,839	8	20	28	53,263	201,604	254,867

May 4, 2018 Wind Storm – % of Customers Restored									
	Within 60 Hours			Beyond 60 Hours			Total		
Bus kV	Detroit	Non-Detroit	Total	Detroit	Non-Detroit	Total	Detroit	Non-Detroit	Total
4.8	99.98%	99.99%	99.99%	0.02%	0.01%	0.01%	100%	100%	100%
8.3 & 13.2	100%	99.99%	99.99%	0%	0.01%	0.01%	100%	100%	100%

DTE Electric Company **Auditor:** **T. Becker**
Case No. U-20169 **Request No:** **TJB-1.47**
Page: **1 of 1**

Request:

47. Please confirm the number of actual customer outages during the April 15, 2018 ice storm. Of these outages, how many customers were not restored within 60 hours? Please provide the number of customers not restored within 60 hours into the following categories.

   a. 4.8 kV Detroit
   b. 4.8 kV non-Detroit
   c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

The number of customers restored and not restored within 60 hours for the April 15, 2008 ice storm are shown in the table below. The data show that DTE met the MPSC Service Quality and Reliability Standard of restoring 90% or more of customers within 60 hours under catastrophic conditions in each category.

April 15, 2018 Ice Storm – Number of Customers Restored									
	Within 60 Hours			Beyond 60 Hours			Total		
Bus kV	Detroit	Non-Detroit	Total	Detroit	Non-Detroit	Total	Detroit	Non-Detroit	Total
4.8	85,739	95,518	181,257	5,498	2,798	8,296	91,237	98,316	189,553
8.3 & 13.2	365	97,160	97,525	0	1,898	1,898	365	99,058	99,423
Total	86,104	192,678	278,782	5,498	4,696	10,194	91,602	197,374	288,976

April 15, 2018 Ice Storm – % of Customers Restored									
	Within 60 Hours			Beyond 60 Hours			Total		
Bus kV	Detroit	Non-Detroit	Total	Detroit	Non-Detroit	Total	Detroit	Non-Detroit	Total
4.8	93.97%	97.15%	95.62%	6.02%	2.85%	4.38%	100%	100%	100%
8.3 & 13.2	100%	98.08%	98.09%	0%	1.92%	1.91%	100%	100%	100%

DTE Electric Company
Case No. U-20169

Auditor: **T. Becker**
Request No: **TJB-1.48**
Page: **1 of 1**

Request:

48. Please provide results of R 460.722(a)-(c) from January 1, 2018 to June 30, 2018.

Response:

Performance to R 460.722(a)-(c) for YTD June 30, 2018 is shown in the table below. The data show that DTE met the MPSC Service Quality and Reliability Standard for service restoration for each rule.

R 460.722(a)-(c) Performance 2018 YTD June 30	
Rule	Percent of Customers Restored within the Specified Time Frame
R 460.722(a) Restore not less than 90% of customers within 36 hours under all conditions	96%
R 460.722(b) Restore not less than 90% of customers within 60 hours under catastrophic conditions	98%
R 460.722(c) Restore not less than 90% of customers within 8 hours under normal conditions	92%

DTE Electric Company **Auditor:** **T. Becker**
Case No. U-20169 **Request No:** **TJB-1.49**
Page: **1 of 1**

Request:

49. DTE's 2017 service quality and reliability annual report in U-12270 indicates that 4% of DTE's circuits have experienced 5 or more same circuit interruptions in a 12-month period. Please provide the number of circuits which have experienced 5 or more of the same circuit repetitive interruptions in the 2017 12-month period for the following categories.

a. 4.8 kV Detroit
b. 4.8 kV non-Detroit
c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

R 460.702 Rule 2(s) of Case U-12270 states that " at its option, an electric utility may report on specific identifiable circuit segments rather than whole circuits ". DTE uses distribution transformers rather than whole circuits. The numbers of circuit segments (distribution transformers) with customers experiencing five or more interruptions are shown in the table below. DTE's sytem has a total of approximately 440,000 distribution transformers.

Number of Circuit Segments with 5 or More Interruptions in 2017			
4.8 kV Detroit	4.8 kV Non-Detroit	8.3 & 13.2 kV	Total
1,078	3,044	14,792	18,914

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.50**
	Page:	**1 of 1**

Request:

50. For the May 4, 2018 wind storm, please identify the duration for each time the online outage map was not available for customers to view. Please also explain how the mapping software updates the outage information and the frequency of the updates. How has DTE ensured that the map is still available when traffic is higher than average?

Response:

During the May 4th wind storm, the DTE Energy outage map was continuously available to the customer. There were no service interruptions.

Based on experience during previous catastrophic storms, DTE Energy developed approach to make the outage map more resilient to periods of high customer traffic. The approach includes caching data from the source system and is driven by the number of customers impacted by the event.

During normal “Blue Sky” scenarios and storms impacting less than 50,000 customers, outage data for outage map is extracted every 15 minutes from the DTE Energy Outage Management System (OMS) and then loaded into the GIS system for display on the Outage Map. This data is then aggregated and plotted at an individual outage level.

During storms impacting greater than 50,000 customers, the outage map is switched to show a rendered overlay image of all individual outages in the GIS system, rather than pulling each individual outage image. This map provides the same outage information as the “Blue Sky” map but at a lower visual resolution and is refreshed every 30 minutes. This change is done to manage the traffic going to the GIS system, and prevent it from experiencing traffic related performance issues.

Both the “Blue Sky” and Storm Maps have a legend indicating the last time map data was updated.

During the May 4 storm, the map was available via the website until we reached the 50,000 customer threshold, at approximately 1:00PM. At approximately 1:00PM, we switched from the individual outage map to the map with image overlay. The image overlay approach was used until the number of customer outages went below the threshold of 50,000.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.51**
	Page:	**1 of 1**

Request:

51. Please explain any work DTE is doing to enhance the outage mapping system to ensure that customers have access to the up-to-date outage map at all times.

Response:

The approach taken to make the DTE Energy Customer Outage Map more resilient to high traffic events was implemented for the May 4th Wind Storm and will continue to be used for future outage events.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-1.52**
	Page:	**1 of 1**

Request:

52. Figure 6 on page 13 of DTE's report filed on June 29, 2018, outlines the number of reported wire downs per hour on May 4th and 5th. Please provide the average customer call answer time and call blockage factor (as a percentage) for hours 13- 15 on May 4th.

Response:

The average customer call answer time was 18 seconds between 13:00 and 15:00 on May 4th. The call blockage factor is 0.18% and a total of 72 calls were blocked between 13:00 and 15:00 on May 4th.

DTE Electric Company | **Auditor:** **T. Becker**
Case No. U-20169 | **Request No:** **TJB-1.53**
Page: **1 of 1**

Request:

53. Table 4 on page 26 of DTE's report filed on June 29, 2018, summarizes the 2017 compliance with Rule 723. Please provide a table outlining the results of Rule 460.723(1) and (2) for the May 4th wind storm and the April 15th ice storm.

Response:

Performance to Rule 460.723(1) and (2) for the May 4th wind storm and the April 15th ice storm are shown in the table below. Each of these storms was catastrophic per the U-12270 definition " service interruptions for 10% or more of a utility's customers."

Contributing factors to the overall response rate are the volume of Police/Fire events, the time required to mobilize, and the travel time to the more remotely located service area, especially if road conditions are hazardous.

Rule 460.7231(1) and (2): Police/Fire Standing By Performance 2018 YTD June 30 Catastrophic Storms (10% or more customers interrupted)		
Rule	April 15, 2018 Storm	May 4, 2018 Storm
Relieve 90% of Police/Fire Standing By cases within 240 minutes in Metropolitan Areas	73%	55%
Relieve 90% of Police/Fire Standing By cases within 360 minutes in Non-Metropolitan Areas	86%	34%

DTE Electric Company
Case No. U-20169

Auditor: **T. Becker**
Request No: **TJB-1.54**
Page: **1 of 1**

Request:

54. Please provide the results of R 460.723(1) and (2) from January 1, 2018 to June 30, 2018 broken down into the following categories.

    a. 4.8 kV Detroit
    b. 4.8 kV non-Detroit
    c. Rest of distribution service territory (8.3 kV and 13.2 kV)

Response:

Performance to Rule 460.723(1) and (2) from January 1, 2018 to June 30, 2018 are shown in the tables below (all weather and excluding catastrophic storms). Catastrophic storms typically have a negative impact on performance due to the volume of Police/Fire events, the time required to mobilize, and the travel time to the more remotely located service area.

For DTE, only the northern-most service center (North Area Energy Center) is considered non-metropolitan by R 460.702 Rule 2(n) of Case U-12270.

Rule 460.723(1) and (2): Police/Fire Standing By Performance 2018 YTD June 30				
Rule	4.8 kV Detroit	4.8 kV non-Detroit	8.3 & 13.2 kV	Total
Relieve 90% of Police/Fire Standing By cases within 240 minutes in Metropolitan Areas	84%	85%	87%	86%
Relieve 90% of Police/Fire Standing By cases within 360 minutes in Non-Metropolitan Areas	n/a	63%	56%	61%

Rule 460.723(1) and (2): Police/Fire Standing By Performance 2018 YTD June 30 Excluding Catastrophic Storms (10% or more customers interrupted)				
Rule	4.8 kV Detroit	4.8 kV non-Detroit	8.3 & 13.2 kV	Total
Relieve 90% of Police/Fire Standing By cases within 240 minutes in Metropolitan Areas	92%	94%	95%	94%
Relieve 90% of Police/Fire Standing By cases within 360 minutes in Non-Metropolitan Areas	n/a	86%	100%	89%

DTE Electric Company		**Auditor:**	**T. Becker**
Case No. U-20169		**Request No:**	**TJB-1.55**
		Page:	**1 of 1**

Request:

55. Please provide the results of R 460.724(a) and (b) for the duration of the May 4, 2018 wind storm as they relate to customer calls.

Response:

Performance to R 460.724(a) and (b) (Average Customer Call Answer Time and Call Blockage Factor) for the May 4, 2018 wind storm are shown in the table below. The data shows DTE met the average customer call answer time standard during May 4, 2018 wind storm.

Rule 460.724(a) and (b) May 4, 2018 Wind Storm - Performance	
Average Customer Call Answer Time Standard < 90 seconds	Call Blockage Factor Standard <= 5 %
29 seconds	0%

DTE Electric Company **Auditor:** **T. Becker**
Case No. U-20169 **Request No:** **TJB-1.56**
Page: **1 of 1**

Request:

56. Please the results of R 460.724(a) and (b) for the duration of the April 15, 2018 ice storm as they relate to customer calls.

Response:

Performance to R 460.724(a) and (b) (Average Customer Call Answer Time and Call Blockage Factor) for the April 15, 2018 ice storm are shown in the table below.The data shows DTE met the average customer call answer time standard during April 14, 2018 ice storm.

Rule 460.724(a) and (b) April 15, 2018 Ice Storm - Performance	
Average Customer Call Answer Time Standard < 90 seconds	Call Blockage Factor Standard <= 5 %
28 seconds	0%

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-2.57**
	Page:	**1 of 1**

Request:

57. Please provide the most recent vegetation management consultant, ECI, report as referred to in Questions #2 and #4.

Response: Please see the attachment named U-20169 TJB-2.57 ECI report.

DTE Electric Company
Case No. U-20169

Auditor: **T. Becker**
Request No: **TJB-2.58**
Page: **1 of 2**

Request:

58. Please provide tables showing the information in the response to Question #16 for the 2013-2016 DTE Electric Pole Inspection reports.

Response:

The DTE Electric pole inspection results for 2013-2016 are contained in the following four tables.

	Poles Inspected in **2016**	Percent of Poles Inspected in each Category		
Inspection Type		4.8 kV Detroit	4.8 kV non-Detroit	8.3 & 13.2 kV
PTM Visual Inspections	50,583	5%	28%	67%
PTM Testing	35,370	5%	33%	62%
Joint Use/Planned Work Inspections	29,280	14%	30%	56%
Poles Replaced on Trouble	2,978	21%	30%	49%
Total	118,211	8%	30%	62%

	Poles Inspected in **2015**	Percent of Poles Inspected in each Category		
Inspection Type		4.8 kV Detroit	4.8 kV non-Detroit	8.3 & 13.2 kV
PTM Visual Inspections	20,682	34%	20%	46%
PTM Testing	30,294	33%	8%	59%
Joint Use/Planned Work Inspections	30,333	13%	28%	59%
Poles Replaced on Trouble	1,970	24%	29%	47%
Total	83,279	26%	19%	55%

DTE Electric Company
Case No. U-20169

Auditor: **T. Becker**
Request No: **TJB-2.58**
Page: **2 of 2**

Inspection Type	Poles Inspected in **2014**	Percent of Poles Inspected in each Category		
		4.8 kV Detroit	4.8 kV non-Detroit	8.3 & 13.2 kV
PTM Visual Inspections	23,513	21%	6%	73%
PTM Testing	28,739	27%	14%	59%
Joint Use/Planned Work Inspections	48,883	19%	29%	52%
Poles Replaced on Trouble	969	23%	27%	50%
Total	102,104	22%	19%	59%

Inspection Type	Poles Inspected in **2013**	Percent of Poles Inspected in each Category		
		4.8 kV Detroit	4.8 kV non-Detroit	8.3 & 13.2 kV
PTM Visual Inspections	31,352	12%	33%	55%
PTM Testing	43,875	17%	39%	44%
Joint Use/Planned Work Inspections	14,276	40%	55%	5%
Poles Replaced on Trouble	930	15%	31%	54%
Total	90,433	19%	39%	42%

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-2.59**
	Page:	**1 of 1**

Request:

59. The response to Questions #35 and #36 indicate that there were no wire guards used for the April 15, 2018 and May 4, 2018 storms. Please identify how many wire downs met the stand-by criteria that were not repaired or cut in the clear for each storm and explain why a wire guard was not utilized.

Response:

All downed wires that met stand-by criteria were repaired or cut in the clear. Wire guards were not utilized because as stated previously in questions 35 and 36, the nearest crew is dispatched to the wire immediately. If there is no crew available, then one is pulled from the nearest outage. See response to question 64 for further details on the Company's wire down procedures.

DTE Electric Company | **Auditor:** **T. Becker**
Case No. U-20169 | **Request No:** **TJB-2.60**
Page: **1 of 1**

Request:

60. The response to Question #45 indicates that capital and O&M spend is not tracked on a circuit basis. Please identify how the historical spend is tracked and provide the amount of capital and O&M spend for each of the past five years in each of the respective tracking categories.

Response:

DTE Electric makes capital and maintenance investments based on the prioritization methodology detailed in the Company's Five-Year Investment and Maintenance Plan submitted to MPSC on January 31, 2018. Programs and projects are prioritized based on their customer benefit cost scores to address the most critical asset and system issues. For certain programs, such as pole and pole top maintenance, tree trimming, and preventive maintenance, program spend is allocated to adhere to program cycles for the entire system regardless of geographical locations.

The capital and O&M spend by category for each of the past five years is provided in the attachment named U-20169 TJB-2.60.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-2.61**
	Page:	**1 of 1**

Request:

61. Regarding the response to question #3, do both circuits consist of rear-lot construction?

Response: Yes, both APPOL1346 and BUNRT8404 have rear-lot construction. A desk-top estimate indicates APPOL1346 has approximately 75% rear-lot construction and BUNRT8404 has approximately 40% rear-lot construction.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-2.62**
	Page:	**1 of 2**

Request:

62. Regarding the response to question #13, the response states that "[a]verage trimming cycles are not separable for the three categories requested." Is this due to a lack of documentation and recordkeeping, lack of the ability to retrieve this information through the management system, or both? Based on the response to question #10, it appears as though the number of years that have passed since the last tree trim is used to prioritize trimming.

Response: Average cycle time is not a metric specifically tracked because it is not a component of our tree trimming prioritization. As stated in question #10, the Company prioritizes circuits for trimming based on reliability impacts, wire down reductions, the number of years that have passed since the last trim, and alignment with constrution/capital programs. Resource balancing across the service territory is also considered to ensure resources are available to respond to unplanned events in a timely manner. Although the data in the charts can be used to calculate an average cycle time, it is not representative of the targeted cycle length. We would like to meet to discuss this data and nuances in terminology further.

The following charts show the number years that have past since the last trim for the 4.8 kV miles in the City of Detroit, the remainder the miles on the 4.8 kV system that are not in Detroit, and the miles on the remainder of the distribution system. The charts are representative of the status as forecasted upon completing the 2018 tree trimming plan for distribtuion circuits, excluding subtransmission.

DTE Electric Company		**Auditor:**	**T. Becker**
Case No. U-20169		**Request No:**	**TJB-2.62**
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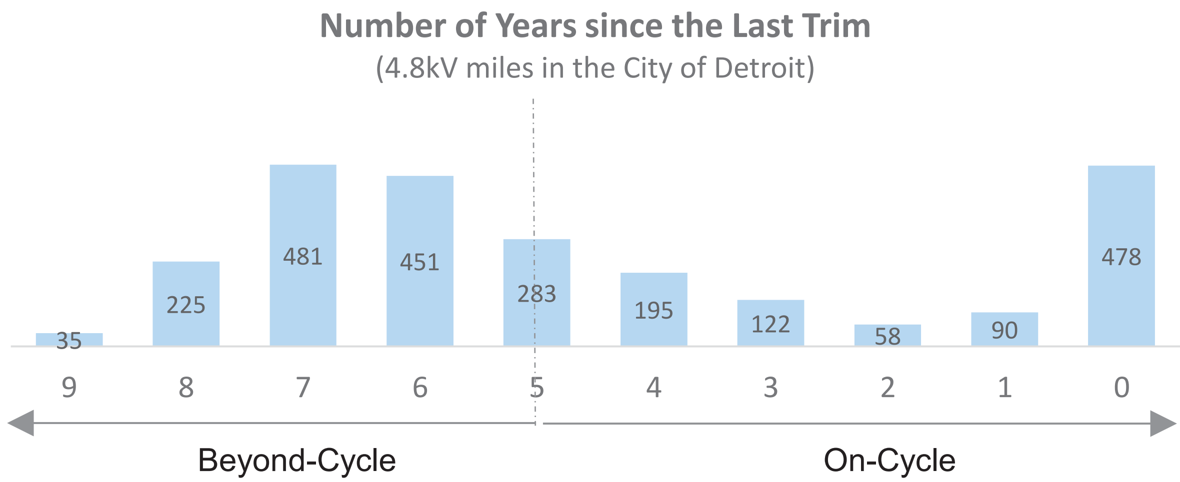

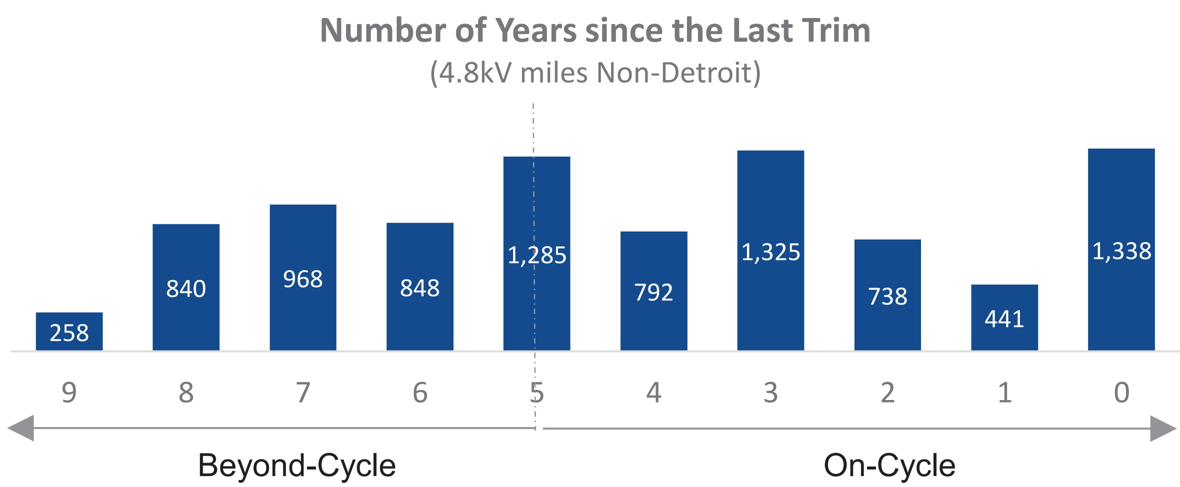

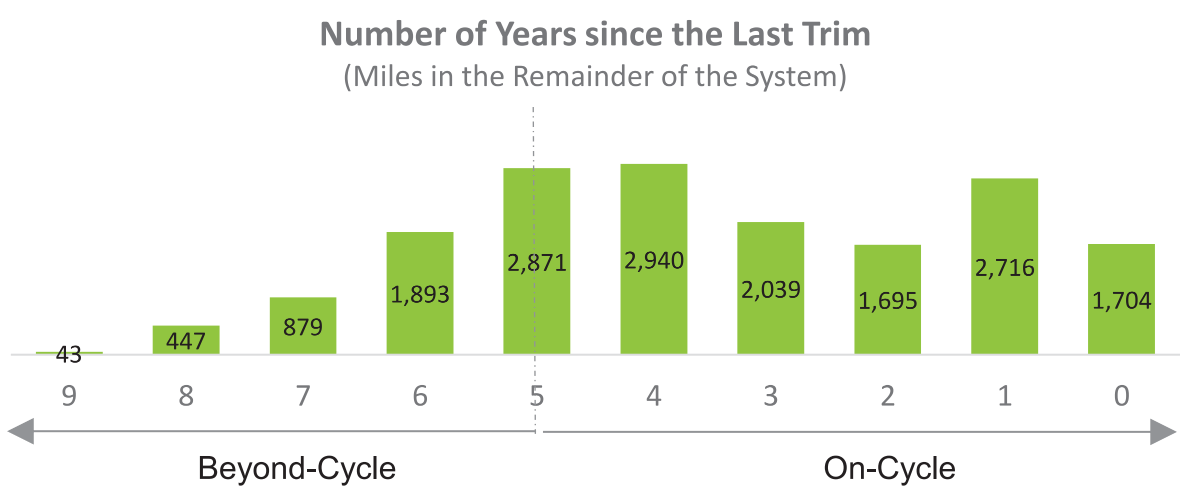

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-2.63**
	Page:	**3 of 1**

Request:

63. Regarding the responses to #17 and #18, the response states that "DTE was not able to identify the number of poles in each category which exceeded the 10-12-year inspection frequency." Is this due to a lack of documentation and recordkeeping, lack of the ability to retrieve this information through the management system, or both?

Response: During storm restorations, the exact locations (geographic XY coordinates) of broken poles are not recorded. Hence, the inspection cycle of the broken poles is not readily known.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-2.64**
	Page:	**1 of 1**

Request:

64. Regarding the response to #23, could you please send the actual wire down response procedure(s) outlining what is required from the time the wire down is reported until the wire down is resolved? The Commission order requests that Staff provide an analysis of the strength and effectiveness of DTE's down wire procedures.

Response:

The Company will make its response procedures available for Staff's review at our Lansing office.

DTE Electric Company | **Auditor:** | **T. Becker**
Case No. U-20169 | **Request No:** | **TJB-2.65**
Page: | **1 of 1**

Request:

65. Regarding the responses to #29 and #30, could DTE provide us information showing how many of the wire downs were not identified within 4-hours (when a ground alarm is detected)? If so, please provide. It seems like this information could be obtained through the OMS system since milestones such as the creation of wire down, dispatch time, arrival time, and the action taken by the field resource are tracked.

Response:

As previously stated 45 ground alarms and 37 ground alarms in the April 15th and May 4th storms respectively lead to the de-energization of circuits.

A downed wire may not be the cause of a ground alarm (for example, there is an equipment issue within a substation), however, if the cause of a ground alarm is a downed wire, there is no tie between the events (the downed wire and the ground alarm) in the OMS. For a downed wire to appear in the OMS there needs to be a customer, or police and fire department report of one. A ground alarm itself does not trigger the creation of a wire down event as there often might be other causes within the substation for the ground.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-2.66**
	Page:	**1 of 1**

Request:

66. Regarding the responses to #35 and #36, DTE did not use any wire guards for the April and May storms in 2018. Was this because none of the locations met the enhanced stand-by criteria? See attached question #59.

Response:

DTE did not use any wire guards in the April or May storms. Any location that met the standby criteria was addressed by dispatching a qualified overhead resource. See response to question 64 for further details on the Company's wire down procedures.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-2.67**
	Page:	**1 of 1**

Request:

67. Regarding the response to question #40, does DTE have an internal wire down relief target? Page 2 of DTE's report filed under U-16462 regarding wire down relief seems to indicate that the target was 120 minutes back in 2010. Page 3 states, "To assist in achieving this higher level of performance, Detroit Edison has set an internal goal of 120 minutes to relieve non-utility personnel standing-by downed wires." Is this goal still something that the Company targets?

Response:

The 120 minutes indicated in U-16462 is not a metric that the company currently targets. DTE follows the MPSC requirement of relieving non-utility personnel standing by downed wires within 240 minutes in a metropolitan area and 360 minutes in a non-metropolitan area 90% of the time.

DTE Electric Company	**Auditor:**	**T. Becker**
Case No. U-20169	**Request No:**	**TJB-2.68**
	Page:	**1 of 1**

Request:

68. Regarding the response to Question #45, it appears that DTE does not track capital and O&M spend on a circuit basis. Please explain how the capital and O&M funding is allocated to ensure that the funding is equally distributed across the entire system and how DTE tracks the historical spend. See the attached request #60.

Response:

Please refer to response to question 60.

The Vision for U.S. Community Solar:
A Roadmap to 2030

Prepared For:

VOTE SOLAR

FULL REPORT

July 2018

gtmresearch is now Wood Mackenzie

Acknowledgements

The Vision for U.S. Community Solar: A Roadmap to 2030 and Beyond **was prepared by Wood Mackenzie and GTM Research on behalf of Vote Solar**

VOTE SOLAR

With special thanks to our project partners Coalition for Community Solar Access and GRID Alternatives

COALITION FOR COMMUNITY SOLAR ACCESS

GRID ALTERNATIVES

Acknowledgements

We would also like to thank the many stakeholders who contributed their thoughts and time to review this report, including primary reviewers listed below:

Community Solar Advisory Committee

- Jeff Cramer — Coalition for Community Solar Access
- Tom Figel — Grid Alternatives
- Joel Henri — ForeFront Power
- Tom Hunt — Clean Energy Collective
- Hannah Muller — Clean Energy Collective
- John Murphy — Nexamp
- Jennifer Spinosi — CleanChoice Energy
- Joel Thomas — Community Energy Inc.

Low Income and Equity Advisory Committee

- Sara Baldwin — Interstate Renewable Energy Council
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- Coreina Chan — Rocky Mountain Institute
- Michael DiRamio — Department of Energy
- Ariel Drehobl — American Council for an Energy-Efficient Economy
- Marcus Franklin — NAACP
- Mari Hernandez — Interstate Renewable Energy Council
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- Odette Mucha — Department of Energy
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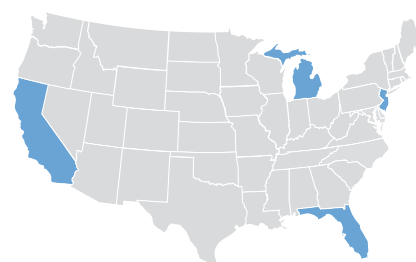
1. Executive Summary

A Vision for Community Solar: Study Overview

We establish a vision for a market where community solar is a mainstream option for consumers to choose and control their own energy generation — especially for those lacking access to traditional solar options, such as renters and the low- and moderate-income community.

This Vision for Community Solar:

- Outlines Benefits of Community Solar and Subscriber Preferences
- Addresses Key Bottlenecks to the Expansion of Community Solar
- Provides Strategies to Enhance Inclusivity of Low- and Moderate-Income Populations
- Walks through National Market Potential and Forecasts for Community Solar along with Deep Dives in 4 States:
  - California
  - Florida
  - Michigan
  - New Jersey
- Presents the National Impacts of Community Solar Market Transformation



Community Solar Makes Solar an Option for Everyone with an Electric Bill

U.S. consumers want solar…

The number of solar energy systems purchased by U.S. homeowners and businesses has grown tenfold since 2010. By the end of 2018, nearly 2 million homeowners and businesses will produce their own solar energy.

…and solar is getting more affordable

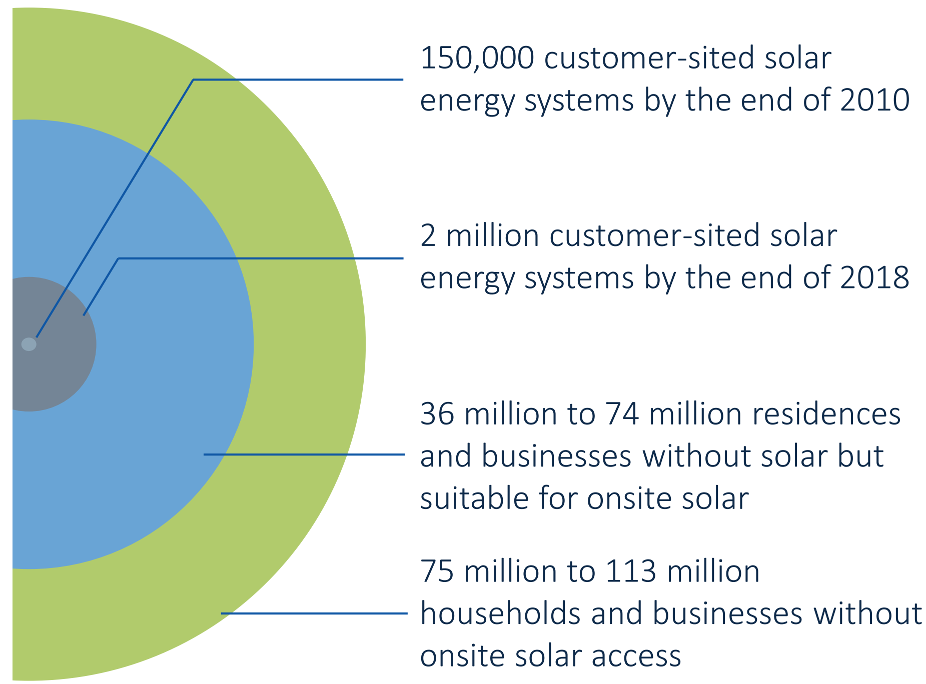
The price of rooftop solar has fallen by 40% in the past five years and currently beats the average retail price of electricity in 27 states and Washington, D.C.

…but access to solar is limited.

Between 50% and 75% of U.S. consumers cannot access traditional rooftop solar, either because they do not own their roof or due to technical restrictions. Community solar gives all 151 million electricity customers in the U.S. an opportunity to directly participate in solar.

Community solar gives all customers the ability to choose local clean electricity that can support local economic development, resiliency and healthier communities.

Community Solar Can Reach All Potential U.S. Customers



Source: GTM Research Wood Mackenzie, GTM Research/SEIA, NREL, EIA, U.S. Census

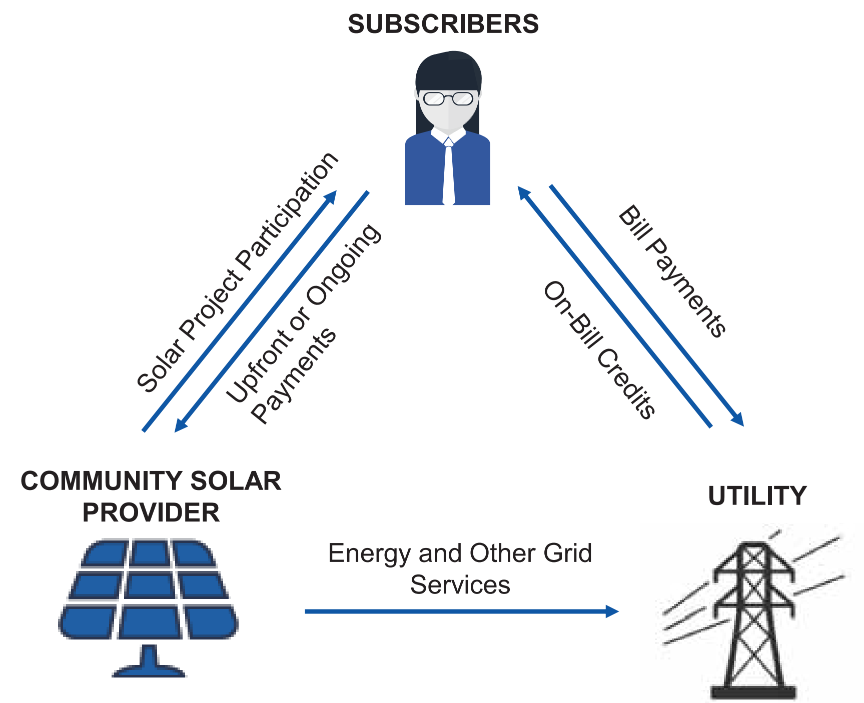
Defining Community Solar

Community solar – also called shared solar or solar gardens – refers to local solar facilities shared by multiple subscribers that receive credit on their electricity bills for their share of power produced.

Over the years, many projects have been labeled community solar, but we define **community solar** as a solar project with **multiple subscribers that receive on bill benefits directly attributable to the community solar project**.

- Subscribers must be credited with the benefits of community solar on their electric utility bills, either in the form of a monetary or energy (kWh) credit
- Subscribers must be tied to a specific solar project of which they are direct subscriber, not generic renewable certificates

The Community Solar Model



Source: GTM Research Wood Mackenzie

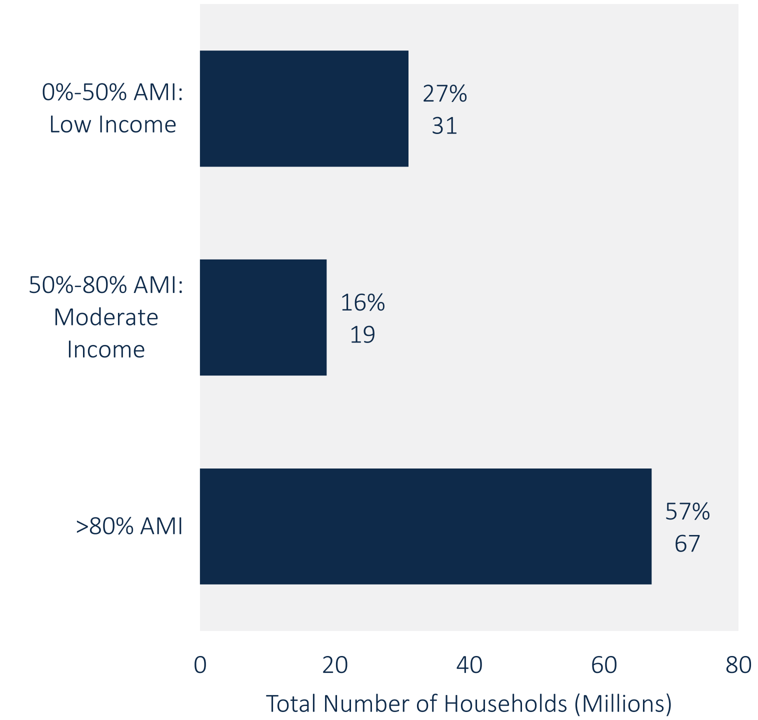
Community Solar Can Empower Communities Most in Need

50 million reasons why community solar needs to tap into the low-to-moderate income customer segment

Why community solar is the key to unlocking 50 million low-to-moderate income (LMI) households' access to clean, affordable energy solutions…

- **The LMI subscriber opportunity is massive, accounting for approximately 43% of U.S. households.** Of that total, there are 31 million low-income households, 19 million moderate-income households, and 5.78 million affordable housing properties across the U.S. that would benefit from cost-saving community solar solutions.
- Community solar provides the **flexibility to deliver clean energy access to all LMI customers, including renters and multifamily housing** – which LMI households are more likely to occupy.
- **Community solar also offers significant benefits to low-income customers**, including opportunity for bill savings and energy burden reduction, targeted, flexible value propositions tailored to LMI customers' unique needs, and local economic opportunity to drive the clean energy transition.
- At the same time, the LMI subscriber opportunity remains untapped, in large part due to higher costs to acquire LMI subscribers and limited access to capital for community solar projects involving LMI subscribers.
- But with the right combination of **policy solutions, incentives, consumer protections, business model innovations, financing and programmatic support**, there's an opportunity for community solar to play a critical role in creating an equitable clean energy future.
    - Targeted policy, financing and subscriber management solutions can reduce the perceived risk of serving LMI households and deliver significant benefits to LMI customers.

Share of U.S. Households:
Low-to-Moderate Income (LMI) vs. Non-LMI



Source: NREL, 2018

An Equitable Transition to Serve Communities of Color and Environmental Justice Communities

Communities of color and environmental justice communities must also have equitable access to clean energy solutions

- LMI households are not the only customer segment that must proactively be included in solar markets moving forward. This work must also extend to communities of color and environmental justice communities. **Community solar can be used as a tool to target benefits to communities who have historically been at the front lines of environmental pollution and negative impacts from traditional energy generation.**
  - Fossil fuel power has disproportionately impacted the health and well-being of low-income communities, particularly communities of color and indigenous communities. Emissions from power plants sited in these communities contribute to high rates of asthma and cancer, and the presence of heavy industry contributes to a cycle of poverty and public disinvestment in neighborhoods that can least afford it.
  - Approximately 68% of African Americans live within 30 miles of a coal-fired power plant and nearly 40% of communities of color breathe polluted air. Meanwhile, environmental justice communities are disproportionately affected by public health effects of traditional generation.

Policymakers can target the benefits of community solar to communities of color and environmental justice communities through a number of strategies. Support can include program carve outs, job training programs, project ownership, siting preferences and incentives specifically focused on communities who have been disproportionately impacted by the electric system to date.

- Such solutions would not only provide **workforce development opportunities**, but also enable legislators and regulators to better quantify and measure **public health benefits** of community solar that displaces the need for fossil fuel generation.
- This report acknowledges that environmental justice communities and communities of color are critical to serve in the nation's transition to a low-carbon electricity system. Analysis of community solar's addressable market focuses on low and moderate income households, affordable housing owners and affordable housing tenants.

Source: Low-Income Solar Policy Guide, 2018

Community Solar Can Be an Attractive Solution for All Electric Customers

Community solar expands the important benefits of distributed solar to a much broader set of consumers, while also bringing unique solutions to physical, financing and equity challenges of onsite solar and current competitive retail electricity offerings.

Community solar is an energy source that ultimately provides:

FINANCIAL SECURITY
Community solar can provide **energy bill savings** as well as **predictable and stable** long-term energy costs

ENERGY BILL SAVINGS

STABLE AND PREDICTABLE BILLS

PLATFORM FOR ADDITIONAL SERVICES

ALIGNMENT WITH VALUES
Community solar gives more customers the **freedom and choice** to support energy sources and providers that align with their social and environmental values

BUY LOCAL, CLEAN ENERGY

CONTROL OF ENERGY SUPPLY

SUPPORT TRUSTED PARTIES

LOCAL BENEFITS
Community solar encourages new **local economic development** near the customer, including support to low-income residents and other vulnerable and disadvantaged communities

LOCAL ECONOMIC INVESTMENT

SUPPORT VULNERABLE COMMUNITES

PROVIDE LOCAL GRID RESILIENCY

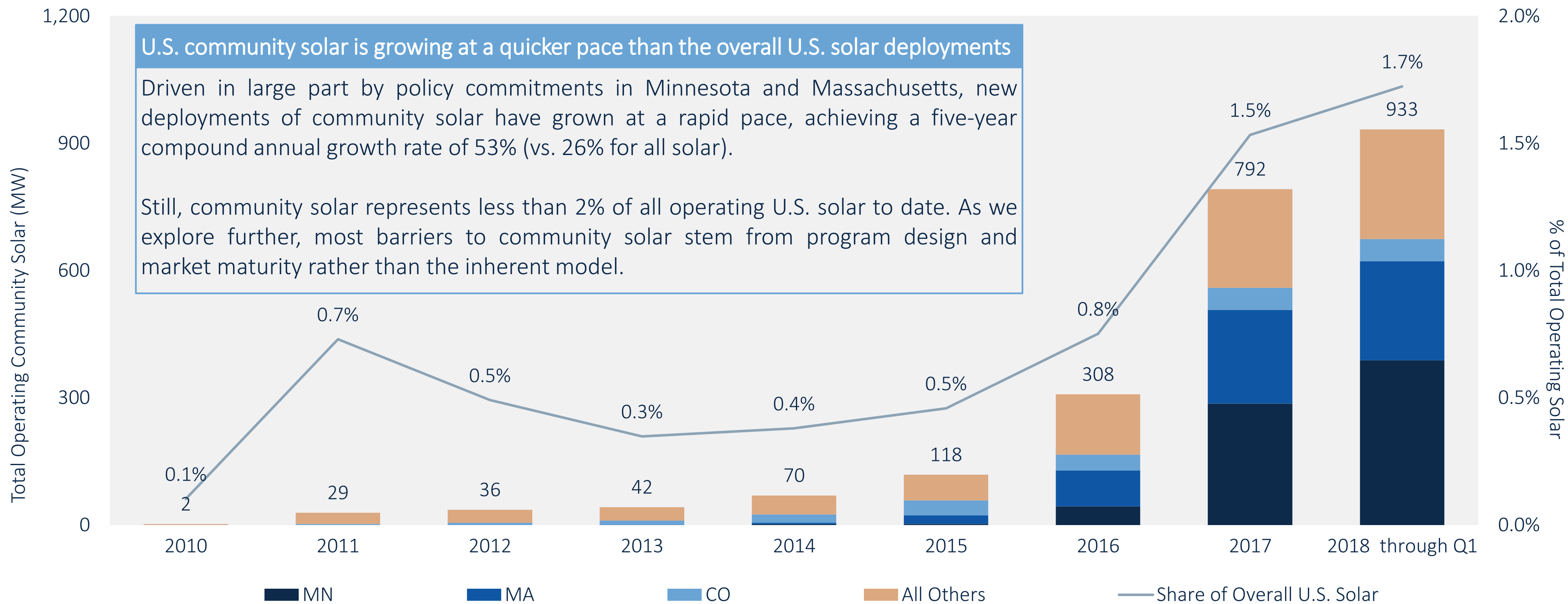
U.S. Community Solar Nears 1 GW of Total Capacity Operating Nationwide

Cumulative U.S. Community Solar Installed Capacity by State

U.S. community solar is growing at a quicker pace than the overall U.S. solar deployments

Driven in large part by policy commitments in Minnesota and Massachusetts, new deployments of community solar have grown at a rapid pace, achieving a five-year compound annual growth rate of 53% (vs. 26% for all solar).

Still, community solar represents less than 2% of all operating U.S. solar to date. As we explore further, most barriers to community solar stem from program design and market maturity rather than the inherent model.



Source: GTM Research Wood Mackenzie

Community Solar Is Small Today — but It Can Rapidly Become a Mainstream Energy Source

If all states enabled community solar and adopted market rules that recognize the benefits community solar brings to subscribers and broader stakeholders – it could transform the energy landscape.

New programs can benefit by learning from early pioneers, leveraging solar's significantly reduced costs and drawing upon best practices—ultimately giving customers of all types, income-levels and geographies access to the rapidly growing clean energy economy.

U.S. Community Solar Market Potential by 2030

Total Community Solar Capacity Operating: **57 GW to 84 GW**

Annual Electricity Generated: **72 TWh to 107 TWh**

- Share of National Electricity Consumption: **1.6%-2.6%**

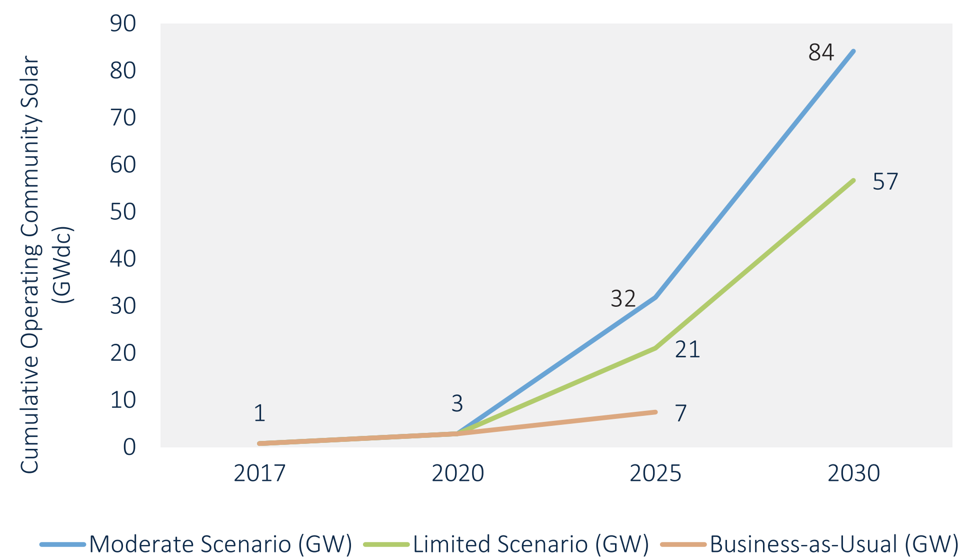
Subscribers Served: **6.4 million to 8.8 million**

- Low- and Moderate-Income Households Supported: **3.5 million to 4.0 million**

Cumulative Capital Invested*: **$81 billion to $121 billion**

*Cumulative capital invested represents total initial costs to build community solar plants, including all installation materials, labor, upfront supply chain, development and financing costs. Does not include ongoing operating costs

U.S. Community Solar through 2030: Market Potential



Source: GTM Research Wood Mackenzie

"Limited Scenario" and **"Moderate Scenario"** refer to the set of grid and environmental benefits included in the compensation for community solar. Neither reflect a full account of all costs and benefits, especially more difficult to calculate economic development and societal health benefits. Adoption forecast also includes assumptions of strong community solar and LMI adoption policy and continued subscription product innovations

Key Solutions to Unlock Community Solar's Potential

- Enabling policy to open viable new markets
  - Bill introduction & passage of ***legislation to open the community solar market*** in states where it is not yet enabled.
  - Program implementation that provides ***stable, fair rates and market participation structures*** that recognize and compensate community solar facilities for the full range of their grid, environmental and societal benefits.
- Expanding existing programs to support sustainable and scalable markets
- Improvements in program design to support meaningful participation by underserved communities with *the* ***inclusion of low- and moderate-income (LMI) communities*** in mind, recognizing the societal benefits and overall market opportunity that full LMI participation represents
- Product innovation by community solar providers and financiers around costs, technology and the services offered

Resources to guide a sustainable and scalable community solar future:

1. Shared Renewables Guiding Principles (Interstate Renewable Energy Council):

http://www.irecusa.org/publications/guiding-principles-for-shared-renewable-energy-programs/

2. Low Income Solar Policy Guide – Community Solar:

http://www.lowincomesolar.org/best-practices/community-solar/

3. Policy Decision Matrix and Model Legislation (Coalition for Community Solar Access):

http://www.communitysolaraccess.org/resources/

4. Smart Electric Power Alliance Community Solar Program Designs 2018:

https://sepapower.org/resource/community-solar-program-designs-2018-version/

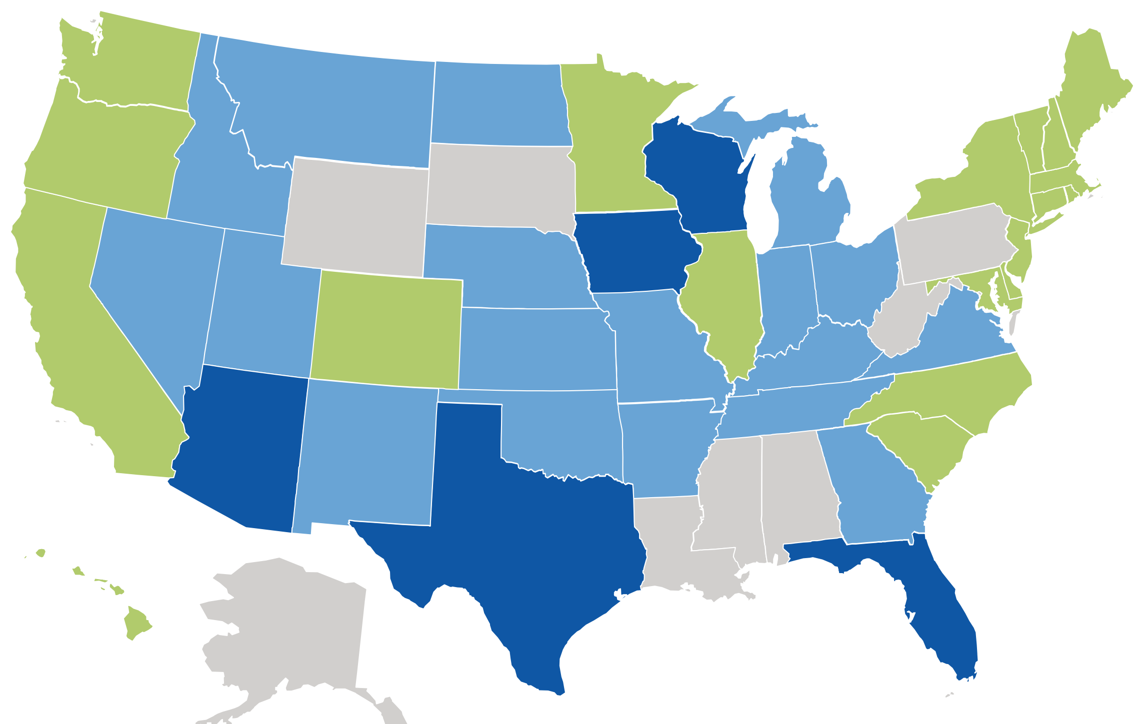
Today: A Patchwork of State-Level Policies and Utility Pilots Drive Community Solar

42 states and Washington, D.C. currently have community solar projects, but only 19 states and D.C. have statewide programs that provide an early opportunity for community solar to scale.

Voluntary utility-led community solar programs—including those initiated by investor-owned utilities, municipal utilities and rural cooperatives—provide limited access in states without state-wide policy.

Community solar is both enabled and encumbered by individual program rules and regulations on who can participate and how community solar projects and subscribers are compensated.

Although nearly every state has a community solar project, policy-enabled markets account for 71% of all currently operating community solar capacity.



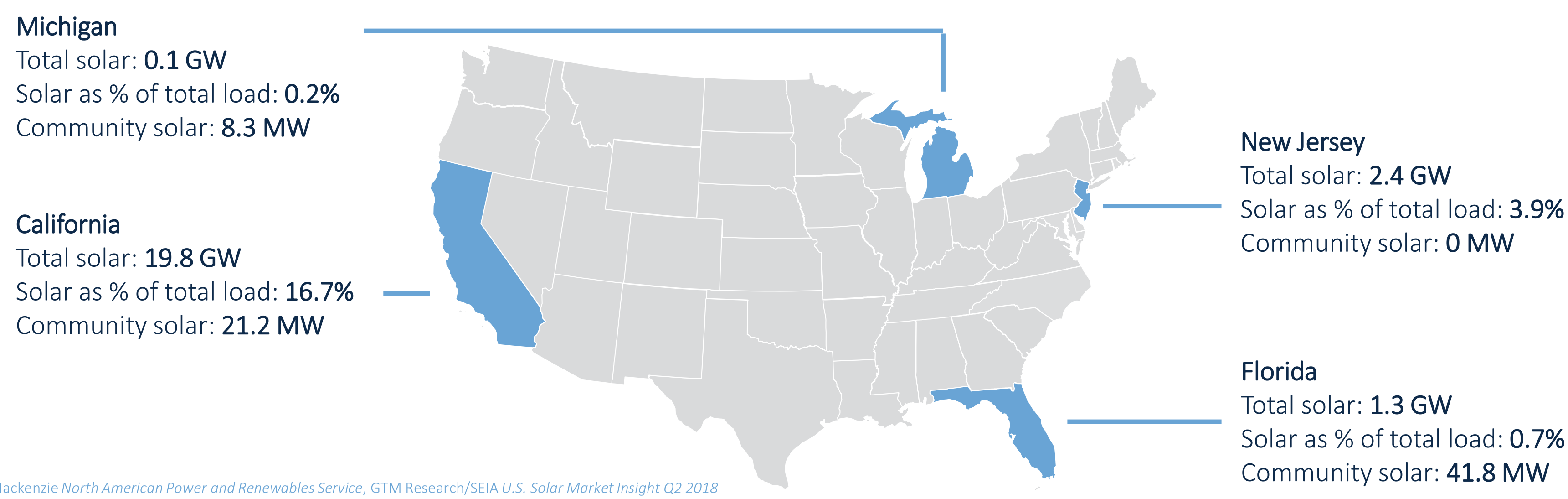
Policy-Enabled Market | One-Off Programs (1-5) | One-Off Programs (5+)

Four Early Community Solar Markets in Focus

We examine four state markets in different regions with different makeups: California, Florida, Michigan and New Jersey

Two leading distributed solar states (CA, NJ) and two lagging distributed solar states (FL, MI). Each state differs in its current level of experience with community solar. NJ recently passed legislation and has yet to begin program implementation. CA also passed legislation back in 2013, but only two community solar projects from that program are under development. All operating community solar capacity in CA comes from voluntary utility-led programs administered by municipal utilities. Meanwhile, MI and FL have several voluntary utility-led programs among their investor-owned utilities, rural-electric cooperatives, and municipal utilities but lack statewide enabling legislation.

Solar Deployments in States-in-Focus as of 2017 Year End



Source: Wood Mackenzie *North American Power and Renewables Service*, GTM Research/SEIA *U.S. Solar Market Insight Q2 2018*

Community Solar in California: Market Potential

California is undergoing a significant energy transition, with a 50% renewables target for 2030 and solar already providing nearly 17% of total electricity consumption — over 6% from distributed generation alone. High deployments of solar have already sparked the transition to rates that reflect the temporal value of energy with the consideration of locational benefits. Meanwhile, major load pockets are shifting away from traditional load-serving entities to community-choice aggregators, which could use distributed and community solar as a means to meet clean energy goals.

By 2030, with strong enabling policies, community solar could reach half a million subscribers, supporting hundreds of thousands of renters, LMI individuals, and businesses that have so far been left with few options in the California energy transition.

Community Solar Market Potential in California, 2030 Vision Scenarios

Total Addressable Market: **15.6 million customers**

Total Community Solar Capacity Operating: **6.3 GW to 8.2 GW**

Annual Electricity Generated: **9.4 TWh to 12.4 TWh**

- Share of State Electricity Consumption: **3.4% to 4.4%**

Subscribers Served: **747,000 to 964,000**

- Low- and Moderate-Income Households Supported: **440,000 to 550,000**

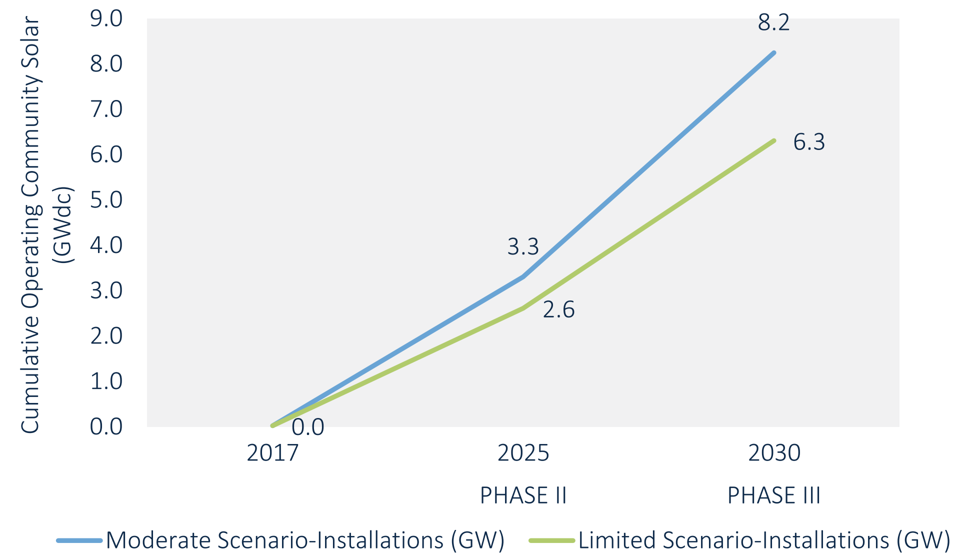
Cumulative Capital Invested*: **$9.8 billion to $12.8 billion**

Annual Spend on Operations, Leases and Taxes: **$125 million to $165 million**

Further Details on California Market Potential

*Cumulative capital invested represents total initial costs to build community solar plants, including all installation materials, labor, upfront supply chain, development and financing costs. Does not include ongoing operating costs

Community Solar in California: Market Potential



Source: GTM Research Wood Mackenzie

"Limited Scenario" and **"Moderate Scenario"** refer to the set of grid and environmental benefits included in the compensation for community solar. Neither reflect a full account of all costs and benefits, especially more difficult to calculate economic development and societal health benefits. Adoption forecast also includes assumptions of strong community solar and LMI adoption policy and continued subscription product innovations

Community Solar in Florida: Market Potential

Community solar in Florida could provide critical economic relief and local resiliency to vulnerable communities. By 2030, low income, moderate income and affordable housing subscribers could make up nearly half of subscriptions and one-third of electricity generated as, according to our modeling, community solar could eventually provide 25%-30% savings on LMI household bills.

Community solar's ability to be paired with energy storage and microgrids could be a key driver in also assuring that the state and utilities can ensure clean, reliable electricity to communities during hurricanes and other disasters.

Community Solar Market Potential in Florida, 2030 Vision Scenarios

Total Addressable Market: **8.9 million customers**

Total Community Solar Capacity Operating: **2.3 GW to 3.6 GW**

Annual Electricity Generated: **3.2 TWh to 5.1 TWh**

- Share of State Electricity Consumption: **1.1% to 1.8%**

Subscribers Served: **287,000 to 384,000**

- Low- and Moderate-Income Households Supported: **141,000 to 189,000**

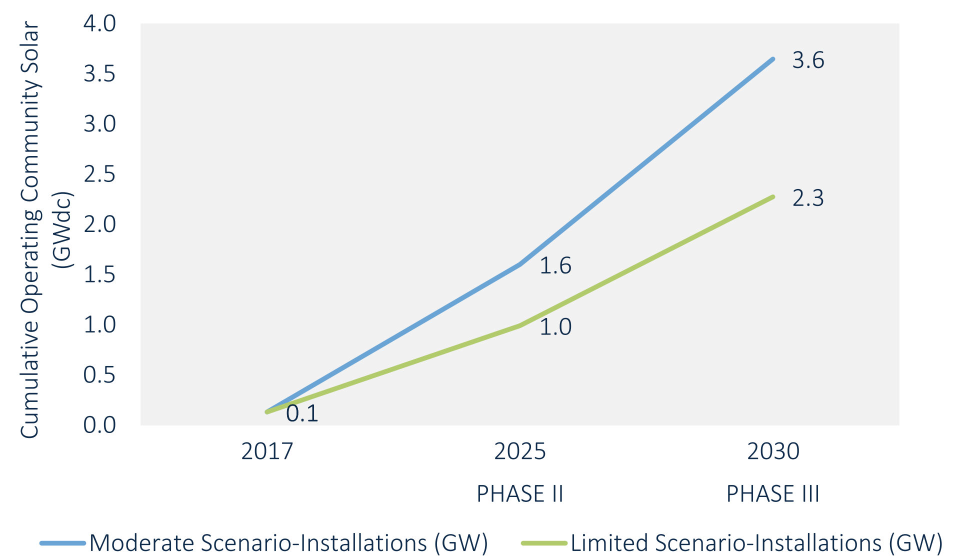
Cumulative Capital Invested*: **$3.3 billion to $4.0 billion**

Annual Spend on Operations, Leases and Taxes: **$34 million to $55 million**

Further Details on Florida Market Potential

*Cumulative capital invested represents total initial costs to build community solar plants, including all installation materials, labor, upfront supply chain, development and financing costs. Does not include ongoing operating costs

Community Solar in Florida: Market Potential



Source: GTM Research Wood Mackenzie

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Community Solar in Michigan: Market Potential

Community solar in Michigan could be a significant boost for distributed generation in the state. With just over 100 MW of solar installed to date and few supportive statewide policies for solar, Michigan lags nationally in the deployment of distributed generation. In the current regulatory debate around the compensation for the little distributed solar that does exist, policymakers could also look to community solar as a critical resource for ensuring all customer segments can access local clean electricity.

Community Solar Market Potential in Michigan, 2030 Vision Scenarios

Total Addressable Market: **3.9 million customers**

Total Community Solar Capacity Operating: **1.4 GW to 2.3 GW**

Annual Electricity Generated: **1.5 TWh to 2.5 TWh**

- Share of State Electricity Consumption: **1.5% to 2.4%**

Subscribers Served: **177,000 to 288,000**

- Low- and Moderate-Income Households Supported: **92,000 to 176,000**

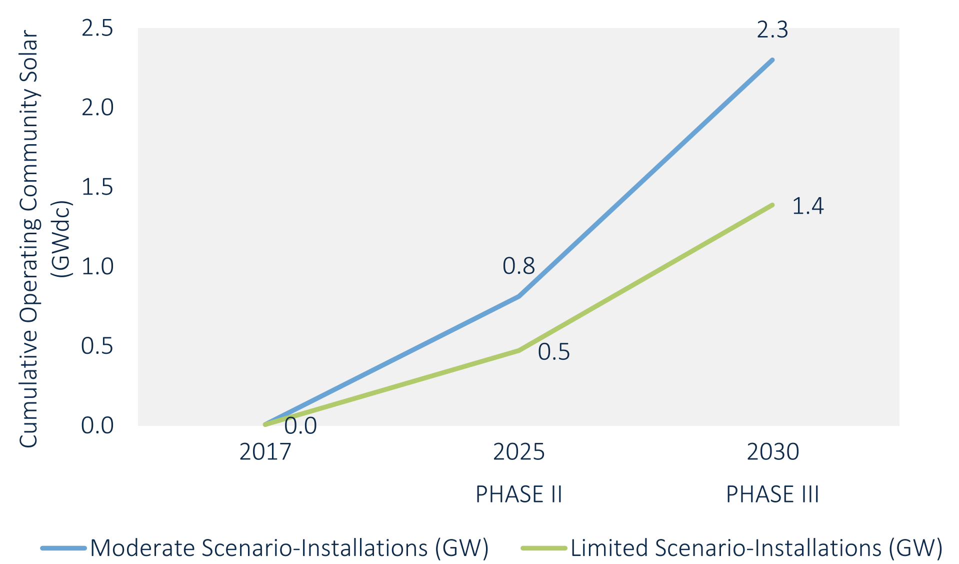
Cumulative Capital Invested*: **$2.0 billion to $3.0 billion**

Annual Spend on Operations, Leases and Taxes: **$21 million to $35 million**

Further Details on Michigan Market Potential

*Cumulative capital invested represents total initial costs to build community solar plants, including all installation materials, labor, upfront supply chain, development and financing costs. Does not include ongoing operating costs

Community Solar in Michigan: Market Potential



Source: GTM Research Wood Mackenzie

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Community Solar in New Jersey: Market Potential

New Jersey is in the beginning stages of incorporating community solar into its portfolio. A leader in distributed energy deployment, New Jersey recognizes the importance of setting strong solar policy. Robust design of pilots and sustained community solar programs would help residents and businesses thus far locked out of New Jersey's solar success. For example, by 2030, community solar could serve over 250,000 LMI households, including 25%-35% of all affordable housing tenants in the state.

Community Solar Market Potential in New Jersey, 2030 Vision Scenarios

Total Addressable Market: **3.6 million customers**

Total Community Solar Capacity Operating: **2.3 GW to 3.3 GW**

Annual Electricity Generated: **2.6 TWh to 3.6 TWh**

- Share of State Electricity Consumption: **3.3% to 4.5%**

Subscribers Served: **219,000 to 410,000**

- Low- and Moderate-Income Households Supported: **119,000 to 255,000**

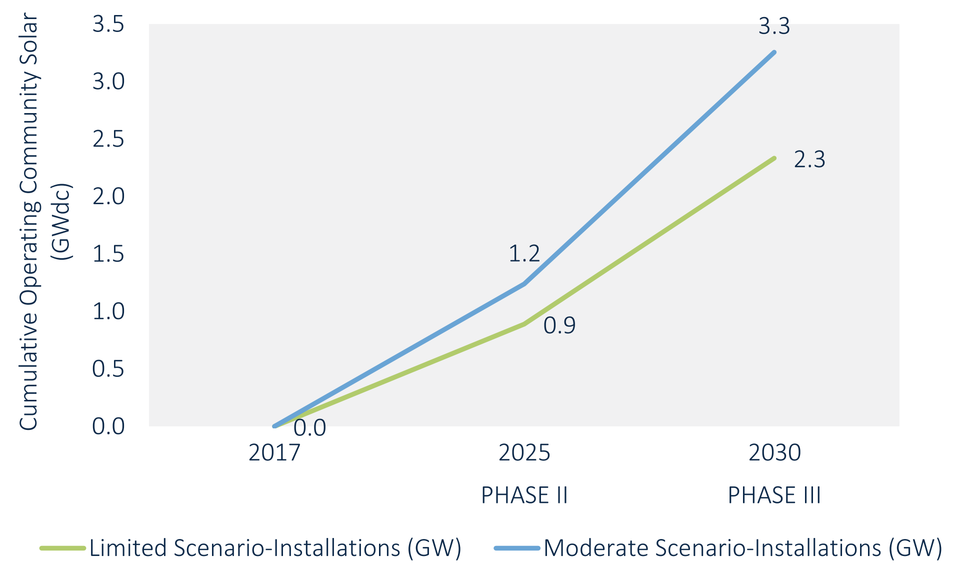
Cumulative Capital Invested*: **$2.8 billion to $4.9 billion**

Annual Spend on Operations, Leases and Taxes: **$47 million to $65 million**

Further Details on New Jersey Market Potential

*Cumulative capital invested represents total initial costs to build community solar plants, including all installation materials, labor, upfront supply chain, development and financing costs. Does not include ongoing operating costs

Community Solar in New Jersey: Market Potential



Source: GTM Research Wood Mackenzie

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Upfront Community Solar Investment in the Four States Could Top $24.3 billion by 2030

Community solar could add $1.5 billion to $2.0 billion in upfront capital investment per year in the four studied states combined through 2030. This represents private sector investment in the electricity infrastructure of the future.

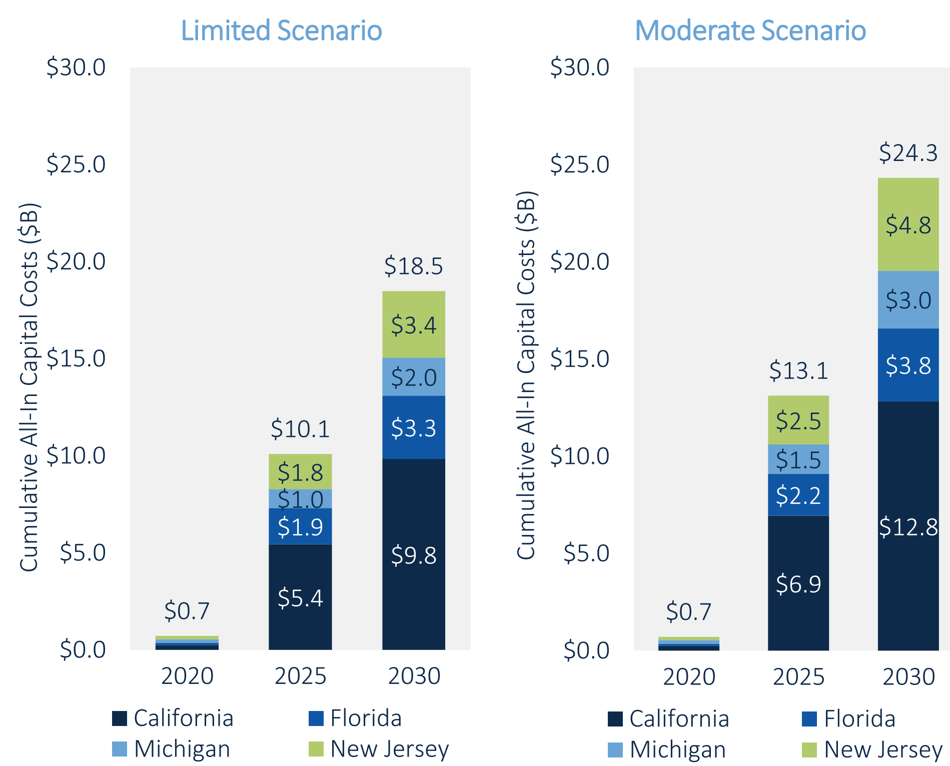
This estimate accounts for only capital expenditures for new solar installations and does not include payments from subscribers, nor ongoing costs such as land lease and property taxes.

Even in our low projection, over $18.5 billion ($1.5 billion per year) would be invested into community solar.

California leads the way, with $9.8 billion to $12.8 billion invested by 2030, triple the spend of Florida, the next highest ranked state.

Despite falling solar costs, Michigan's investment in community solar accelerates from $1.3 billion between 2020 and 2025 to $1.5 billion between 2025 and 2030.

Cumulative Community Solar Upfront Capital Expenditures



Source: GTM Research Wood Mackenzie

What If Every State Opened Its Doors to Community Solar?

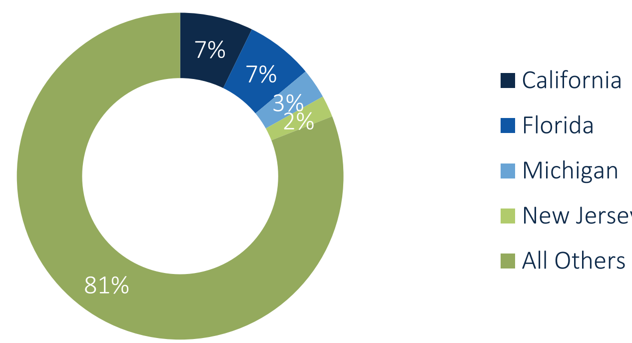
Contribution from community solar rises from a negligible share to as much as 3.1% of total energy consumption in the four states examined in the span of a decade.

The four states in focus represent one-fifth of all electricity sales nationally. Even the 19 states with current statewide community solar programs in place represent only 40% of total energy customers.

If over the next decade, every state were to adopt policies that similarly supported and valued community solar for an expanded array of customer, environmental, grid and social benefits, community solar could exceed 84 GW by the end of the next decade.

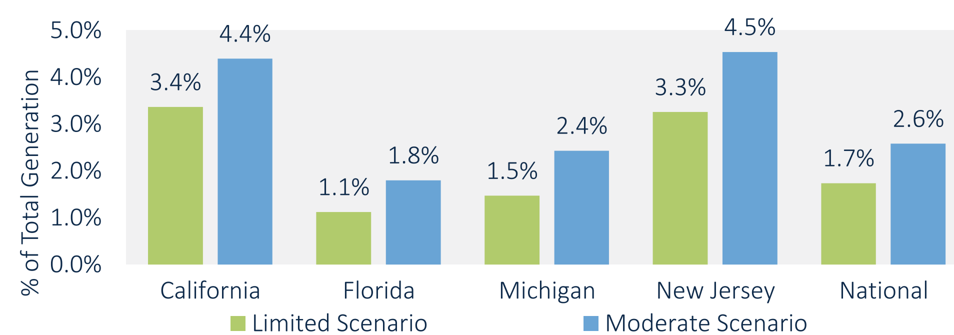
In other words, if all states were to see similar adoption rates as the four states examined (accounting for differences in state load and solar resource), community solar could supply 1.7%-2.6% of all electricity consumed in the U.S. by 2030.

State-Level Electricity Consumption as Share of National Total



Source: EIA

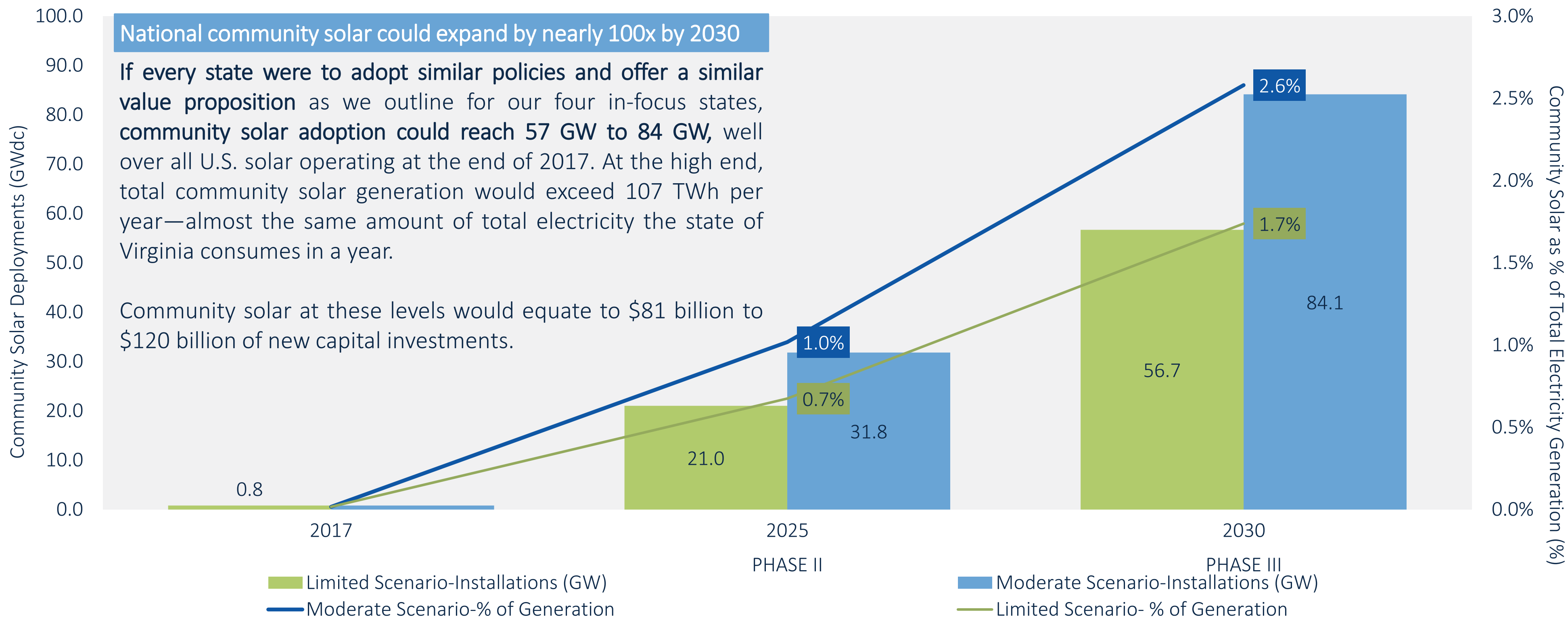
Forecasted Electricity Contribution From Community Solar by Scenario, 2030



Source: GTM Research Wood Mackenzie

Community Solar Could Reach Over 2.6% of U.S. Electricity by 2030 Equaling 57 GW to 84 GW

National Community Solar Installations by Scenario (Assuming All States Adopt Forward-Looking Community Solar Policies)



National community solar could expand by nearly 100x by 2030

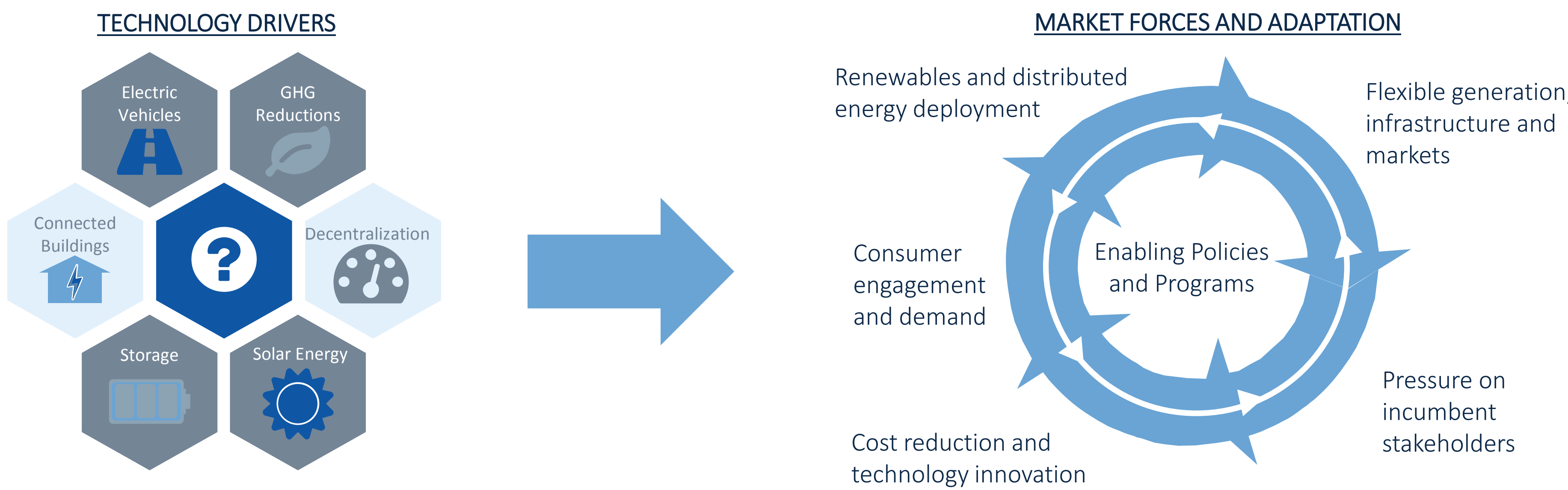
If every state were to adopt similar policies and offer a similar value proposition as we outline for our four in-focus states, **community solar adoption could reach 57 GW to 84 GW,** well over all U.S. solar operating at the end of 2017. At the high end, total community solar generation would exceed 107 TWh per year—almost the same amount of total electricity the state of Virginia consumes in a year.

Community solar at these levels would equate to $81 billion to $120 billion of new capital investments.

Source: GTM Research Wood Mackenzie

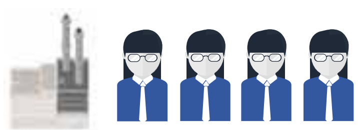
The Next Decade: The Power Sector is Changing – and Invites Community Solar Innovation

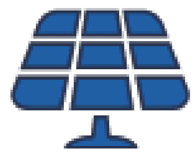
Community solar can be a foundational pillar in the ongoing and future power market transformation — one driven by more engaged customers that demand decentralized and decarbonized energy. In this future, distributed solar — including community solar — becomes a platform for a holistic clean, local, reliable and flexible energy service that opens up opportunities for flexible investment and business models in combination with other onsite and co-located distributed energy resources.



Embracing New Distributed Energy Technology Will Increase the Value of Community Solar

Community solar facilities will evolve, both as a virtual interactive energy platform and as a physical energy resource.

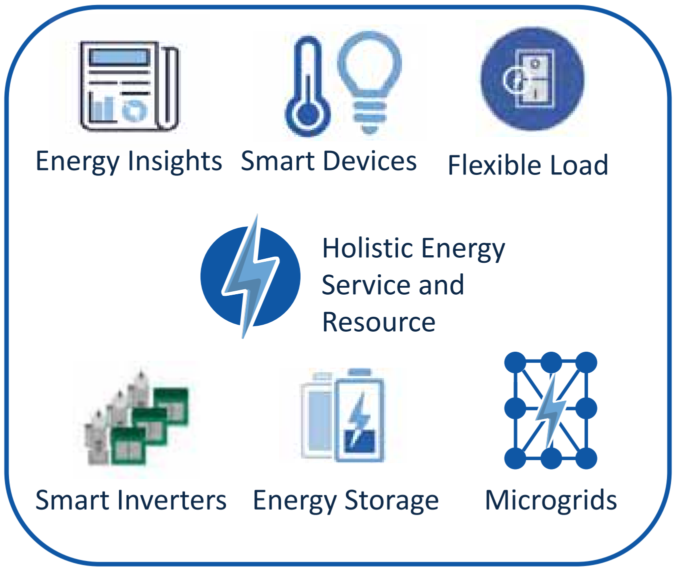




Community Solar Subscribers

Community solar operators will need to interact with subscribers beyond a bill, forming a holistic energy service.

Subscribers will receive tailored insights into their energy use, resulting in adoption of new devices and services that further increases the efficiency and lowers the cost of their energy use.



Utilities and the Electricity Grid

Community solar will create value beyond the energy generated — initially from offsetting new generation capacity, transmission and distribution assets, and longer term, in the form of flexibility and resiliency as community solar facilities are co-located with other distributed energy hardware.

A Market Transformation in Three Phases

Transformative growth of community solar will not happen overnight. Improvements in program design and implementation, financing solutions, and customer-focused offerings can expand solar access to all customer types. Proper valuation methodologies are critical to support community solar in a changing market landscape, and inclusive policies are essential to ensure equitable access for underserved communities

We envision a path through three phases: **1) Market Emergence, 2) Market Transition** and **3) Market Maturity**

PHASE I: Market Emergence

Community solar is still in pilot or early stages, driven primarily by early programs or virtual net metering programs with shifting compensation mechanisms. Community solar is proving itself to regulators, customers and investors.

PHASE II: Market Transition

Lessons from Phase I are incorporated. Community solar benefits from cost reductions through product innovations, streamlined program administration and investor trust. Improved program design and financing solutions encourage and increase LMI participation. Regulators, utilities and community solar stakeholders negotiate the benefits and the compensation for community solar.

PHASE III: Market Maturity

Community solar is an attractive offering to customers that delivers recognized benefits in the forms of cost savings, cost visibility, environmental attributes, grid value, local societal and economic support, and energy resiliency.

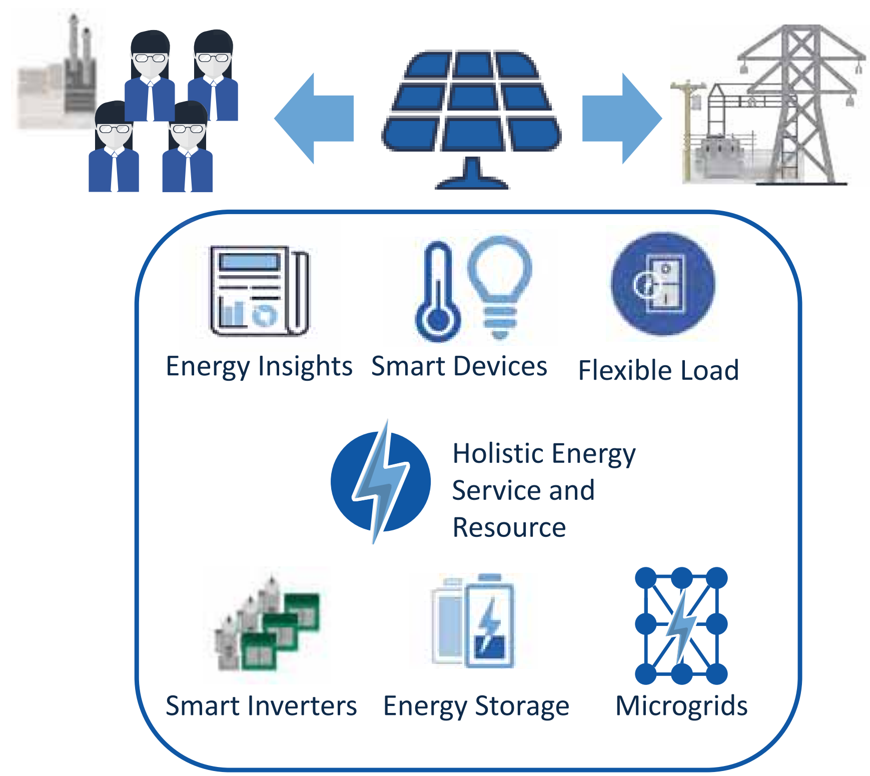
Community Solar at Scale: Looking Beyond 2030

Our 2030 Vision Represents an Early Milestone

Even though it is already supplying millions of new adopters of solar, community solar is just starting its journey as a mainstream energy source. Even under our most ambitious adoption forecast for 2030, community solar serves just 8.8 million out of the 75 million to 113 million households and businesses that lack access to onsite solar.

As community solar operators continue to innovate on the service offering by packaging energy insights and smart energy devices for their subscribers and incorporating physical grid assets like smart inverters and energy storage into their facilities, community solar will transition into a holistic energy service and resource.

As policymakers, utilities and the solar industry continue to deliberate the evolution of electricity rates and energy value, community solar can play a central role in providing benefits for all parties: predictable cost savings for consumers, financial value for operators, grid resilience, local environmental benefits and economic development — as long as policy and innovation evolve to meet these goals.



2. Introducing the Vision for Community Solar

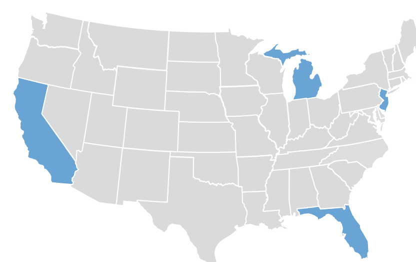
Realizing the Value of Community Solar

A Vision for Community Solar: Study Overview

We establish a vision for a market where community solar is a mainstream option for consumers to choose and control their own energy generation — especially for those lacking access to traditional solar options, such as renters and the low- and moderate-income community.

This Vision for Community Solar:

- Outlines Benefits of Community Solar and Subscriber Preferences
- Addresses Key Bottlenecks to the Expansion of Community Solar
- Provides Strategies to Enhance Inclusivity of Low- and Moderate-Income Populations
- Walks through National Market Potential and Forecasts for Community Solar along with Deep Dives in 4 States:
  - California
  - Florida
  - Michigan
  - New Jersey
- Presents the National Impacts of Community Solar Market Transformation



Community Solar Makes Solar an Option for Everyone with an Electric Bill

U.S. consumers want solar…

The number of solar energy systems purchased by U.S. homeowners and businesses has grown tenfold since 2010. By the end of 2018, nearly 2 million homeowners and businesses will produce their own solar energy.

…and solar is getting more affordable

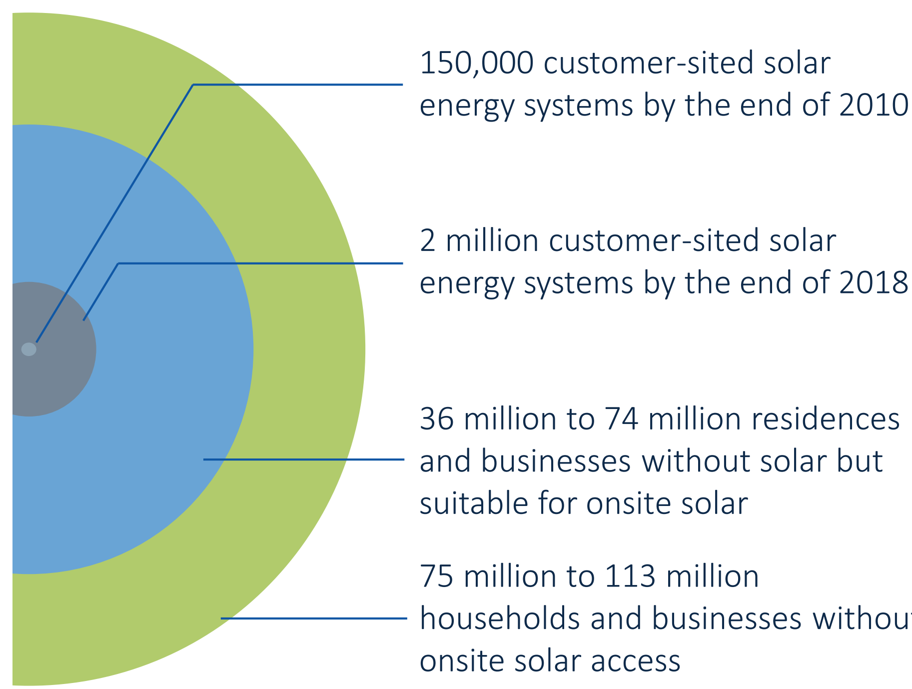
The price of rooftop solar has fallen by 40% in the past five years and currently beats the average retail price of electricity in 27 states and Washington, D.C.

…but access to solar is limited.

Between 50% and 75% of U.S. consumers cannot access traditional rooftop solar, either because they do not own their roof or due to technical restrictions. Community solar gives all 151 million electricity customers in the U.S. an opportunity to directly participate in solar.

Community solar gives all customers the ability to choose local clean electricity that can support local economic development, resiliency and healthier communities.

Community Solar Can Reach All Potential U.S. Customers



Source: GTM Research Wood Mackenzie, GTM Research/SEIA, NREL, EIA, U.S. Census

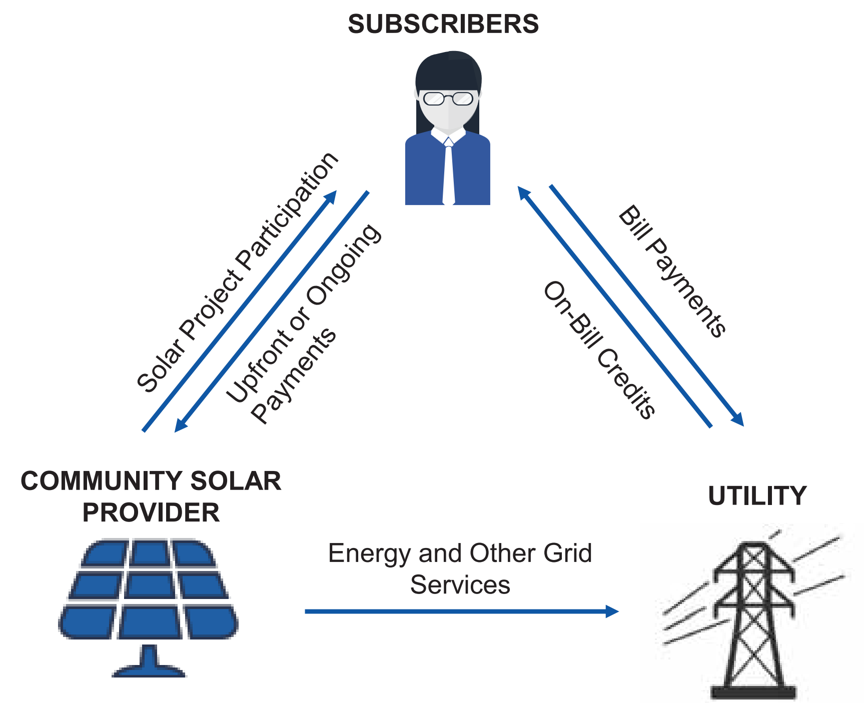
Defining Community Solar

Community solar – also called shared solar or solar gardens – refers to local solar facilities shared by multiple subscribers that receive credit on their electricity bills for their share of power produced.

Over the years, many projects have been labeled community solar, but we define **community solar** as a solar project with **multiple subscribers that receive on bill benefits directly attributable to the community solar project**.

- Subscribers must be credited with the benefits of community solar on their electric utility bills, either in the form of a monetary or energy (kWh) credit
- Subscribers must be tied to a specific solar project of which they are direct subscriber, not generic renewable certificates

The Community Solar Model



Source: GTM Research Wood Mackenzie

Community Solar Extends Key Benefits of Distributed Solar to a Broader Set of Consumers

Community solar expands the important benefits of distributed solar to a much broader set of consumers, while also bringing unique solutions to the physical, financing and equity barriers of on-site solar and retail electricity.

Community solar is an energy source that ultimately provides:

FINANCIAL SECURITY Community solar can provide **energy bill savings** as well as **predictable and stable** long-term energy costs	ENERGY BILL SAVINGS	STABLE AND PREDICTABLE BILLS	PLATFORM FOR ADDITIONAL SERVICES
ALIGNMENT WITH VALUES Community solar gives more customers the **freedom and choice** to support energy sources and providers that align with their social and environmental values	BUY LOCAL, CLEAN ENERGY	CONTROL OF ENERGY SUPPLY	SUPPORT TRUSTED PARTIES
LOCAL BENEFITS Community solar encourages new **local economic development** near the customer, including support to low-income residents and other vulnerable and disadvantaged communities	LOCAL ECONOMIC INVESTMENT	SUPPORT VULNERABLE COMMUNITES	PROVIDE LOCAL GRID RESILIENCY

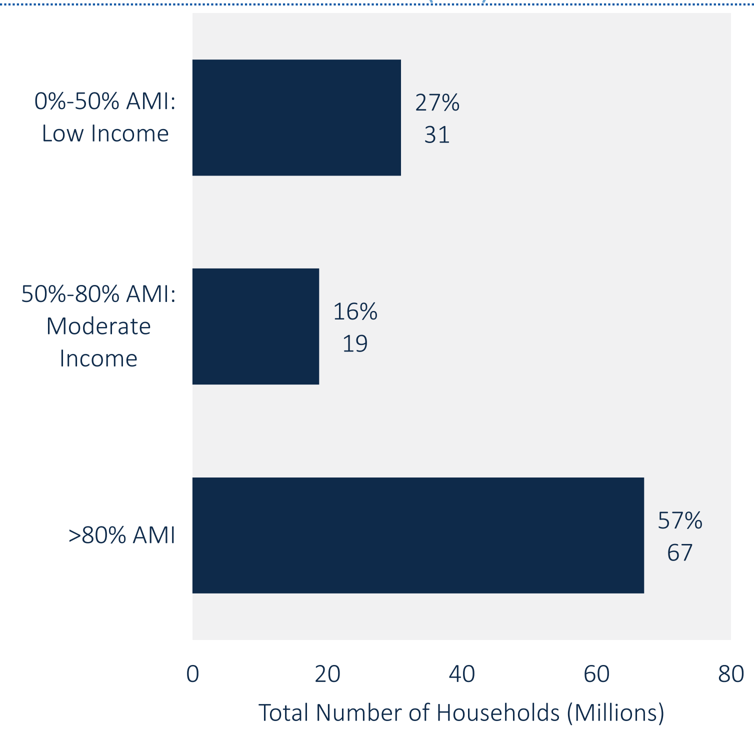
Community Solar Can Empower Communities Most in Need

50 million reasons why community solar needs to tap into the low-to-moderate income customer segment

Why community solar is the key to unlocking 50 million low-to-moderate income (LMI) households' access to clean, affordable energy solutions…

- **The LMI subscriber opportunity is massive, accounting for approximately 43% of U.S. households.** Of that total, there are 31 million low-income households, 19 million moderate-income households, and 5.78 million affordable housing properties across the U.S. that would benefit from cost-saving community solar solutions.
- Community solar provides the **flexibility to deliver clean energy access to all LMI customers, including renters and multifamily housing** – of which LMI households are more likely to occupy.
- **Community solar also offers significant benefits to low-income customers**, including opportunity for bill savings and energy burden reduction, targeted, flexible value propositions tailored to LMI customers' unique needs, and local economic opportunity to drive the clean energy transition.
- At the same time, the LMI subscriber opportunity remains untapped, in large part due to higher costs to acquire LMI subscribers and limited access to capital for community solar projects involving LMI subscribers.
- But with the right combination of **policy solutions, incentives, consumer protections, business model innovations, financing and programmatic support**, there's an opportunity for community solar to play a critical role in creating an equitable clean energy future.
    - Targeted policy, financing and subscriber management solutions can reduce the perceived risk of serving LMI households and deliver significant benefits to LMI customers.

Share of U.S. Households:
Low-to-Moderate Income (LMI) vs. Non-LMI



Source: NREL, 2018

An Equitable Transition to Serve Communities of Color and Environmental Justice Communities

Communities of color and environmental justice communities must also have equitable access to clean energy solutions

- LMI households are not the only customer segment that must proactively be included in solar markets moving forward. This work must also extend to communities of color and environmental justice communities. **Community solar can be used as a tool to target benefits to communities who have historically been at the front lines of environmental pollution and negative impacts from traditional energy generation.**
    - Fossil fuel power has disproportionately impacted the health and well-being of low-income communities, particularly communities of color and indigenous communities. Emissions from power plants sited in these communities contribute to high rates of asthma and cancer, and the presence of heavy industry contributes to a cycle of poverty and public disinvestment in neighborhoods that can least afford it.
    - Approximately 68% of African Americans live within 30 miles of a coal-fired power plant and nearly 40% of communities of color breathe polluted air. Meanwhile, environmental justice communities are disproportionately affected by public health effects of traditional generation.

Policymakers can target the benefits of community solar to communities of color and environmental justice communities through a number of strategies. Support can include program carve outs, job training programs, project ownership, siting preferences and incentives specifically focused on communities who have been disproportionately impacted by the electric system to date.

- Such solutions would not only provide **workforce development opportunities**, but also enable legislators and regulators to better quantify and measure **public health benefits** of community solar that displaces the need for fossil fuel generation.
- This report acknowledges that environmental justice communities and communities of color are critical to serve in the nation's transition to a low-carbon electricity system. Analysis of community solar's addressable market focuses on low and moderate income households, affordable housing owners and affordable housing tenants.

Source: Low-Income Solar Policy Guide, 2018

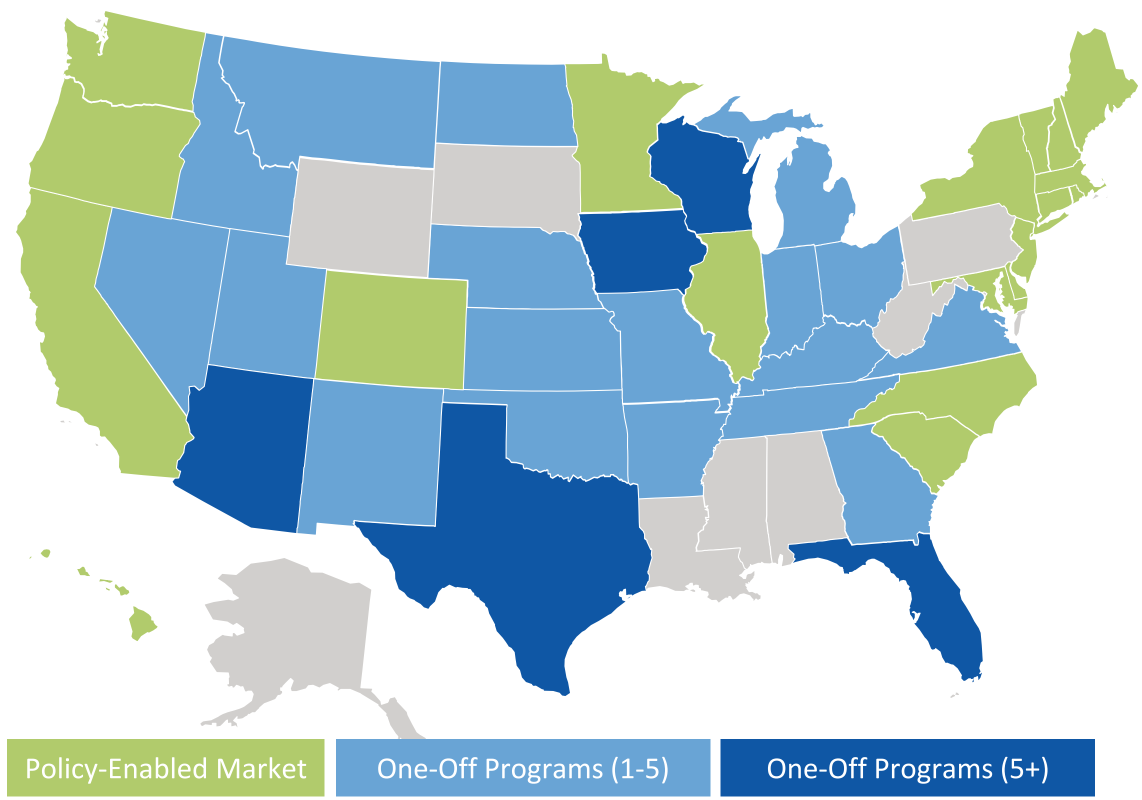
Today: A Patchwork of State-Level Policies and Utility Pilots Drive Community Solar

42 states and Washington, D.C. currently have community solar projects, but only 19 states and D.C. have statewide programs that provide an early opportunity for community solar to scale.

Voluntary utility-led community solar programs—including those initiated by investor-owned utilities, municipal utilities and rural cooperatives—provide limited access in states without state-wide policy.

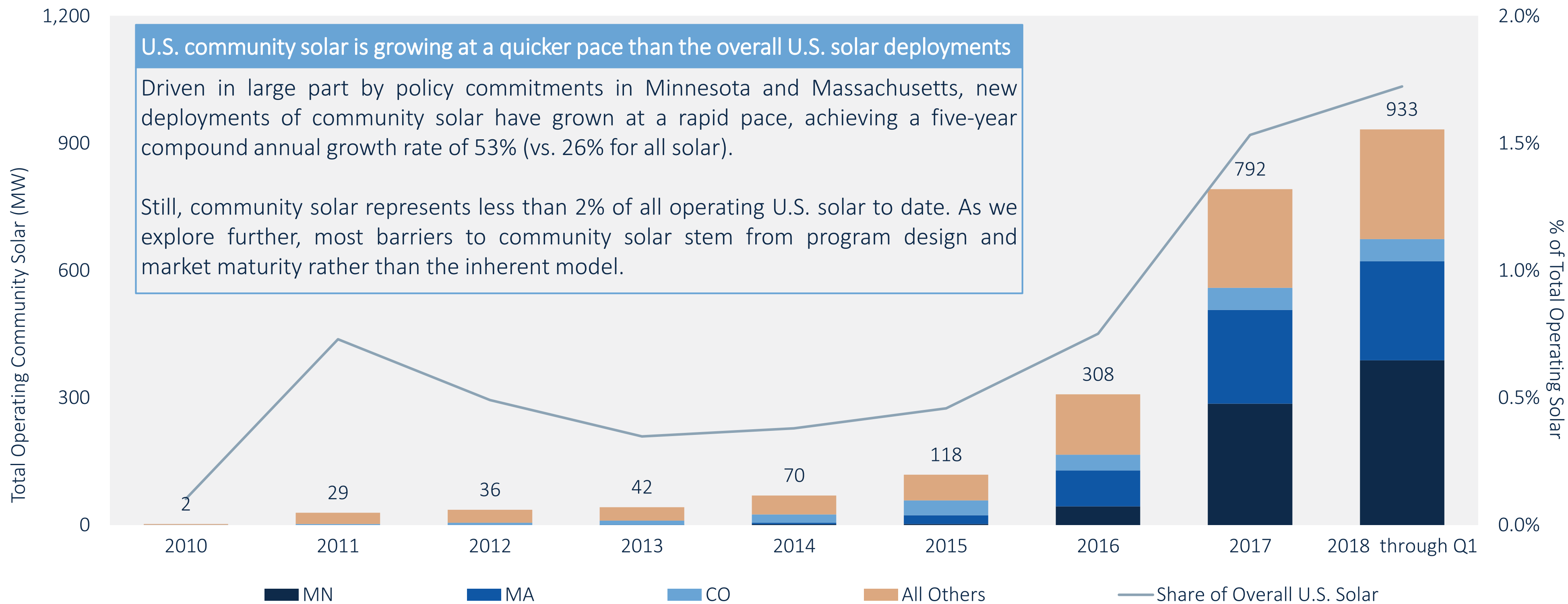
Community solar is both enabled and encumbered by individual program rules and regulations on who can participate and how community solar projects and subscribers are compensated.

Although nearly every state has a community solar project, policy-enabled markets account for 71% of all currently operating community solar capacity.



U.S. Community Solar Nears 1 GW of Total Capacity Operating Nationwide

Cumulative U.S. Community Solar Installed Capacity by State



U.S. community solar is growing at a quicker pace than the overall U.S. solar deployments

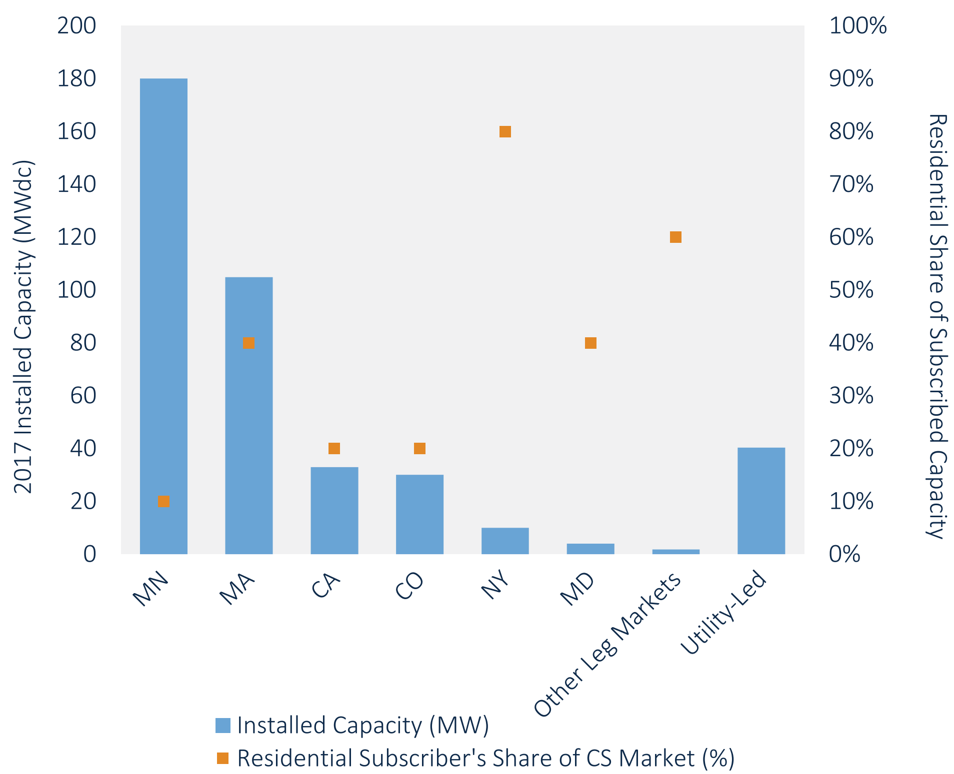
Driven in large part by policy commitments in Minnesota and Massachusetts, new deployments of community solar have grown at a rapid pace, achieving a five-year compound annual growth rate of 53% (vs. 26% for all solar).

Still, community solar represents less than 2% of all operating U.S. solar to date. As we explore further, most barriers to community solar stem from program design and market maturity rather than the inherent model.

Source: GTM Research Wood Mackenzie

Community Solar Subscriber Mixes Vary Between Markets

Estimated Subscriber Mix of Community Solar by Subscription Size, 2017



Source: GTM Research Wood Mackenzie

Non-residential (e.g., commercial, nonprofits, government) entities made up 73% of all community solar subscribed capacity in 2017

- Program design and local rates strongly influence the participation mix. For example, the high national non-residential mix is in large part driven by Minnesota's large volume and policy that results in high participation of commercial entities. **Excluding Minnesota, the national residential subscription share rises to 36%.**
- All other variables held equal, non-residential subscribers tend to be more attractive to community solar providers due to creditworthiness and large subscription size. Policymakers seeking subscriber diversity must craft a balance between supporting a mix and being overly prescriptive.
- Expect increasing residential participation in 2018 as new programs come online and policymakers realize the importance of increasing residential participation.

Because program design and subscription features can strongly influence subscriber mix, we explore motivations of various subsets of residential and non-residential subscribers so that programs can more aptly address consumer needs.

Key Solutions to Unlock Community Solar's Potential

- Enabling policy to open viable new markets
  - Bill introduction & passage of ***legislation to open the community solar market*** in states where it is not yet enabled.
  - Program implementation that provides ***stable, fair rates and market participation structures*** that recognize and compensate community solar facilities for the full range of their grid, environmental and societal benefits.

- Expanding existing programs to support sustainable and scalable markets

- **Improvements in program design to support meaningful participation** by underserved communities with *the* ***inclusion of low- and moderate-income (LMI) communities*** in mind, recognizing the societal benefits and overall market opportunity that full LMI participation represents

- **Product innovation by community solar providers and financiers** around costs, technology and the services offered

Resources to guide a sustainable and scalable community solar future:

1. Shared Renewables Guiding Principles (Interstate Renewable Energy Council):

http://www.irecusa.org/publications/guiding-principles-for-shared-renewable-energy-programs/

2. Low Income Solar Policy Guide – Community Solar:

http://www.lowincomesolar.org/best-practices/community-solar/

3. Policy Decision Matrix and Model Legislation (Coalition for Community Solar Access):

http://www.communitysolaraccess.org/resources/

4. Smart Electric Power Alliance Community Solar Program Designs 2018:

https://sepapower.org/resource/community-solar-program-designs-2018-version/

Introducing the Vision for Community Solar

What Subscribers Want

Motivations for Boosting Distributed Solar Translate to Community Solar

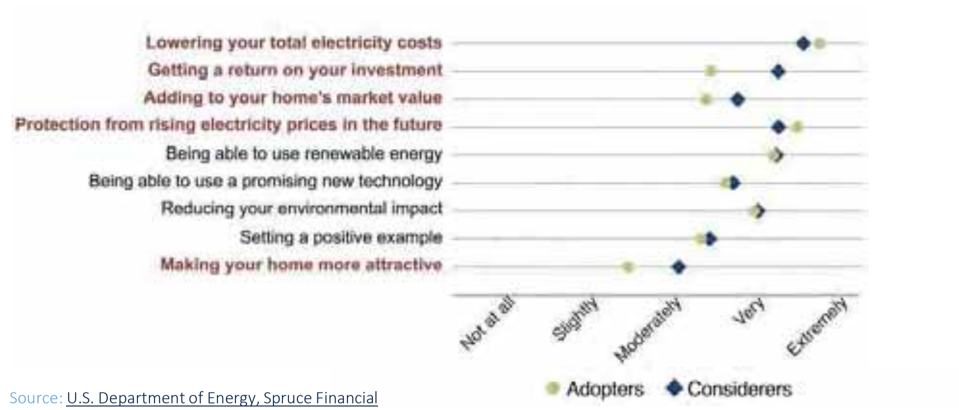
Community solar offers several benefits of distributed solar generation, including:

- Electricity cost savings and predictable long-term energy costs
- Environmental benefits from clean energy, including healthier communities and climate change mitigation
- Locally produced generation

In addition, community solar mitigates some key customer concerns about rooftop solar:

- How much maintenance will be required
- Risk of damaging the roof during installation and operation
- Aesthetics, for those who do not prefer the look of rooftop solar
- Reduces the steps and potentially lag between customer sign up and receiving solar benefits
- Costs, as greater economies of scale can help to deliver a lower cost of solar energy

Motivations for Rooftop Solar by Adopters and Considerers



Source: U.S. Department of Energy, Spruce Financial

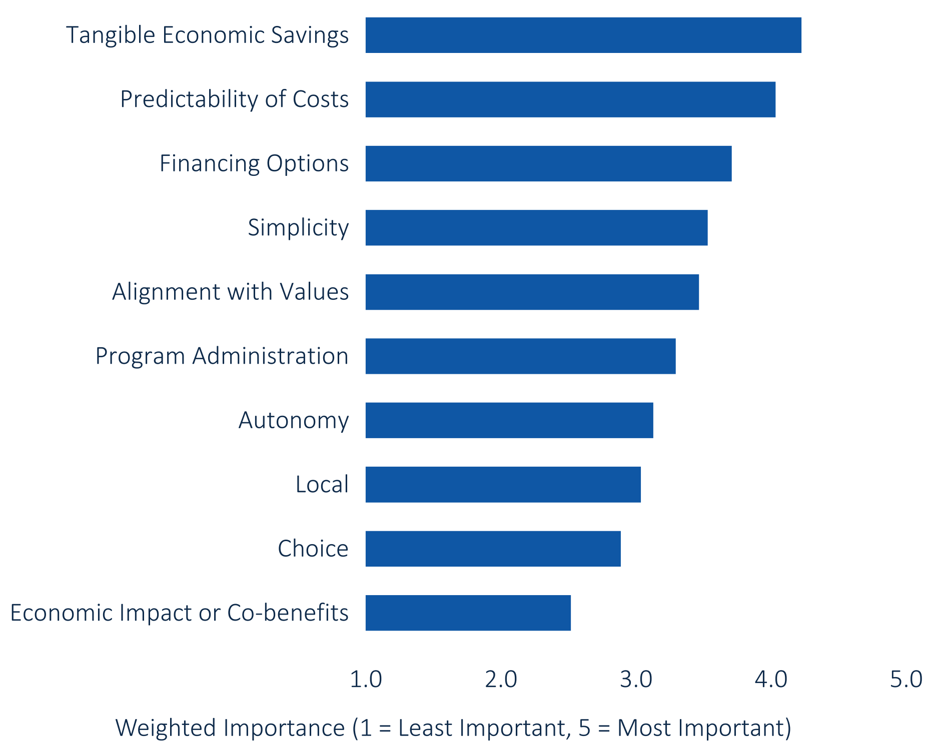
Economic motivations dominate decision-making, but other motivators should not be discounted

- A Department of Energy SEEDS program survey of 3,600 households found that solar economics were the primary motivating factors, but also that reduction of environmental impacts and use of renewables ranked highly.

GTM Research interviews with developers and customers reveal a similar set of economic and environmental motivations for community solar subscriptions

Community Solar Subscribers Value a Breadth of Financial and Non-Financial Benefits

Average Score to "Rate the Importance of the Following Attributes to You / Customer Constituencies You Work With"—All Subscriber Segments



Source: GTM Research Wood Mackenzie

From a survey of over two dozen community solar operators and subscriber organizations, we find that:

Community solar economics are important…

Subscribers overwhelmingly chose community solar due to financial options and benefits:

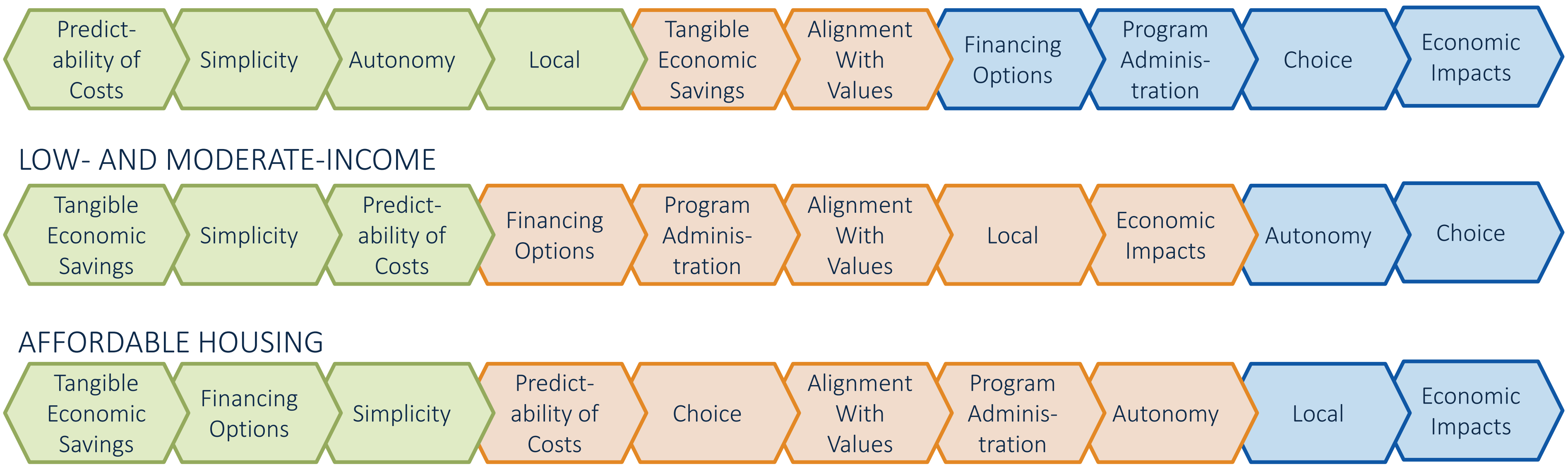
- Over 60% of responses ranked "tangible economic savings" as the most important factor of a community solar subscription
- The second and third most important factors were, respectively, a predictable cost of electricity and compelling finance options (e.g., zero-down leases and pay-as-you-go models)

…but non-financial benefits need to be included

- Simplicity is the highest rated non-financial benefit identified, referencing an easy-to-subscribe and intuitive process to procure solar energy
- Subscribers also care about *who* is administering the program, meaning trust is important. But that can mean local organizations, private developers or a local utility, depending on the party.
- While subscribers may not universally value economic co-benefits highly (e.g., workforce development), other stakeholders, such as community leaders, policymakers and regulators, will.

Residential Customer Segments Universally Value the Simplicity of Community Solar

TYPICAL RESIDENTIAL

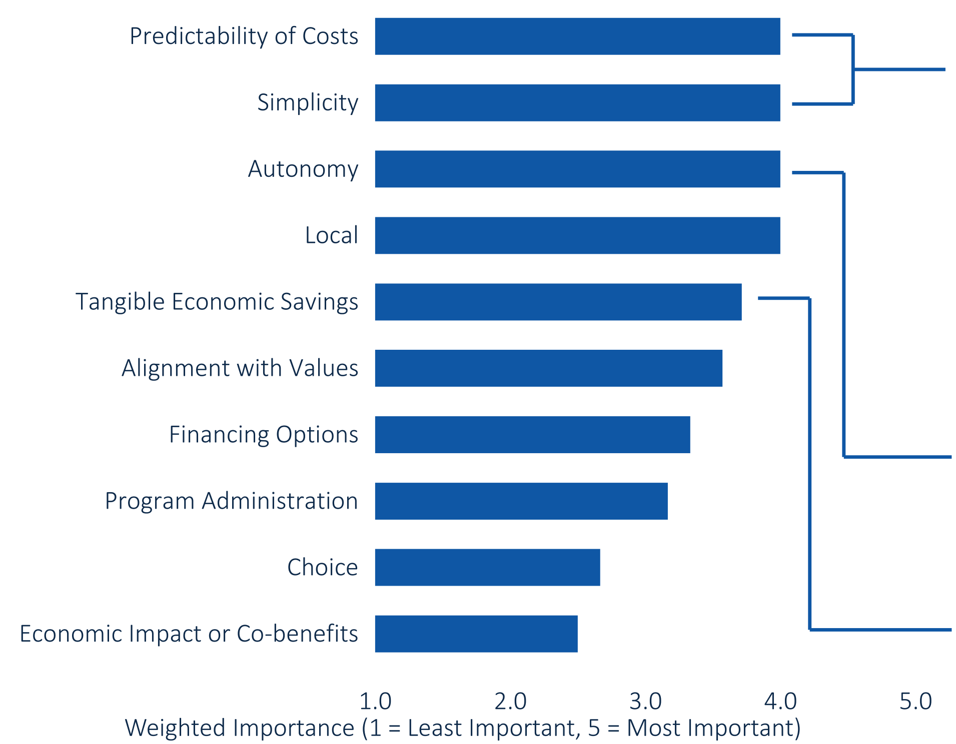


Unsurprisingly, economic and financial benefits bubble to the top — tangible savings are key for LMI customers and affordable housing operators, while predictability is key for traditional residential subscribers. Simplicity is universally strongly valued, as most residential customers lack tools and patience to digest complex energy concepts.

LMI subscribers require greater savings, but less-tangible community solar benefits such as alignment with personal values and local impacts are still rated as important and shouldn't be ignored.

Residential Subscribers Are Looking for Simplicity and Predictability of Costs

Average Score to "Rate the Importance of the Following Attributes to Potential Residential Customers"



Source: GTM Research Wood Mackenzie

Residential subscribers are primarily looking for predictable energy costs where the benefits and terms are simple to understand. Interviews indicate that:

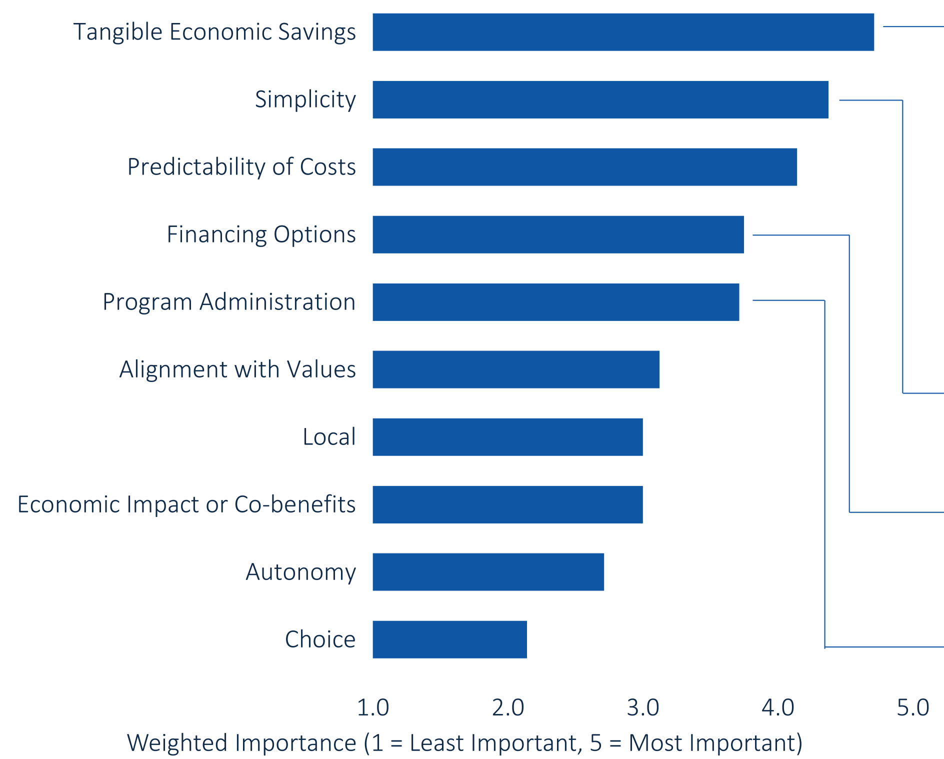
- Rate escalators and double bills (one from utility and another from community solar operator) result in more difficult communication around savings
- Short-term contracts may be needed to attract renters, who may not be willing to sign up for 15- to 25-year contracts that include exit fees

Residential subscribers are looking for more independence in their supply and consumption of energy — something that a mature community solar subscription offering can increasingly provide

While not the primary motivator, residential subscribers still want savings on their energy bills. Community solar operators and lead generators indicate that 5%-15% savings is typically considered desirable

Low- and Moderate-Income Subscribers Require Significant Cost Savings

Average Score to "Rate the Importance of the Following Attributes to Potential Low- and Moderate-Income Customers / Constituents You Work With"



Source: GTM Research Wood Mackenzie

Low- and moderate-income subscribers put top priority on tangible economic savings from community solar, and given their relatively lower energy use, often need higher relative discounts on their energy bill—sometimes at least 20%-50%--to see the same dollar savings. In order to decrease the cost of a subscription, community solar operators could build an engagement platform that provides subscribers with:

- Energy efficiency services that reduce their energy costs
- Controllable energy devices that allow community solar operators and energy aggregators to optimize subscribers' energy use for various retail rate structures and future aggregated grid services programs

Streamlined Billing: Additional bills are a significant barrier for low-income customers. Billing needs to be as streamlined as possible, for example, by being integrated into a single platform or on-bill (per recommendation on Slide 63), or by allowing benefits to be transferred through an intermediary purchaser or service provider.

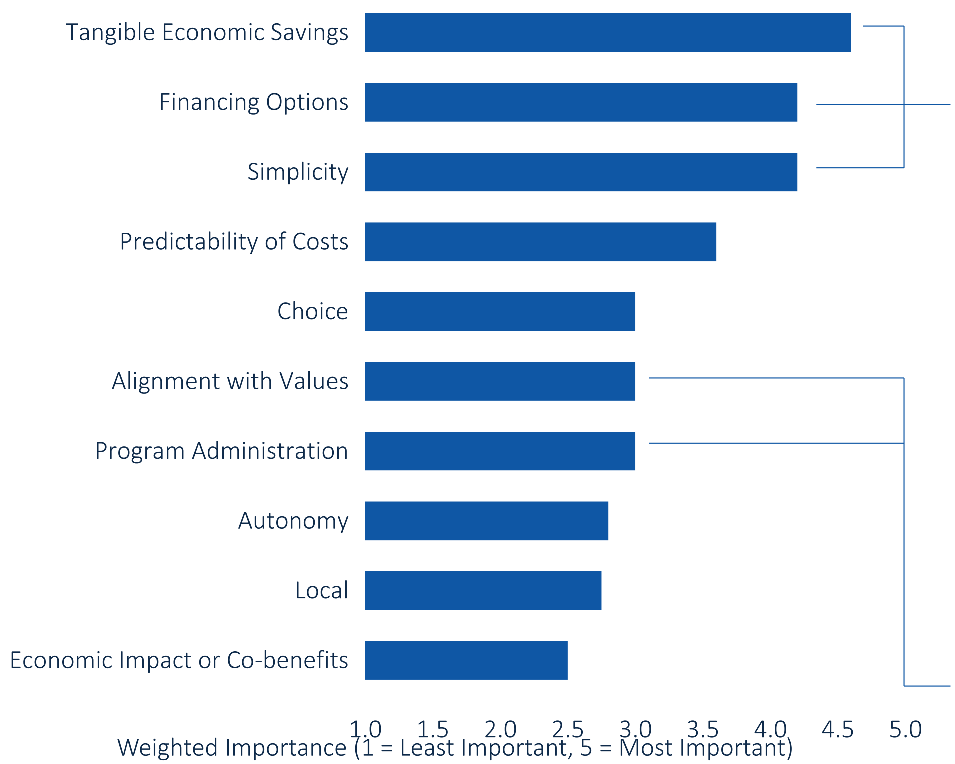
LMI subscribers typically cannot afford subscriptions with upfront payments

Program administration is an important component for low-income subscribers as trust can be a major issue. Many representatives of LMI subscribers indicated that these customers often look at community solar as being "too good to be true."

Community solar operators will need to work through local organizations. Programs can be designed with targeted market education in mind.

Affordable Housing Operators Require Clear Savings and Simplicity

Average Score to "Rate the Importance of the Following Attributes to Potential Affordable Housing Owners / Constituents You Work With"



Source: GTM Research Wood Mackenzie

Economic savings and financial components rise as the top motivators for affordable housing operators.

Savings are key, as affordable housing operators are looking to lower operating costs as much as possible. From GTM Research interviews, operators are often looking for energy bill discounts of 20% or more.

In contrast with non-residential subscribers, simplicity is important for affordable housing representatives who often have fewer resources and more pressing priorities than energy costs.

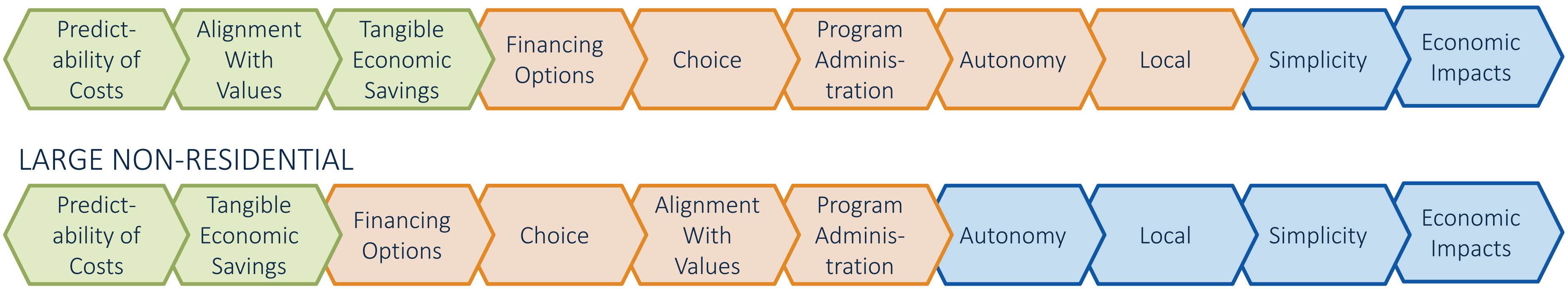
Some affordable housing operators have been advised against locking into long-term energy contracts, creating an impetus for short-term contracts or significant market education and assurances of long-term savings.

Property managers are looking for organizations they can trust and with similar goals of supporting the LMI community.

Non-Residential Customers Are Looking for Savings and Choice

SMALL NON-RESIDENTIAL

LARGE NON-RESIDENTIAL

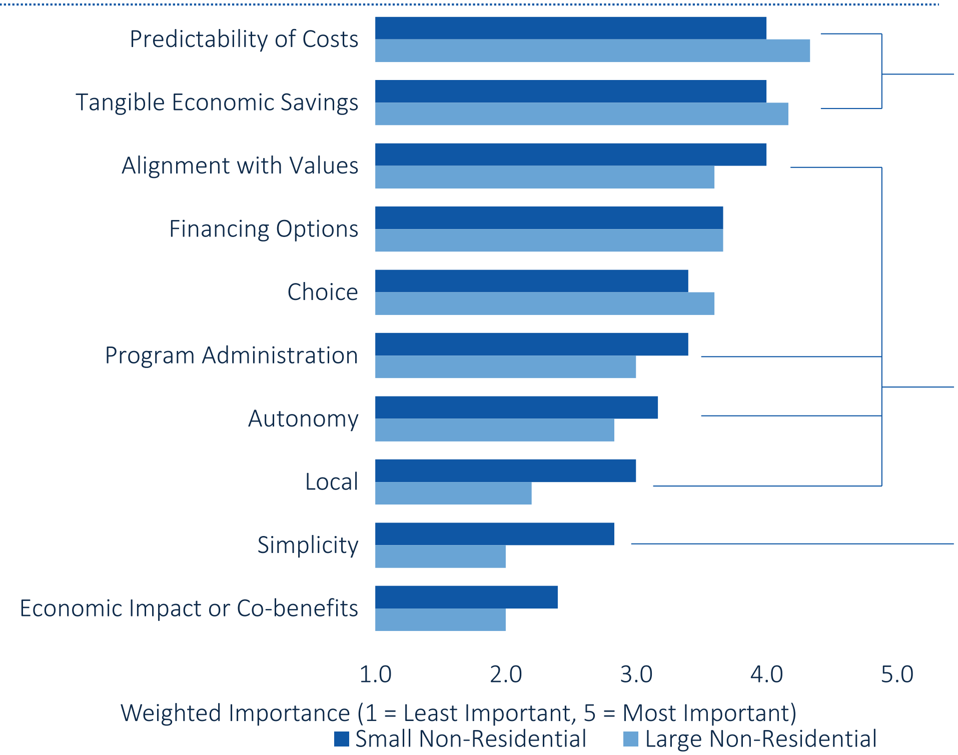


Like traditional residential subscribers, predictability around costs is the most important community solar benefit for non-residential subscribers (e.g., commercial, industrial, government and nonprofit).

In contrast with residential subscribers, non-residential customers are comfortable with complexity — typically because there are larger resources and economic incentives to spend time understanding and addressing energy costs.

Non-Residential Subscribers Are Focused on Economics and Less Sensitive to Complexity

Average Score to "Rate the Importance of the Following Attributes to Potential Non-Residential Customers You Work With"



Source: GTM Research Wood Mackenzie

Motivations for community solar subscriptions generally match between small and large non-residential subscribers, with predictability of energy bills and savings the two highest-rated items.

Generally 10%-15% savings are required to attract commercial and non-residential customers. While these are similar to savings targets for residential subscribers, commercial and industrial electricity rates tend to be significantly lower than residential rates. This necessitates a lower subscription price to achieve the same discount.

Non-residential subscribers, especially smaller entities, still strongly value intangible benefits, such as alignment with values (e.g., meeting corporate sustainability and social responsibility goals) and autonomy.

Non-residential customers tend to be less sensitive to complex energy services and comfortable with long-term contracts, rate escalators and termination fees. In combination with volume purchasing, this reduces the cost of acquiring non-residential subscribers. Large organizations may also have more resources directed toward energy procurement, further decreasing the importance of a simple service to large non-residential customer.

Introducing the Vision for Community Solar

The Potential Evolution of Community Solar

Community Solar Can Be Further Improved to Expand Its Availability and Reach

Subscription Cost and Subscriber Value

- Maximize economies of scale and reduce customer acquisition costs to reach subscribers’ target savings and create competitive offerings compared to alternative energy sources
- Package with other devices to maintain and increase subscriber and societal value as energy sector changes
- Ensure regulations around compensation are stable and predictable over the long term

Simplicity, Availability, Access and Transparency

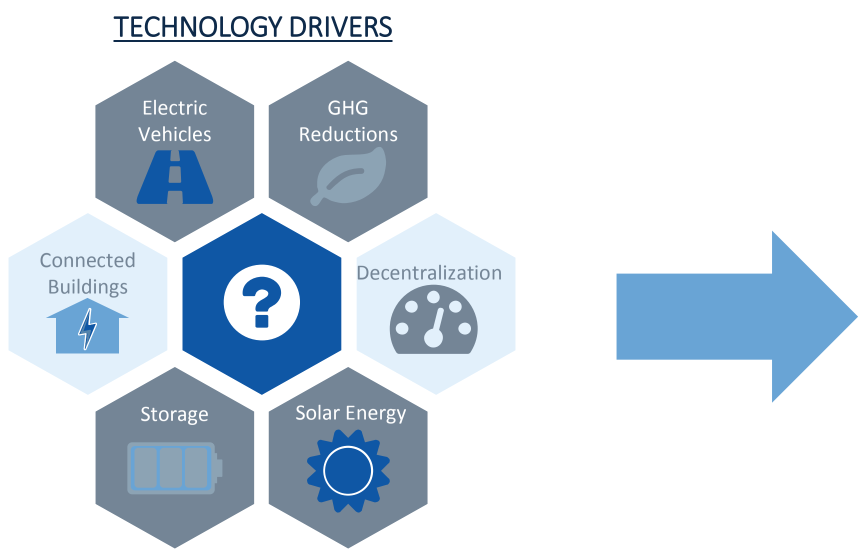
- Focus on streamlining project and subscriber qualification requirements and ease of processing subscriber changes
- Ensure accurate, timely bill crediting and ease of accessing necessary subscriber information
- Reduce contract lengths, escalators, exit fees and hard credit checks that reduce subscriber qualification and interest
- Create platforms that allow subscribers and operators to quickly assess net energy and bill savings (e.g., via a single bill)

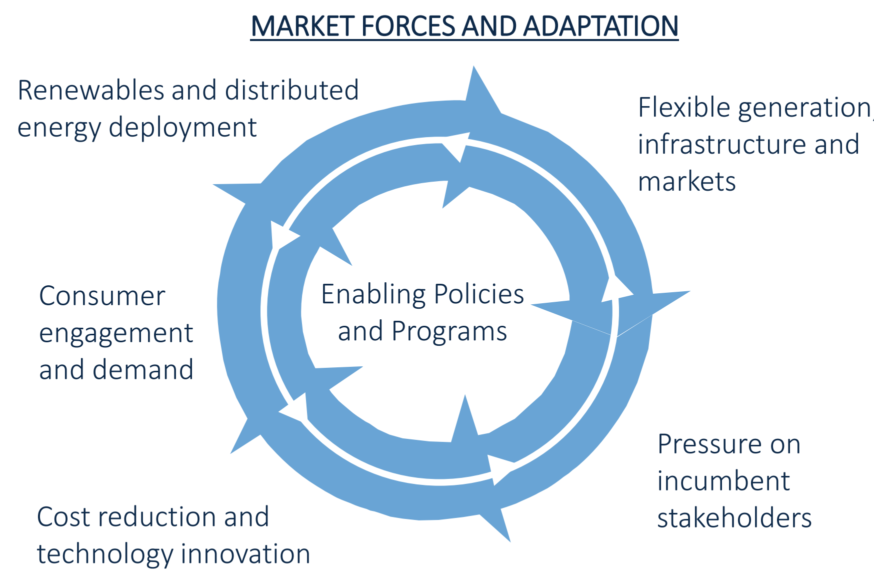
Local Investment and Resilience

- Prioritize community influence via direct engagement with potential subscribers and local organizations
- Package with co-located distributed energy storage and microgrids to provide local energy resilience
- Increase economic support for local affordable housing and low- and moderate-income households
- Target local workforce for training and employment

The Next Decade: The Power Sector is Changing – and Invites Community Solar Innovation

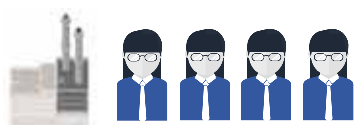
Community solar can be a foundational pillar in the ongoing and future power market transformation — one driven by more engaged customers that demand decentralized and decarbonized energy. In this future, distributed solar — including community solar — becomes a platform for a holistic clean, local, reliable and flexible energy service that opens up opportunities for flexible investment and business models in combination with other onsite and co-located distributed energy resources.

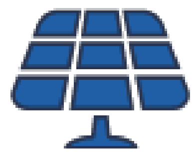




Embracing New Distributed Energy Technology Will Increase the Value of Community Solar

Community solar facilities will evolve, both as a virtual interactive energy platform and as a physical energy resource.

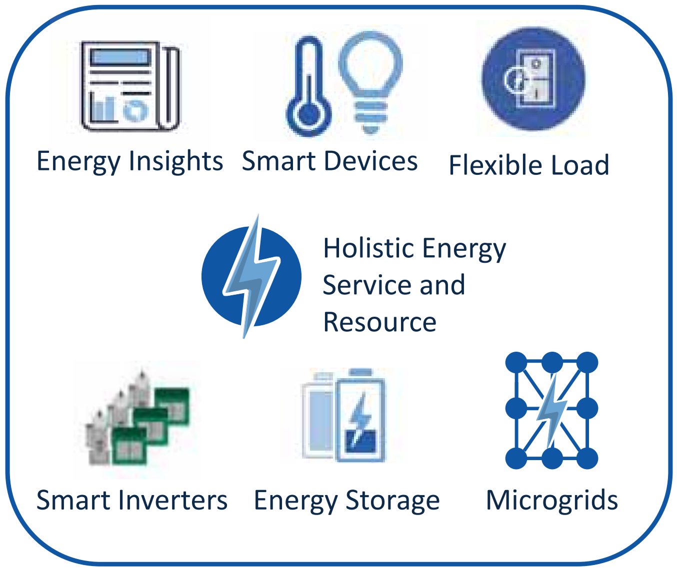




Community Solar Subscribers

Community solar operators will need to interact with subscribers beyond a bill, forming a holistic energy service.

Subscribers will receive tailored insights into their energy use, resulting in adoption of new devices and services that further increases the efficiency and lowers the cost of their energy use.



Utilities and the Electricity Grid

Community solar will create value beyond the energy generated — initially from offsetting new generation capacity, transmission and distribution assets, and longer term, in the form of flexibility and resiliency as community solar facilities are co-located with other distributed energy hardware.

Community Solar's Potential to Be an Attractive Service for Homes and Businesses

As community solar proves itself in leading markets, improvements to program design and implementation, subscriber acquisition and project finance will proliferate with concentrated efforts to innovate the community solar model beyond business-as-usual improvements.

Our vision for community solar addresses three principles for the ideal, mature community solar market:

I. Community solar providers must engage in ***deep product innovation*** around costs, technology and the services offered in order to substantially improve the individual and communal economic, environmental and social attractiveness and benefits of community solar.

II. Policymakers and utilities must enable access to community solar by crafting scalable markets through ***stable, fair rates and market participation structures*** that recognize and compensate community solar facilities for the full range of their grid, environmental and societal benefits.

III. All stakeholders must craft programs and products with *the* ***inclusion of low- and moderate-income communities*** in mind, recognizing the societal benefits and overall market opportunity that full LMI participation represents.

A Market Transformation in Three Phases

Transformative growth of community solar will not happen overnight. Improvements in program design and implementation, financing solutions, and customer-focused offerings can expand solar access to all customer types. Proper valuation methodologies are critical to support community solar in a changing market landscape, and inclusive policies are essential to ensure equitable access for underserved communities.

We envision a path through three phases, while noting that the starting point and transition will vary by state and market maturity

PHASE I: Market Emergence

Community solar is still in pilot or early stages, driven primarily by early programs or virtual net metering programs with shifting compensation mechanisms. Community solar is proving itself to regulators, customers and investors.

PHASE II: Market Transition

Lessons from Phase I are incorporated. Community solar benefits from cost reductions through product innovations, streamlined program administration and investor trust. Improved program design and financing solutions encourage and increase LMI participation. Regulators, utilities and community solar stakeholders negotiate the benefits and the compensation for community solar.

PHASE III: Market Maturity

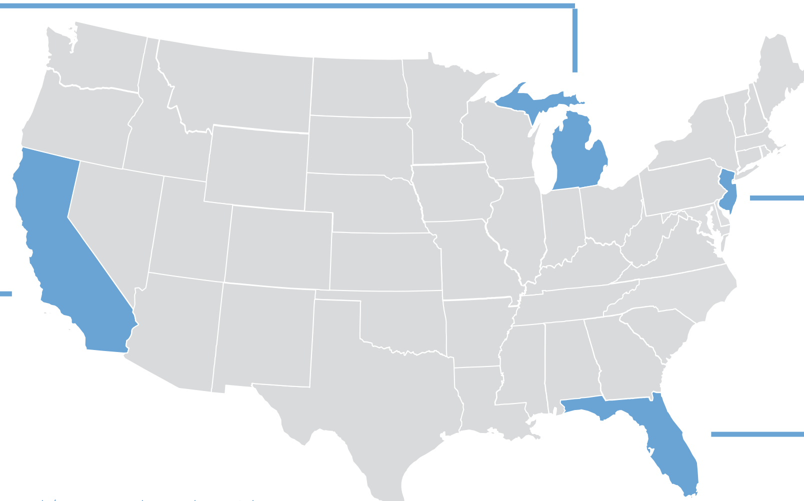
Community solar is an attractive offering to customers that delivers recognized benefits in the forms of cost savings, cost visibility, environmental attributes, grid value, local societal and economic support, and energy resiliency.

Four Early Community Solar Markets in Focus

We examine four state markets in different regions with different makeups: California, Florida, Michigan and New Jersey

Two leading distributed solar states (CA, NJ) and two lagging distributed solar states (FL, MI). Each state differs in its current level of experience with community solar. NJ recently passed legislation and has yet to begin program implementation. CA also passed legislation back in 2013, but only two community solar projects from that program are under development. All operating community solar capacity in CA comes from voluntary utility-led programs administered by municipal utilities. Meanwhile, MI and FL have several voluntary utility-led programs among their investor-owned utilities, rural-electric cooperatives, and municipal utilities but lack statewide enabling legislation.

Solar Deployments in States-in-Focus as of 2017 Year End



Source: Wood Mackenzie *North American Power and Renewables Service*, GTM Research/SEIA *U.S. Solar Market Insight Q2 2018*

3. Expanding the Reach of Community Solar

Community Solar's Evolution in Three Phases

Phase I: Building the Foundation to Further Community Solar Innovation

PHASE I: Market Emergence

Potential customers see clear economic benefits — including savings and predictable costs — while community solar operators reduce costs and build engagement platforms that simply and transparently communicate benefits to all customer segments.

PHASE II: Market Transition

The economic benefits of community solar are preserved and expanded through a combination of cost reduction and stable policies that value grid benefits of distributed solar. Access to community solar continues to expand as industry and policy matures to support access for LMI and other underserved communities.

PHASE III: Market Maturity

Subscribers receive community solar as a component of a broad, holistic energy service that delivers lower cost to subscribers; resilient, flexible energy to the grid; and clean energy to all members of the local community.

Improving community solar subscription attractiveness starts with strong programs and targeting simplicity and costs

- Strong and ambitious program design is necessary to ensure that community solar starts off in the right direction
- In the early stages, market education is critical, as subscriber acquisition depends on dispelling general myths about solar and explaining the community solar model. Working through local organizations and community partners will help establish trust, especially with LMI communities.
- While clean, local and independent supply of energy is a key motivator for subscribers, project operators must continue to improve on the transparency and attractiveness of community solar's economic proposition.
- Operators will need robust virtual interfaces to ensure that cost savings and other benefits are simply and transparently communicated to subscribers.

Phase II: Continuing to Expand Community Solar's Value in a Changing Power Market

PHASE I: Market Emergence	PHASE II: Market Transition	PHASE III: Market Maturity
Potential customers see clear economic benefits — including savings and predictable costs — while community solar operators reduce cost and build engagement platforms that simply and transparently communicate benefits to all customer segments.	The economic benefits of community solar are preserved and expanded through a combination of cost reduction and stable policies that value grid benefits of distributed solar. Access to community solar continues to expand as industry and policy matures to support access for LMI and other underserved communities.	Subscribers receive community solar as a component of a broad, holistic energy service that delivers lower cost to subscribers, resilient, flexible energy to the grid, and clean energy and development to all members of the local community.

With a simple, transparent and attractive community solar product established in Phase I, the focus in Phase II shifts to expand subscriber and societal value in the context of broader changes to the electricity industry

- Cost reduction will continue, but utilities will develop tools or be incentivized to limit stubborn interconnection equipment costs.
- Policymakers and industry representatives will establish a stable, long-term value for distributed solar generation, which must ultimately reflect the full breadth of community solar's benefits.
- Flexible subscription offerings more tailored to different customer preferences are the norm, and when coupled with further reduced subscription costs, lead to a step function increase in low- and moderate-income subscribers as financiers grow more comfortable with subscriber retention platforms.

Phase III: Community Solar as a Holistic Energy Service

PHASE I: Market Emergence	PHASE II: Market Transition	PHASE III: Market Maturity
Potential customers see clear economic benefits — including savings and predictable costs — while community solar operators reduce cost and build engagement platforms that simply and transparently communicate benefits to all customer segments.	The economic benefits of community solar are preserved and expanded through a combination of cost reduction and stable policies that value grid benefits of distributed solar. Access to community solar continues to expand as industry and policy matures to support access for LMI and other underserved communities.	Subscribers receive community solar as a component of a broad, holistic energy service that delivers lower cost to subscribers, resilient, flexible energy to the grid, and clean energy to all members of the local community.

Community solar must be seen as a holistic energy service, not just a policy-dependent bill savings opportunity

- Community solar platforms serve as a primary interface of customers to a deeper connection and involvement in their energy choices.
- Community solar becomes a key tool for ensuring equitable participation in the clean energy economy, regardless of income level or housing type.
- Community solar assets coupled with distributed equipment like energy storage provides services beyond virtual energy.
- By building community solar into microgrids and decentralized energy markets, community solar can provide energy for critical services and be further valued for “softer” local social and economic benefits typically left out of retail rate-based compensation.

Expanding the Reach of Community Solar

Addressing Policy and Customer Engagement Barriers

Addressing the Immediate Barriers to Community Solar

The primary barrier to adoption is the lack of policy that enables a broadly attractive community solar subscription

- Only 19 states and Washington, D.C. have statewide policies for community solar. While these states represent 41% of total electricity customers nationally, these state programs can be further limited due to program caps, limits on facility and subscriber qualification or otherwise unattractive bill crediting mechanisms.

We outline several key challenges faced by community solar facilities and operators when building an attractive subscription offering.

Program Design and Implementation Challenges

- Lack of control over full customer experience
- Limited pilot programs and capped program sizes
- Limitations to facility size, reducing economics of scale
- Restrictions on subscription sizes
- Restrictions on project siting or where credits can be allocated
- Insufficient bill credit/compensation levels
- Inaccurate or late bill credits
- Insufficient incentives or programmatic support for low- and moderate-income subscribers to overcome financial barriers
- Lag time between subscriber signup and facility connection due to permitting or regulatory restrictions
- Limited windows or long delays for transferring subscribers, leading to difficulties adding or swapping subscribers

Customer Engagement and Product Offering Challenges

- Low level of market awareness on the part of customers
- Unattractive or difficult-to-predict energy bill savings due to project economics
- Overly restrictive subscriber vetting and contract terms due to nascence of innovative metrics, market education and track record for lenders
- Lag time between subscriber signup and delivery of benefits due to lender restrictions on when a project can begin construction
- Little focus on low- and moderate-income customers and affordable housing tenants due to perceived repayment risks
- Difficulty showing economic benefits due to multiple bills or bills that do not show overall energy generation and consumption
- Insufficient consumer protection, especially for vulnerable communities

Addressing Key Initial Policy Barriers for Community Solar

Program Design and Implementation Challenges

Attractive, sustainable community solar starts with strong program design. Many policy best practices have already been outlined in the Coalition for Community Solar Access's Community Solar Policy Decision Matrix. Key initial hurdles brought forth in GTM Research's conversations with community solar subscribers and operators are outlined here.

- **Limited or insufficient bill crediting:** For community solar programs to be successful, they must offer a clear economic value proposition to subscribers. A bill credit should be stable, long-term and high enough to ensure that subscribers reach their primary targets, whether it's predictable costs, modest (5%-15%) savings for typical residential and commercial customers or a deeper discount (20%-50% at minimum) for low- and moderate-income customers.
- **Customer Qualification and Subscriber Mixes**: Depending on the specific policy goals, a customer carve-out may be appropriate. But if carve-outs are implemented, they must be examined closely so that targets can feasibly be reached. For example, clear qualification processes and support for low-income participation can advance community solar inclusiveness without hindering economic feasibility.
- **Lag time between customer sign up and project availability:** Policymakers and utilities should ensure that interconnection queue management and other approval processes do not cause undue delays between customer signup and facility connection. Operators must also work with lenders to reduce the hurdles and time between customer signup and the start of construction.
- **Ability to quickly move or remove subscription:** Community solar can be ideal for renters and affordable housing tenants who may not intend to stay in their residence long-term. Programs should allow community solar operators and subscribers to move or remove subscriptions on a monthly basis to reduce customer confusion and increase community solar's availability.

Source: Community Solar Policy Decision Matrix, 2016

Community Solar Subscriptions: Key Features of a Consumer-Focused Subscription

Community solar offers key economic benefits to subscribers, but a key barrier is the simplicity, transparency and reliability of these benefits.

Improving community solar subscriptions will require better execution and communication of the following subscription features:

- **Discount to or security of electricity service costs**: Community solar should offer a discount to a customer's existing electricity service and provide secure long-term visibility on energy costs. Typical residential and non-residential consumers require a 5%-15% discount before subscriptions are considered attractive, whereas LMI subscribers may need upward of 20%-50% before consideration. Where possible, a long-term fixed or guaranteed discount would also increase the attractiveness to potential subscribers.
- **Short-term contracts**: The long length of the contract can give customers pause and reduce customer interest. Increasing access to renters—a key potential benefit of community solar—can be more easily realized with contracts that are five years in length or less. For LMI subscribers, the contract itself may be a barrier that need to be creatively addressed.
- **Simple contracts:** Contracts that have high termination fees or rate escalators make it more difficult for customers to accept the economic benefits, ultimately raising the cost of subscriber acquisition.
- **Fewer limits to credit requirements**: High FICO scores and investment ratings are typically required to minimize risk to financiers, but credit checks and lengthy underwriting processes can cause customers to lose interest. Furthermore, alternatives to FICO scores, such as electricity bill payment history, may prove a stronger correlation between risk to energy bill repayment.[1] Moving to quicker, more inclusive and more predictive metrics could reduce risk, lower cost and increase access to community solar — especially for LMI customers.
- **Transparent billing and engagement**: In states where community solar is provided by a non-utility organization, customers must deal with two electric bills: their traditional one and one from the community solar provider. Ideally, customers would receive a single bill reflecting the net cost of electricity service to minimize confusion and increase transparency of costs. Furthermore, community solar operators should provide a platform where subscribers can easily view the performance and benefits of their subscription. As the electricity sector moves toward more complex electricity rates, customers will need to easily track their net energy profile and the temporal and locational value of their solar subscription.

[1] Solstice, EnergyScore: An Alternative to FICO Credit Requirements for Low- to Moderate-Income Community Solar.

An Integrated Billing and Customer Engagement Portal Is Critical for Innovation

For community solar operated by third parties, regulators and utilities will need to address current billing issues, as existing utility billing capabilities and customer engagement infrastructure are not well suited for products like community solar. Integrating community solar payments onto the utility bill or allowing single bill platforms would:

- **Reduce customer confusion** from needing to pay two distinct energy bills that may be on different billing cycles and help reduce inaccurate/late bill credits.
- **Improve transparency** of community solar benefits as subscribers could more easily compare the performance of their community solar share against their own consumption and avoided utility billing costs. In addition, an integrated platform could smooth the process of accessing critical customer information.

As retail rates grow more complex in response to changing energy market dynamics, an integrated billing and customer consumption platform is the first step toward deep community solar product innovation. For example:

- With monthly updates on its subscribers' energy usage, community solar operators **could better tailor subscription sizes** to match ongoing consumption.
- As a trusted provider, community solar operators could better **assist subscribers with efficiency products, weatherization and eventually grid services.** A bundled product offering could be an effective strategy to ensure sufficient bill savings when marketing to LMI subscribers with higher energy burdens.
- Community solar operators with periodic — and eventually real-time — visibility into their subscribers' energy consumption could optimize community solar design (and eventually generation) to match its subscribers' consumption trends in the case of time-of-use rates or demand charges.

As discussed previously, these changes need to coupled with regulations that encourage product innovation with bill crediting that reflects these services and the ability to easily swap subscriber lists.

Expanding the Reach of Community Solar

Reducing the Cost of Community Solar

Delivering a Lower-Cost Community Solar Subscription

Customers clearly want cost savings, so this report explores several approaches to reducing community solar subscription costs to provide stable, long-term savings for customers. Reduced community solar costs can provide:

- **A better value proposition for the subscribers**: Whether community solar is being weighed against a bill credit, the value to the grid, the utility cost of service, or simply alternative forms of procuring solar, lower costs are crucial to realizing a larger benefit.
- **More headroom for packaging other technologies:** Lower solar costs make it easier to package in energy storage and grid support technologies, and ultimately to deliver more grid and social value at similar costs.
- **Greater focus on inclusion and local development:** Lower costs give operators more space to focus on broad adoption, including the LMI segment or price-sensitive non-residential customers, as well as other local benefits (e.g., workforce development), while still meeting targeted financial performance and returns.

Current community solar costs fall between rooftop residential and small-scale utility solar projects.

Projects benefit from larger scale (typically between 1-5 MW) and the ability to choose locations with fewer land, shading and interconnection constraints. As a result, community solar projects are typically:

- **Easier to scale**: Community solar can target larger tracts of land and potentially locate on adjacent parcels, enabling larger systems with greater cost efficiencies
- **Simpler to maintain**: Projects can be built in close proximity to reduce fixed costs of preventative and corrective maintenance
- **Better performance:** Instead of conforming to rooftop constraints, projects can be optimized to deliver better performance through technologies like single-axis tracking or simply more optimized tilt angles and orientation

All-In Costs to Build Community Solar Could Fall by 42% by 2030

Community solar costs are driven by a combination of industry-wide improvements and community-solar-specific activity

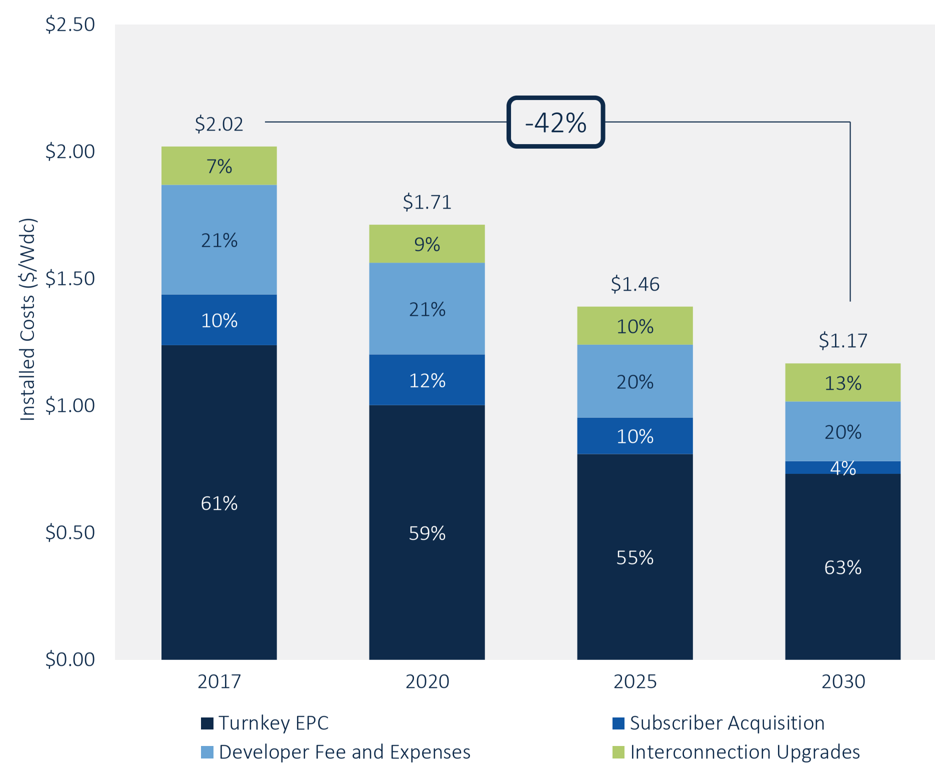
The cost to build 1 to 5 MW ground-mount solar arrays is expected to drop by 41% between 2017 and 2030, which is slower than historical declines of 40% between 2012 and 2017. Improvements are driven by:

- **Solar module cost reduction**, including expiration of the Section 201 tariff, silicon cost reduction, shift to higher-efficiency monocrystalline technologies, and further automation of production facilities.
- **Balance-of-system improvements** will be incremental, with small gains from lower material usage, reduced labor costs and operational efficiency focus.

Development costs may increase as share of costs

- Development fees, overhead and margins could fall as community solar grows more competitive and project developers become more efficient.
- Legal fees, land acquisition and permitting costs will be tougher to reduce, especially as competition forces developers to explore suboptimal sites.
- Interconnection fees and equipment costs could rise as distributed solar deployment increases and optimal feeders become more saturated.

National All-In Cost Projections for Community Solar by Major Component Cost



Source: GTM Research Wood Mackenzie

Subscriber Acquisition and Management Are Key Targets for Lowering Costs

Community solar stakeholders generally have more direct control over subscription acquisition and management costs, leading to greater opportunities for cost reduction

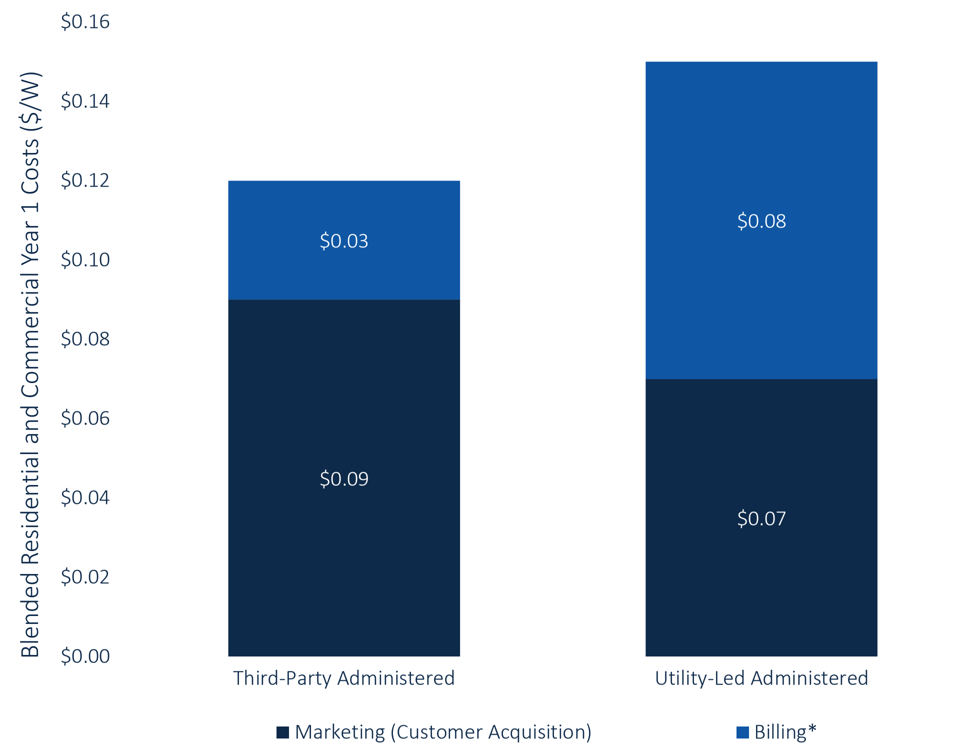
As a virtual product, community solar has the advantage of not requiring customer-specific site studies, permitting fees and interconnection.

Subscriber acquisition costs range from $0.06/W to $0.25/W, based on anecdotal information.

- Acquisition costs generally reflect a blend of residential and non-residential
- Due to fixed costs, small subscription sizes and failed leads, residential subscriptions typically have higher acquisition and billing costs
- Ongoing billing and subscriber management (including subscriber replacement costs) generally range between $0.12/W and $0.35/W
- But subscriber acquisition costs are typically less than residential rooftop acquisition costs, which currently total around $0.57/W

A survey conducted by the Smart Electric Power Alliance found that median first-year customer marketing and billing costs for mixed residential and commercial subscriptions ranged between $0.12/W and $0.15/W.

Median First-Year Subscriber Acquisition and Management Costs of Surveyed Programs by Smart Electric Power Association



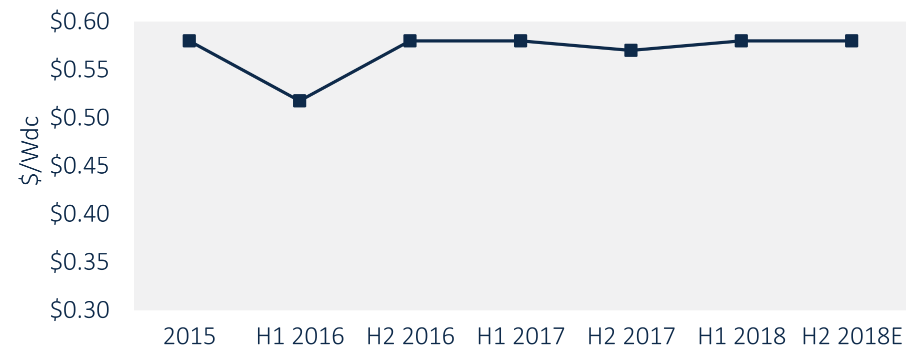
Source: Smart Electric Power Alliance/Coalition for Community Solar Access *Community Solar Program Design Models*

Lowering the Cost of Subscription Acquisition

Customer acquisition costs do not automatically decrease as the industry scales

- As volumes grow, installers turn from referrals to more expensive sales channels and sources for customer leads
- Despite residential solar doubling in terms of annual installations from 2015 to 2018, average customer acquisition costs have remained the same
- While non-residential acquisition costs tend to be much smaller, attrition rates on non-residential leads result in difficulties in reducing costs

National Average Residential Solar Rooftop Customer Acquisition Costs ($/Wdc)



Source: GTM Research *U.S. PV System Pricing H1 2018: Forecasts and Breakdowns*

Community solar must simultaneously make strides on two paths to reduce subscriber acquisition costs

I. Find greater efficiencies in sales channels and sales strategies

- Partnerships with local community organizations can both leverage trusted relationships to educate potential community solar customers and help streamline the vetting process to identify qualified participants.
- Historically, rooftop solar lead generators have kept a tight rein on disqualified leads — but these could be a source of low-cost leads.

II. Build more consumer-friendly customer offerings

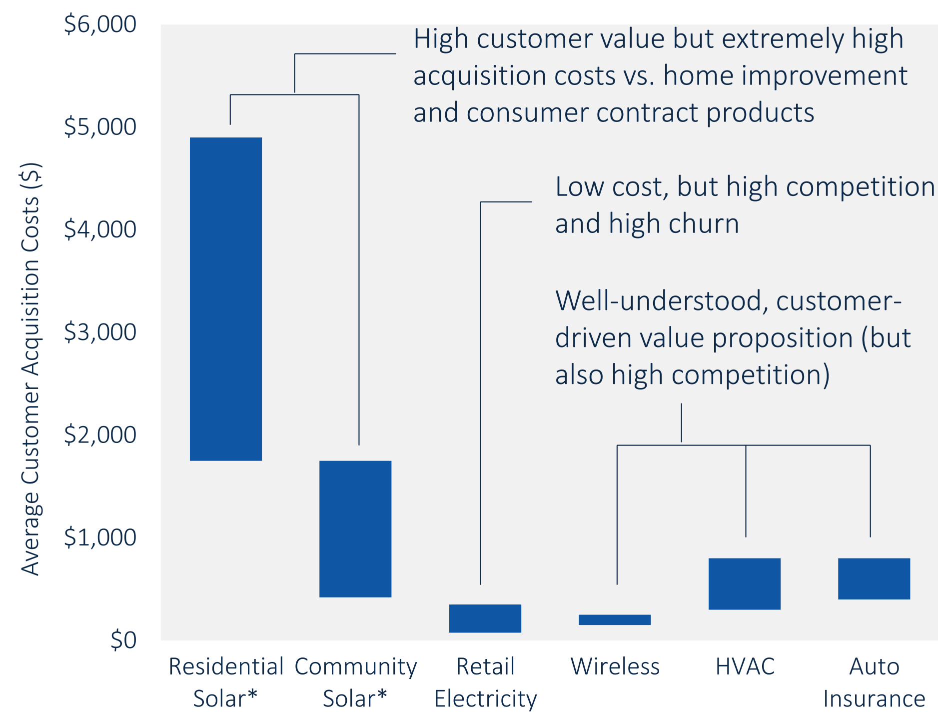
- Community solar operators must tackle key obstacles that give subscribers pause, including escalators, large exit fees and lengthy contracts, although these are typically requirements from financiers, not operators.
- Community solar operators can couple other service offerings on top of solar generation, including weatherization, energy efficiency, time-of-use benefits and local resiliency.

Creating Consumer-Focused Offerings to Lower Subscription Acquisition Costs

Customer and financier education can help create consumer-focused offerings and lower subscription acquisition costs.

- **Options for shorter contract lengths:** Current community solar contract lengths are typically similar to rooftop solar contracts, requiring customers to lock themselves in for 15 to 25 years. While these may work for some residential and commercial subscribers, some customer segments (e.g., renters, affordable housing) desire shorter commitments.
- **Low or refundable termination fees:** In order to minimize financier risk, especially in markets where regulators or utilities limit the transferability of community solar subscriptions, operators may require termination fees. Better policies around subscription transfers and having more robustly qualified customers on waiting lists can help reduce the need for exit fees.
- **Low or no rate escalators:** Rising subscription costs can turn off subscriber interest. Reducing build costs will help operators provide fixed-price products at a desirable savings target for subscribers.
- **Robust subscriber management:** Additional innovation to subscriber management platforms could reduce the need for stringent terms on individuals, relying instead on the platform's ability to maintain and replace subscribers through continued community engagement and waiting lists.

Customer Acquisition Costs of Solar vs. Other Products



* Assumes 7 kW rooftop solar array or 7 kW community solar subscription

Source: GTM Research , Sunrun

The Evolution of Community Solar Finance: Chasing a Lower Cost of Capital

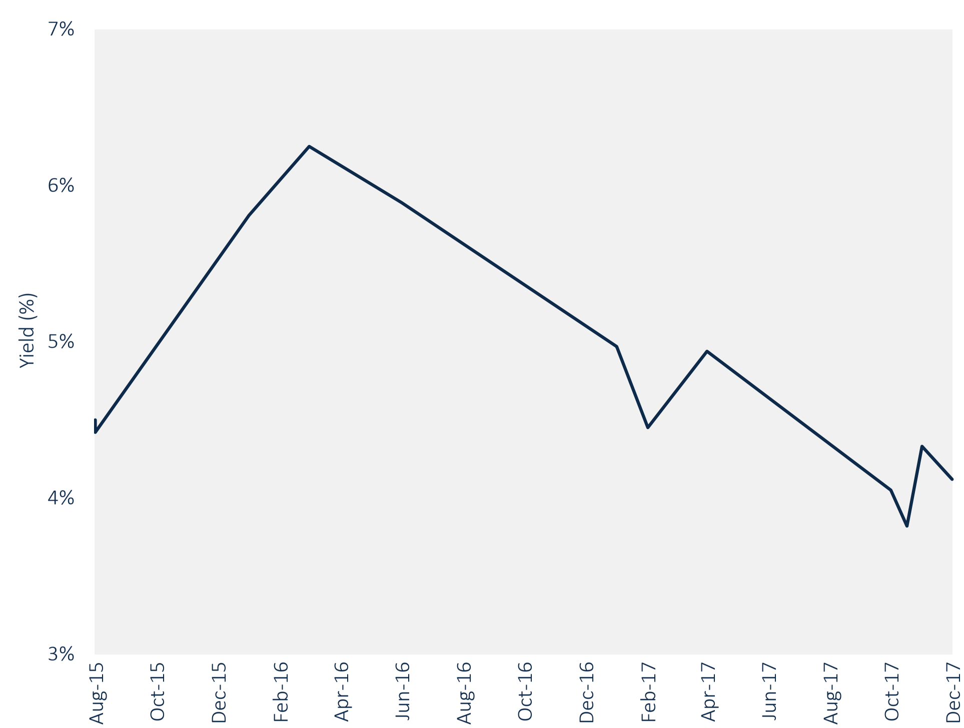
Long-term cash flows could be sold to lower cost of capital providers, potentially lowering subscription costs or increasing the space to finance other services alongside community solar.

For example, as of early 2018, over $2 billion of capital has been raised through asset-backed securitizations of distributed solar assets. Yields have fallen as low as 4%—a marked discount from typical equity returns between 8% and 12%. Other low-cost capital providers are also interested in solar as an investment vehicle, representing a significant opportunity for community solar operators to reduce overall costs.

In today's conservative case, long contracts and sizable exit fees are required to reduce the perceived risk of subscriber payment and cancellation. LMI subscribers are typically not specially considered because of preconceived notions of being higher risk.

In the near future, investors and lenders may evaluate the risk of a subscriber management "platform" — not necessarily contract terms — to determine the risk to the subscriber base (i.e., subscribers are quickly replaced without loss to the overall cash flows). Alternative credit scoring, such as utility payment history, may also help to qualify additional subscribers — especially LMI subscribers — while reducing overall portfolio risk.

Average Yield Rate of Securitized Distributed Solar Assets (%)



Source: GTM Research, Standard and Poor's, Kroll Bond Rating Agency

Expanding the Reach of Community Solar

Building a Holistic, Consumer-Focused Subscription

Community Solar as a Foundation for Participation in the Energy Future

Community solar's role in a decentralized, clean energy future

The year is 2030. The electricity grid is dominated by efficient, clean and low-cost energy. Millions of people are producing their own energy with on-site solar generation. In fact, most homes and businesses across America have some form of generation, energy storage, electric transportation or connected load control and are actively participating in new markets and services that help balance the time-variant and locational complexities of a massively electrified economy. In the background, utilities and decentralized service providers are able to operate consumer and distribution-level resources with minimal intrusion and impact to customers, thus maximizing savings, ensuring grid balance and providing local social and economic benefits.

At its core, community solar provides its subscribers with stable, low-cost, clean, sustainable and locally produced energy. But community solar also provides significant local development, including jobs for construction and management, opportunities for workforce development and economic support to LMI and other underserved communities. Furthermore, community solar plays the important role of ensuring that all residents are able to contribute to services and markets for distributed energy resources.

Community solar starts first as an engagement tool — a way for customers to more actively participate in how and what they consume for energy — but can evolve into a portal for more holistic energy services such as energy efficiency, energy analytics and active load control for flexible demand. In parallel to virtual engagement, community solar also provides a physical location and equipment with which to pair other distribution infrastructure, including smart inverters and energy storage. These assets can be shared between the community solar operator and the grid operator to maximize community solar's contribution.

Finally, as a modular and local generation resource, community solar can be a key asset for clean energy-based microgrids that can support local resiliency. By pairing community solar with other microgrid necessities like switch/protection equipment, advanced power electronics and high-speed communication, community solar-based microgrids can ensure critical services remain up and running during minor grid disruptions and in times of disasters.

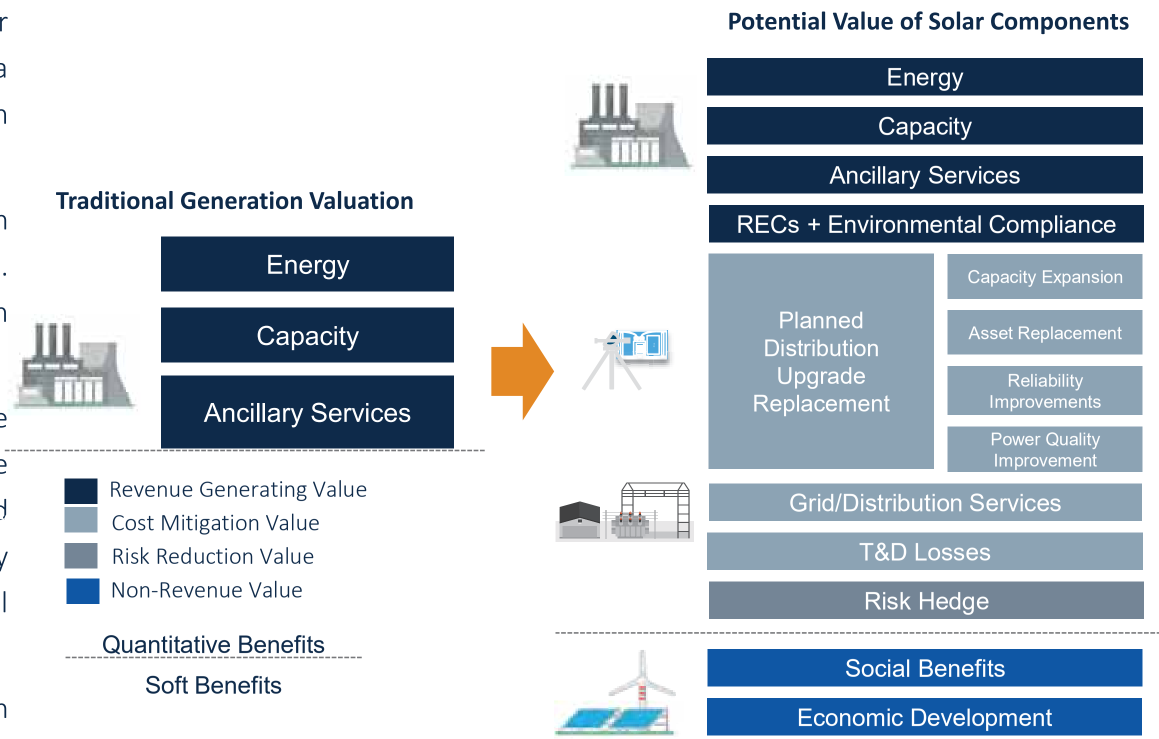
The Compensation and Valuation of Community Solar will Evolve

At low penetration rates, "the cost-shift from distributed solar is negligible,"[1] meaning that net metering may serve as a convenient near-term basis for community solar valuation in most territories.

Even at low penetration rates, utilities and regulators may push back against retail-rate-based bill compensation mechanisms. Some have pressed for a traditional model of generation valuation—only including immediate marginal energy costs.

However, some regulators are looking toward calculated "value of distributed energy" tariffs to more "fairly" compensate distributed solar for its benefits and costs, such as avoided grid investments due to its proximity to load. While community solar is not located at the point of consumption, it can still offset grid costs and provide locational grid resources.

As industry, utilities and regulators seek a compensation mechanism beyond standard retail rates, a negotiated value of solar methodology and calculation could serve as the basis for onsite and community solar bill credits.



Source: GTM Research Wood Mackenzie, Pacific Gas & Electric

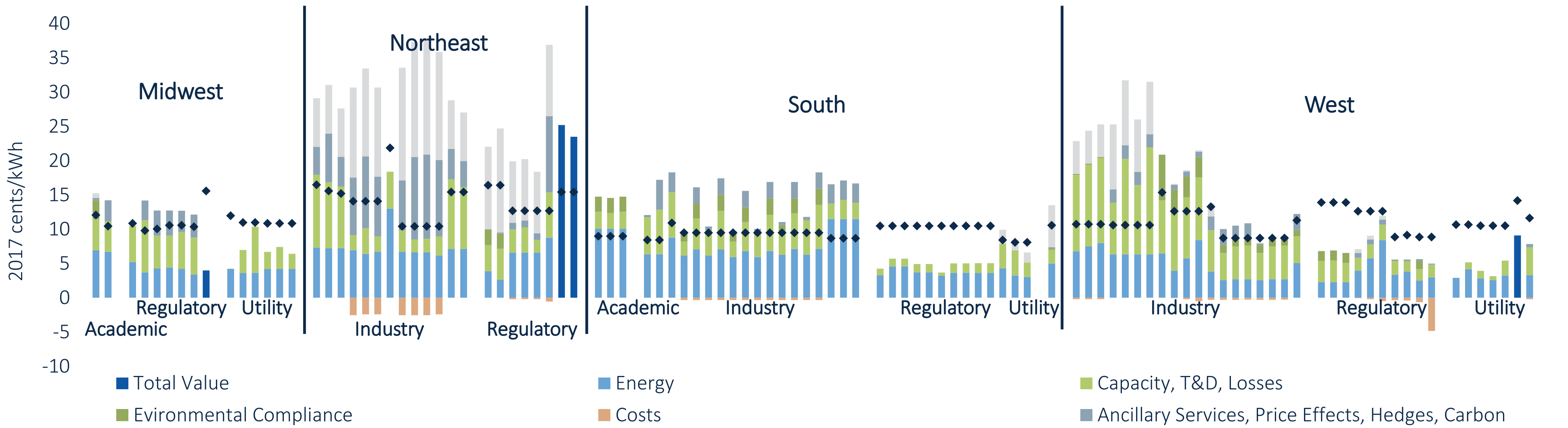
[1]Net Metering and Rate Reforms for Distributed Solar, Lawrence Berkeley National Laboratory

A Review of the Value of Solar Literature Shows Incredibly Varied Results

GTM Research's literature review of 40 value-of-solar studies show estimates that typically fall between 60% to 150% of average retail rates (including all segments). Values vary due to differences in locational inputs and the breadth of studied components. More discussion can be found in the Appendix.

Even beyond the variances in the results, the studies inherently portray different breadth of studied values and may also include inaccurate or simply incomplete assumptions. As there remains significant work for deriving appropriate and accurate value of solar figures, **our goal for introducing value of solar is to create proxy values for our customer adoption forecast, not to prescribe or create definitive values for community solar or distributed energy as a whole.**

Review of Value of Solar by Component From 40 Value of Solar/Value of Distributed Energy Studies vs. Average EIA Retail Rates



Source: GTM Research, EIA (average retail rates in study year) Various Regulatory Filings and Studies (See References for Full List of Studies)

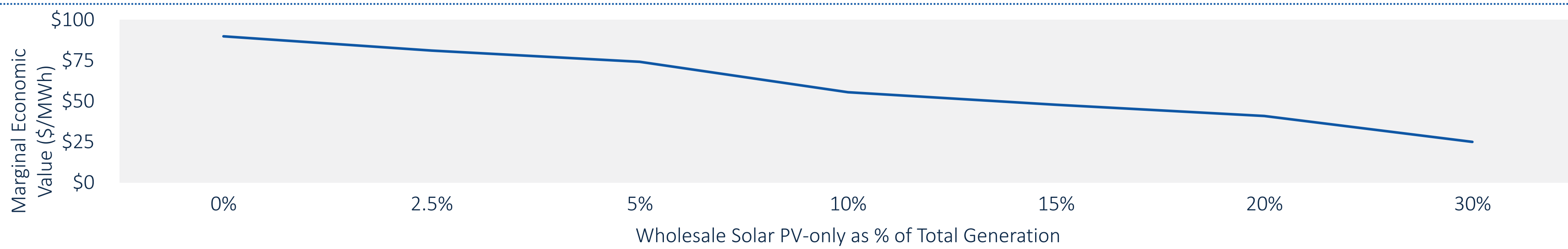
The Value of Energy Is Not Static

Electricity prices will change, potentially resulting in a shifting economic value for both subscribers and the grid.

For subscribers, if the underlying retail rates change or increase without a corresponding increase in community solar bill crediting, the relative savings from community solar will erode. These utility rate increases can come with increased utility and energy costs or a shift to fixed charges, demand charges and time-varying rates that aren't offset by solar generation.

For utilities and the grid, future rates are always influenced by changes in energy input costs (e.g., natural gas prices) and grid infrastructure investment. With light solar volumes, distribution infrastructure investment can be offset by generation closer to load (i.e., distributed solar). However, at higher penetration levels, marginal solar additions will have diminishing impacts on grid investments — and some argue, could even increase costs from integration.

Lawrence Berkeley National Laboratory: Marginal Economic Value of Wholesale/Utility Solar PV-only as Percentage of Total Generation in Simulated 2030 Grid



Source: Lawrence Berkeley National Laboratory, *"Changes in the Economic Value of Variable Generation at High Penetration Levels: A Pilot Case Study of California"*

For example, looking only at wholesale solar, marginal energy and capacity values fall with increasing share of pure solar. As discussed previously, distributed solar value needs to include a full set of benefits, including avoided grid infrastructure costs as well as social and environmental benefits. ***But community solar also requires deep product innovation — and regulations and program design that will allow that innovation to flourish.***

Community Solar Value Can Grow through Innovation

Community solar can evolve in response to changing rate and market dynamics, preserving and adding value — even as solar penetration increases. We discuss two interwoven tracks, both of which will need significant enabling policy.

Virtual engagement and advanced market participation

Subscribers see community solar operators as trusted energy advisers. Using online portals or in-person/phone-based customer advocates that link to the subscriber's energy use, bills and all the rates and services available, subscribers can find ways to further reduce their energy costs.

Community solar operators can start with advice, such as energy efficiency tips or weatherization, but can evolve into a more active relationship. Subscribers can lower their costs by procuring efficiency and load control devices — such as smart thermostats, electric water heaters, batteries and EV chargers — from operators.

Eventually subscribers may even allow operators to optimize and control these devices to lower their bills through rate optimization and services like aggregated demand response.

Distributed Infrastructure Co-Location and Grid Services

In many markets, community solar operators already bear the burden of grid upgrades. These could be better targeted and utilized to ensure that operators, utilities and consumers are all seeing a net benefit.

For example, utilities could help operators site community solar more optimally and target congested feeders. Or utilities could help operators install telemetry devices, smart inverters, batteries and other equipment that grant utilities greater visibility into the distribution grid and a better ability to balance voltage and power.

Eventually, community solar operators can aggregate their subscribers' flexible load devices while controlling the community solar facility output to help utilities better respond to changing energy demand.

Subscribers Can Optimize Their Energy Use With a Holistic Community Solar Platform

Subscribers can use an integrated billing and engagement platform to make better energy choices and lower their costs.

The billing and engagement platform for community solar could serve as:

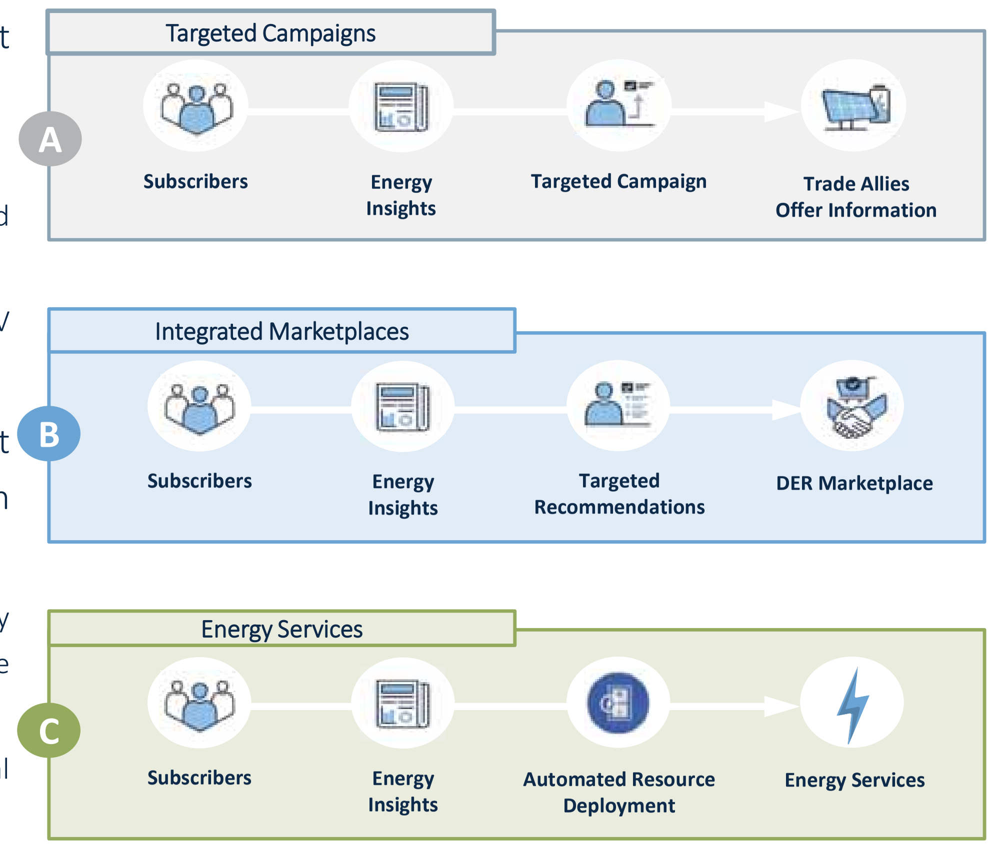
A) A warehouse of information that connects subscribers with targeted campaigns to reduce energy costs and local initiatives

B) A marketplace from which to buy products like smart thermostats and EV chargers or services like weatherization and energy storage-as-a-service.

With energy storage and controllable local energy management devices, community energy facilities could deliver a full breadth of services, further lowering and stabilizing subscribers' costs.

With controllable loads (e.g., EV chargers, smart thermostats) and energy storage located at subscribers' site, community solar providers could aggregate and sell flexible demand resources for utilities and markets.

Depending on the cost and values, these services could offset potential distributed resource integration costs or reduce subscription costs.



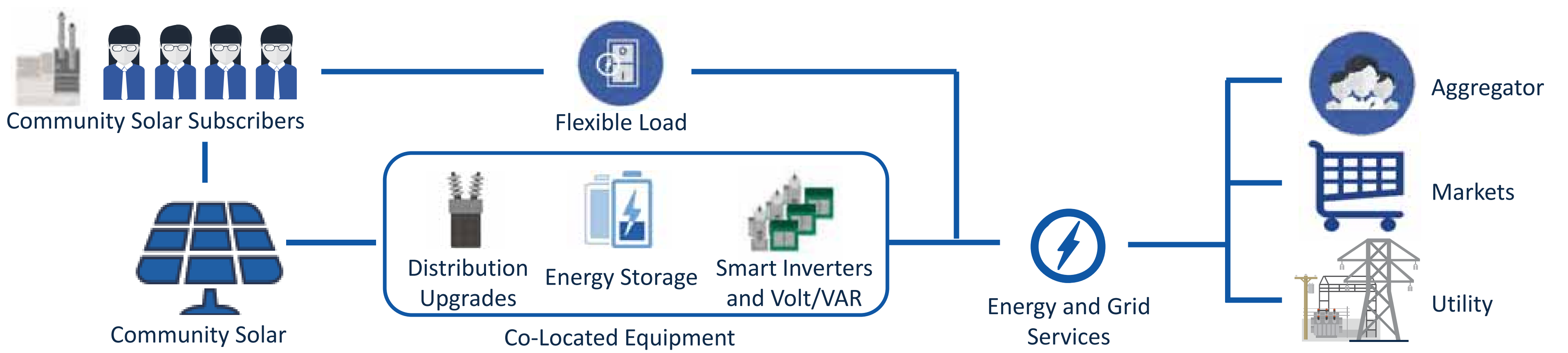
Utilities and Operators Can Leverage Community Solar for Greater Grid Benefits

To preserve and increase community solar's value to the grid, facilities can help utilities, grid operators and energy aggregators by layering on co-located distributed hardware.

Beyond energy, community solar platforms could provide:

- A virtual platform and management system to interface with and control subscriber loads, either through direct control or price signals
- A physical asset with which to co-locate distribution system upgrades, energy storage and smart power electronics for grid support

These assets can either be packaged and sold to energy markets (or otherwise compensated by regulators) for the benefit of the grid and subscribers. These services will ultimately help community solar maintain its grid value — and potentially offer more revenue streams that can be shared with subscribers.



Using Community Solar to Enhance Local Resilience

As a distributed generation source, community solar can be the primary generation source for microgrids for local resilience.

Businesses and governments are quickly realizing the importance of local grid resilience, especially in the case of disaster relief, to keep critical infrastructure powered during disasters or other outage events.

- During normal operation, community solar-based microgrids continue to provide all the benefits of community solar to subscribers and the grid.
- During grid disruptions and disasters, community solar facilities can provide the necessary generation component for critical and emergency services — or simply ensure that local consumers have backup generation.

Community-solar-based microgrids can be sited near underserved communities, including remote neighborhoods that are typically last to be serviced during a large disaster or in low-income and vulnerable neighborhoods that may have fewer resources to weather long power outages.

In order to assure deployment and optimal performance of community solar in microgrids, policy must be carefully constructed to allow and incentivize all the services and value streams these assets can provide.

Representative Value Streams for Microgrids

Customer Value Streams	Distribution Value Streams	Wholesale Value Streams
BACKUP POWER	RESILIENCE	BLACK-START
GRID SERVICE PROGRAMS	DISTRIBUTION LOSSES	VOLTAGE SUPPORT
ENVIRONMENTAL INCENTIVES	VOLTAGE AND REACTIVE POWER SUPPORT	FREQUENCY REGULATION
SYSTEM PEAK CHARGES	LOAD SHAPING	SPIN/NON-SPIN RESERVES
DEMAND CHARGES	T&D DEFERRAL	ENERGY
ENERGY PRICE ARBITRAGE	CAPACITY	CAPACITY

Source: GTM Research, *U.S. Microgrids 2017: Market Drivers, Analysis and Forecast*

Solar-based microgrid deployments are growing quickly

Operational microgrid capacity in the U.S. currently stands at 3.3 GW. Microgrids for critical infrastructure will grow most rapidly with increasing solar PV adoption, combined heat and power incentives, state resilience programs and commercial interest in keeping power on during disasters.

GTM Research expects a total of nearly 1 GW of solar-based microgrids to be deployed over the next five years — a 29% annual growth rate.

4. Realizing the Low- and Moderate-Income Opportunity

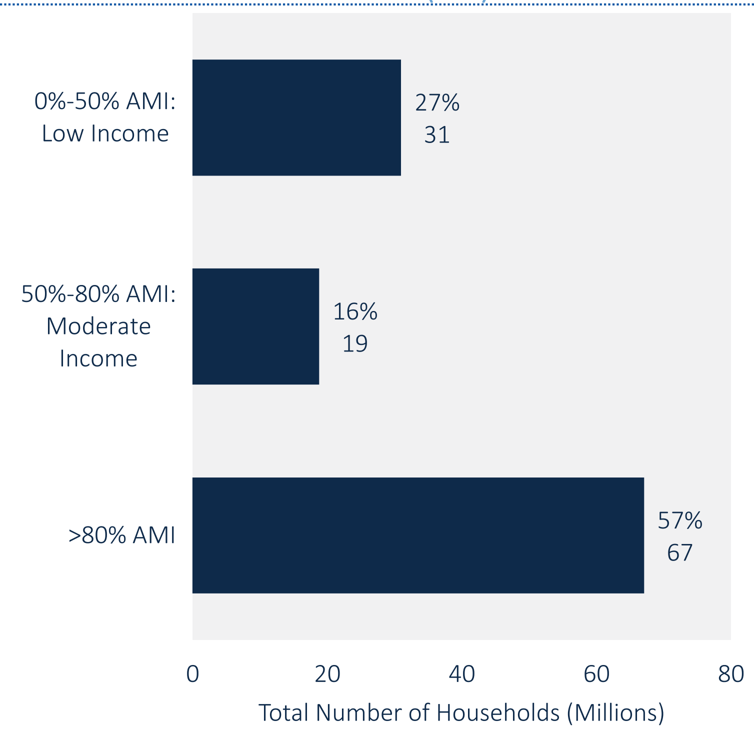
The Low-to-Moderate Income Community Solar Market

50 million reasons why community solar needs to tap into this customer segment

Why community solar is the key to unlocking 50 million low-to-moderate income (LMI) households' access to clean, affordable energy solutions…

- **The LMI subscriber opportunity is massive, accounting for approximately 43% of U.S. households.** Of that total, there are 31 million low-income households, 19 million moderate-income households, and 5.78 million affordable housing properties across the U.S. that would benefit from cost-saving community solar solutions.
- Community solar provides the **flexibility to deliver clean energy access to all LMI customers, including renters and multifamily housing** – of which LMI households are more likely to occupy. While 40% of the LMI household addressable market lives in multi-family housing, rental and multi-family housing together comprise nearly 60% the total LMI addressable market.
- **Community solar also offers significant benefits to low-income customers**, including opportunity for bill savings and energy burden reduction, targeted, flexible value propositions tailored to LMI customers' unique needs, and local economic opportunity to drive the clean energy transition.
- But the LMI community remains relatively untapped due to a number of challenges that can be bucketed into three overarching bottlenecks.
  - Program design, subscriber acquisition and project finance challenges have resulted in insufficient incentive levels, higher soft costs and limited access to capital for community solar projects involving LMI subscribers.

Share of U.S. Households:
Low-to-Moderate Income (LMI) vs. Non-LMI



Source: NREL, 2018

Key Barriers Holding Back LMI Participation in Community Solar

These challenges are evaluated in greater detail in subsequent sections of this report

Program Design Challenges

- **Carve-Outs:** At best, these result in community solar providers meeting, not exceeding, LMI subscription requirements.
- **Incentives:** Incentive funding is insufficient and other forms of program support are not available to address subscriber acquisition and project finance challenges.

Subscriber Acquisition Challenges

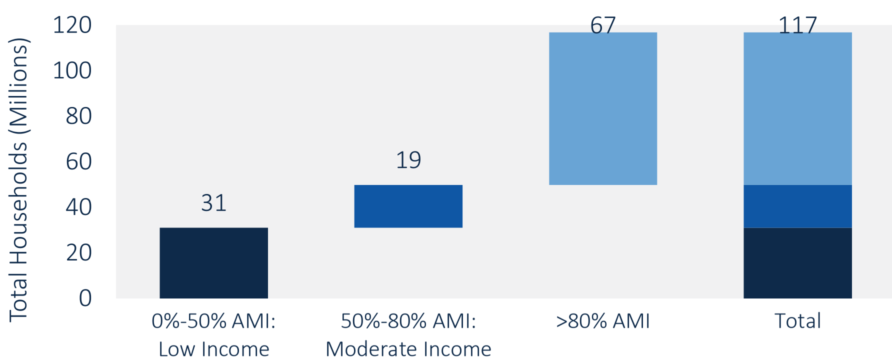
- **Consumer Product Design:** Rigid contract terms may not align with LMI customer preferences and struggle to generate sufficient savings.
- **Lead Generation and Sales:** Community solar providers may lack internal capabilities and resources to scale up LMI-oriented sales channels.
- **Streamlined Billing:** Additional bills are a significant barrier for low-income customers. Billing needs to be as streamlined as possible, for example, by being integrated into a single platform or on-bill (per recommendation on Slide 63), or by allowing benefits to be transferred through an intermediary purchaser or service provider.

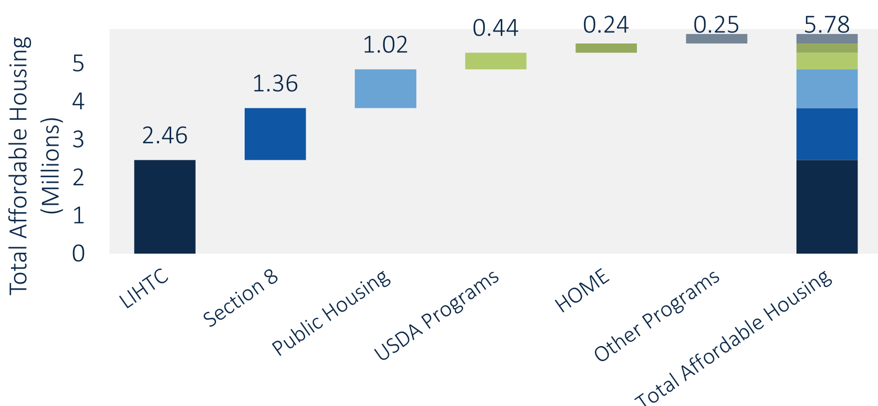
Project Finance Challenges

- **Access to Capital:** LMI customers may lack sufficient capital and/or adequate credit scores for community solar providers to raise capital at the same cost of financing as projects backed by residential subscribers with high credit scores and investment-grade C&I subscribers.

Assessing the LMI Addressable Market
Low Income vs. Moderate Income vs. Affordable Housing

U.S. Single Family and Multi-Family Households and Affordable Housing Buildings (2017)





Source: NREL; HUD

Low Income vs. Moderate Income vs. Affordable Housing

- **Low Income:** Per the U.S. Department of Housing and Urban Development (HUD), a household whose income does not exceed 50% of the area median income
- **Moderate Income:** A household whose income ranges between 50% and 80% of AMI
- **Affordable Housing:** Households that receive financial support or direct rental assistance from a federally supported program that targets low-income households offered by HUD and U.S. Department of Agriculture and Rural Development (USDA)
  - Includes Low Income Housing Tax Credit (LIHTC), Section 8 (also called the Housing Choice Voucher Program), HOME Investment Partnerships Program (HOME), public housing, USDA programs and all other smaller programs
- In total, there are 31 million low-income households, 19 million moderate-income households and 5.78 million affordable housing properties across the U.S. that could benefit from cost-saving community solar solutions.

(Affordable housing is treated as a separate segment from low income for three key reasons outlined on the following slide)

Additional Challenges Unique to Affordable Housing Customers

With impacts on subscriber acquisition and raising project finance

1. Who pays the electricity bill impacts who is the actual subscriber and financiers' risk assessment

- Approximately 55% of affordable housing is in a master metered building, where the property owner pays the electricity bill instead of the tenant. This means that a community solar provider only has to sell a subscription to the property owner when the affordable housing building is master metered, as opposed to tenant metered.
  - With master metered buildings, issues of low credit scores, LMI targeted sales channels and other challenges involving LMI subscribers are not relevant, which typically means a lower cost of subscriber acquisition for the community solar provider and easier access to capital for projects that do not rely on individual tenants. However, this also means that property owners in master metered buildings typically do not pass through the benefits and savings of community solar to the tenant.

2. Community solar bill savings can be zeroed out by corresponding increases in rent

- In most types of affordable housing, there is a "utility allowance," which means that rent plus utilities must equal 30% of a household's adjusted monthly income. If the utility allowance is based on actual tenant bills (i.e., is site-specific), then a tenant receives no community solar bill savings because any savings that lower a utility allowance is paired with a corresponding increase in rent. Meanwhile, alternative methodologies that estimate electricity bill costs can allow a tenant to still receive some or all community solar bill savings.
  - It's worth noting that Low-Income Housing Tax Credit properties typically are not required to adopt a specific utility allowance methodology (although rules vary state-by-state). However, most LIHTC property owners use a methodology that allows tenants to capture 100% of community solar bill savings without any increase in rent.

3. HUD approval of community solar subscription agreements can increase soft costs and limit savings for public housing authorities

- If a public housing authority or its tenants subscribe to community solar via a power purchase agreement (PPA), then the subscriber is only eligible for 50% of the bill savings, although requests to receive 100% of the bill savings have been approved by HUD. Second, if the PPA lasts longer than five years, then the PPA must also be approved by HUD via its Rate Reduction Incentive Program.
  - The majority of today's community solar subscription agreements are structured in a $/kWh PPA contract that lasts longer than five years. This means that all public housing authorities are likely to only receive 50% of bill savings, and must go through a HUD approval process that can last upward of 12 to 18 months. However, if the subscriber directly owns a community solar subscription, then the subscriber receives 100% of the savings and no additional approval is required by HUD.

Source: NREL, HUD

Realizing the Low- and Moderate-Income Opportunity

Policy and Market Barriers in Depth

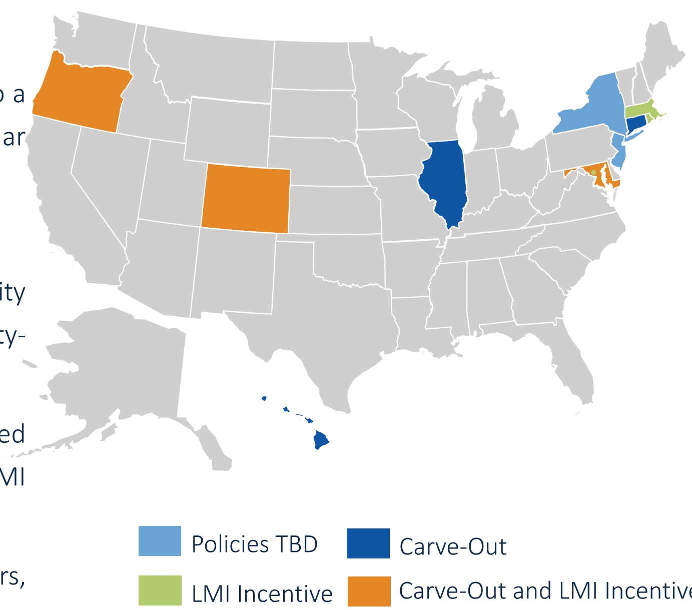
Today's LMI Market: Primarily Driven by Carve-Outs and Incentives

11 states with policies in place or development to support LMI adoption of community solar

- **Incentives or Incentive Adders:** Targeted performance-based incentives, adders to performance-based incentives or grants to support LMI subscriptions in community solar projects.
- **Notable Carve-Outs:** Require a certain share of a community solar program or individual project capacity to be subscribed by LMI customers.

Notable Carve-Out and Incentive Programs

- **Colorado:** Xcel Energy used to have a 5% project level carve-out. For 2017 to 2019, Xcel's program shifted to a program carve-out, which includes 13.5 MW of third-party-led and 5.25 MW of utility-led community solar that must be 100% subscribed by LMI. These projects are eligible for higher incentives for the sale of RECs.
- **Connecticut:** 20% of a 6 MW pilot program is dedicated to LMI subscriber participation.
- **Illinois:** In the Illinois Solar for All Program, more than 60% of REC incentive funding is dedicated to community solar. Incentive levels vary by system size range, and each project must partner with at least one community-based organization.
- **Maryland:** 30% of a 200 MW pilot program must serve LMI, with one-third of that program carve-out required to serve low-income households. On top of SREC incentives, there are grants available for projects with LMI subscribers.
- **Massachusetts:** The current SMART incentive program has incentive adders for projects with LMI subscribers, which vary for projects with LMI customers and affordable housing property owners.
- **Oregon:** There is a 5% carve-out for every project, plus an additional 5% target for the entire program, with incentive program design to be determined.



Source: NREL; Low-Income Solar Policy Guide, Vote Solar, Grid Alternatives

LMI Carve-Outs Are an Important Policy Tool but Not a Panacea to Scale LMI Adoption

Key Benefit of Carve-Outs: Carve-out requirements are a straightforward policy that guarantee a percentage of a program will ultimately serve the LMI segment.

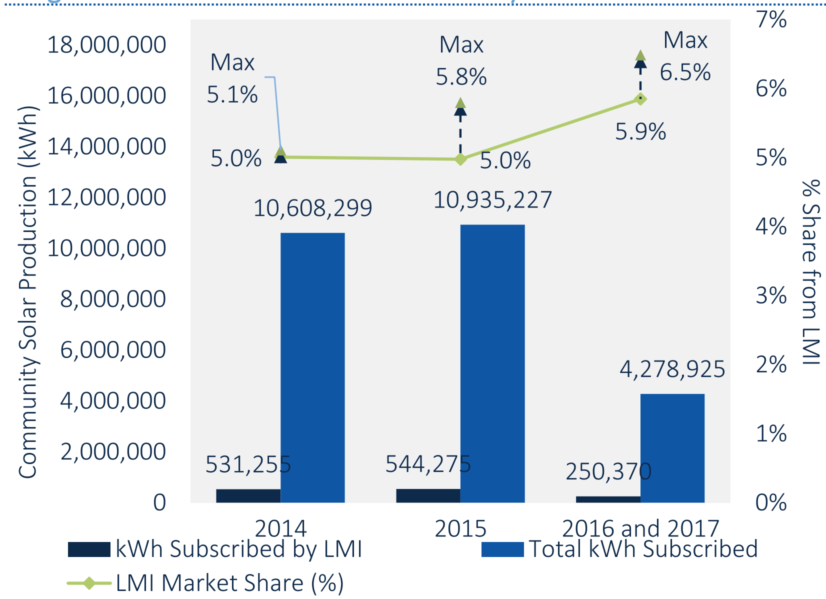
Key Challenges of Carve-Outs

- **Without additional/adequate incentives and programs**, community solar providers often just meet the minimum carve-out requirement when set at the project level. As a result, carve-outs can act as an artificial cap on LMI participation.
- A number of LMI carve-outs **do not set additional targets within the LMI segment**. As a result, community solar providers primarily or exclusively focus on master-metered affordable housing authorities that financiers view as less risky subscribers than low-income homeowners and renters.

Colorado case study: Why hasn't the longest-standing LMI program for community solar achieved scale?

- For projects with a 5% LMI subscription requirement, community solar providers have consistently hovered around that 5% target, and have sometimes given LMI subscriptions away for free in tenant-metered buildings.
- **Key Reason:** Carve-outs alone do not directly address any of the financing or subscriber acquisition challenges associated with LMI subscriptions.

Annual Community Solar Installations in Xcel Energy Colorado's Programs: kWh and % share subscribed by LMI



Source: NREL, Xcel Energy

Why Subscriber Acquisition Is a Challenge in the LMI Customer Segment

Consumer Product Design

- *Rigid contract terms may not align with LMI customer preferences*
- *Subscription offerings may not generate sufficient savings for LMI customers*

Source: Low-Income Solar Policy Guide, 2018; Lotus Engineering and Sustainability, 2015; Colorado Energy Office, 2017; GTM Research and Wood Mackenzie

- **Rigid Contracts That Do Not Align With LMI Customer Preferences:** Many low-income subscribers are tenants of multifamily buildings and are more likely to move every few years. But today's subscription terms are often structured as 20- to 25-year subscription agreements, which do not align with the needs of LMI customers who tend to be more mobile than residential homeowners.
  - **Note on Affordable Housing Customers:** As mentioned, certain affordable housing buildings that are tenant-metered face additional constraints of utility allowance methodologies that can limit or zero out community solar bill savings, while PPAs with public housing customers (master- or tenant-metered) may only be allowed to claim 50% of bill savings and may not even be granted approval for PPAs with durations greater than five years. Given that, there is a major misalignment between today's 20- to 25-year pay-as-you-go subscription agreements and the needs of tenant-metered affordable housing customers and most public housing customers.
- **Inability to Generate Sufficient Savings:** The majority of community solar subscriptions offer residential customers between 5% and 20% year 1 savings. However, for LMI customers, it has been found that even 10% to 20% percent savings is not sufficient because of the higher energy burden of low-income households (discussed further in a subsequent section of this report).
  - **Note on LMI Retail Rate Schedules:** A number of utilities offer LMI customers alternative, lower retail rates via ratepayer assistance programs. These retail rate discounts pose an unintended challenge of lowering community solar bill credits when subscribers are compensated via net metering.

Why Subscriber Acquisition Is a Challenge for the LMI Customer Segment (Cont.)

Lead Generation and Sales

- *Community solar providers may lack internal capabilities and resources to scale up LMI-oriented sales channels*

- **Identifying and Verifying Which Customers Qualify as "LMI" is Challenging:** Community solar providers lack standardized processes to identify which households qualify as low or moderate income, and must pay additional soft costs to partner with outside organizations to support the customer identification process.
- **Challenges of LMI Customer Oriented Marketing:**
  - **High Trust Barrier to Overcome When Selling Subscriptions to LMI Households:** Without possessing a pre-existing relationship with LMI customers, and even in some cases with those relationships, it takes multiple conversations to gain trust from an LMI household to sign up for a deal that when structured correctly (i.e., at least 20% to 50% year 1 bill savings) may be viewed as too good to be true.
    - **Note on Affordable Housing Customers:** Affordable housing property owners can be hesitant to disclose information on tenants, so the community solar provider sometimes must overcome an additional trust barrier with the property owner in order to secure leads in the first place.
  - **Community Solar Providers Tend to Lack Internal Expertise to Tap Into Necessary Sales Channels:** Marketing collateral and sales channel strategies are not a one-size-fits-all approach when seeking to tap into households that are multicultural and multilingual, lack internet access and/or are already enrolled under other affordable energy assistance programs. Such factors impact the degree of consumer awareness an LMI customer has entering an initial sales pitch and the diversity of sales channels required to increase the funnel of high-quality leads.
- **The Challenge of Multiple Bills:** Oftentimes, a subscriber must pay a separate bill to the community solar provider in addition to the customer's remaining bill owed to the utility. This requirement has been a challenge in the subscription acquisition process for LMI customers with burdensome preexisting financial obligations.

Source: Low-Income Solar Policy Guide, 2018; Lotus Engineering and Sustainability, 2015; Colorado Energy Office, 2017; Wood Mackenzie

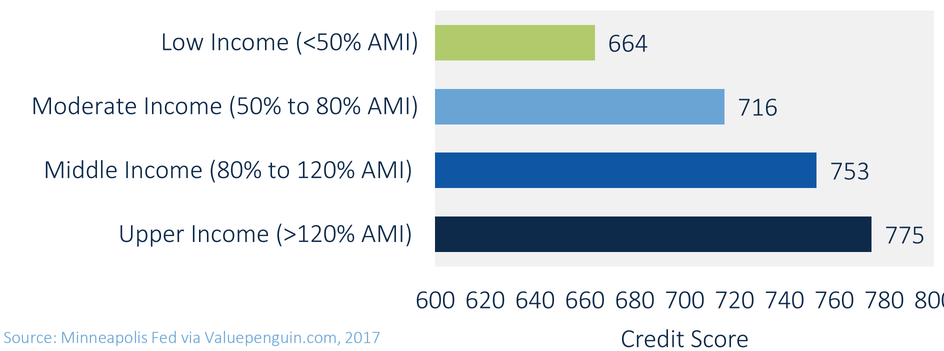
Project Finance Challenges

Why it is currently more difficult and expensive to raise capital for projects backed by LMI subscribers

Project Finance Challenges

- *LMI customers may lack sufficient capital and/or adequate credit scores for community solar providers to raise capital at the same cost of financing as projects backed by residential subscribers with high credit scores and investment-grade C&I subscribers.*

National Median Credit Score by Income Bracket



Source: Minneapolis Fed via Valuepenguin.com, 2017

- **Credit and Income — The Lifeblood of Distributed Solar Project Finance:** Both credit score and income are key elements of a consumer credit underwriting process. For rooftop and community solar, investors across the capital stack typically seek credit scores of at least 680 for any project involving a residential customer.
    - However, LMI customers often lack sufficient capital to prepay subscriptions (which community solar providers sometimes require LMI customers to do to mitigate perceived risk of customer default). Also, LMI subscribers — especially those with credit scores below 680 — can fail to meet the minimum credit scores required for lenders to finance a project. ***However, it is important to note that while there might be overlap, there is not a 100% correlation between low credit scores and low income levels.*** High-income customers can have low credit scores as well.
- **Different Needs for Low Income vs. Moderate Income:** Given that moderate income customers might have higher credit scores, conversations with market participants suggest that certain financing solutions to attract capital for LMI community solar projects, such as credit enhancements administered by green banks, have proven more successful at tapping into moderate-income customers. Additional strategies, such as incentives or leveraging existing LMI subsidies/programs, to improve the affordability of subscriptions may still need to be paired with project-level financing solutions to access the low-income segment.

Source: IREC, 2016; GTM Research and Wood Mackenzie, Sustainable Capital Advisors

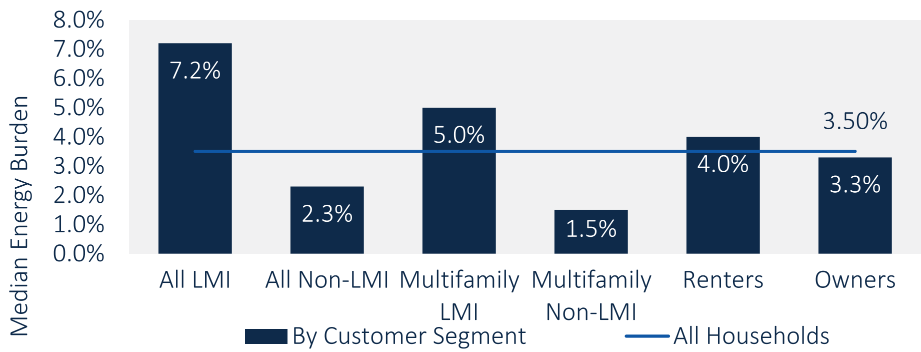
Realizing the Low- and Moderate-Income Opportunity

Policy & Market Solutions to Scale LMI Adoption of Community Solar

Key Elements of a Compelling LMI Offering

Higher % annual savings paired with shorter contract terms and minimal upfront investment

National Median Energy Burden for Electricity and Heating Fuels: All Households vs. Customer Segments

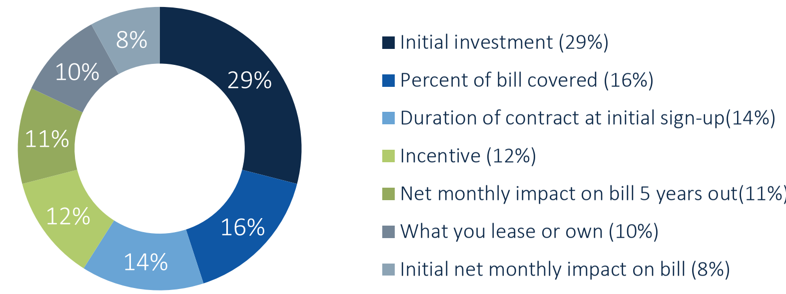


Higher Energy Burdens for LMI Subscribers Require Higher % Bill Savings

- The concept "energy burden" refers to the percent of income spent on energy bills. Given that household electricity consumption does not vary as widely as household incomes, the energy burden is greater for low-income households. In fact, on a national basis, all LMI households have more than three times the energy burden of non-LMI households.
- **Expected Savings:** Conversations with market participants validate the fact that higher energy burdens mean that community solar subscriptions need to offer anywhere between at least 20% and upwards of 50% year 1 bill savings in order to secure commitments from LMI subscribers. The lower end of that range is more viable for master-metered affordable housing property owners, where bill savings are not always directly passed through to the tenants.
  - One notable exception to that range is in Colorado, where much of the initial community solar capacity installed that serves LMI subscribers offers greater than 50% bill savings.

Source: Pacific Consulting Group 2017, SEPA Webinar; ACEEE, 2016; GTM Research and Wood Mackenzie

Considerations for LMI Subscribers' Participation in Community Solar



Leading Considerations for LMI Customers When Assessing a Subscription

- **Initial Investment:** Market participants note that higher energy burdens make pay-as-you-go subscription offerings with zero or minimal upfront payments especially attractive subscription offerings for LMI customers.
- **Percent of Bill Covered:** Given that LMI subscribers may be on a retail-rate schedule or enrolled in an energy assistance program that lowers their electricity bills, it is critical that a community solar subscription covers as close to 100% of a customer's electricity consumption as possible to ensure sufficient bill savings.
- **Subscription Length:** Since LMI renters are more likely to move every few years, flexible subscription terms that allow for a subscriber to opt out of the contract in less than 20 to 25 years (i.e., the current industry range for subscriptions) are another key differentiator.
- **Streamlined Billing:** Additional bills are a significant barrier for low-income customers. Billing needs to be as streamlined as possible, for example, by being integrated into a single platform or on-bill (per recommendation on Slide 63), or by allowing benefits to be transferred through an intermediary purchaser or service provider.

Evolving Program Design to Address Major Barriers to LMI Adoption of Community Solar

Current State of Program Design

- *Today's LMI program designs primarily include carve-outs and incentives that at best result in community solar providers meeting, not exceeding, LMI subscription requirements.*

Source: Low-Income Solar Policy Guide, 2018; Lotus Engineering and Sustainability, 2015; Colorado Energy Office, 2017; Wood Mackenzie

Menu of Market and Policy Solutions

- **Carve-Outs:** Tailored LMI carve-out requirements could be created for affordable housing and all other LMI subscribers, including distinct carve-outs for master-metered and tenant-metered affordable housing buildings. Providing carve-outs at the program level may also be useful to provide program administrators with flexibility to implement 100% LMI programs.
- **Incentives:** Performance-based and upfront incentives and incentive adders could be set for different types of LMI customers, such as varying incentives for affordable housing, low income and moderate income participation.
- **Flexible Subscription Rules for Affordable Housing Customers:** Affordable housing property owners typically own multiple properties across a utility service territory. Allowing affordable housing subscribers across multiple load zones to subscribe to the same community solar project is a key program design feature to increase the funnel of leads and support subscriber acquisition efforts.
- **Organizational Backstops and Intermediaries:** Program administrators could also allow housing authorities, state energy offices, cities and nonprofits to serve as financial backstops in the event that LMI customers default, and/or serve as intermediaries to purchase and pass through community solar benefits and savings to LMI customers.

Program Design Evolutions

- *Community solar providers possess sufficient incentive funding and revenue stream certainty from projects with LMI subscribers to lower the cost of LMI subscriber acquisition and lower the cost of capital for projects with LMI subscribers as well.*

Evolving Program Design to Address Major Barriers to LMI Adoption of Community Solar (Cont.)

Current State of Program Design

- *Today's LMI program designs primarily include carve-outs and incentives that at best result in community solar providers meeting, not exceeding, LMI subscription requirements.*

Source: Low-Income Solar Policy Guide, 2018; IREC, 2016; Lotus Engineering and Sustainability, 2015; Colorado Energy Office, 2017; Wood Mackenzie

Menu of Market and Policy Solutions (Continued)

- **Allow Subscriptions to Exceed 100% of Customer Load:** Given the relatively lower energy consumption profiles of LMI subscribers, along with utility allowances and energy assistance programs that can reduce community solar bill savings, allowing LMI customers to subscribe to more than 100% of their customer load can help ensure sufficient bill savings.
- **Removing Caps for Large C&I Anchor Subscribers' Share of Community Solar Projects:** This strategy can enable investment-grade anchor subscribers to provide a backup guarantee to increase its subscription if any LMI subscribers default.
- **Guaranteed Bill Credit Values for Low-Income Subscribers:** Given the higher energy burden that LMI customers face, it is that much more important for LMI subscribers to have predictability in their energy costs. By leveraging ratepayer assistance funds or some other public funding source, program administrators could guarantee bill credit values for LMI subscribers.
- ***The next slide outlines key factors to consider when involving regulated utilities in community solar programs for LMI subscribers.***

Program Design Evolutions

- *Community solar providers possess sufficient incentive funding and revenue stream certainty from projects with LMI subscribers to lower the cost of LMI subscriber acquisition and lower the cost of capital for projects with LMI subscribers as well.*

Factors to Consider When Involving Regulated Utilities in LMI Community Solar Programs

Involvement from regulated utilities should support competitive market development, while ensuring community solar programs are designed to be in the best interests of LMI subscribers and all ratepayers

- Utilities have resources that can be used to address subscriber acquisition and project finance challenges associated with LMI participation in community solar. Some of those resources include **customer information, access to cheap financing, a longstanding customer relationship and the utility brand itself.**
    - At the same time, **it is important to ensure that utility participation does not stifle the solar market's ability to drive down costs** through competition or edge out community-driven and nonprofit solutions. Also, if utilities build and own community solar projects with LMI subscribers, regulators must ensure such programs are designed in the best interest of LMI customers and ratepayers. More broadly, any utility-led program should be designed to ensure fair market competition, which should allow for the LMI community to benefit from the most attractive offerings.
- There are a number of **best practices that utilities could implement** to address both subscriber acquisition and project finance challenges. The below strategies are options that could be considered in tandem with all of the preceding program design solutions outlined in the prior two slides:
    - *Facilitate LMI subscriber enrollment, education and engagement*
    - *Facilitate on-bill payment and/or financing to increase low-income customers' access to solar*
    - *Facilitate siting for solar projects that will serve low-income customers*
    - *Serve as a backup subscriber in the event that LMI subscribers default*
    - *Facilitate the participation of other large entities as backup subscribers*

Source: *Working Draft -- Principles and Recommendations for Utility Participation in Solar Programs for Low-Income Customers, 2018*

Evolving Subscriber Acquisition to Address Barriers to LMI Adoption of Community Solar

Current State of Subscriber Acquisition

- *Community solar providers often lack internal capabilities and resources to scale up LMI-oriented sales channels, while offering standard subscriptions with rigid contract terms that may not align with LMI customer preferences and savings expectations.*

Menu of Market and Policy Solutions

- **Integrating community solar with energy efficiency and energy assistance programs:** By pairing community solar with energy efficiency and energy assistance programs, such as the Low Income Home Energy Assistance Program (LIHEAP), community solar subscriptions are more likely to reach at least 20%-50% savings via a bundled product offering. Certain states, such as Colorado and Minnesota, are also using LIHEAP to finance community solar projects, recognizing that community solar can serve as a long term, flexible solution to energy assistance.
- **Partnerships with organizations that already have established trust or have direct experience building trust with LMI communities:** By partnering with affordable housing property owners and other low-income-oriented community organizations, community solar providers can access customer data to more efficiently verify that a subscriber meets the definition of low or moderate income and design more tailored subscription offerings that meet the needs of LMI subscribers in that particular community.
- **Tailor marketing campaigns and sales channels to the needs of LMI customer preferences:** Conversations with market participants suggest that more than one sales channel and conversation are needed to secure an LMI subscriber. But in-person events, workshops or door-to-door campaigns that involve a trusted organization are particularly effective best practices for overcoming trust barriers among LMI leads.
- **Importance of building out a waitlist:** Given that LMI renters tend to move every few years, on average, it is critical to build out a pipeline of customers to manage LMI subscriber turnover.

Subscriber Acquisition Evolutions

- *Community solar providers tailor subscription offerings to be flexible, short term and eclipse 20% year 1 savings, while leveraging community partnerships to develop scalable LMI-oriented sales channels that lower the costs of subscriber acquisition and retention.*

Source: Low-Income Solar Policy Guide, 2018; IREC, 2016; Lotus Engineering and Sustainability, 2015; Colorado Energy Office, 2017; Wood Mackenzie

Evolving Project Finance to Address Barriers to LMI Adoption of Community Solar

Current State of Project Finance

- *Many LMI subscribers lack sufficient capital and/or adequate credit scores for community solar providers to raise capital at the same cost of financing as projects backed by residential subscribers with high credit scores and investment-grade C&I subscribers.*

Menu of Market and Policy Solutions

- **On-bill financing:** This financing tactic involves the LMI subscriber repaying the costs on his or her utility bill. Conversations with market participants suggest that this tactic could lead to lower default rates and a more compelling sales pitch if a subscription payment is structured as a line item on a customer's utility bill.
- **Rolling out green banks to provide credit enhancements:** Green banks can serve a critical role of providing low-cost public financing to attract private capital at cheaper financing terms. Key tactics include credit enhancements, such as loan loss reserves or loan guarantees, which set aside capital to cover losses incurred during the loan term. Such financing mechanisms can provide a pool of capital to provide lenders with a backstop against customer default, as community solar providers prove out subscriber retention strategies to reduce the perceived risk of customer default over time.
- **Moving beyond credit score to alternative underwriting assessments:** Given that a FICO score is not necessarily the most accurate indicator of an LMI customer's likelihood to pay a subscription, lenders could consider more tailored, alternative underwriting criteria, such as an LMI subscriber's utility bill payment history.
- **Layering on additional tax credits:** Market participants note that some community solar providers have been able to attract investors that can layer on additional tax credits, such as the LIHTC, to further defray upfront installation costs.

Project Finance Evolutions

- *By tapping into alternative consumer finance strategies and/or public sources of capital, community solar providers will have an opportunity to minimize the perceived risk of higher customer default across LMI subscribers that possess low credit scores.*

Source: Low-Income Solar Policy Guide, 2018; IREC, 2016; NREL, 2016; GTM Research and Wood Mackenzie

Putting the Vision Together: Scaling LMI Adoption of Community Solar

An Evolution in Program Design, Subscriber Acquisition and Project Finance

Current State of Program Design

Today's LMI program designs primarily include carve-outs and incentives that at best result in community solar providers meeting, not exceeding, LMI subscription requirements.

Current State of Subscriber Acquisition

Community solar providers often lack internal capabilities and resources to scale up LMI-oriented sales channels, while offering standard subscriptions with rigid contract terms that may not align with LMI customer preferences and savings expectations.

Current State of Project Finance

Most LMI subscribers lack sufficient capital and/or adequate credit scores for community solar providers to raise capital at the same cost of financing as projects backed by residential subscribers with high credit scores and investment-grade C&I subscribers.

Program Design Evolutions

Programs offer sufficient financial support and other resources for community solar providers to exceed program-level LMI carve-outs:

Community solar programs pair carve-outs with sufficient incentive funding that varies by customer type within the LMI segment, integrate with other energy assistance programs, support creative solutions that address LMI customer default risk for community solar providers, and include strong consumer protections for more financially vulnerable LMI subscribers.

Subscriber Acquisition Evolutions

Community solar providers design subscription offerings and invest in sales channels that are specific to LMI customers' preferences and needs:

Community solar providers tailor subscription offerings to be flexible, short term and eclipse 20% year 1 savings, while leveraging community partnerships to develop scalable LMI-oriented sales channels that lower the costs of subscriber acquisition and retention.

Project Finance Evolutions

Low-cost sources of private bank and institutional investor capital are willing to finance portfolios of projects with 20% to even up to 100% LMI subscribers:

Financing strategies, such as on-bill financing, alternative credit scoring or credit enhancement, loan loss reserves and green banks, enable community solar providers to access financing while proving out business models that erase perceived risk of higher customer default across LMI subscribers.

5. Charting Potential Adoption for Community Solar

Quantifying the Phases of Market Transformation

A Market Transition in Three Phases

PHASE I: Market Emergence

The business model for community solar is being proven out and tailored to fit local regulations and risk-averse investor sentiment.

Costs have a strong premium for interconnection upgrades, subscription acquisition and subscription management.

LMI adoption is limited to programs that pair carve-out requirements with sufficient incentive funding.

PHASE II: Market Transition

Community solar begins to flourish as policymakers and regulators see its economic and societal values. Programs are uncapped and solar is compensated based on negotiated or studied value.

Community solar costs fall rapidly through programmatic, policy and industry innovations, as well as specific improvements to subscription acquisition and management.

LMI adoption improves as regulators implement incentives and other support programs to exceed carve-out requirements.

PHASE III: Market Maturity

Community solar is an attractive default option as customers and policymakers recognize the broad grid, environmental and even socioeconomic values of solar.

Community solar costs have levelized but deliver cost-competitive energy with an accounting of environmental, societal and grid benefits.

Strong LMI support programs and improved subscriber retention models result in LMI customers being viewed similarly to medium- and high-income subscribers.

Building an Adoption Forecast for Our Envisioned Market Transformation

To forecast potential customer adoption, we assume that the necessary community solar policies and industry innovations previously described are in place, including inclusion of strong support for low- and moderate-income adoption.

Our forecast focuses on economic adoption based on pragmatic bill crediting and solar valuation outlooks via historically-observed and literature-based customer adoption curves for distributed solar. Constraints based on local distributed solar adoption, market resource mix and known near-term broad market policies are also applied.

Our analysis also attempts to quantify key inputs in the following categories:

Subscription costs

- Based on the costs to build and finance community solar, how much would subscribers pay for community solar?
- Key assumptions: System lifetime, all-in costs, operation costs, subscriber acquisition and management, interest rates, investor rate of returns

Customer benefit

- Based on assumed subscriber offerings, what is the economic benefit for subscribers compared to either a bill credit or valuation for community solar?
- Key assumptions: Compensation mechanism and rate for community solar

Market segment-specific adoption

- How does adoption differ between residential, non-residential (commercial, industrial, government and nonprofit) and low- and moderate-income market segments (including affordable housing tenants and property owners)?
- Key assumptions: Addressable market for each segment, desired benefits for each segment (residential, low- and moderate-income residential, affordable housing, small non-residential, and large non-residential, value comparison to adoption by onsite distributed solar options, assumption of LMI adoption-focused policies and subscription offerings

Charting a Path for the Cost of Community Solar Subscriptions

Collating the innovations and cost reductions identified in our Section on "Reducing the Cost of Community Solar", we chart potential community solar subscription costs

Our national roadmap for community solar costs and other asset parameters may be viewed as conservative:

- Most community solar assets have an expected functional lifetimes well beyond the typical 20- or 25-year subscription period.
- All-in prices for solar have fallen by over 40% in the past five years, whereas we expect only a 30% cost reduction over the next 12 years.
- All-in operation costs are held steady in our model although many industry stakeholders expect asset management and operations and maintenance costs to fall due to scale, focus on operational efficiencies and better software tools.

Meanwhile, we note that while project finance costs have dipped as new, low-cost of capital sources enter the market, rising interest rates, tax revisions and any number of macroeconomic factors could raise the cost to finance solar.

Even so, community solar holds a number of cards to reduce the cost of capital, including the asset securitization or reducing real and perceived payment risk with new qualification metrics. Shifting financiers' attention to "subscriber platform" risk rather than focusing on individual subscribers could also help keep the long-term cost of capital steady.

KEY ASSUMPTIONS (NATIONAL)	2018	2025	2030
Asset Life (years)	25	25	25
All-In Price, Not Including Subscription Acquisition ($/Wdc)	$1.95	$1.46	$1.36
All-In Operation Costs ($/kW/year)	$15.0	$15.0	$15.0
Subscriber Acquisition Costs ($/Wdc)	$0.20	$0.14	$0.05
Subscriber Maintenance Costs ($/W/year)	$0.02	$0.02	$0.01
Interest Rate (%)	5.0%	5.0%	5.0%
Equity IRR (%)	9.0%	9.0%	9.0%
Interest Rate (%)	5.0%	5.0%	5.0%
Debt Fraction (%)	40%	40%	40%

State-Level Differences in Community Solar Cost Inputs

We build state- and utility-level cost inputs by adjusting national level inputs based on proprietary forecasts and industry interviews. Differences include:

- **Capacity factor**: Primarily a function of solar resource and system type (single-axis tracking vs. fixed tilt PV). We use PVWatts to model local performance for each major state investor-owned utility.
- **Upfront costs**: While equipment costs are relatively even across state lines, local permitting, labor, taxes and other soft costs can vary considerably even for larger solar projects.
- **Operation costs**: O&M costs differ slightly between states. The primary differences are typically the result of property taxes, insurance and ongoing land leases.
- **Subscriber acquisition and management:** Given relatively low experience to date with community solar, acquisition costs are difficult to estimate. We believe that more competitive states with higher rates of solar deployment will have higher acquisition costs.
- **State-level incentives**: We do not model in any new incentives — especially important for New Jersey where the state is embarking on an SREC successor program.

KEY ASSUMPTIONS	CA	FL	MI	NJ
PV System Type	Single-Axis	Single-Axis	Fixed Tilt	Fixed Tilt
Capacity Factor (%)	21%-22%	18%-21%	13%-15%	14%-16%
Upfront Costs vs. National	+7%	-2%	+4%	+9%
Operation Costs vs. National	+50%	---	---	+25%
Subscriber Acquisition and Management Costs vs. National	+50%	---	---	+25%
Weighted Cost of Capital	7%	7%	7%	7%
State-Level Incentives	None	None	None	SRECs until program expiry

How Could Community Solar Be Valued in the Future?

PHASE I: Retail Rate → PHASE II: Two Value of Solar Options → PHASE III: Moderate Value of Solar

Based on recent policy action on compensation structures, we expect that community solar will evolve from full retail net metering in states with growing distributed solar deployments

- According to the Database of State Incentives for Renewables & Efficiency, 31 states and Washington, D.C. have introduced policy action on distributed generation compensation in 2017 alone.
  - At the time of writing, a value-of-solar methodology for community solar is currently implemented in three geographies: Austin Energy, Minnesota and New York.
  - Other geographies are in the process of considering a value-of-solar mechanism, including Illinois and Oregon, although the implementation has been stalled in Oregon due to Oregon Public Utility Commission concerns. In Illinois, the value of solar will determine a rebate paid to the project owner for community solar, not a bill credit rate.

Given the difficulty in predicting precisely where policy will land at a state—or even broad national—level, we make the following assumptions for community solar in each phase with solar estimates:

- Phase I: Retail net metering offsetting all volumetric charges
- Phase II: Two Scenarios —Limited Scenario (Limited Value of Solar) and Moderate Scenario (Moderate Value of Solar) - Explained more fully in “Phase II: What Might a Transitional Credit Look Like?”
- Phase III: Moderate Value of Solar that includes many though not all benefits from community solar

In addition to a fair compensation level, a sustainable community solar program requires stable and long-term credits and values to ensure attractiveness to the customer and financeability.

The Examined Community Solar Compensation Paths

While a movement away from full retail-rate net metering is likely, when and how this will occur remains in the realm of speculation

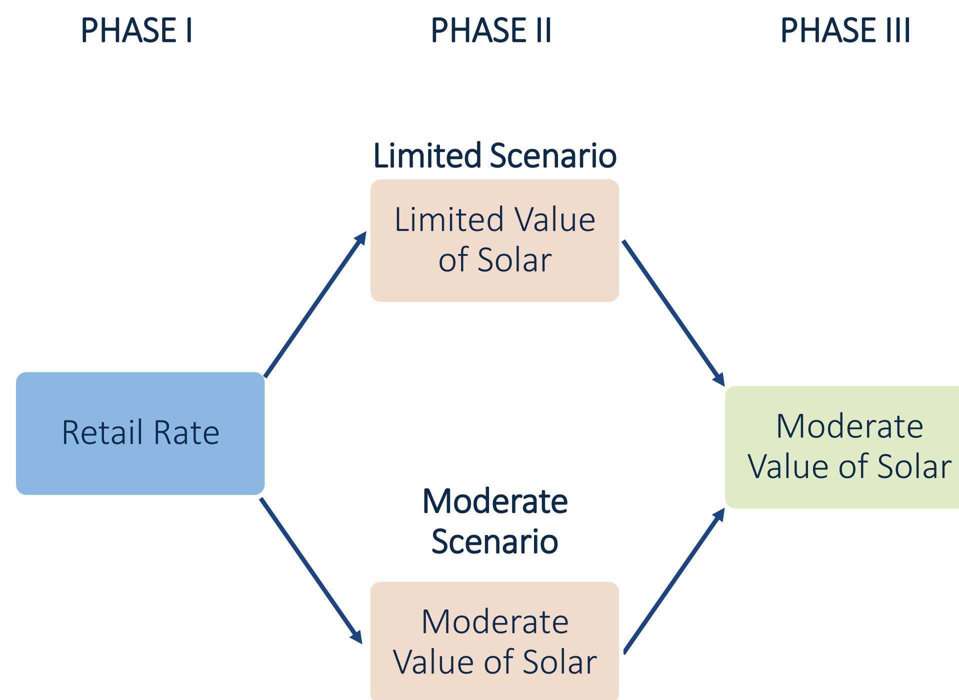
Every state is in a different place in terms of solar penetration and political atmosphere for a transition away from retail-rate net metering. Even in states undergoing a change (e.g., Michigan), the rates are still unknown.

Rather than make a predictive stance as to when the four profiled state markets move into new compensation structures, we use two scenarios in Phase II to help us model customer adoption in Phase II:

- **Limited Value of Solar**: An estimate based on the literature that includes only a narrow set of grid benefits (see Value of Solar Cost Categories and Components)
- **Moderate Value of Solar:** An estimate using an increased, though not full, set of grid and environmental benefits (see Value of Solar Cost Categories and Components)

By Phase III, we model the market to converge on the moderate value of solar methodology that takes into account a greater range of benefits that community solar provides the grid, customers and the environment. As noted previous, due to uncertainty, our modeled moderate value still excludes additional economic and societal values as described in "Value of Solar Cost Categories and Components"

Value of Community Solar Compensation Mechanism for Each Market Phase



Phase II: What Might a Transitional Credit Look Like?

Considering the nascence of community solar and the uncertainty of the future of solar valuation, we examine two different scenarios for a transitional valuation of community solar.

Limited Scenario: This scenario represents an early transition to an export tariff that reflects compromise or an otherwise reduced scope of components that field a full value-of-solar tariff. These components include the marginal value of generation, avoided capacity, transmission and distribution equipment build-out and environmental compliance. However, it lacks recognition of further grid (e.g., ancillary services and demand reduction-induced price effects), societal, environmental and economic benefits. Examples of implementation include:

- Austin Energy: Austin Energy had the first implementation of a value-of-solar tariff, using mostly core components plus a societal rate for carbon
- Minnesota: A value-of-solar tariff that encompasses core value-of-solar components with valueless placeholders for future costs and credits

Moderate Scenario: This scenario reflects an environment that accepts that distributed solar could provide additional grid and societal values. ***An moderate value of solar credit may not be easily calculated for all markets nor will it necessarily capture every economic, societal and environmental benefit and cost.***

Practically, transitioning to an Moderate Value of Solar framework could take the form of either:

- **A limited value of solar with a market transition credit (MTC)**, where the MTC is used to give credit for uncertain values without requiring a deeper methodology for valuation. An example includes:
  - New York: Community solar is granted an MTC on top of the "Value of DER" components that serves as the base of community solar bill credits
- **"Retail minus"** representing a continuation of legislative and regulatory stakeholders that look for a convenient compromise between advocates of full retail-rate net metering and those seeking a low compensation rate for distributed solar. Typically seen as a temporary transition, retail minus simply assumes a credit with a fixed discount off of prevailing retail rate, but finding the "right" number can be arbitrary or speculative. Examples of implementation include:
  - NV Energy: Residential solar bill credit for exported generation starts at 95% of retail rate and steps down to 75% of retail rate based on installation "blocks"
  - Rocky Mountain Power (Utah): Residential solar bill credit is set at 90% of retail rate for exported generation

Value of Solar: Overview of Methodology

In Phase II, we use "value of solar" estimates that represent an average of proxy values from an extensive review of existing studies. ***These values are meant to be illustrative and should not be interpreted as a prescription or prediction for the actual value of solar in the studied states nor applied more broadly.*** The studied literature provide a convenient result for modeling potential adoption but may be incomplete, inaccurate or inconsistent with best practices, current conditions and a full set of benefits.

We estimate the value of solar in the four states in focus via the following steps

1. Conduct an extensive literature review of various value-of-solar studies with a focus on studies that provide component-by-component estimates
   - Categorize value-of-solar component values into general buckets as described in the next slide
   - Compare value-of-solar component estimates against EIA average retail electricity rates at the time of the study to derive a net discount/benefit (in %)
2. Weight relevance of each study according to its recency (i.e., when study was conducted), state and wholesale market structure
   - Recent, in-state studies are given the most weight whereas older, out-of-state studies with a different market structure (i.e., regulated vs deregulated) are given the least weight
   - Aggregate and average the estimated net discount/benefit off average retail rate to derive a regional/state-proxy estimate
3. Apply resulting average value-of-solar discount/benefit off retail to utility-specific retail rates to derive utility-specific value-of-solar costs
   - Rates are escalated according to Wood Mackenzie projected retail rates for each state

For a more detailed description of our value-of-solar methodology, see our Value of Solar Methodology in the Appendix

Caveats for Our Value of Solar Methodology

Value-of-solar estimates vary due to the inherent locational and temporal details and a lack of commonly accepted core assumptions and methodologies

While various handbooks, white papers and initiatives seek to establish a common language and a set of methods to calculate the value of solar, an inherently balkanized utility and regulatory landscape results in very different sets of methods and values.

A bottom-up analysis of value of solar in each territory would be extensive, complex and no less controversial nor more valid than our top-down analysis, due to limited data for critical pieces of the analysis. Our intent is to convey the promise of community solar — not set a value-of-solar rate that warrants adoption.

Our purpose is not to prescribe a "value of community solar," but rather to use existing frameworks and literature to create proxy values we can couple with strong community solar policies, product innovation and LMI inclusivity to paint potential community solar adoption. In short, these are illustrative values only and should not be viewed as a proper valuation study nor used as robust, geography-specific estimates.

We accept that there are a number of shortcomings in our calculated value of community solar estimates, including but not limited to the small population of studies and variations to study methodologies on calculated components. We believe that a number of studies fall short in building in the true value of solar because of scope, data and calculation limitations. Similarly, a handful of broad studies incorporate values that may not be realistically employed.

In short, our values represent a simplistic proxy where further standardization, study and clarity is much needed.

Quantifying a Limited and Moderate Value of Solar for Our In-Focus States

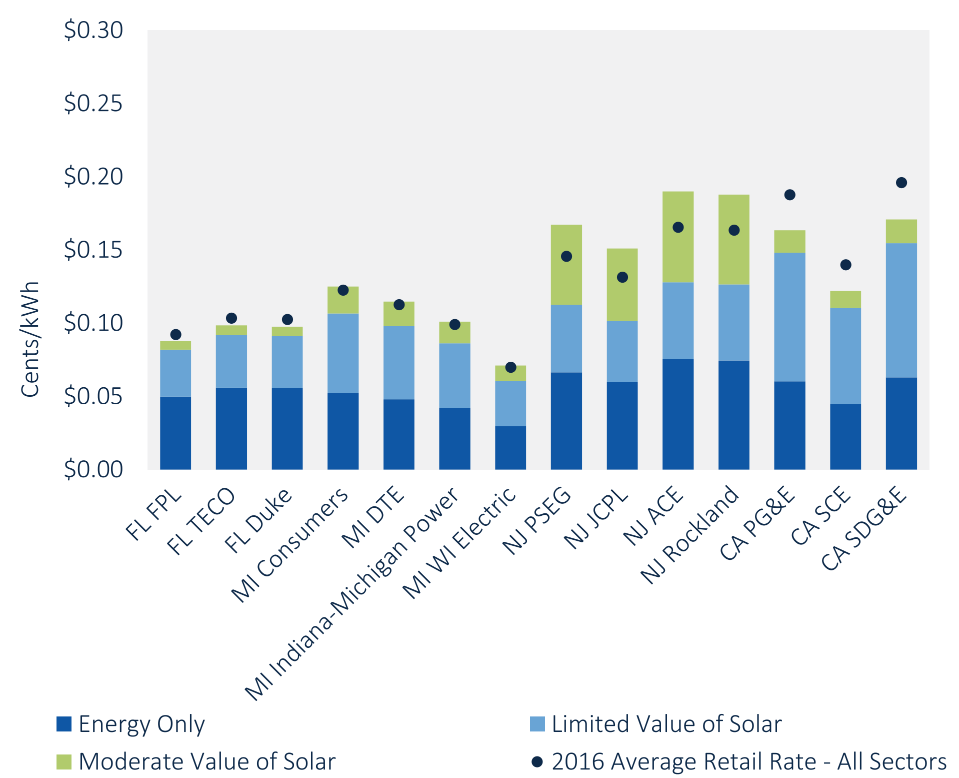
We build two value-of-solar estimates for each studied state

Despite differences in methodology, nearly all value-of-solar studies accept that distributed solar has value beyond the generated electrons (i.e., an energy-only value). However, adopted methodologies generally differ in which components are included and how these are calculated. Using our guide to different components, we come to two general categories of value of solar:

- **Limited value of solar:** Using only components that are more commonly calculated for value of solar in studies, including direct avoided costs and environmental credits that are directly monetizable (e.g., RECs)
- **Moderate value of solar:** Using a broader, but incomplete, set of components that pertain to grid value, excluding non-monetizable and more difficult-to-calculate societal benefits (e.g., social cost of emissions, jobs, low-income support).

Ultimately, our moderate value-of-solar averages range from a 13% discount to a 15% premium of average state-wide retail rates, with an average close to average retail rates. ***We also note that, due to the limitations of the literature reviewed, our moderate value of solar does not include a full benefit and cost accounting, including additional economic and societal benefits.***

Weighted Value of Solar vs. Average Retail Rate Based on Literature Review



Source: GTM Research

Identifying the Uncertainty and Potential Biases in Our Study

In addition to pragmatic differences in the reviewed studies' methodologies, we acknowledge the risk inherent to using a broad set of literature for values rather than a bottom-up calculation. The main risks to our utilized values include:

- **Bullish views on forward wholesale electricity prices:** Given the limitation of available data on the studied geographies and our intent for these estimates to be representatives rather than definitive, we employ a rough top-down average of existing studies rather than using best-in-class bottom-up calculations in each studied geography. Older studies may have more bullish views on natural-gas-driven wholesale energy prices, which would increase the long-term value of solar. We attempt to mitigate the impact of these factors by filtering out studies before 2010, as well as more heavily weighting recent studies with up-to-date views on energy and infrastructure costs.
- **Increasing solar deployment erodes the value of pure solar**: Our discount to average retail rate method could **overestimate the value of solar in high-penetration scenarios**, as concurrent solar generation does not mitigate all capacity costs and may increase certain integration costs. We assert that broad deployment of energy storage and flexible devices installed could mitigate the value erosion. These components will come at an additional cost but can also be utilized for services beyond mitigation of the effects of high solar penetration, adding value or potentially offsetting the costs of these additions.
- **Many value-of-solar studies take a limited view on broad values**: Our methodology averages in value-of-solar studies that ignore or cast aside best practice values, e.g., assuming capacity offset of solar is zero or assuming no ability to offset distribution equipment even at low solar penetration. In other circumstances, we look at estimates from regulatory filings in which the value-of-solar definition may be intentionally narrow, i.e., broader components are not even considered. Because these limited studies are also included in our averaged results, **our estimates may undersell the full value of solar**.

Overall, there is an inherent risk in mischaracterizing the value of distributed solar because current literature is incomplete or may otherwise inaccurately portray different component values. Significantly more work on a standard, agreed-upon framework and methodology should be implemented in markets that move towards a value of solar bill credit for community solar facilities.

Charting the Vision for Community Solar

California

California's Community Solar Market to Date

Community Solar in a Time of Transition

California has been a clear market leader in solar energy in nearly every aspect, making up just over 38% of overall U.S. solar deployed to date.

In 2016, California adopted time-of-use rates as mandatory for new net-metering customers as a first step toward reflecting the temporal costs and benefits of energy. Going forward, the California Public Utilities Commission committed to revisiting net metering in 2019 and in that context, consider export compensation, which takes into account locational- and time-differentiated values.

As the CPUC considers a change to the key tariff for distributed solar generators in the state, major changes in the composition of load-serving entities are occurring, with a majority of the state's load potentially transitioning to being served by community choice aggregators with ambitious clean energy goals. Community solar could be a means by which CCAs cost-competitively meet their goals for developing new local renewable energy resources and meet medium-term goals for being 100% renewable.

California by the Numbers

- Total Cumulative Solar: **19.8 GWdc**
- State Solar Rank*: **1**
- Solar % of Total Electricity: **13.2%**
- Community Solar: **21.1 MW**
- Community Solar Rank*: **3**

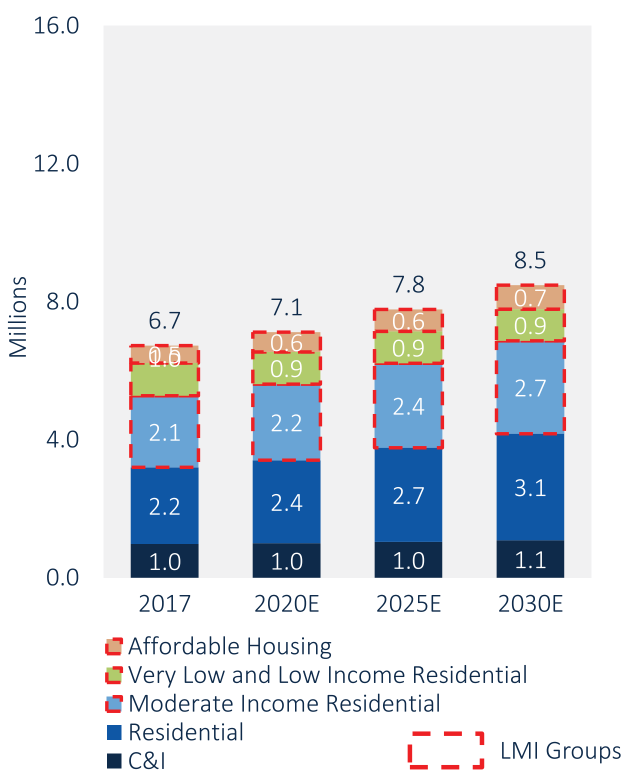
*By cumulative installed solar capacity

An Underwhelming Community Solar Program To Date

Under the Green Tariff Shared Renewables program enacted in 2013, the three CA IOUs are required to procure up to 600 MW of new renewables to which customers can subscribe. However, to date, only a few community solar projects are under development. In June 2018, the California PUC approved a program similar to the Green Tariff, where low-income customers living in polluted areas can receive a 20% overall bill discount from a local renewable project. However, these programs are not expected to drive significant amounts of capacity.

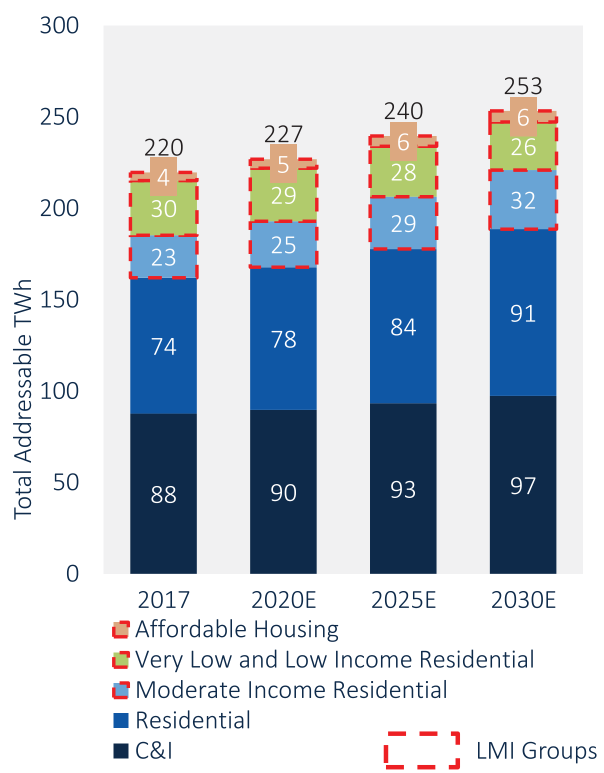
Total Addressable Market for Community Solar – California

Addressable Households and Organizations (#)



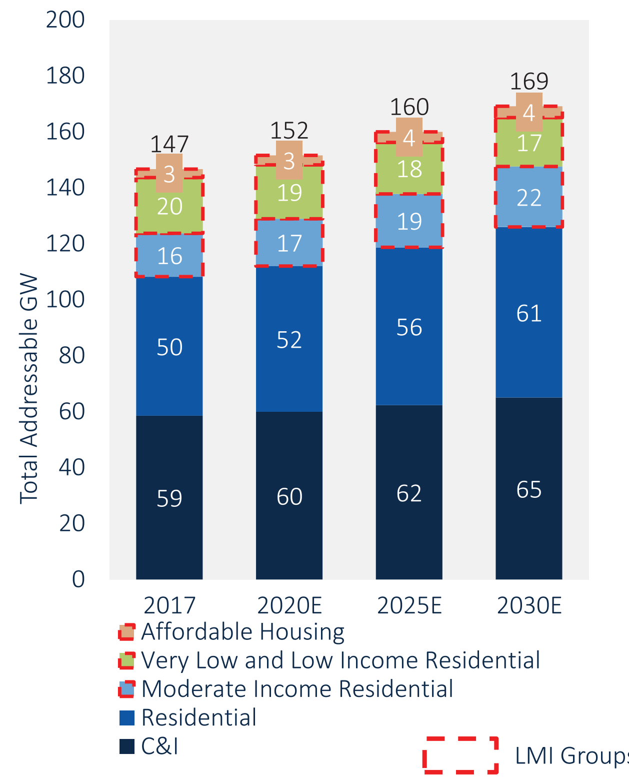
Source: GTM Research Wood Mackenzie, NREL, U.S. Census

Addressable Households and Organizations (TWh)



Source: GTM Research Wood Mackenzie, NREL, U.S. Census

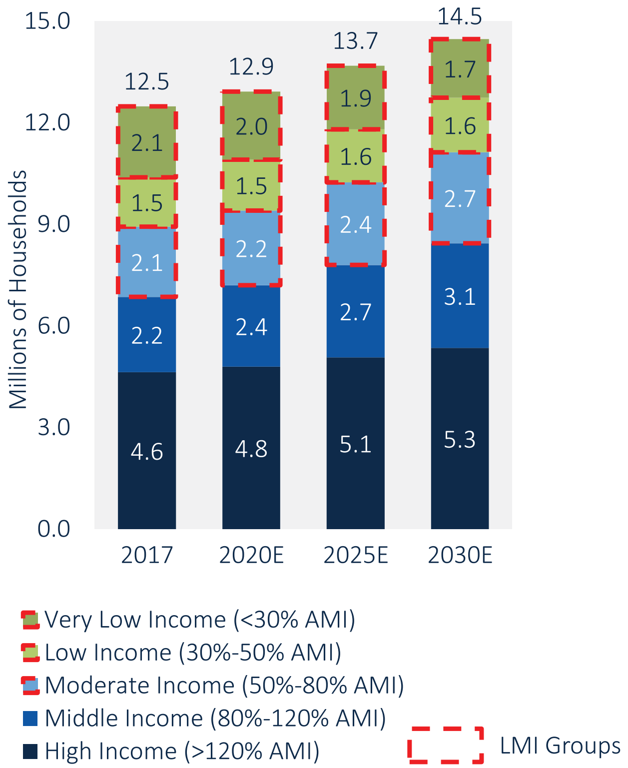
Addressable Households and Organizations (GW)



Source: GTM Research Wood Mackenzie, NREL, U.S. Census

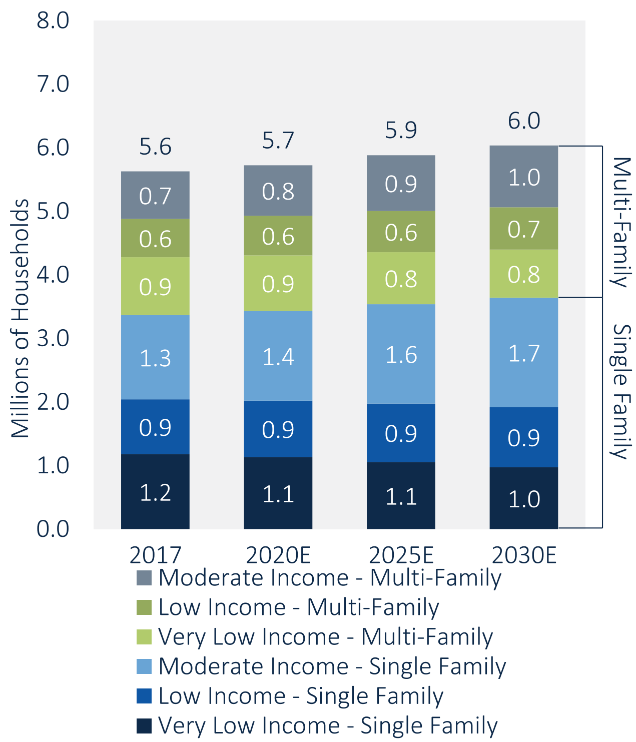
Low- and Moderate-Income Addressable Market – California

Residential Addressable Market by Income (# of HHs)



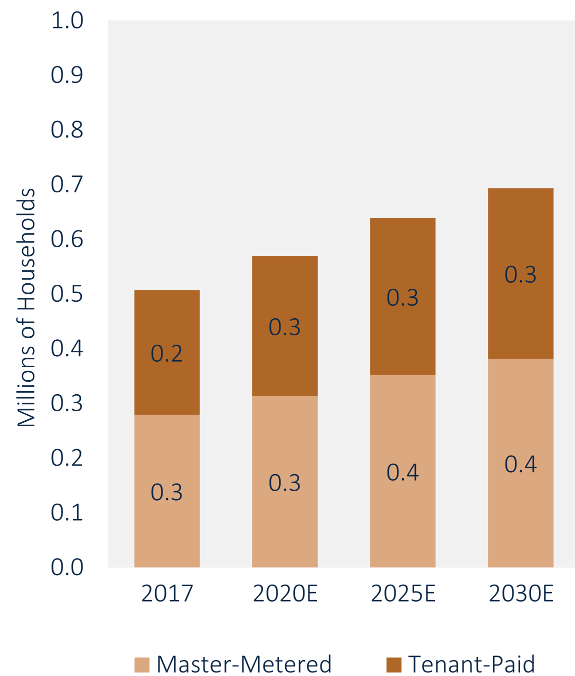
Source: GTM Research Wood Mackenzie, NREL, U.S. Census

LMI Households by Single- vs. Multi-Family Unit



Source: GTM Research Wood Mackenzie, NREL, U.S. Census

Affordable Housing Market by Type (# of HHs)



Source: GTM Research Wood Mackenzie, NREL, U.S. Census

Modeling Customer Benefits for Community Solar

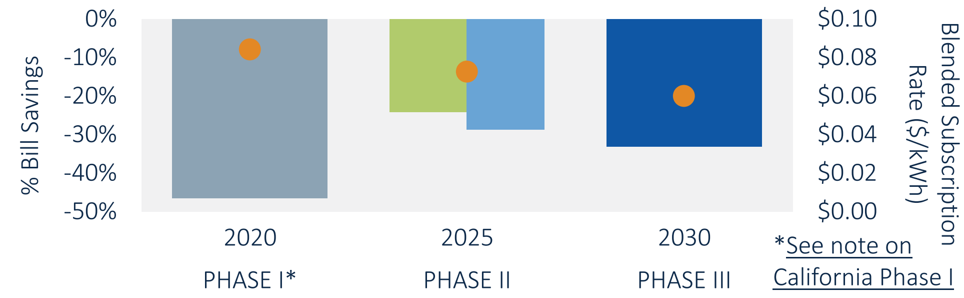
Community solar in California could provide strong savings across the board for all customer segments, although shifting peak periods and planned net metering revisions will influence future savings for residential customers

- Our model of residential community solar subscriptions account for time-of-use generation and rates, although no shifts in relative rates nor applicable periods are projected in the model.
- The CPUC is currently developing locationally variant valuations of distributed energy, which could form the basis of a value-of-solar-based successor to net metering

Growing penetration of utility solar has pushed peak generation periods into the evening. This shift is being seen in changing time-of-use (TOU) periods and would likely be reflected in time-variant value-of-solar rates.

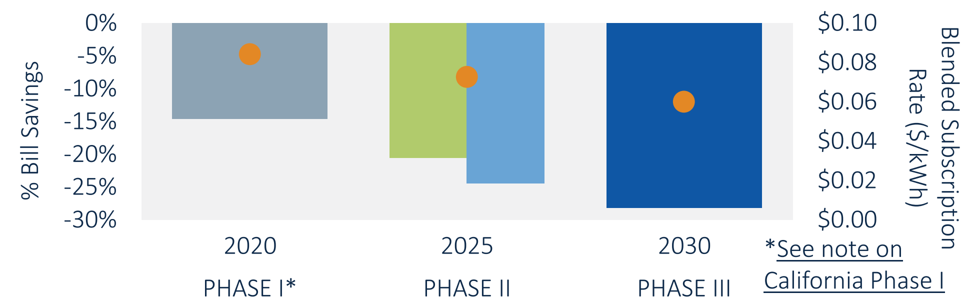
- Shifts will likely affect solar-only community solar; pairing with energy storage may be able to shift solar toward more valuable periods.
- With single-axis systems, community solar captures a small addition of late afternoon, early evening peak that contributes to more savings.
- For co-location of storage components to shift generation to when it's most beneficial for the grid, community solar with storage could capture significant cost economies of scale. For example, 4-hour duration front-of-the-meter battery systems are currently 70% the cost of residential systems on a $/kW basis.

Potential Residential Community Solar Subscription Rate and Bill Savings by Compensation Mechanism and Value, PG&E Territory



Source: GTM Research, Wood Mackenzie

Potential Large Commercial & Industrial Community Solar Subscription Rate and Bill Savings by Compensation Mechanism and Value, PG&E Territory



[1]Modeled subscription rate utilizes assumptions in "Charting a Path for the Cost of Community Solar"

California's Community Solar Deployments Could Reach 6.3 to 8.2 GW by 2030

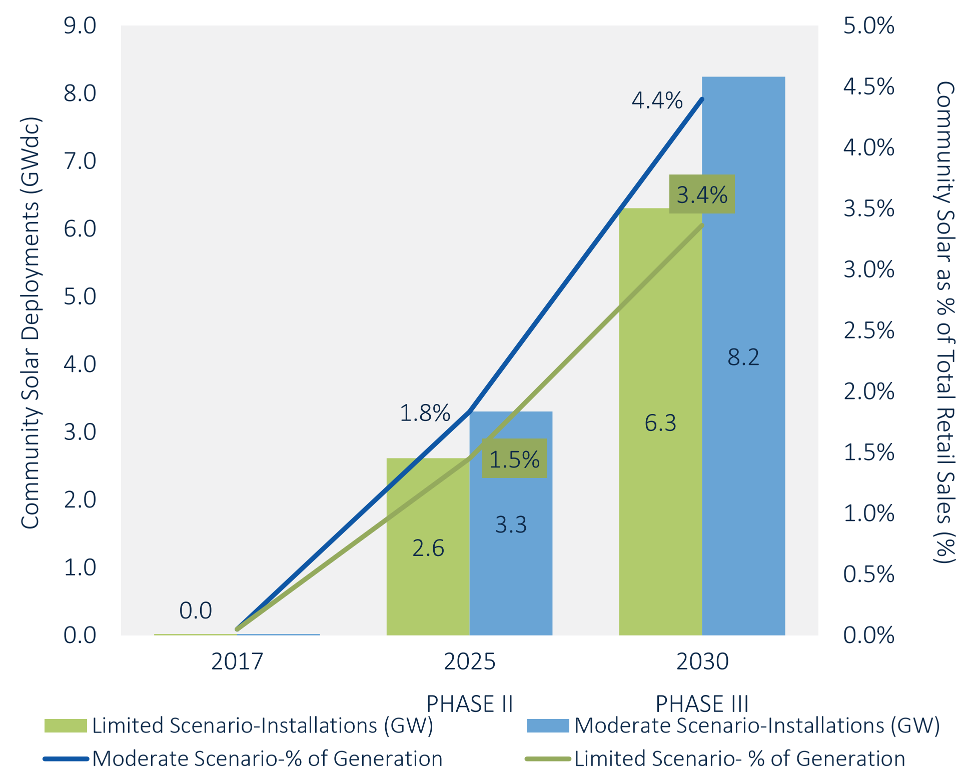
California could add a significant contribution to its diverse set of options for consumers with community solar.

While community solar may not be on the same growth path as utility solar — or even some segments of rooftop solar — it can provide a significant adder that uniquely serves renters and other residents that lack access to traditional rooftop options.

By 2030, community solar could contribute an additional 3.4% to 4.4% of solar to the state's electricity mix, serving nearly one million residents and businesses across the state.

Ensuring that community solar policy and facilities can respond to changing rates that look to temporal and locational values of energy will be critical in realizing these volumes.

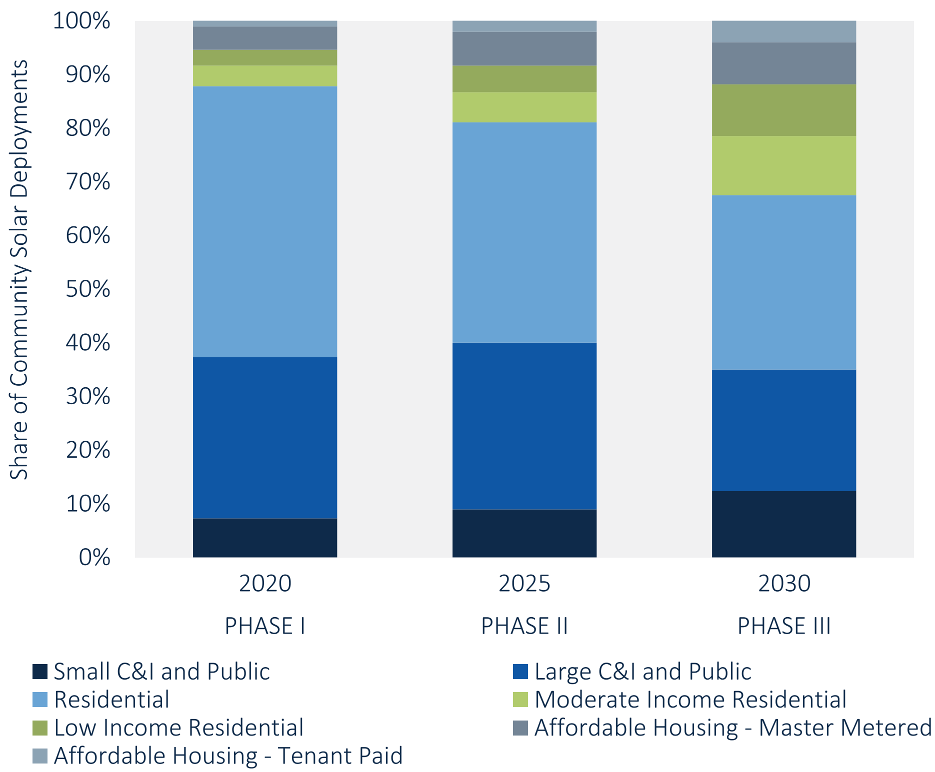
Cumulative Community Solar Market Potential: California



Source: GTM Research Wood Mackenzie

A Balanced Subscriber Mix for California Community Solar

California Community Solar Segmented Subscriber Adoption



Source: GTM Research Wood Mackenzie

With significant savings possible for all customer classes, California community solar could have a balanced subscriber mix

Although community solar does not necessarily compete directly with rooftop solar, community solar adoption needs to be considered against the backdrop of a large existing distributed solar base and the relative attractiveness of on-site generation — as well as changing rates due to the large volumes of utility-scale solar.

As such, community solar has relatively low total addressable market penetration — just 3%-4% of total residents and businesses, but the sheer size of California's market means that it's sure to be a community solar leader if a compelling program is created.

Community Solar in California: Market Potential

California is undergoing a significant energy transition, with a 50% renewables target for 2030 and solar already providing nearly 17% of total electricity consumption — over 6% from distributed generation alone. High deployments of solar have already sparked the transition to rates that reflect the temporal value of energy with the consideration of locational benefits. Meanwhile, major load pockets are shifting away from traditional load-serving entities to community-choice aggregators, which could use distributed and community solar as a means to meet clean energy goals.

By 2030, with strong enabling policies, community solar could reach half a million subscribers, supporting hundreds of thousands of renters, LMI individuals, and businesses that have so far been left with few options in the California energy transition.

Community Solar Market Potential in California, 2030 Vision Scenarios

Total Addressable Market: **15.6 million customers**

Total Community Solar Capacity Operating: **6.3 GW to 8.2 GW**

Annual Electricity Generated: **9.4 TWh to 12.4 TWh**

- Share of State Electricity Consumption: **3.4% to 4.4%**

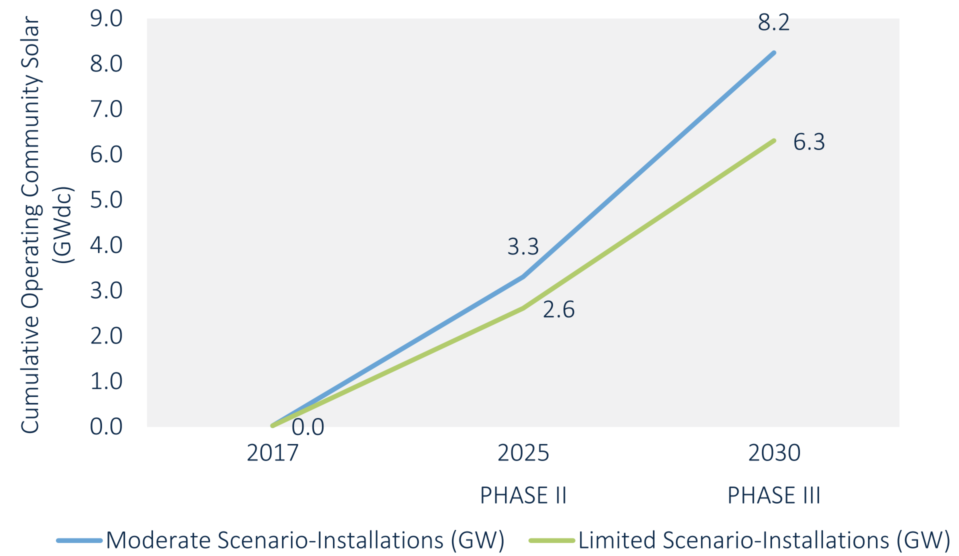
Subscribers Served: **747,000 to 964,000**

- Low- and Moderate-Income Households Supported: **440,000 to 550,000**

Cumulative Capital Invested*: **$9.8 billion to $12.8 billion**

Annual Spend on Operations, Leases and Taxes: **$125 million to $165 million]**

Community Solar in California: Market Potential



Source: GTM Research Wood Mackenzie

"Limited Scenario" and **"Moderate Scenario"** refer to the set of grid and environmental benefits included in the compensation for community solar. Neither reflect a full account of all costs and benefits, especially more difficult to calculate economic development and societal health benefits. Adoption forecast also includes assumptions of strong community solar and LMI adoption policy and continued subscription product innovations

*Cumulative capital invested represent total initial costs to build community solar plants, including all materials, installation materials and upfront supply chain, development and financing costs. Does not include ongoing operating costs

Charting the Vision for Community Solar

Florida

Florida's Community Solar Market to Date

Florida Overview

Florida does not have a statewide renewable portfolio standard in place, nor does it allow for third-party power-purchase agreements, both of which are often critical drivers for solar. Its recent growth comes primarily from utility solar installations – distributed solar makes up less than 20% of all statewide capacity.

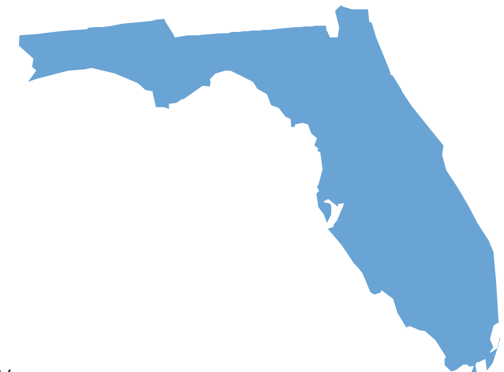
While several voluntary community solar programs have been approved by the Florida Public Service Commission or adopted by local municipal utilities, these generally present a limited value proposition to subscribers and almost universally charging a premium for subscriptions.

Nevertheless, solar's momentum is rapidly growing: Florida utilities are expected to install more than 4.6 GW of solar over the next five years, as solar costs in Florida are among the lowest in the country.

Community solar adds to the options for low-cost solar with resiliency to local businesses and the low- and moderate-income population as a key driver for its deployment.

[1] Reuters. "With 7.4 million without power, utility workers get respect"

Florida by the Numbers



- Total Cumulative Solar: **1.3 GWdc**
- State Solar Rank*: **10**
- Solar % of Total Electricity: **0.7%**
- Community Solar: **41.8 MW**
- Community Solar Rank*: **5**

*By cumulative installed solar capacity

Building community solar with a focus on resilience

In September 2017, Hurricane Irma wrought $50 billion[1] of damage across Florida and left 7.4 million customers without electricity at shortly after the storm. While power was restored quickly to most neighborhoods, distributed generation could be deployed to increase grid resilience.

Solutions like community solar-paired-with-storage or community solar-based microgrids may not prevent every outage, but they could provide a generation resource near vulnerable communities to help support critical infrastructure and reduce system restoration times.

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Exhibit SOU-14
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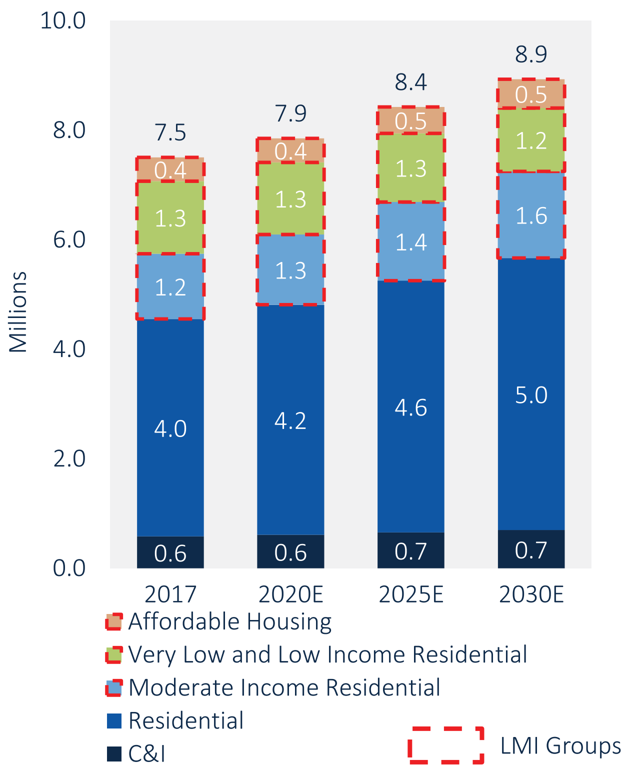
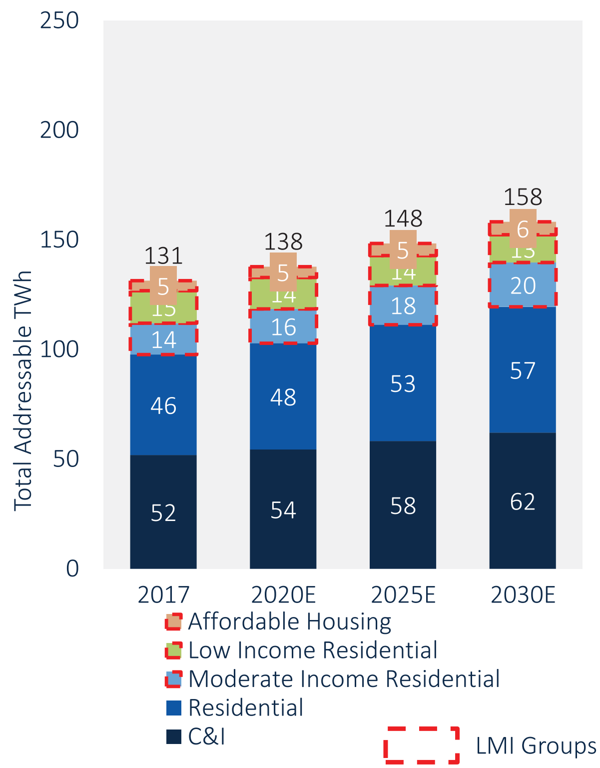
Total Addressable Market for Community Solar – Florida

Addressable Households and Organizations (#)



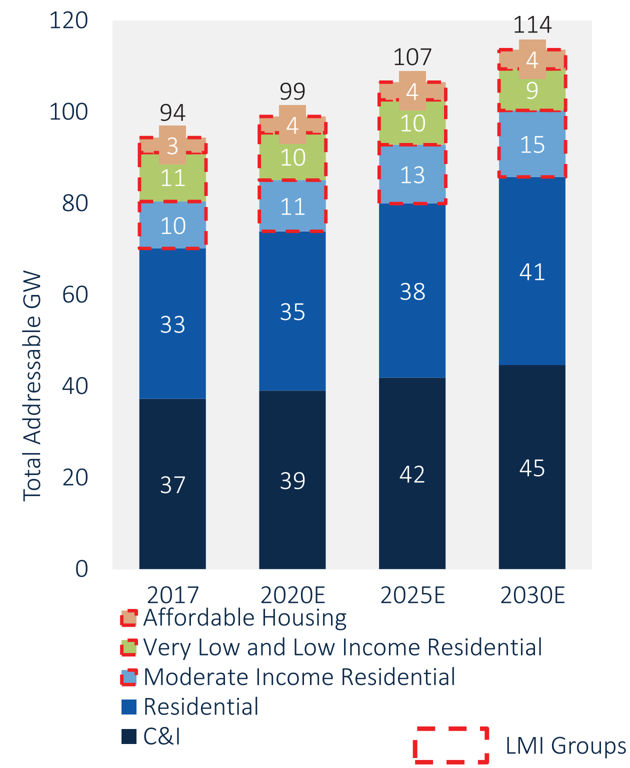
Source: GTM Research Wood Mackenzie, NREL, U.S. Census

Addressable Households and Organizations (TWh)



Source: GTM Research Wood Mackenzie, NREL, U.S. Census

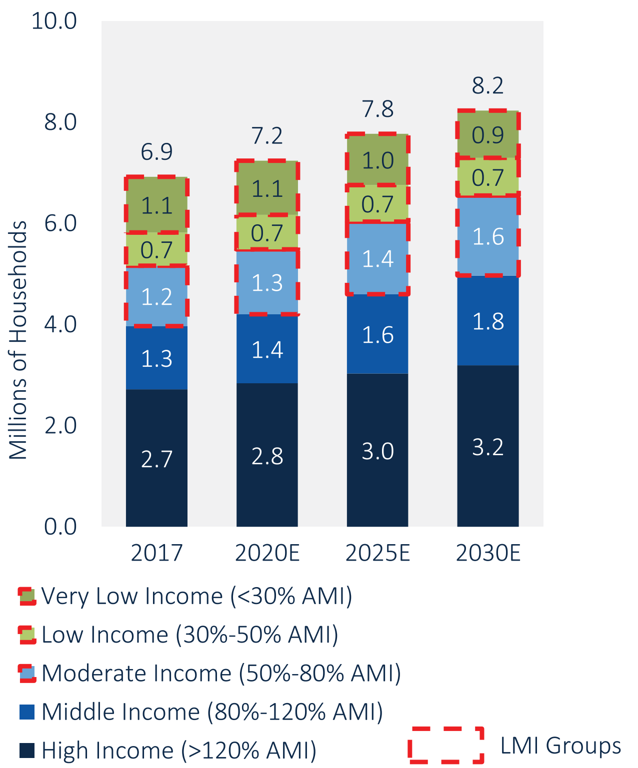
Addressable Households and Organizations (GW)



Source: GTM Research Wood Mackenzie, NREL, U.S. Census

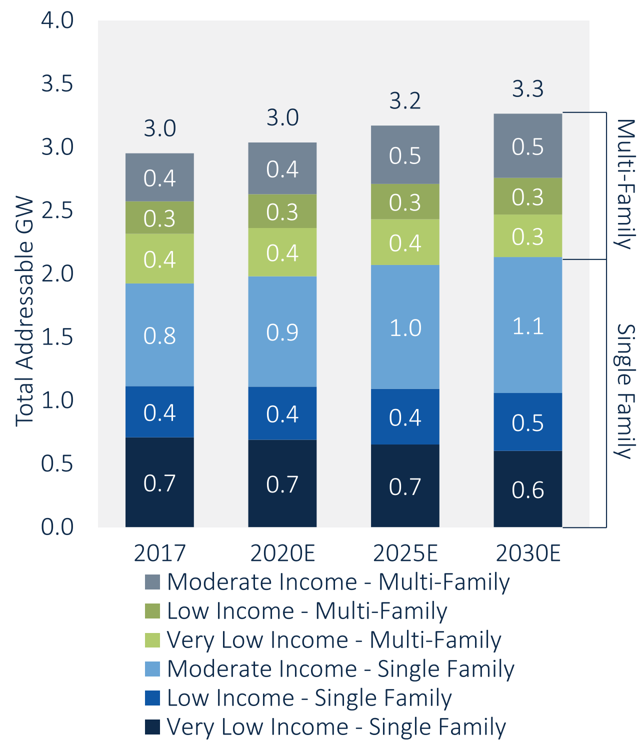
Low- and Moderate-Income Addressable Market – Florida

Residential Addressable Market by Income (# of HHs)



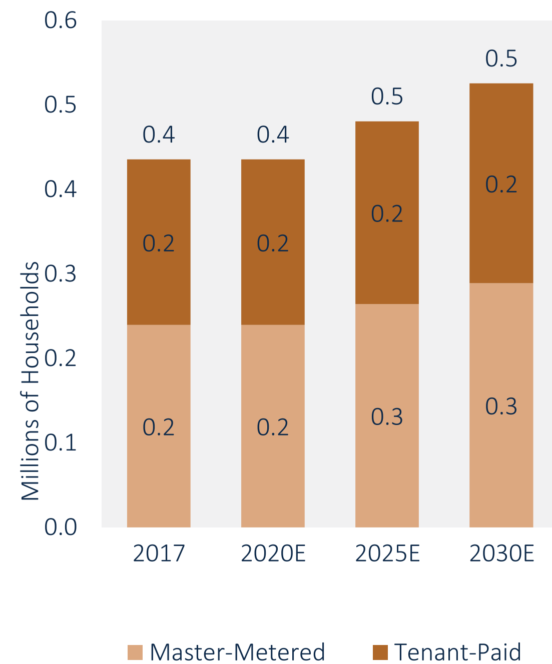
Source: GTM Research Wood Mackenzie, NREL, U.S. Census

LMI Households by Single- vs. Multi-Family Unit



Source: GTM Research Wood Mackenzie, NREL, U.S. Census

Affordable Housing Market by Type (# of HHs)



Source: GTM Research Wood Mackenzie, NREL, U.S. Census

Modeling Customer Benefits for Community Solar in Florida

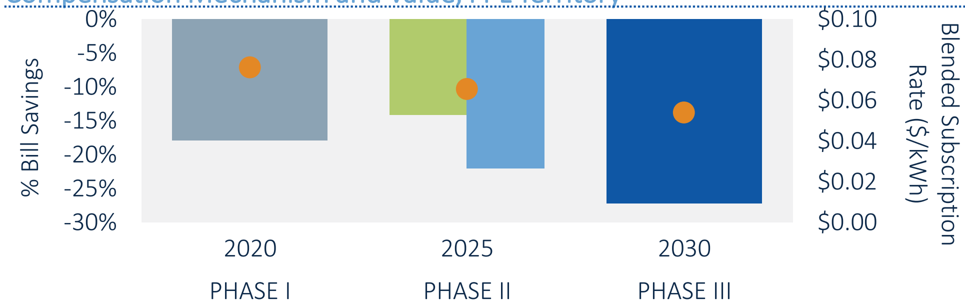
Current retail rates results in tight economics for commercial customers but improve as costs fall

In the three IOUs studied for Florida, the large C&I segment may have difficulties in getting off the ground under current retail rates, as 1) commercial rates are low in Florida and 2) the amount of volumetric charges that can be offset with community solar is limited. Strong reductions in community solar costs coupled with a meaningful distributed solar bill credit would need to be implemented for significant large commercial adoption.

Community solar could provide more than 10% in residential customer savings in both scenarios

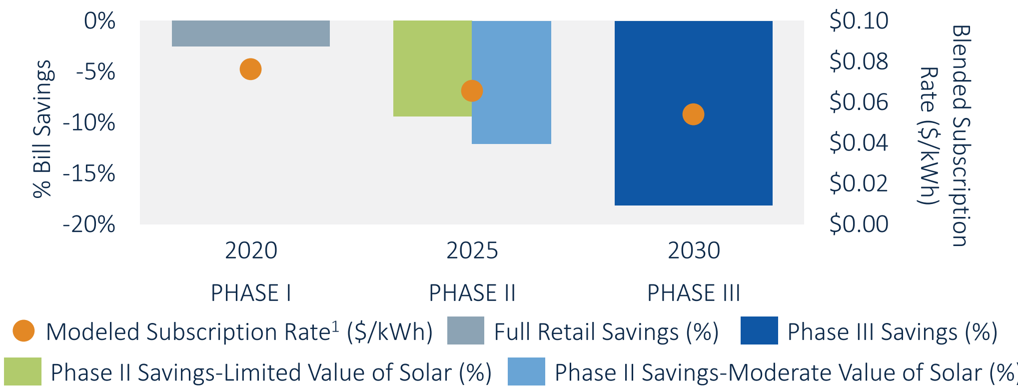
While retail electricity prices tend to much lower in Florida, blended community solar subscription rates are also the lowest of the four states we examined. In larger bill credit scenarios, residential subscription bill savings could be cut back to provide more savings to commercial customers while not affecting the return for the community solar project investor.

Potential Residential Community Solar Subscription Rate and Bill Savings by Compensation Mechanism and Value, FPL Territory



Source: GTM Research, Wood Mackenzie

Potential Large Commercial and Industrial Community Solar Subscription Rate and Bill Savings by Compensation Mechanism and Value, FPL Territory



[1]Modeled subscription rate utilizes assumptions in "Charting a Path for the Cost of Community Solar"

Florida Community Solar Deployments Could Reach 2.3 to 3.6 GW by 2030

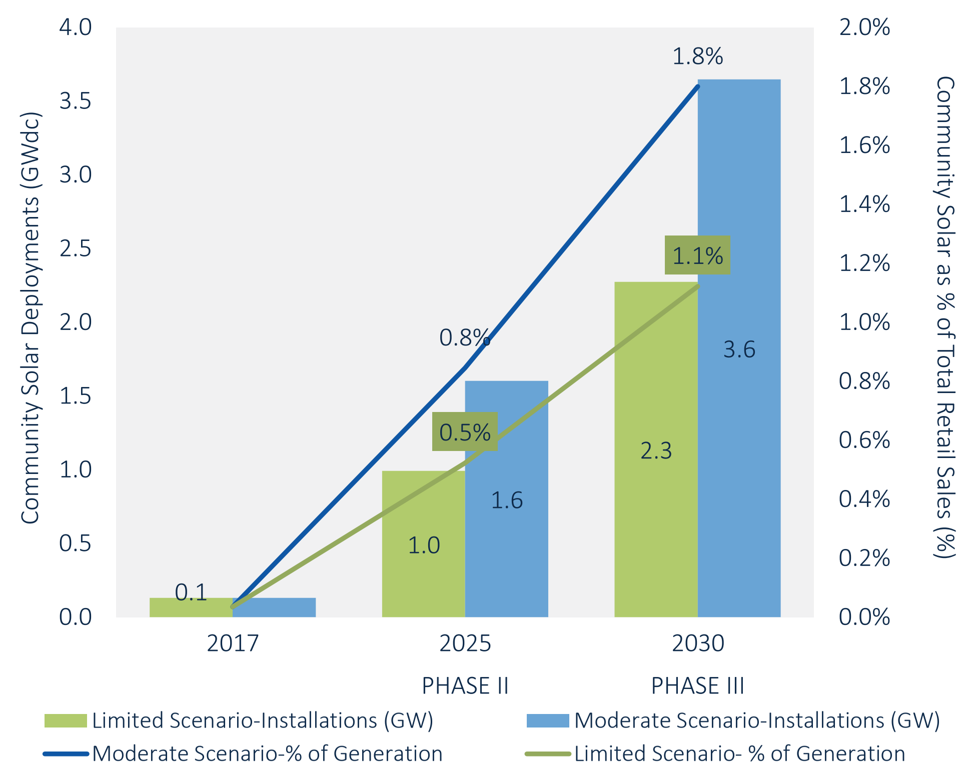
Florida could become one of the most promising community solar markets, accounting for 1.1% to 1.8% of all retail electricity sales

Community solar generation could be equal to or double the amount of current solar generation in Florida.

In general, solar and planned "community solar" projects have taken on more of a utility solar flavor. These projects are an important piece in building a cleaner grid at a low cost, but may not necessarily present end customers with other attributes they value, such as bill savings or autonomy.

Furthermore, an increased look toward resiliency may push customers to investigate more grid backup options. Community solar could serve as an important intermediary platform to provide local, district-level resiliency.

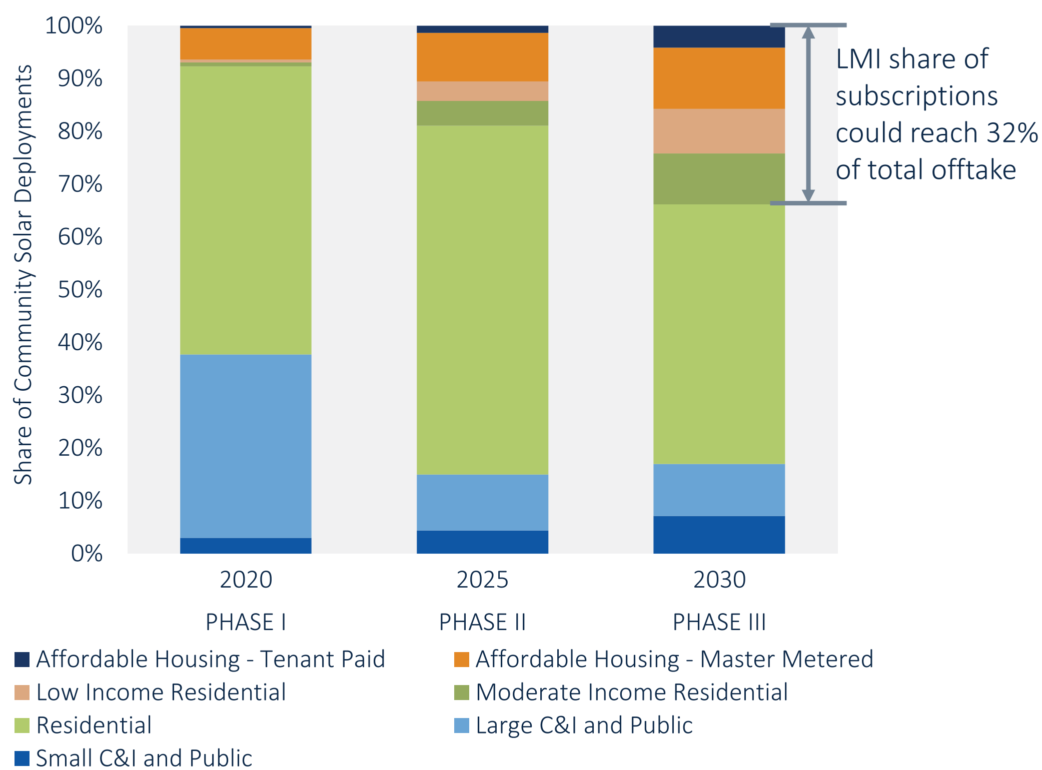
Cumulative Community Solar Market Potential: Florida



Source: GTM Research Wood Mackenzie

Residential and LMI Customers Should Be the Main Focus of Community Solar in Florida

Florida Community Solar Segmented Subscriber Adoption



Source: GTM Research Wood Mackenzie

With more muted economics for large commercial customers, residential and LMI subscribers should be the main focus for community solar programs in Florida

By 2030, the LMI sector could represent nearly one-third of total community solar capacity in Florida, equating to over 750 MW serving over 141,000 individuals.

Traditional residential community solar offtake makes up a small piece of the total addressable market for homeowners and renters (just 1%-2% of the total population) but could still serve nearly 100,000 residents with over a terawatt-hour of solar generation every year.

Community Solar in Florida: Market Potential

Community solar in Florida could provide critical economic relief and local resiliency to vulnerable communities. By 2030, low income, moderate income and affordable housing subscribers could make up nearly half of subscriptions and one-third of electricity generated as, according to our modeling, community solar could eventually provide 25%-30% savings on LMI household bills.

Community solar's ability to be paired with energy storage and microgrids could be a key driver in also assuring that the state and utilities can ensure clean, reliable electricity to communities during hurricanes and other disasters.

Community Solar Market Potential in Florida, 2030 Vision Scenarios

Total Addressable Market: **8.9 million customers**

Total Community Solar Capacity Operating: **2.3 GW to 3.6 GW**

Annual Electricity Generated: **3.2 TWh to 5.1 TWh**

- Share of State Electricity Consumption: **1.1% to 1.8%**

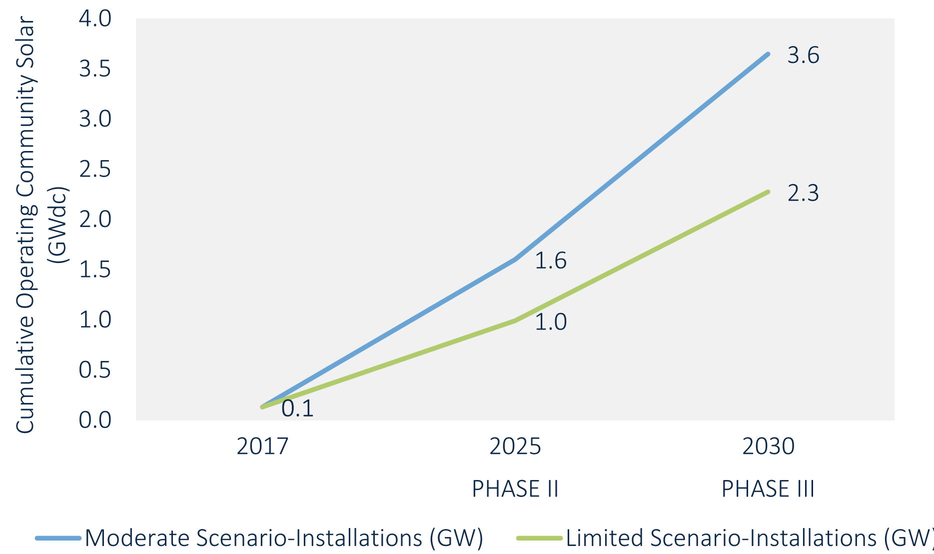
Subscribers Served: **287,000 to 384,000**

- Low- and Moderate-Income Households Supported: **141,000 to 189,000**

Cumulative Capital Invested*: **$3.3 billion to $4.0 billion**

Annual Spend on Operations, Leases and Taxes: **$34 million to $55 million**

Community Solar in Florida: Market Potential



Source: GTM Research Wood Mackenzie

"Limited Scenario" and **"Moderate Scenario"** refer to the set of grid and environmental benefits included in the compensation for community solar. Neither reflect a full account of all costs and benefits, especially more difficult to calculate economic development and societal health benefits. Adoption forecast also includes assumptions of strong community solar and LMI adoption policy and continued subscription product innovations

*Cumulative capital invested represent total initial costs to build community solar plants, including all materials, installation materials and upfront supply chain, development and financing costs. Does not include ongoing operating costs

Charting the Vision for Community Solar

Michigan

Michigan's Community Solar Market to Date

Michigan Overview

Michigan has significantly lagged behind other states, ranking 32nd in terms of total solar deployed and with just 0.1% of total electricity powered by solar at the end of 2017.

Despite low levels of distributed solar deployments, the Michigan Public Service Commission recently replaced its net metering policy with an "inflow/outflow" mechanism — moving to a potentially limited value-of-solar consideration for exported solar. All future rate cases filed by the state's utilities must now also include a proposed "Inflow/Outflow" with which to compensate exported on-site solar. How these rates influence any statewide community solar policy on bill crediting will likely be hotly contested.

Early community solar experiences in Michigan are mixed. A project developed for the Lansing Board of Water and Light offers a ~14-year payback on an upfront subscription payment. Meanwhile, other community solar programs, such as Consumers Energy's "Solar Gardens" program, offer no economic savings to their customers.

A fair bill crediting mechanism for community solar must be in place to enable a flourishing community solar market in Michigan.

Michigan by the Numbers

- Total Cumulative Solar: **133.5 MWdc**
- State Solar Rank*: **32**
- Solar % of Total Electricity: **0.2%**
- Community Solar: **8.3 MW**
- Community Solar Rank*: **13**

*By cumulative installed solar capacity

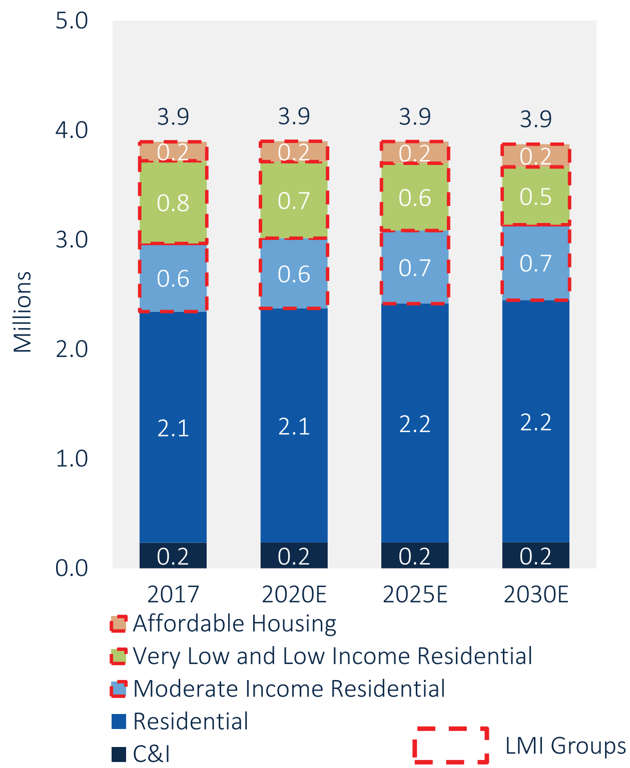
Community Solar that confers economic benefits

300 kW in East Lansing, Michigan

- First of two projects developed by Patriot Solar Group and promoted by Lansing Board of Water and Light, City of East Lansing, City of Lansing and Michigan Energy Options
- Bill credit of approximately 6.5¢/kWh yields small savings to customer
- Upfront payment of ~$1.33/W promises approx. 14-year payback

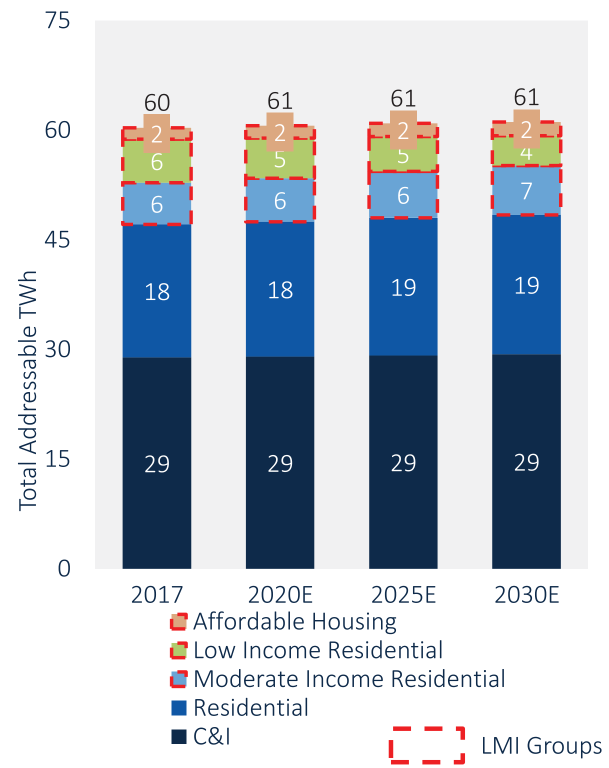
Total Addressable Market for Community Solar – Michigan

Addressable Households and Organizations (#)



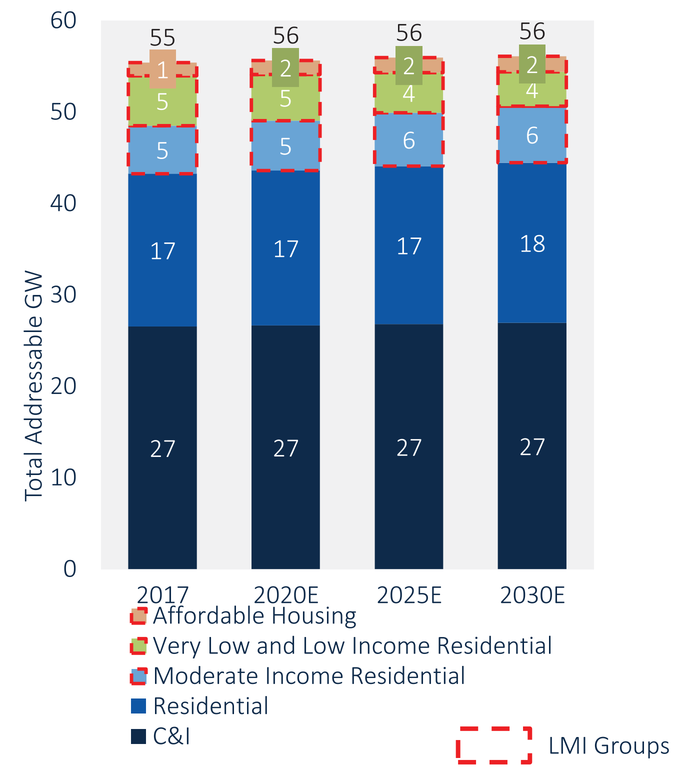
Source: GTM Research Wood Mackenzie, NREL, U.S. Census

Addressable Households and Organizations (TWh)



Source: GTM Research Wood Mackenzie, NREL, U.S. Census

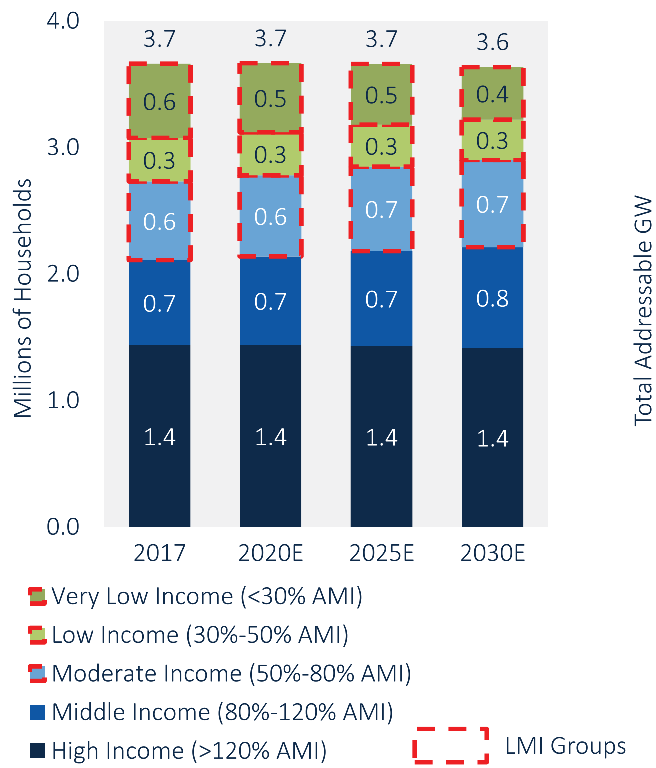
Addressable Households and Organizations (GW)



Source: GTM Research Wood Mackenzie, NREL, U.S. Census

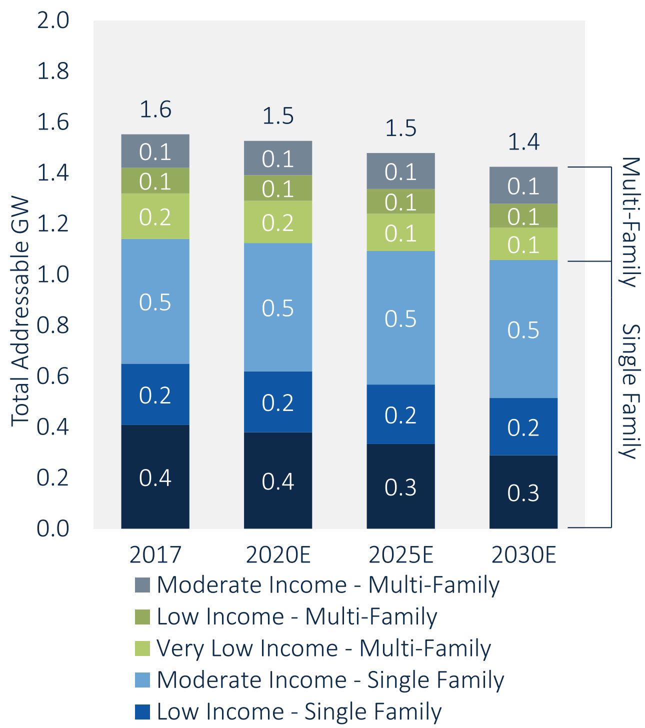
Low- and Moderate-Income Addressable Market – Michigan

Residential Addressable Market by Income (# of HHs)



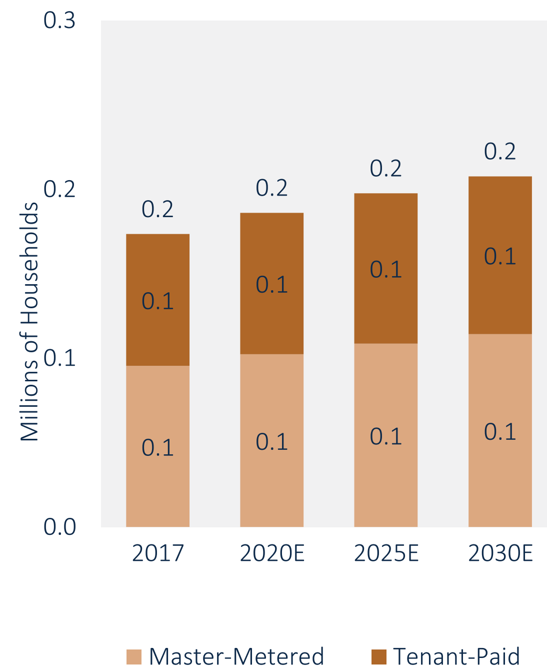
Source: GTM Research Wood Mackenzie, NREL, U.S. Census

LMI Households by Single- vs. Multi-Family Unit



Source: GTM Research Wood Mackenzie, NREL, U.S. Census

Affordable Housing Market by Type (# of HHs)



Source: GTM Research Wood Mackenzie, NREL, U.S. Census

Modeling Customer Benefits for Community Solar in Michigan

Customer benefits generally tight for community solar in Phase I and II in Michigan

Relatively low solar resources and relatively little industry scale in Michigan inflate the community solar subscription price relative to other markets studied.

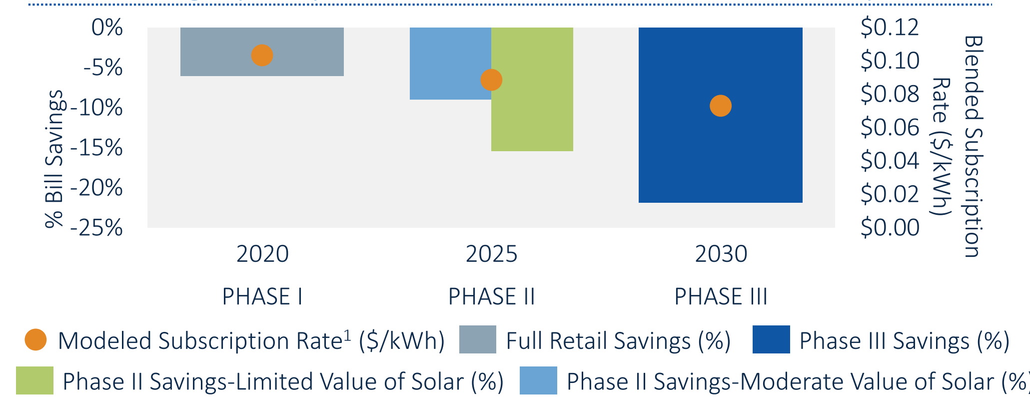
In the Limited Scenario, most customer segments would see relatively weak savings from community solar — just 10%-15% net savings off the total bill. While these are compelling numbers for today's community solar market, they will lag offerings in Michigan's peer states.

Michigan would likely need to pull together a compromise on net metering, a transitional credit, or accept a moderate value-of-solar tariff in order to jump-start community solar in the state.

Potential Residential Community Solar Subscription Rate and Bill Savings by Compensation Mechanism and Value, DTE Territory

Source: GTM Research, Wood Mackenzie

Potential Large Commercial and Industrial Community Solar Subscription Rate and Bill Savings by Compensation Mechanism and Value, DTE Territory



[1]Modeled subscription rate utilizes assumptions in "Charting a Path for the Cost of Community Solar"

Michigan Community Solar Deployments Could Reach 1.4 GW to 2.3 GW by 2030

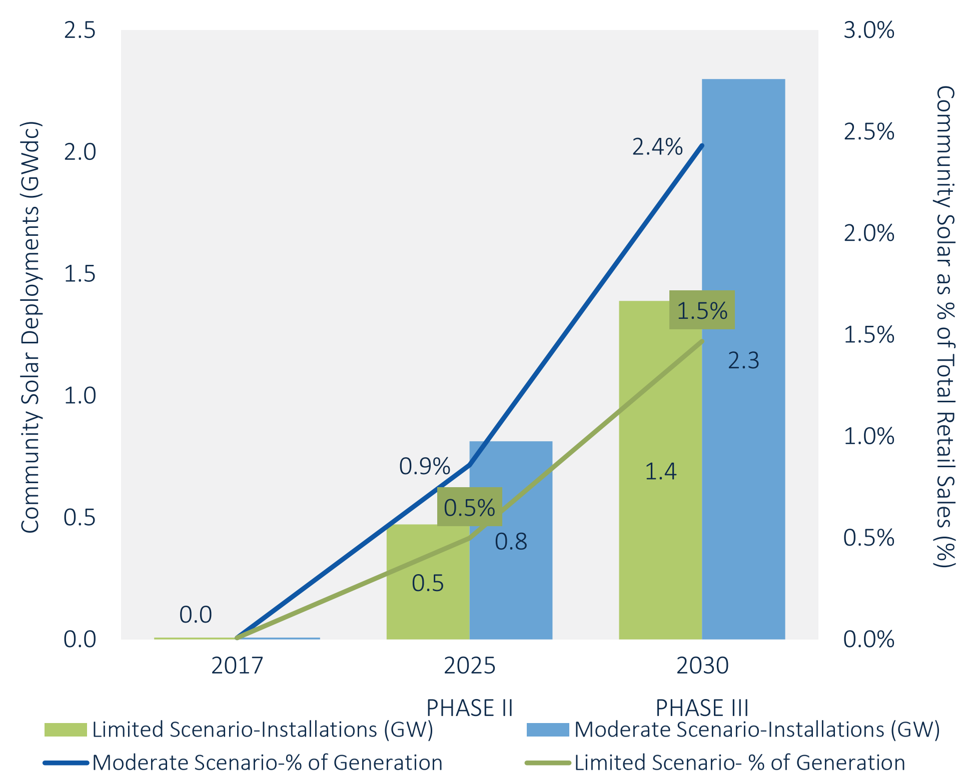
Community solar could be a main driver of Michigan's overall solar market if properly incentivized

Solar generation would likely require a broad value-of-solar tariff or another compelling bill credit mechanism. But if a compelling bill credit were introduced, community solar could quickly make up more than a quarter of the state's total annual solar build.

In fact, the 1.4 GW to 2.3 GW of community solar that could be deployed by 2030 would represent a 10x to 15x expansion of Michigan's present-day solar deployments.

Even so, getting to a robust market seems in contrast to the existing utility-sponsored community solar programs built at a premium to customer bills — and to various utility-proposed bill credits at well under average retail rates. Compared to other states covered in this study, Michigan could require significantly more innovation in order to see a flourishing market.

Cumulative Community Solar Market Potential: Michigan



Source: GTM Research Wood Mackenzie

Community Solar in Michigan: Market Potential

Community solar in Michigan could be a significant boost for distributed generation in the state. With just over 100 MW of solar installed to date and few supportive statewide policies for solar, Michigan lags nationally in the deployment of distributed generation. In the current regulatory debate around the compensation for the little distributed solar that does exist, policymakers could also look to community solar as a critical resource for ensuring all customer segments can access local clean electricity.

Community Solar Market Potential in Michigan, 2030 Vision Scenarios

Total Addressable Market: **3.9 million customers**

Total Community Solar Capacity Operating: **1.4 GW to 2.3 GW**

Annual Electricity Generated: **1.5 TWh to 2.5 TWh**

- Share of State Electricity Consumption: **1.5% to 2.4%**

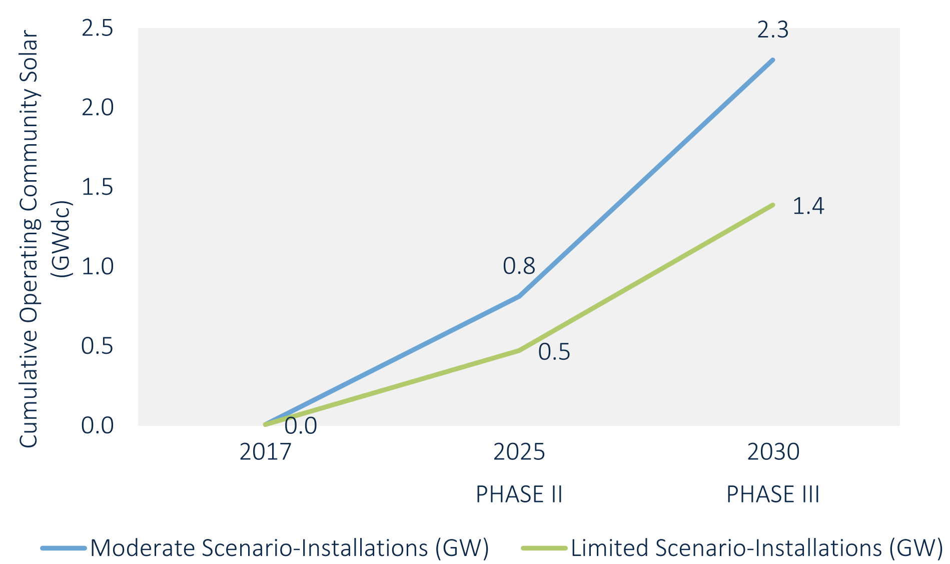
Subscribers Served: **177,000 to 288,000**

- Low- and Moderate-Income Households Supported: **92,000 to 176,000**

Cumulative Capital Invested*: **$2.0 billion to $3.0 billion**

Annual Spend on Operations, Leases and Taxes: **$21 million to $35 million**

Community Solar in Michigan: Market Potential



Source: GTM Research Wood Mackenzie

"Limited Scenario" and **"Moderate Scenario"** refer to the set of grid and environmental benefits included in the compensation for community solar. Neither reflect a full account of all costs and benefits, especially more difficult to calculate economic development and societal health benefits. Adoption forecast also includes assumptions of strong community solar and LMI adoption policy and continued subscription product innovations

*Cumulative capital invested represent total initial costs to build community solar plants, including all materials, installation materials and upfront supply chain, development and financing costs. Does not include ongoing operating costs

Charting the Vision for Community Solar

New Jersey

New Jersey's Community Solar Market to Date

New Jersey Overview

New Jersey has long been one of the nation's leading solar states despite its relatively middling solar resource. Contrary to other states examined in this report, New Jersey's solar installations are primarily on-site distributed generation. At the end of 2017, non-residential systems made up over 50% of cumulative installed solar, with residential systems adding another 27%.

In early 2018, New Jersey passed an ambitious increase to the state's renewable portfolio standard that also includes provisions for offshore wind, energy storage, energy efficiency and community solar. The new law raises the RPS target to 35% in 2025 and 50% in 2030, while also sunsetting the solar renewable energy credits (SREC) incentive program by June 2021.

Given the SREC program's foundational role to New Jersey's historical solar growth, the law requires the Board of Public Utilities (BPU) to develop an "orderly and transparent mechanism" for transitioning from the SREC program — one that ensures sustainable costs and importantly pushes New Jersey toward its 50% renewables target. A fair, stable and transparent successor will be key for the state's continued solar leadership.

New Jersey by the Numbers

- Total Cumulative Solar: **2.4 GWdc**
- State Solar Rank*: **5**
- Solar % of Total Electricity: **3.9%**
- Community Solar: **0 MW**
- Community Solar Rank*: **50**

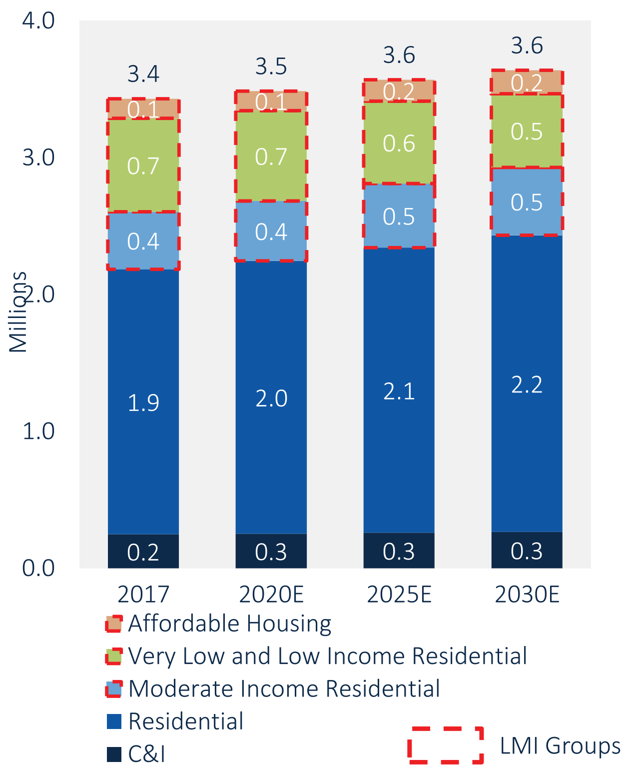
*By cumulative installed solar capacity

A Note on New Jersey's New Community Solar Policy

A key piece of New Jersey's new renewable energy plan is the development of a long-term community solar program. The law is vague beyond a general directive to the BPU to establish a pilot program that is converted to a permanent program within the next three years. The permanent program should aim to develop a minimum of 50 MW annually.

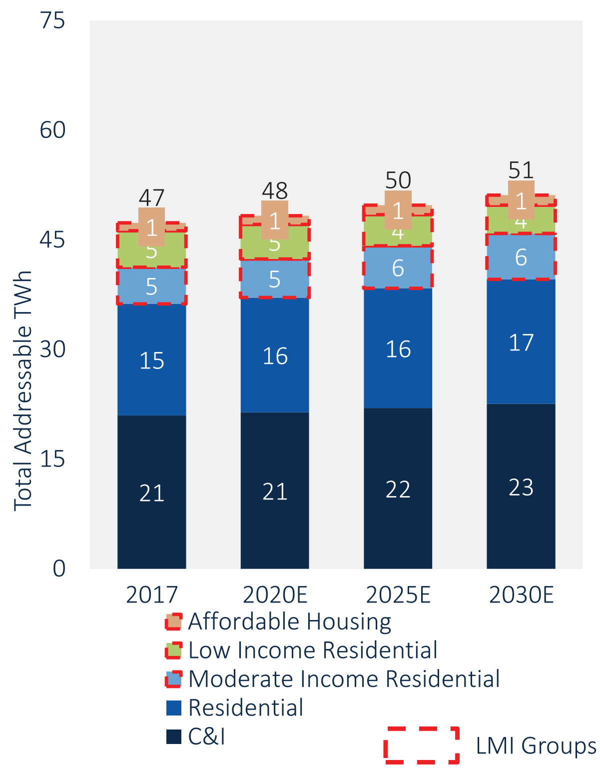
Total Addressable Market for Community Solar – New Jersey

Addressable Households and Organizations (#)



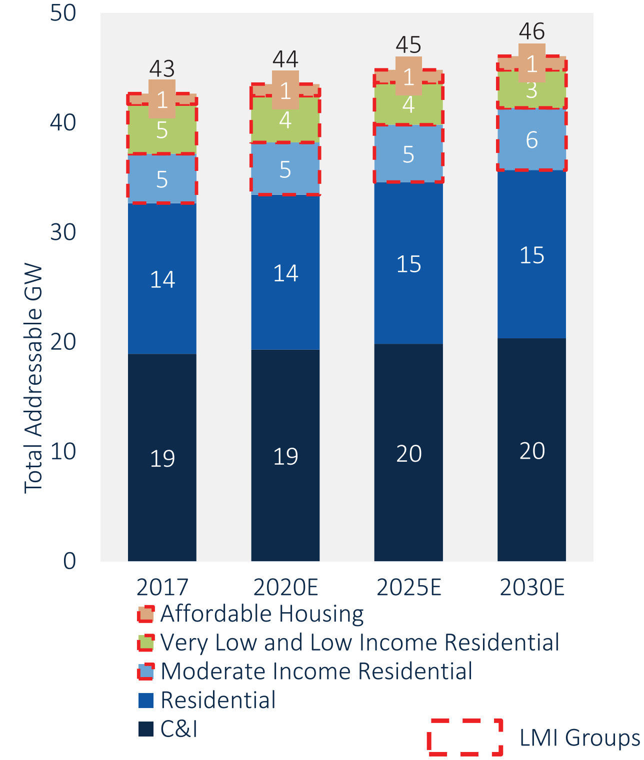
Source: GTM Research Wood Mackenzie, NREL, U.S. Census

Addressable Households and Organizations (TWh)



Source: GTM Research Wood Mackenzie, NREL, U.S. Census

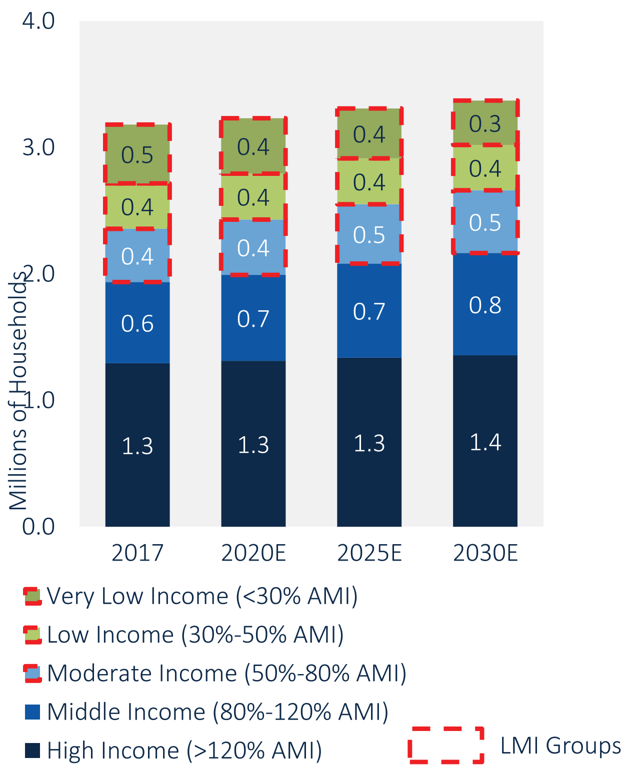
Addressable Households and Organizations (GW)



Source: GTM Research Wood Mackenzie, NREL, U.S. Census

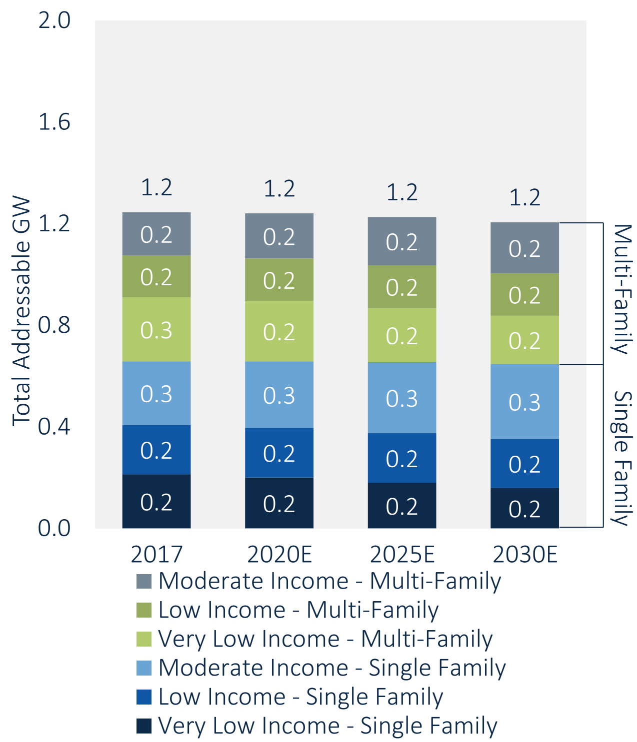
Low- and Moderate-Income Addressable Market – New Jersey

Residential Addressable Market by Income (# of HHs)



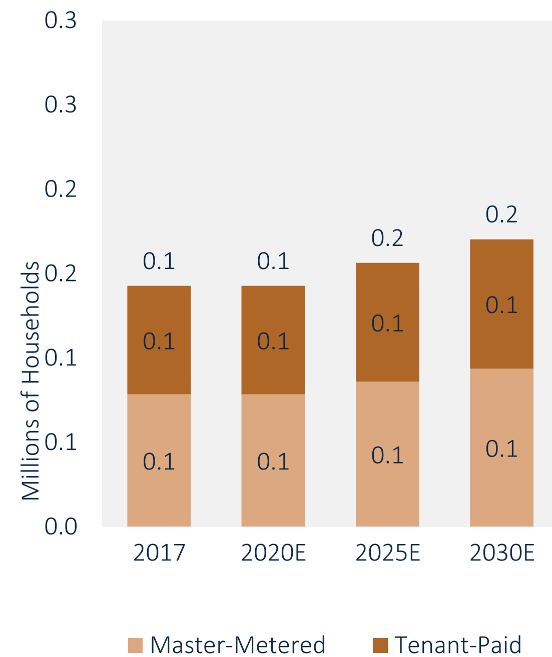
Source: GTM Research Wood Mackenzie, NREL, U.S. Census

LMI Households by Single- vs. Multi-Family Unit



Source: GTM Research Wood Mackenzie, NREL, U.S. Census

Affordable Housing Market by Type (# of HHs)



Source: GTM Research Wood Mackenzie, NREL, U.S. Census

Modeling Community Solar Customer Benefits in New Jersey

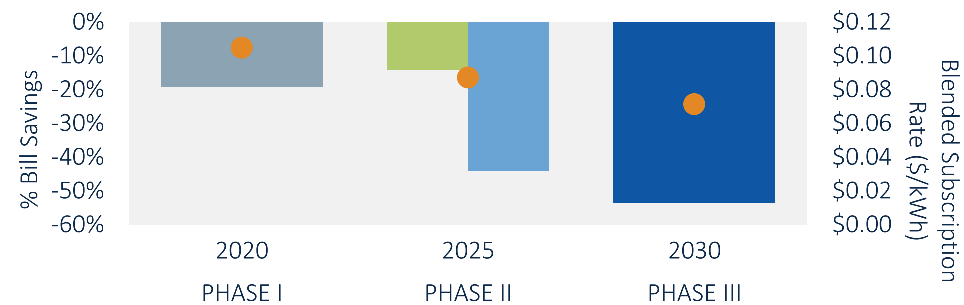
Community solar could provide modest savings to all customer segments in New Jersey for most scenarios

As we note in the walkthrough of state-level costs, our model does not convey a direct state-level incentive or SREC past 2021, but does open the possibility for an SREC successor.

In our Moderate Scenario, an SREC successor could easily fit the bill for a transitional credit — one that could help push New Jersey toward its 2030 target of 50% renewables while also significantly reducing the cost of community solar to renters and other residents that do not have access to rooftop solar or may not be the direct beneficiary of other solar and wind generation programs.

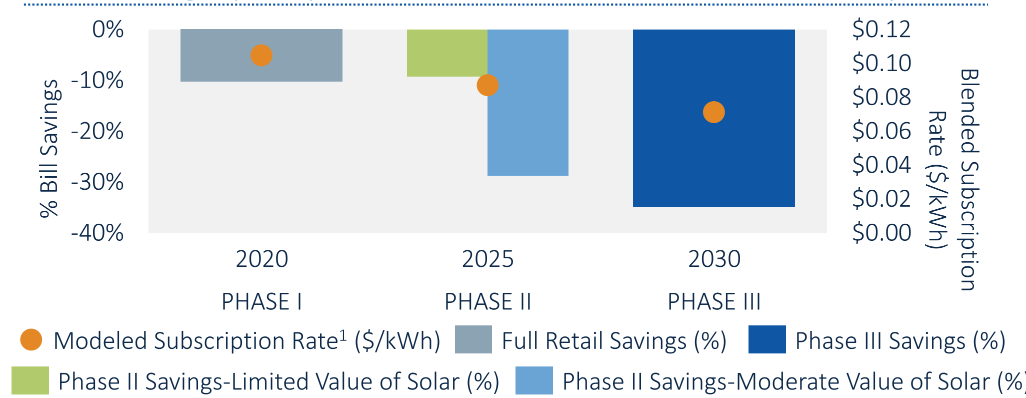
By 2030, community solar with a moderate value of solar compensation could convey 40%-50% savings off customer bills — whether compared to a blended bill or just simply off of what retail electricity would have been.

Potential Residential Community Solar Subscription Rate and Bill Savings by Compensation Mechanism and Value, JCP&L Territory



Source: GTM Research, Wood Mackenzie

Potential Large Commercial and Industrial Community Solar Subscription Rate and Bill Savings by Compensation Mechanism and Value, JCP&L Territory



[1]Modeled subscription rate utilizes assumptions in "Charting a Path for the Cost of Community Solar"

New Jersey Community Solar Deployments Could Reach 2.0 to 3.3 GW by 2030

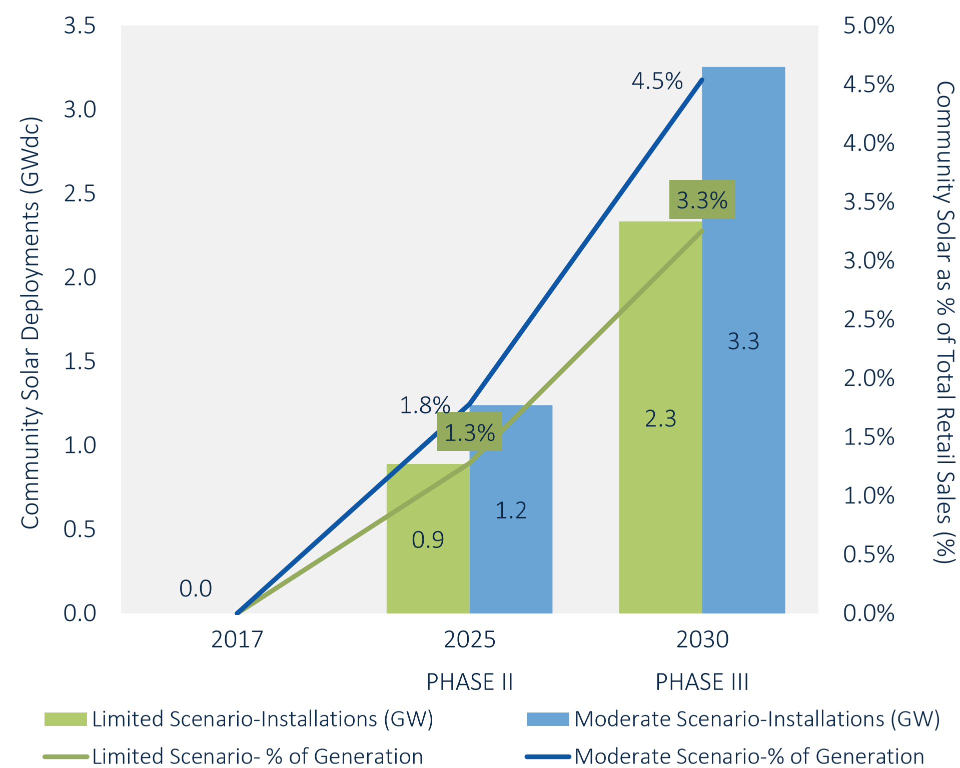
New Jersey could see over 4.5% of its total electricity come from community solar by 2030 – equivalent to all solar energy deployments in New Jersey today.

With continued community solar product improvement and a stable and strong framework in place, New Jersey could deploy 2.3 GW to 3.3 GW of community solar in the span of a little more than 10 years — 3x to 6x the amount that's minimally required by New Jersey's required community solar program.

In other words, New Jersey has the potential to replicate the success of its SREC program with community solar — only at lower costs and higher end value.

New Jersey's pilot community solar program will be vital in proving to subscribers and other stakeholders that community solar can provide the foundation to broad system and societal value.

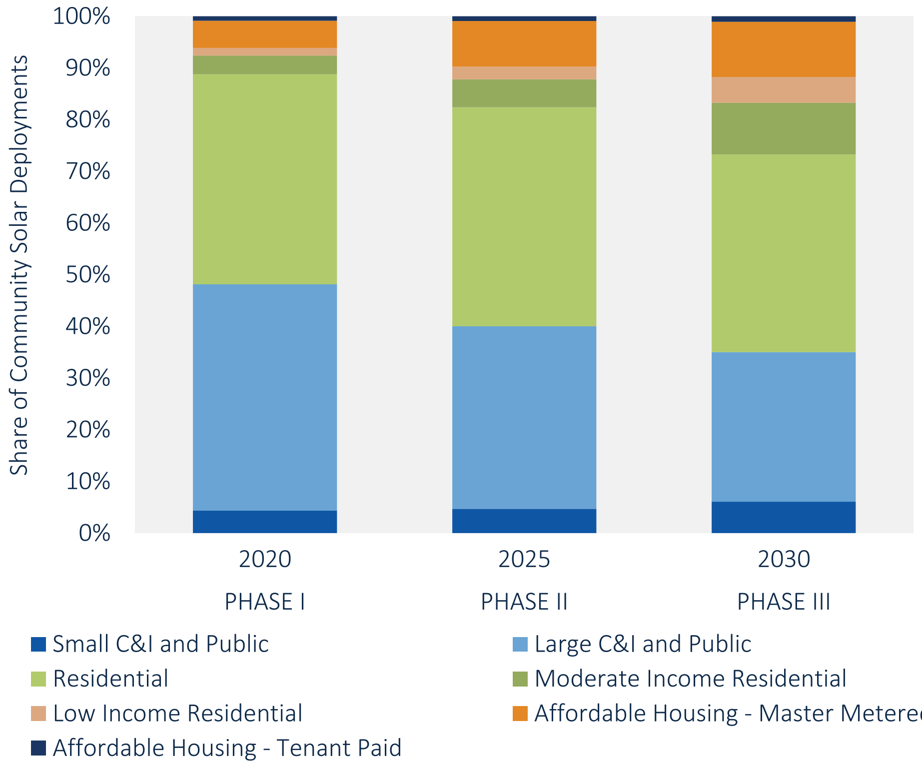
Cumulative Community Solar Market Potential: New Jersey



Source: GTM Research Wood Mackenzie

Master-Metered Affordable Housing Units Could Be Well Served by Community Solar

New Jersey Community Solar Segmented Subscriber Adoption



Source: GTM Research Wood Mackenzie

Community solar could serve between 25% and 35% of all master-metered affordable housing units in New Jersey by 2030.

Partially driven by a relatively low volume of master-metered affordable housing units (an expected 180,000 households by 2030), the penetration is nonetheless a strong opportunity to deliver strong value to the LMI community.

A key driver of this outlook is that the new community solar legislation requires the BPU to ensure that low-income and multifamily housing customers are able to participate in the community solar program. Second, there are multiple paths forward for the state to leverage public sources of capital to support LMI adoption of community solar — whether via a standalone green bank, or the development of a clean-energy-focused division of the governor's proposed Public Bank, or the pre-existing Infrastructure Bank.

State legislation has ensured that the final program design will include policies that encourage LMI adoption of community solar, which could build upon best practices from other states to include a combination of program carve-outs, incentive adders and public sources of financing.

In addition to its benefits for LMI customers, community solar conveys strong and compelling savings for residential and commercial market segments across the major utility territories

By 2030, residential subscribers, including LMI households, will make up the majority of community solar capacity, but non-residential systems won't be left out; in our Moderate Scenario, C&I subscriptions could exceed 1.2 GW by 2030.

Community Solar in New Jersey: Market Potential

New Jersey is in the beginning stages of incorporating community solar into its portfolio. A leader in distributed energy deployment, New Jersey recognizes the importance of setting strong solar policy. Robust design of pilots and sustained community solar programs would help residents and businesses thus far locked out of New Jersey's solar success. For example, by 2030, community solar could serve over 250,000 LMI households, including 25%-35% of all affordable housing tenants in the state.

Community Solar Market Potential in New Jersey, 2030 Vision Scenarios

Total Addressable Market: **3.6 million customers**

Total Community Solar Capacity Operating: **2.3 GW to 3.3 GW**

Annual Electricity Generated: **2.6 TWh to 3.6 TWh**

- Share of State Electricity Consumption: **3.3% to 4.5%**

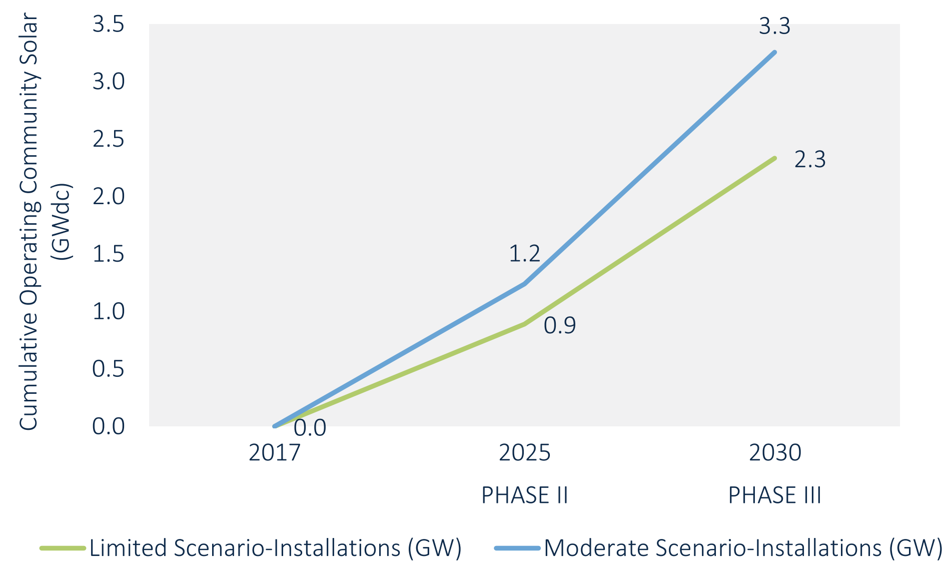
Subscribers Served: **219,000 to 410,000**

- Low- and Moderate-Income Households Supported: **119,000 to 255,000**

Cumulative Capital Invested*: **$2.8 billion to $4.9 billion**

Annual Spend on Operations, Leases and Taxes: **$47 million to $65 million**

Community Solar in New Jersey: Market Potential



Source: GTM Research Wood Mackenzie

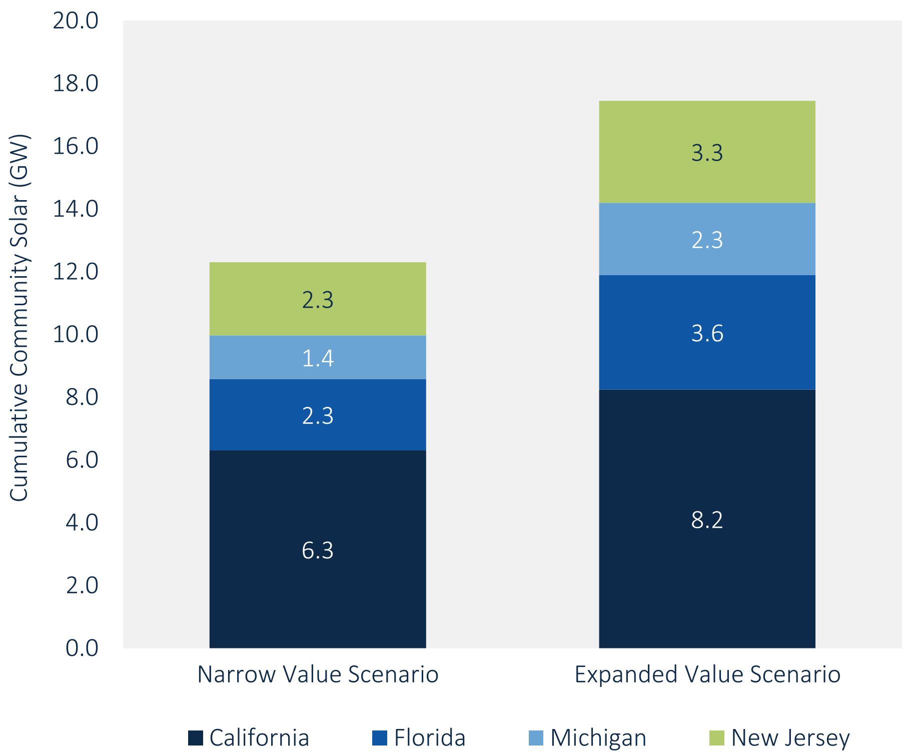
"Limited Scenario" and **"Moderate Scenario"** refer to the set of grid and environmental benefits included in the compensation for community solar. Neither reflect a full account of all costs and benefits, especially more difficult to calculate economic development and societal health benefits. Adoption forecast also includes assumptions of strong community solar and LMI adoption policy and continued subscription product innovations

*Cumulative capital invested represent total initial costs to build community solar plants, including all materials, installation materials and upfront supply chain, development and financing costs. Does not include ongoing operating costs

6. The Community Solar Vision: A National View

With the Four States Combined, Total Deployments Could Reach 12.3 GW to 17.5 GW

Cumulative Community Solar Deployments by State and Scenario, 2030



Source: GTM Research Wood Mackenzie

Based on customer-level economic benefits, while keeping in mind energy and market constraints, community solar could drive a significant portion of new solar generation in each of the four states we study.

Individually, these states represent different policy environments, market structures, levels of solar deployment and experience with community solar.

Yet with the right policy ingredients, these four states could see between 12.3 GW and 17.5 GW of new solar generation, representing between 8% and 40% of total distributed solar deployments in each state. Furthermore, much of community solar will serve populations that have thus far been left behind in the mass solar market.

In addition to the clean energy produced, these deployments will generate multiple decades of stable energy cost reduction for their subscribers, an avenue for policymakers to support low- and moderate-income populations and an asset for deeper customer engagement and grid reliability.

Upfront Community Solar Investment in the Four States Could Top $24.3 billion by 2030

Community solar could add $1.5 billion to $2.0 billion in upfront capital investment per year in the four studied states combined through 2030. This represents private sector investment in the electricity infrastructure of the future.

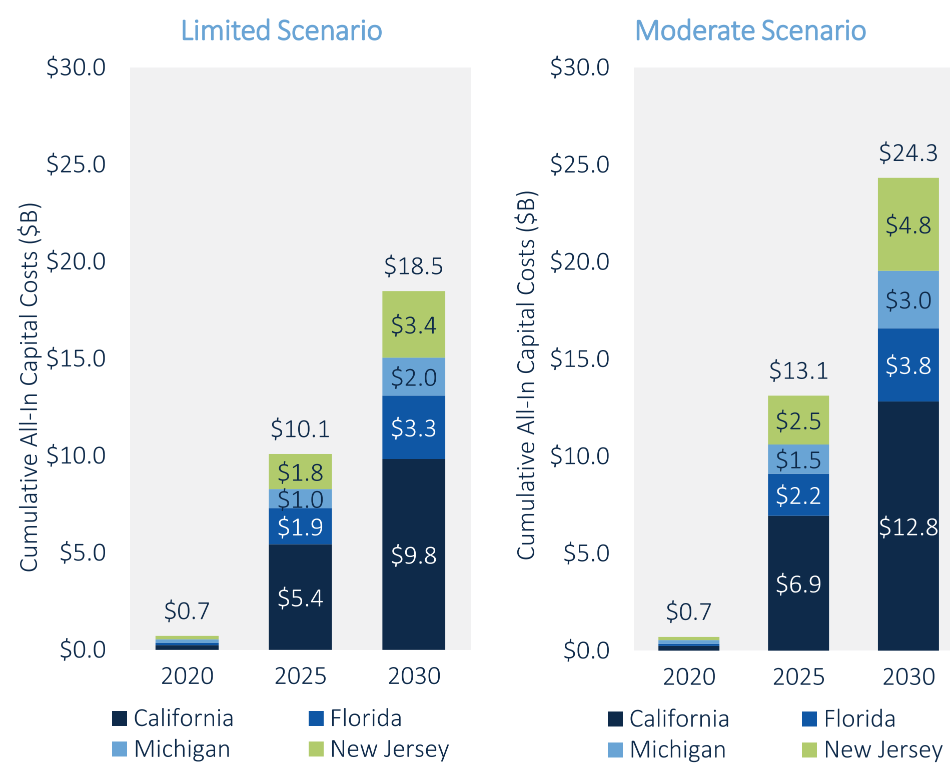
This estimate accounts for only capital expenditures for new solar installations and does not include payments from subscribers, nor ongoing costs such as land lease and property taxes.

Even in our low projection, over $18.5 billion ($1.5 billion per year) would be invested into community solar.

California leads the way, with $9.8 billion to $12.8 billion invested by 2030, triple the spend of Florida, the next highest ranked state.

Despite falling solar costs, Michigan's investment in community solar accelerates from $1.3 billion between 2020 and 2025 to $1.5 billion between 2025 and 2030.

Cumulative Community Solar Upfront Capital Expenditures



Source: GTM Research Wood Mackenzie

What If Every State Opened Its Doors to Community Solar?

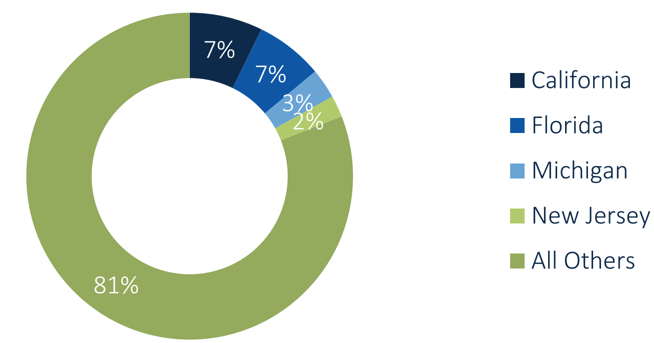
Contribution from community solar rises from a negligible share to as much as 3.1% of total energy consumption in the four states examined in the span of a decade.

The four states in focus represent one-fifth of all electricity sales nationally. Even the 19 states with current statewide community solar programs in place represent only 40% of total energy customers.

If over the next decade, every state were to adopt policies that similarly supported and valued community solar for an expanded array of customer, environmental, grid and social benefits, community solar could exceed 84 GW by the end of the next decade.

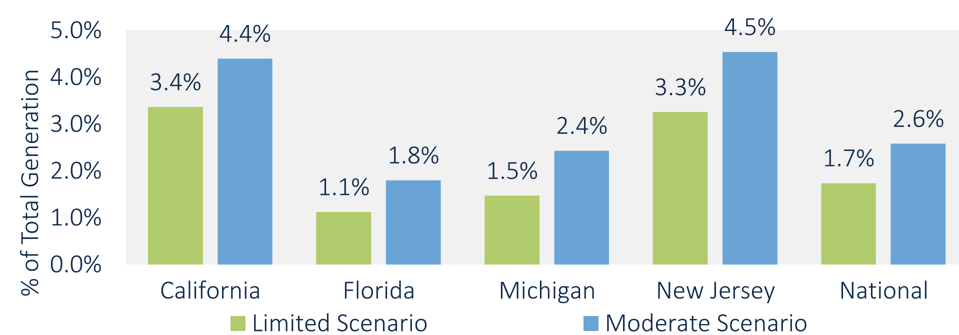
In other words, if all states were to see similar adoption rates as the four states examined (accounting for differences in state load and solar resource), community solar could supply 1.7%-2.6% of all electricity consumed in the U.S. by 2030.

State-Level Electricity Consumption as Share of National Total



Source: EIA

Forecasted Electricity Contribution From Community Solar by Scenario, 2030



Source: GTM Research Wood Mackenzie

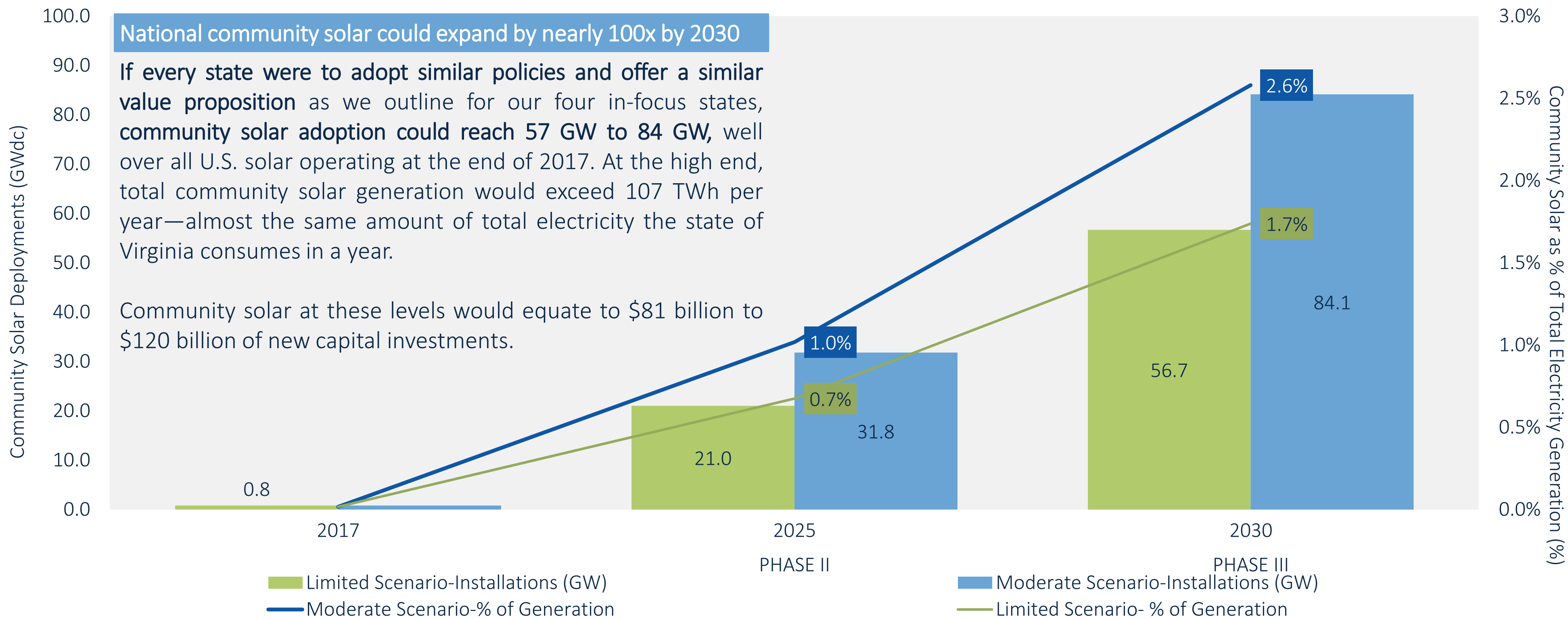
Community Solar Could Generate Over 2.6% of U.S. Electricity by 2030 Equaling 57 GW to 84 GW

National Community Solar Installations by Scenario (Assuming All States Adopt Forward-Looking Community Solar Policies)

National community solar could expand by nearly 100x by 2030

If every state were to adopt similar policies and offer a similar value proposition as we outline for our four in-focus states, **community solar adoption could reach 57 GW to 84 GW,** well over all U.S. solar operating at the end of 2017. At the high end, total community solar generation would exceed 107 TWh per year—almost the same amount of total electricity the state of Virginia consumes in a year.

Community solar at these levels would equate to $81 billion to $120 billion of new capital investments.



Source: GTM Research Wood Mackenzie

7. Appendix: Total Addressable Market Methodology

Total Addressable Market Approach and Data Source

Work Steps	Data Source
Step 1: Establish number of customers for the reference year (2017) • Summarize the number of customers by size and type • Summarize the number of households by income groups at county level • Summarize the number of affordable housing units by government programs at state level	• 2011-2015 American Community Survey, NREL Rooftop Energy Potential of Low Income Communities in America (REPLICA) • National Housing Preservation Database • Statistics of U.S. Businesses (SUSB)
Step 2: Forecast number of customers for total addressable market (2020, 2025, 2030) • Develop projection of C&I customers driven by GDP growth and elasticity rate • Develop projection of county-level households by income group driven by GDP growth, population growth and Gini index • Develop projection of affordable housing units driven by assumptions of the availability to low-income households	• Wood Mackenzie Macro Economic Research • GTM Research
Step 3: Evaluate the average customer capacity and annual consumption • Assume different levels of capacity and consumption by customer sub-segments • Split the affordable housing customers by master-metered and tenant-paid	• EIA • NREL REPLICA • Department of Housing and Urban Development
Step 4: Forecast of capacity and annual consumption for total addressable market (2020, 2025, 2030) • Develop projection of total capacity and annual consumption by subsegments less projected values for onsite solar • Summarize the forecast of capacity and annual consumption by five customer segments at state level	• Wood Mackenzie Power Service • GTM Research Solar Service

5 Customer Segments Are Identified to Represent the Addressable Market

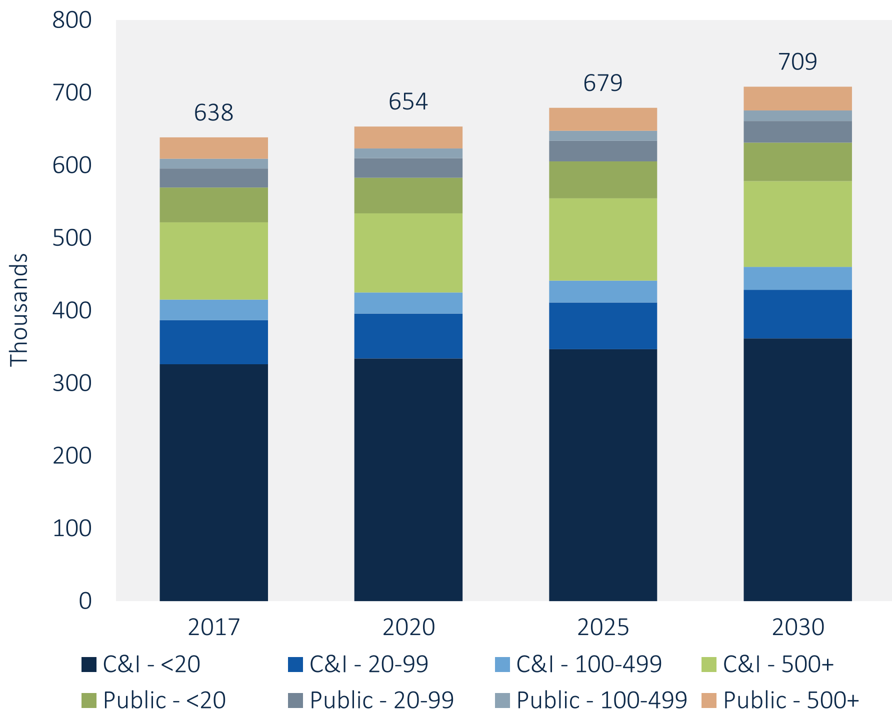
Community Solar Customer Segment Definitions

C&I (Inclusive of public institutions)	The business establishments with fewer than 20 employees are not considered as addressable market. C&I Private includes agriculture, mining, utilities, construction, manufacturing, trade, transportation and warehousing, information, finance and insurance, real estate, professional, management of companies, art and entertainment, accommodations and food. Public includes administrative and support, educational services, health care and social assistance, government/municipal, military.
Residential	Includes high income (greater than 120% AMI[1]) and middle income (between 80% and 120% AMI) households per Department of Housing and Urban Development definition
Moderate-Income Residential	Includes moderate-income (between 50% and 80% AMI) households per HUD definition
Low-Income Residential	Includes low-income (between 30% and 50% AMI) and very-low-income (less than 30% AMI) households per HUD definition
Affordable Housing Properties	Various programs targeting low-income households offered by Department of Housing and Urban Development and U.S. Department of Agriculture and Rural Development. Includes Low-Income Housing Tax Credit (LIHTC), Section 8, HOME, Public Housing, USDA programs and others.

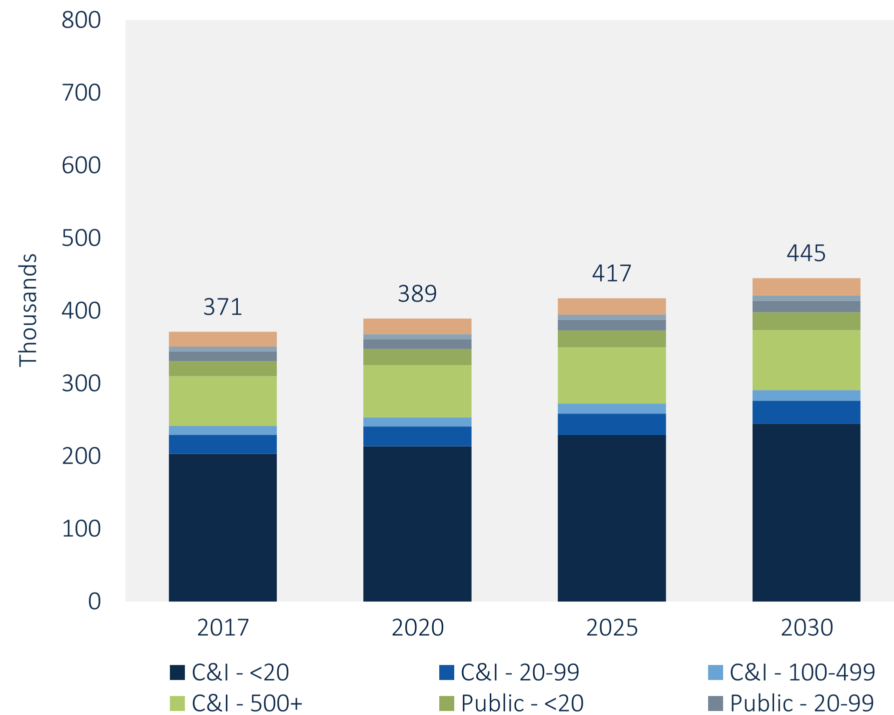
Source: Wood Mackenzie GTM Research. Note 1: AMI refers to area median income

Number of Potential C&I Customers Increases by 10% to 20% by 2030 in California and Florida

Number of C&I Establishments by Type and Size, California



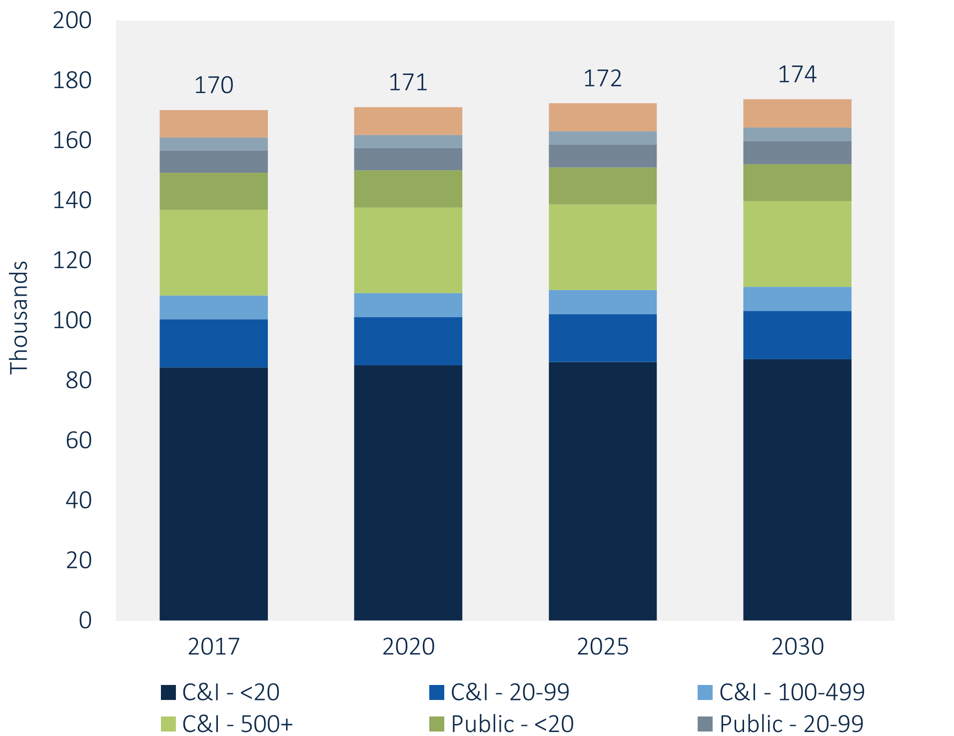
Number of C&I Establishments by Type and Size, Florida



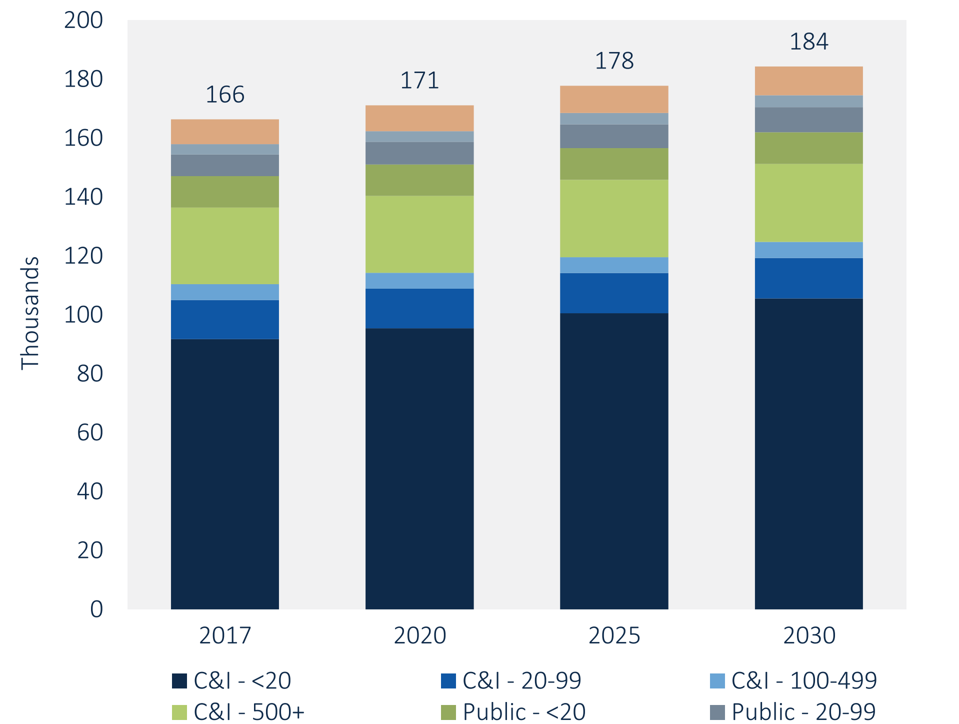
Source: Wood Mackenzie GTM Research, Statistics of U.S. Businesses (SUSB)
Note: <20, 20-99, 100-499 and 500+ refer to the number of employees in each establishment

C&I Addressable Market Stays Flat in Michigan, but Sees Modest Increase in New Jersey

Number of C&I Establishments by Type and Size, Michigan



Number of C&I Establishments by Type and Size, New Jersey

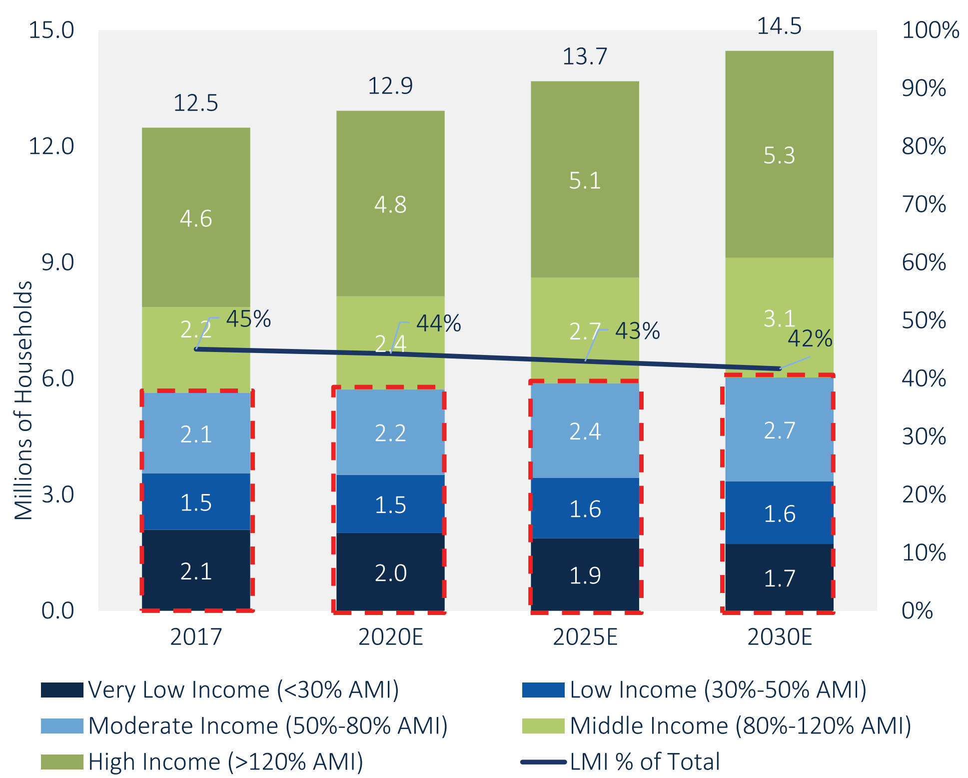


Source: Wood Mackenzie GTM Research, Statistics of U.S. Businesses (SUSB)

Note: <20, 20-99, 100-499 and 500+ refer to the number of employees in each establishment

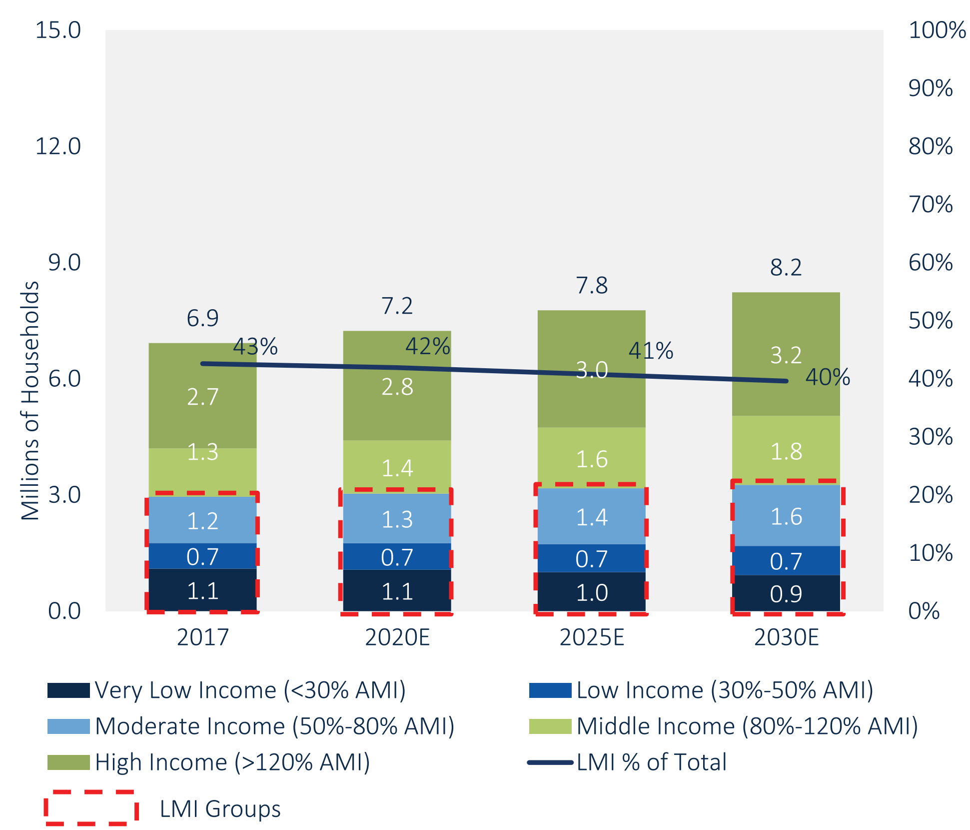
We Expect Strong Population and GDP Growth in California and Florida, Increasing the Total

Number of Households Forecast by Income Group, California



Source: Wood Mackenzie GTM Research, NREL, American Community Survey 2011-2015

Number of Households Forecast by Income Group, Florida

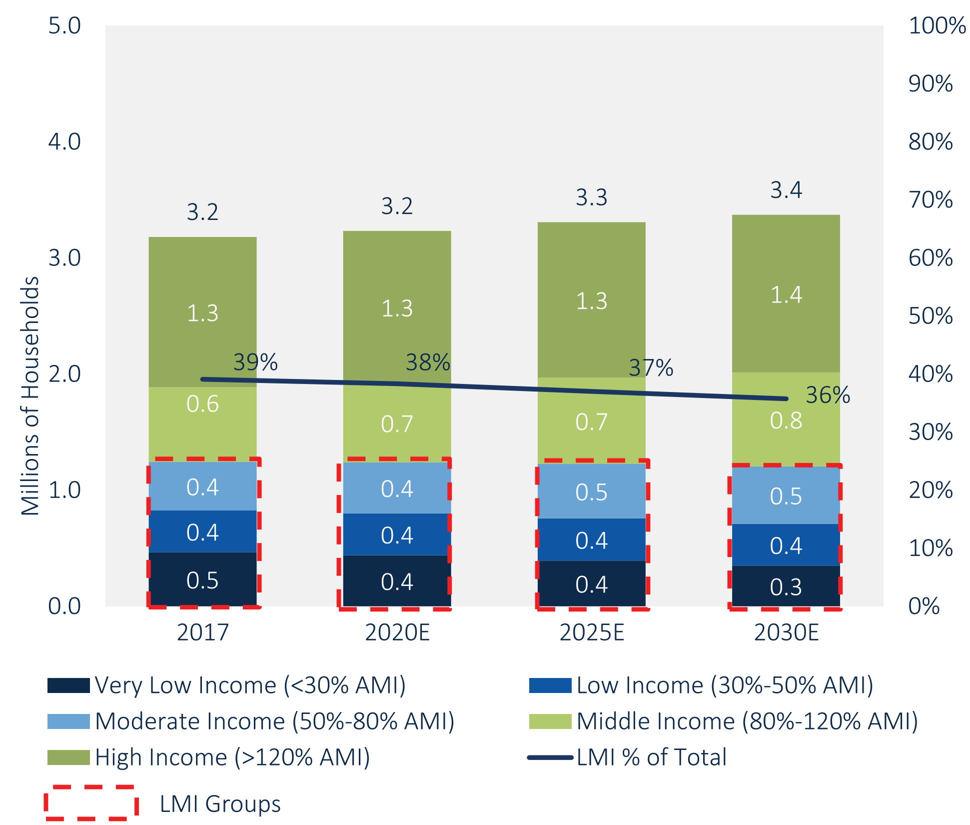


Relative Flat Economic Outlook in Michigan and New Jersey, Further Shrinking the Number of Households Falling Into LMI Group With More Even Income Distribution

Number of Households Forecast by Income Group, Michigan

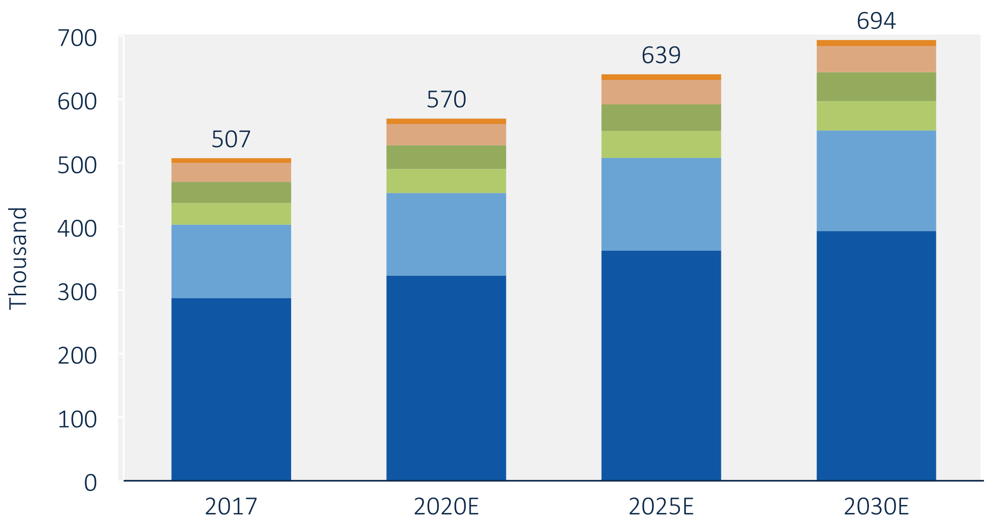
Source: Wood Mackenzie GTM Research, NREL, American Community Survey 2011-2015

Number of Households Forecast by Income Group, New Jersey

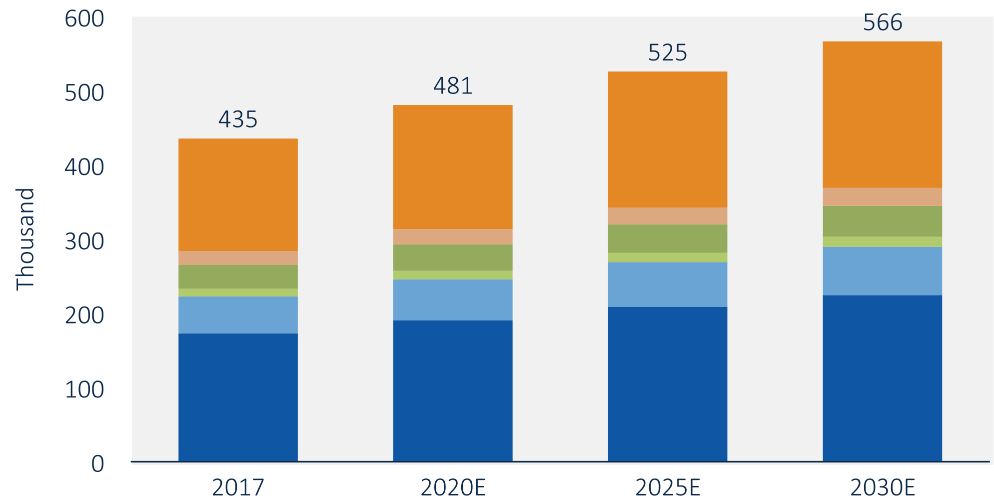


Higher Percentage of LMI Group Is Expected to Receive Affordable Housing Support, Enlarging the Affordable Housing Customer Segment

Number of Affordable Housing Homes, California



Number of Affordable Housing Homes, Florida

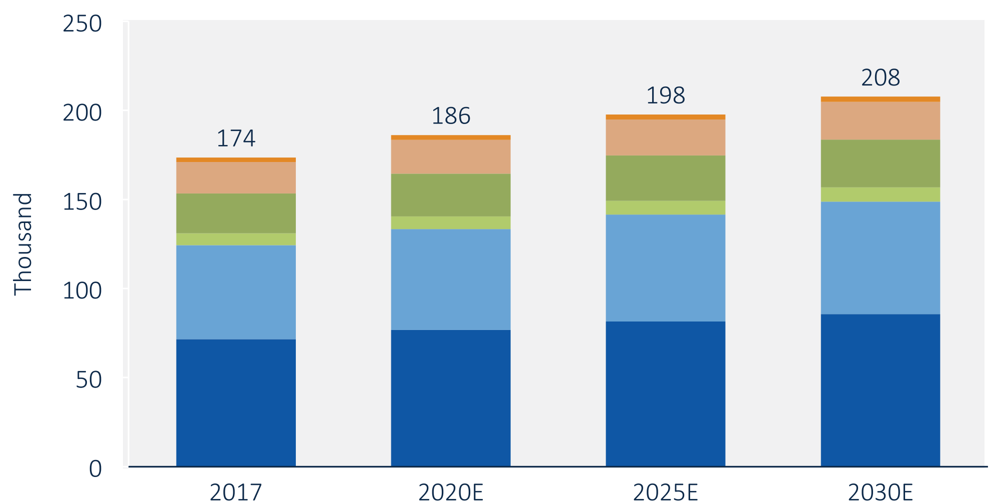


LIHTC   Section 8   HOME   Public Housing   USDA Programs   Others

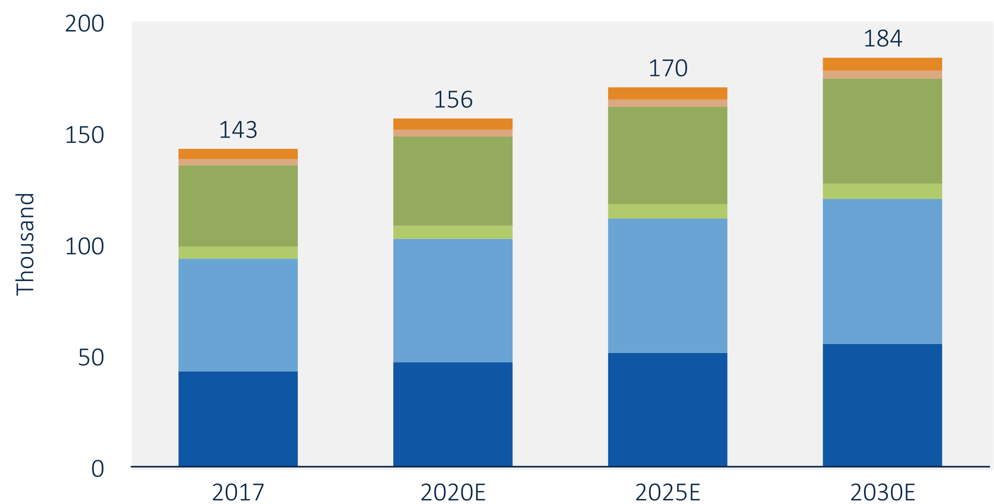
Source: Wood Mackenzie GTM Research, National Housing Preservation Database (NHPD), NREL, HUD, USDA

Michigan and New Jersey Have More Modest Growth Due to the Flat Outlook for Households in These States

Number of Affordable Housing Homes, Michigan



Number of Affordable Housing Homes, New Jersey



LIHTC | Section 8 | HOME | Public Housing | USDA Programs | Others

Source: Wood Mackenzie GTM Research, National Housing Preservation Database (NHPD), NREL, HUD, USDA

A Bottom-Up Approach to Estimate Total Addressable Market

	Addressable Market (# of Customers)		Capacity and Consumption		Addressable Market (GW, TWh)
C&I (Inclusive of public institutions)	# of C&I Businesses by Year *State-level businesses by type, GDP growth forecasts*	×	Average Electricity Capacity and Consumption *State-level average business (private/public)*	=	C&I Capacity and Consumption
Residential	# of Households by Year *County-level household income, GDP growth, population growth and income distribution forecasts*	×	Average Electricity Capacity and Consumption *County-level by home ownership and building type*	=	Residential (Mid/High Income) Capacity and Consumption
Moderate-Income Residential	# of Households by Year *County-level household income, GDP growth, population growth and income distribution forecasts*	×	Average Electricity Capacity and Consumption *County-level by home ownership and building type*	=	Moderate-Income Capacity and Consumption
Low-Income Residential	# of Households by Year *County-level household income, GDP growth, population growth and income distribution forecasts*	×	Average Electricity Capacity and Consumption *County-level by home ownership and building type*	=	Low-Income Capacity and Consumption
Affordable Housing Properties	# of Affordable Housing Properties by Year *State-level publicly supported housing, % of low-income under affordable housing*	×	Average Electricity Capacity and Consumption *State-level multi-family rental homes*	=	Affordable Housing Capacity and Consumption

Affordable Housing Program Definitions

LIHTC	Tax credits for the acquisition, rehabilitation, or new construction of rental housing targeted to lower-income households.
Section 8	The Housing Choice Voucher Program (formerly Section 8) provides tenant-based assistance, in the form of a voucher, to low-income families, seniors and persons with disabilities for rental units chosen by the tenant in the private market.
HOME	Formula grants to fund a wide range of activities including building, buying, and/or rehabilitating affordable housing for rent or homeownership or providing direct rental assistance to low-income people.
Public Housing	Public housing was established to provide decent and safe rental housing for eligible low-income families, the elderly, and persons with disabilities.
USDA Programs	A variety of programs (in the form of loans or loan guarantees) to build or improve housing and essential community facilities in rural areas (low- and moderate-income rural Americans).
Others	Includes Section 236 HUD Insured Mortgages, Section 202 Direct Loans and State Section 236.

8. Appendix: Value of Solar Methodology

Value of Solar Methodology

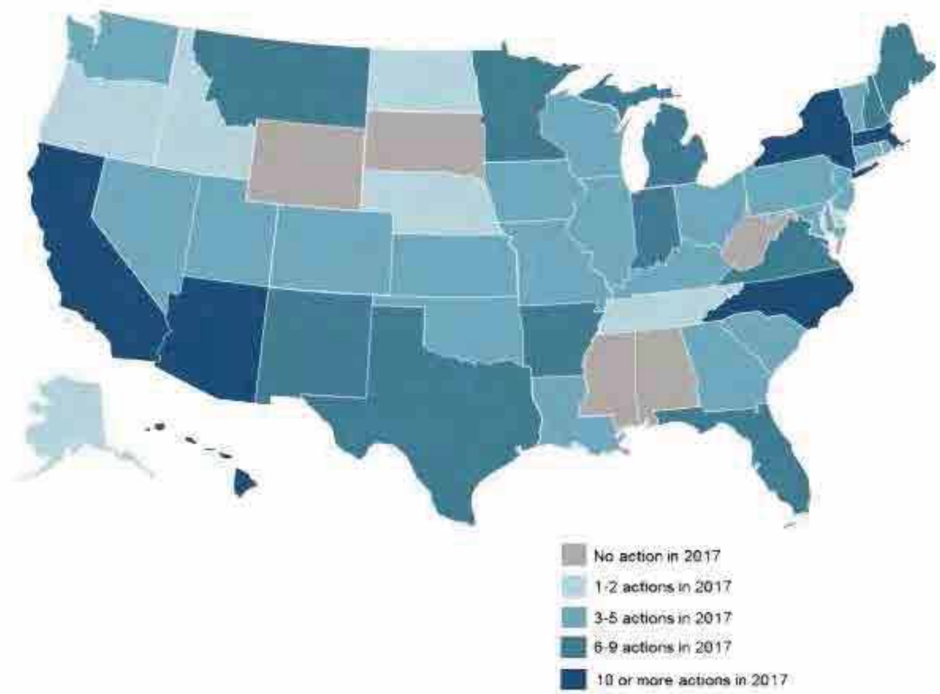
Work Steps	Data Sources
Step 1: Aggregate and categorize value-of-solar component estimates into common buckets • Define and collect individual data points for different value-of-solar components, relying on general categories primarily as defined by Rocky Mountain Institute in *A Review of Solar PV Benefit & Cost Studies* and the Interstate Renewable Energy Council in *A Regulator's Guidebook: Calculating Benefits and Costs of Distributed Solar Generation*	• Full List of Literature Consulted in References • Rocky Mountain Institute • IREC • PACE Energy and Climate Center
Step 2: Compare limited and moderate value-of-solar results with local retail rate at time of study • Use all-sector average rate by utility where study focuses on singular utility and state where study looks at a statewide estimate • Where studies derive multiple values for a specific utility or state territory, use base/average figures or the broadest view (typically multi-year, levelized values) for every utility studied	• EIA
Step 3: Group and weight studies' resulting discount/premium by their proximity and relevance to each studied market • Assign weights to each study that weights closest proximity, recency and similarity of markets most heavily	
Step 4: Apply resulting weighted average premium/discount to current utility-specific all-in rates • Apply resulting premiums/discounts to average retail rates by region to specific utilities' all-in rates • Project value of solar for future years using same escalator as for real retail rates to ensure discount/premium remains static	• EIA • Wood Mackenzie *North American Power Service*

What Is the Value of Distributed Solar Energy?

As more distributed energy, in particular distributed solar PV, is added to the grid, more states and utility territories are wrestling with the future of net metering policy and the proper compensation for distributed solar energy generation.

- According to DSIRE, 31 states and Washington, D.C. undertook some DG compensation policy action in 2017, with 21 states and Washington, D.C. enacting policy to examine the value of solar or net metering.
- These studies seek to find a value or tariff that accurately represents the full costs and benefits that distributed solar brings to customers, ratepayers, system operators and society as a whole.
- The sponsor of a study generally determines how the estimated value of solar weighs against prevailing retail rates. Although not universal, utility-sponsored studies generally show a low value of distributed solar while industry-sponsored studies show a value near or above retail rates. Regulatory filings and sponsored studies generally vary as much as the overall population of studies.

Summary of 2017 Solar Policy and Rate Design Actions



Source: DSIRE *50 States of Solar Q4 2017 Quarterly Report and 2017 Annual Review*

Caveats for Our Value of Solar Methodology

Value-of-solar estimates vary due to the inherent locational and temporal details and a lack of commonly accepted core assumptions and methodologies

While various handbooks, white papers and initiatives seek to establish a common language and a set of methods to calculate the value of solar, an inherently balkanized utility and regulatory landscape results in very different sets of methods and values.

A bottom-up analysis of value of solar in each territory would be extensive, complex and no less controversial nor more valid than our top-down analysis, due to limited data for critical pieces of the analysis. Our intent is to convey the promise of community solar — not set a value-of-solar rate that warrants adoption.

Our purpose is not to prescribe a "value of community solar," but rather to use existing frameworks and literature to create proxy values we can couple with strong community solar policies, product innovation and LMI inclusivity to paint potential community solar adoption. In short, these are illustrative values only and should not be viewed as a proper valuation study nor used as robust, geography-specific estimates.

We accept that there are a number of shortcomings in our calculated value of community solar estimates, including but not limited to the small population of studies and variations to study methodologies on calculated components. We believe that a number of studies fall short in building in the true value of solar because of scope, data and calculation limitations. Similarly, a handful of broad studies incorporate values that may not be realistically employed.

In short, our values represent a simplistic proxy where further standardization, study and clarity is much needed.

Value of Solar Cost Categories and Components

Component	Description
Administrative Costs	Additional cost caused by managing permits and interconnections
Solar Integration Costs	Additional cost to grid operator for balancing solar intermittency
Avoided Energy	Credit for eliminating cost of displaced energy generation
Avoided Capacity	Credit for eliminating cost of displaced investment in new generating capacity
Avoided T&D Capacity	Credit for eliminating cost of displaced investment in new transmission and distribution capacity
Avoided Line Losses	Credit for energy consumed near the source and not lost over transmission and distribution lines
Environmental Compliance	Credit for renewable or environmental compliance requirements at the avoided cost of compliance
Price Reduction Effects	Reduction of total system-wide generation and capacity pricing as the result of reduced demand
Hedge Value	Credit for reduced uncertainty in future energy and generation capacity costs
Ancillary Services	Reduced need for grid support or ancillary services, either due to reduced demand or ability for distributed solar to provide services (e.g., reactive voltage support)
Carbon/GHG	Credit for reduced greenhouse gas emissions, often through the expectation of a future carbon market
Additional Economic, Environmental and Societal Benefits	Benefits to jobs, local economy, public health, and other environmental and societal benefits not otherwise accounted for

Value of Solar, Limited
Value of Solar, Moderate
Value of Solar, Full

Reviewed Literature of State- and Utility-Specific Estimates of the Value of Solar

California
LBNL (2012)
Crossborder Energy (2013)
E3 (2010, 2011, 2012, 2018 Tool)

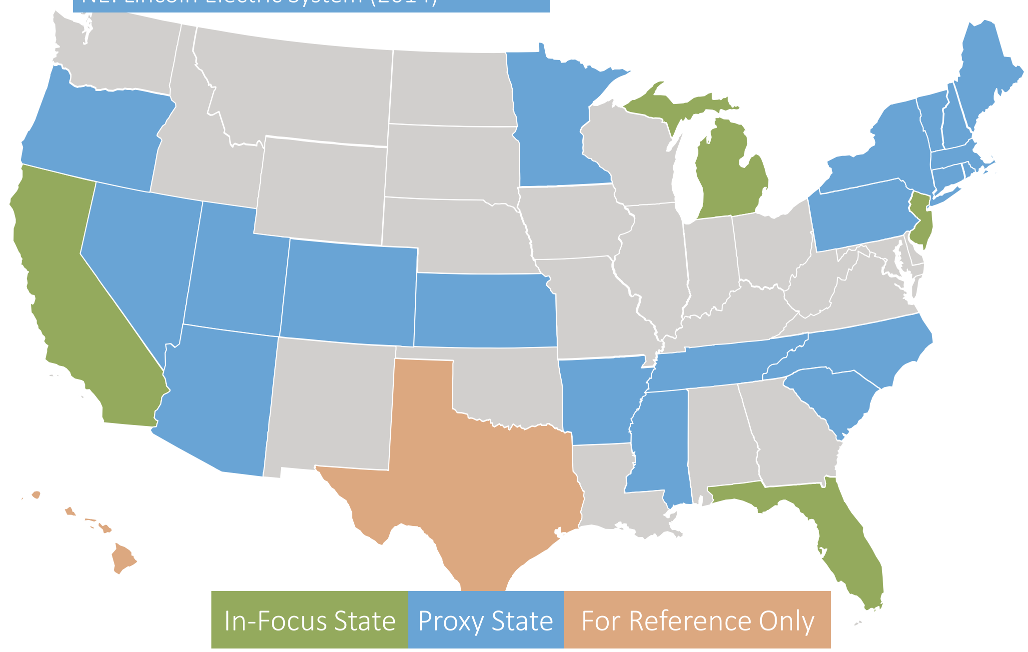
West
AZ: SAIC (2013)
Crossborder Energy (2013, 2016)
CO: Xcel Energy (2013)
Crossborder Energy (2013)
IREC + Clean Power Research (2015)
NV: E3 (2014, 2016)
Navigant consulting (2010)
SolarCity + NRDC (2016)
OR: Crossborder Energy (2018)
PGE (2018)
Idaho Power (2018)
PacifiCorp (2018)

Hawaii: E3 (2014)
Texas: Clean Power Research (2012)
Brattle Group (2012)
Clean Power Research (2013)
Austin Energy (Annual VOST Filings)

Source: GTM Research

Midwest
MN: Minnesota Power (VOS Filings)
Xcel Energy (VOS Filings)
Clean Power Research (2014)
NE: Lincoln Electric System (2014)

Michigan
Utility Financial Solutions (2015)
Utility Financial Solutions (2016)
DTE Energy (2014)



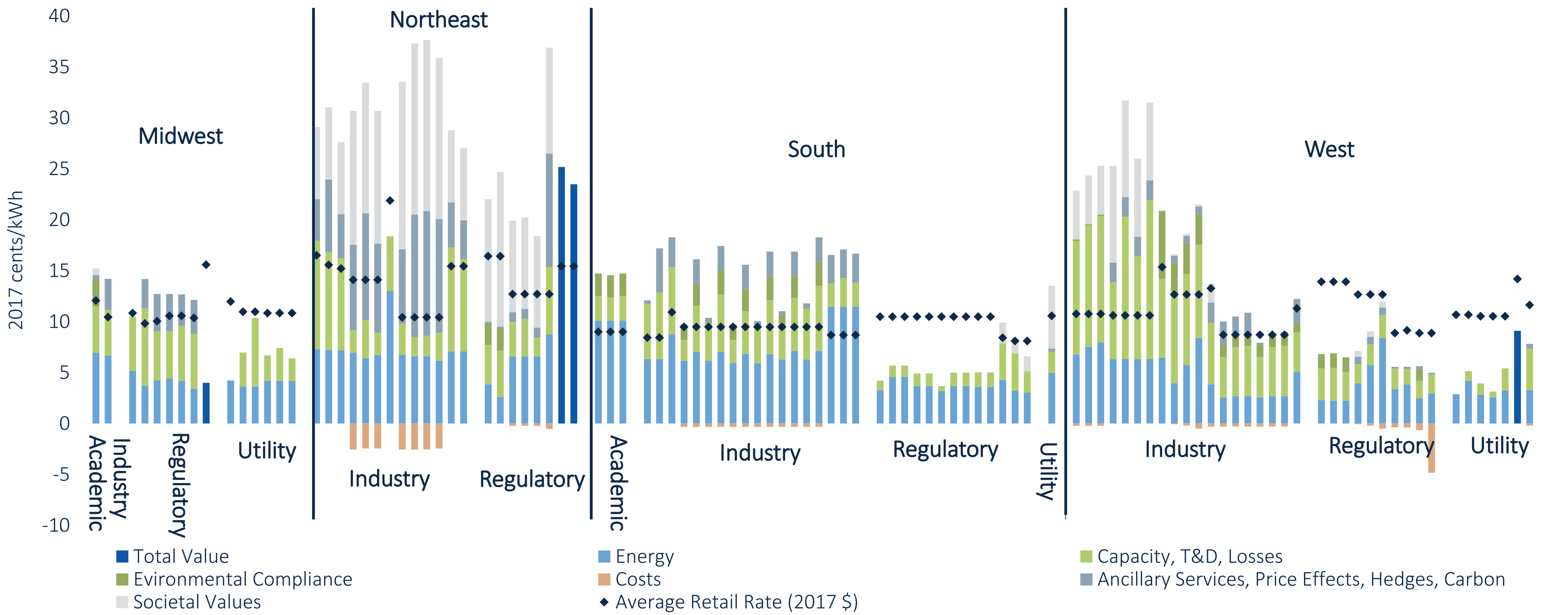
New Jersey
Clean Power Research (2012)

Northeast
CT: Acadia Center (2015)
MA: Acadia Center (2015)
Peregrine+ SEA+ Meister + La Capra (2015)
ME: Maine PUC (2015)
NH: Acadia Center (2015)
NY: VDER Proceedings
PA: Clean Power Research (2013)
RI: Acadia Center (2015)
VT: VT PSD (2014)

SOUTH
AR: Crossborder Energy (2017)
MS: Synapse Energy Economics (2014)
NC: Crossborder Energy (2013)
SC: SCE&G (2016, 2017)
Duke Energy (2016, 2017)
TN: TVA (2015)

Review of Value of Solar Literature: Value of Solar Components vs. Average Retail Rates

Review of Value of Solar by Component From 40 Value of Solar/Value of Distributed Energy Studies vs. Average EIA Retail Rates



Source: GTM Research, EIA (average retail rates in study year) Various Regulatory Filings and Studies (See References for Full List of Studies)

Quantifying a Limited and Moderate Value of Solar for Our In-Focus States

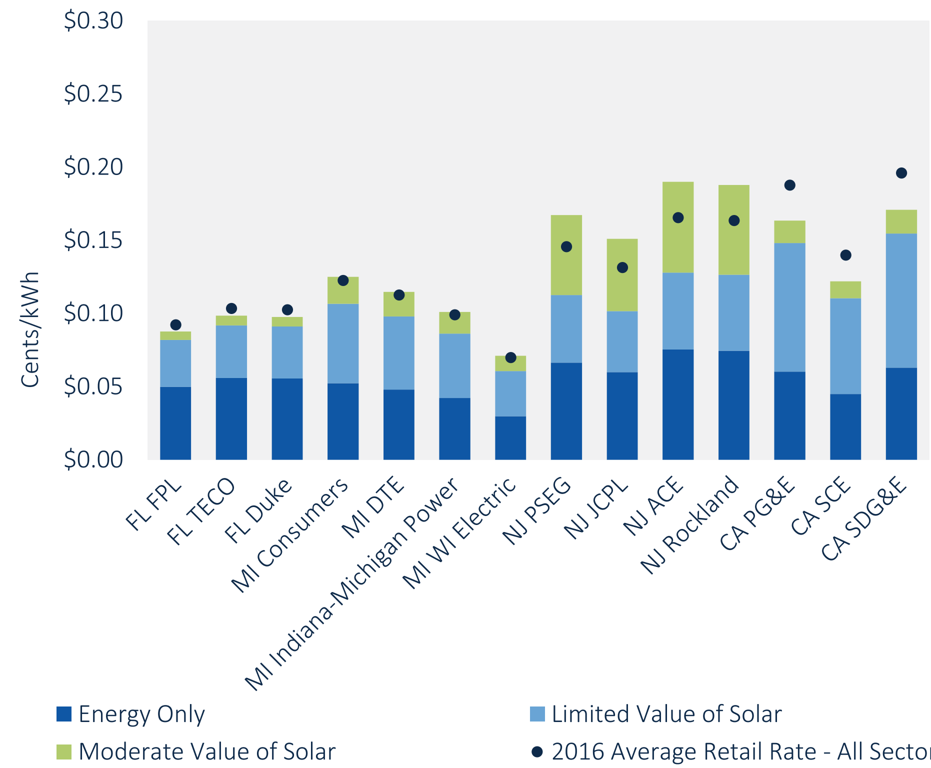
We build two value-of-solar estimates for each studied state

Despite differences in methodology, nearly all value-of-solar studies accept that distributed solar has value beyond the generated electrons (i.e., an energy-only value). However, adopted methodologies generally differ in which components are included and how these are calculated. Using our guide to different components, we come to two general categories of value of solar:

- **Limited value of solar:** Using only components that are more commonly calculated for value of solar in studies, including direct avoided costs and environmental credits that are directly monetizable (e.g., RECs)
- **Moderate value of solar:** Using a broader, but incomplete, set of components that pertain to grid value, excluding non-monetizable and more difficult-to-calculate societal benefits (e.g., social cost of emissions, jobs, low-income support).

Ultimately, our moderate value-of-solar averages range from a 13% discount to a 15% premium of average state-wide retail rates, with an average close to average retail rates. ***We also note that, due to the limitations of the literature reviewed, our moderate value of solar does not include a full benefit and cost accounting, including additional economic and societal benefits.***

Weighted Value of Solar vs. Average Retail Rate Based on Literature Review



Source: GTM Research

Identifying the Uncertainty and Potential Biases in Our Study

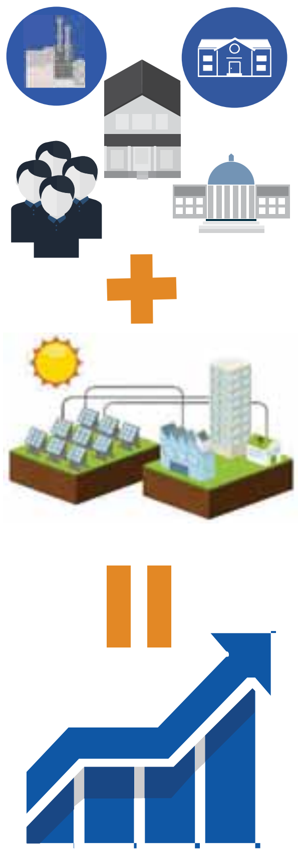
In addition to pragmatic differences in the reviewed studies' methodologies, we acknowledge the risk inherent to using a broad set of literature for values rather than a bottom-up calculation. The main risks to our utilized values include:

- **Bullish views on forward wholesale electricity prices:** Given the limitation of available data on the studied geographies and our intent for these estimates to be representatives rather than definitive, we employ a rough top-down average of existing studies rather than using best-in-class bottom-up calculations in each studied geography. Older studies may have more bullish views on natural-gas-driven wholesale energy prices, which would increase the long-term value of solar. We attempt to mitigate the impact of these factors by filtering out studies before 2010, as well as more heavily weighting recent studies with up-to-date views on energy and infrastructure costs.
- **Increasing solar deployment erodes the value of pure solar**: Our discount to average retail rate method could **overestimate the value of solar in high-penetration scenarios**, as concurrent solar generation does not mitigate all capacity costs and may increase certain integration costs. We assert that broad deployment of energy storage and flexible devices installed could mitigate the value erosion. These components will come at an additional cost but can also be utilized for services beyond mitigation of the effects of high solar penetration, adding value or potentially offsetting the costs of these additions.
- **Many value-of-solar studies take a limited view on broad values**: Our methodology averages in value-of-solar studies that ignore or cast aside best practice values, e.g., assuming capacity offset of solar is zero or assuming no ability to offset distribution equipment even at low solar penetration. In other circumstances, we look at estimates from regulatory filings in which the value-of-solar definition may be intentionally narrow, i.e., broader components are not even considered. Because these limited studies are also included in our averaged results, **our estimates may undersell the full value of solar**.

Overall, there is an inherent risk in mischaracterizing the value of distributed solar because current literature is incomplete or may otherwise inaccurately portray different component values. Significantly more work on a standard, agreed-upon framework and methodology should be implemented in markets that move towards a value of solar bill credit for community solar facilities.

9. Appendix: Forecast and Customer Benefit Calculation Methodology

Translating Customer Benefits to Deployments



Total Addressable Market

Our deployment forecasts starts with identifying the entire universe of all potential customers that could adopt community solar

- Derive total customers and segmentation from U.S. Census and other publicly available datasets
- Assess the factors driving addressable market shift for each segment identified

Community Solar Benefits

Next, we model adoption based on whether customer segments see enough tangible benefits to subscribe to community solar based on:

- Project economics and customer benefits analysis for each customer segment
- For Phase II and Phase III adoption, we build a top-down value-of-solar metric with which to compare community solar

Deployment Forecast

We assess a rate of adoption of community solar in each state and segment based on the tangible economic benefits, policy applications that ease subscribers’ non-economic concerns, and continued maturity in community solar providers' business models to subscriber acquisition, retention and financing that improve attractiveness beyond bill savings with constraints from onsite distributed solar adoption and state-specific power market factors. We note that this is could be a conservative value as it does not fully account for all intangible, non-economic benefits that cause customers to participate.

Five Customer Segments Are Identified to Represent the Total Addressable Market

Community Solar Customer Segment Definitions

C&I (Inclusive of public institutions)	C&I Private includes agriculture, mining, utilities, construction, manufacturing, trade, transportation and warehousing, information, finance and insurance, real estate, professional, management of companies, art and entertainment, accommodation and food. Public includes administrative and support, educational services, health care and social assistance, government/municipal, military.
Residential	Includes high-income (greater than 120% AMI[1]) and middle-income (between 80% and 120% AMI) households per Department of Housing and Urban Development definition
Moderate-Income Residential	Includes moderate-income (between 50% and 80% AMI) households per HUD definition
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Affordable Housing Properties	Various programs targeting low-income households offered by Department of Housing and Urban Development and U.S. Department of Agriculture and Rural Development. Includes LIHTC, Section 8, HOME, Public Housing, USDA Programs and others.

Source: Wood Mackenzie GTM Research. Note 1: AMI refers to area median income

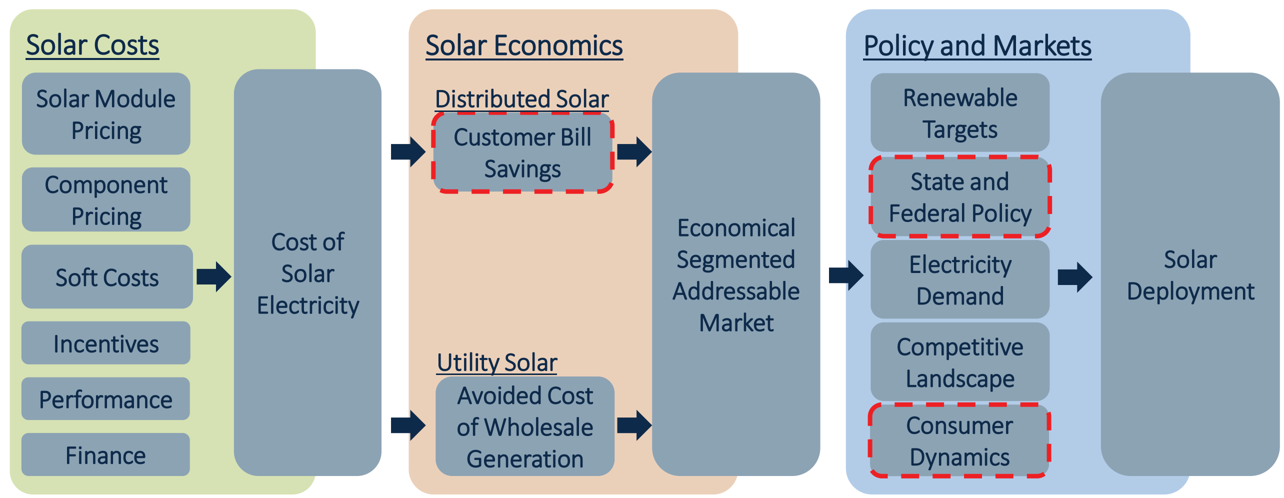
Translating Addressable Markets to a Deployment Forecast

We adapt GTM Research's proprietary deployment forecast model with a specific focus on community solar

- Customer savings are assumed to come in the form of bill credits according to community solar value in each phase
- State policy factors are adapted to allow for community solar without program caps
- New consumer dynamics formula built in to reflect a community solar product that is considerably more attractive than current community solar products
- Community solar forecast also includes consumer and competitive consideration of on-site/rooftop solar
- Policy intervention and market focus on subscriptions attract for increased LMI adoption, i.e., raising customer attraction/adoption scores for LMI segments

GTM Research's adoption forecast model underpins its state- and segment-level forecasts of the overall U.S. solar market

- Forecasts start with the economic foundation for addressable market and customer adoption
- Consumer dynamics built in via customer adoption curves based on historical experience and industry literature



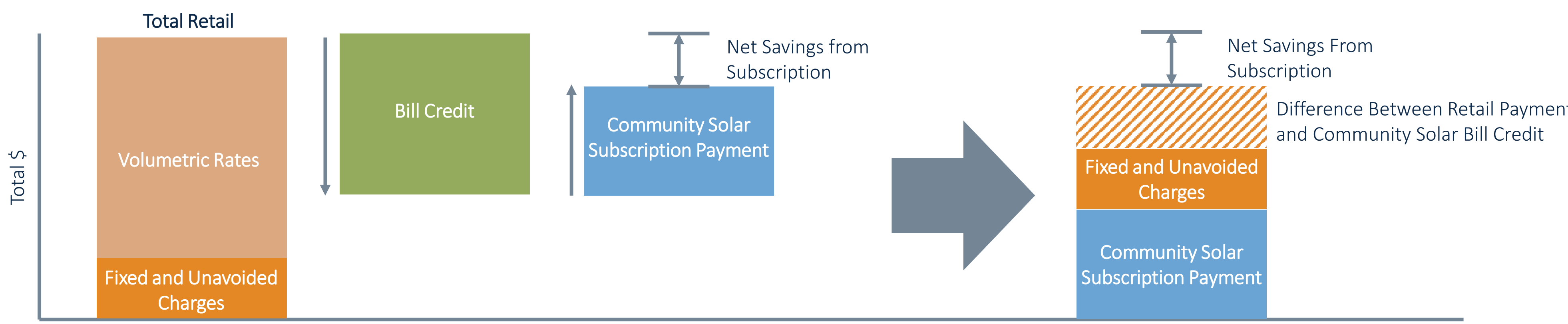
Modeling and Showing Community Solar Subscription Savings

We consider what solar can and can't offset for customers when looking at customer savings

Many residential and non-residential customers have portions of the bill that cannot be offset by on-site or bill credited solar generation, such as fixed charges, non-bypassable charges, demand charges and minimum bills. In addition, solar may not completely offset customer consumption, rendering a small part of the bill that is still subject to prevailing retail rates. Furthermore, when community solar is credited at a different rate than consumption, we must account for this difference in the costs to the subscriber

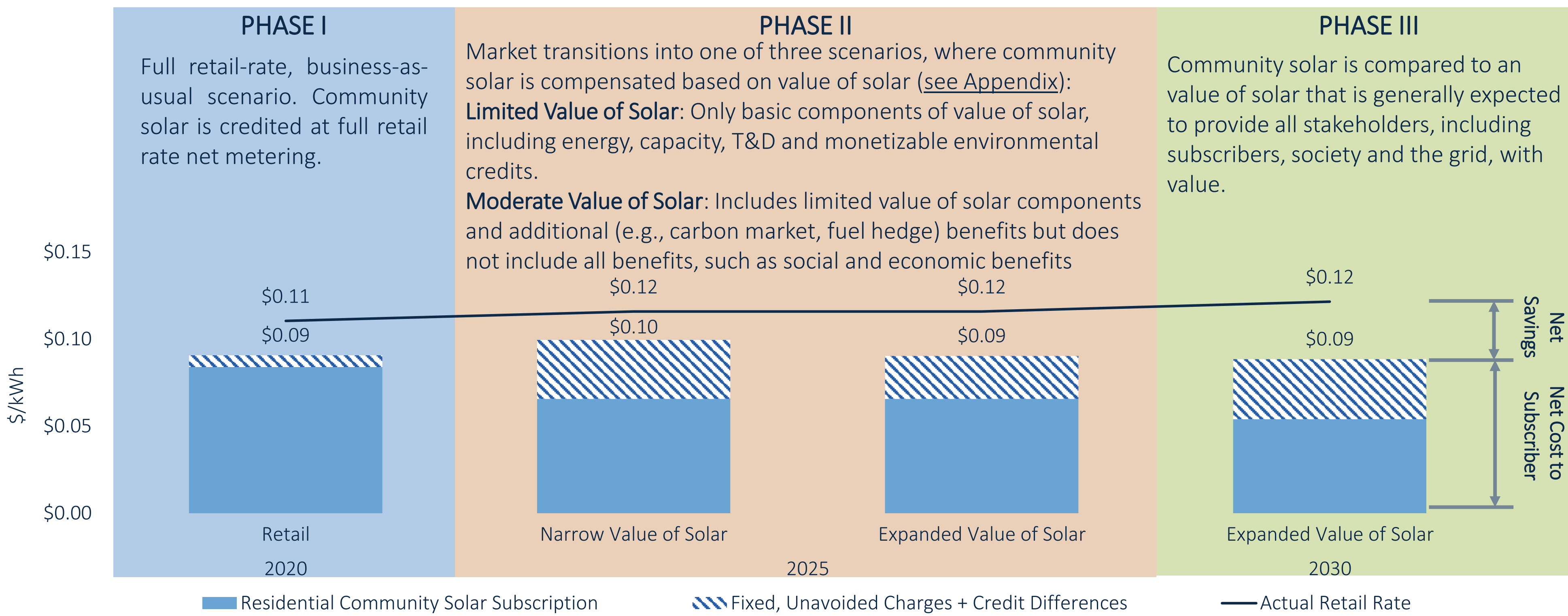
Thus, we use actual residential and commercial rate structures to calculate net avoided costs and bill savings resulting from a community solar subscription.

The example below shows how we arrive at net savings from a community solar subscription while accounting for these additional charges.



Stepping Through the Community Solar Proposition for DTE Territory in Michigan

Florida (in FPL Territory): Retail Rate vs. Net Community Solar Subscription Rate in Each Phase



Source: GTM Research, Wood Mackenzie

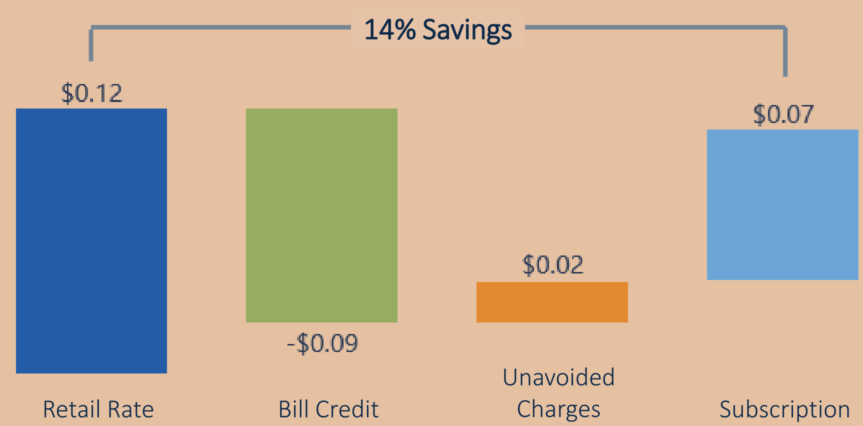
A Deeper Look at Phase II Customer Benefits in FPL Territory

Residential Community Solar Bill Payments and Savings Based on Three Bill Credit Scenarios in Florida FPL Territory

PHASE II: Limited Value of Solar

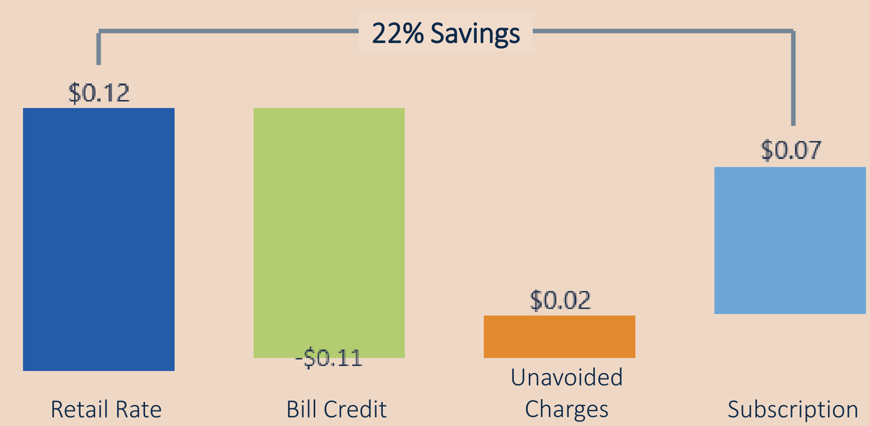
Under a Limited Value of Solar bill credit, subscription rates are well under retail and bill credit rates, but fixed charges and unavoided volumetric charges pull back net savings for the retail customer.

Nevertheless, costs are within an attractive savings range for initial residential community solar adopters.



PHASE II: Moderate Value of Solar

Under an moderate value of solar scenario, similar subscription levels offer greater savings due to a higher bill crediting rate, leading to stronger adoption rates. With a higher bill credit, operators have more space to tailor subscriptions to different customer classes to maximize financial gain while minimizing risk through a diverse customer set.



Source: GTM Research Wood Mackenzie

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General Research

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2) "U.S. Solar Market Insight," GTM Research, Solar Energy Industry Association (Q4 2017, Q3 2017, Q2 2017, YIR 2017)
3) "U.S. Community Solar Outlook 2017," GTM Research Wood Mackenzie (February 2017)
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5) "Sizing Up the Commercial Solar Market," GTM Research Wood Mackenzie (August 2017)
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7) "What the Community Solar Customer Wants," Shelton Group, Smart Electric Power Alliance

Value of Solar

8) "A Regulator's Guidebook: Calculating the Benefits and Costs of Distributed Solar Generation," Interstate Renewable Energy Council (December 2013)
9) Review of Minnesota's Value of Solar tariff, "Minnesota Value of Solar: Methodology," Minnesota Department of Commerce and Clean Power Research (January 2014)
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12) "Getting Solar Pricing Right," Brookings Institute (September 2014)
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MEMORANDUM REPORT

[bw] RESEARCH PARTNERSHIP

Executive Summary

DTE Energy, a large investor-owned utility based in Detroit, Michigan, has asked state regulators to approve the construction of an 1100 megawatt (MW) natural gas-fired power plant to be constructed in St. Clair County, Michigan, where the company is retiring older coal units. DTE Energy's filing before the Michigan Public Service Commission estimates that this plant will result in 520 construction jobs and will employ 35 people on an ongoing basis.

Vote Solar and the Union of Concerned Scientists commissioned BW Research to conduct an analysis of the economic development and job benefits that would occur if DTE Energy invested in solar, wind and energy efficiency resources, rather than building the fossil fuel plant. According to a witness for a coalition of clean energy intervenors[1], DTE Energy could produce the same electric generating capacity as the plant by through roughly 1100 MW of solar, 1100 MW of wind, and 87 MW of energy efficiency savings. Vote Solar and the Union of Concerned Scientists asked BW Research to determine the economic development and job benefits of this portfolio of resources. This memo describes both the conclusions of that research and the methodology we used to derive those conclusions.

Overall, the solar, wind and efficiency portfolio would create 16,360 direct, indirect and induced jobs in Michigan. This number includes jobs designing, siting, engineering, installing, and operating these energy measures, as well as those in the supply chain and those in the broader economy that result from the wage spending expected from these developments.

Making an apples-to-apples comparison between the direct (construction and ongoing operating/maintenance) job creation of the solar, wind and efficiency portfolio and the gas plant as estimated by DTE in its testimony before the Michigan Public Service Commission**, we would expect that the clean energy portfolio would create just over 10 times the number of construction jobs and just under 4 times the number of ongoing jobs.**

[1] The Clean Energy Intervenors included the Environmental Law and Policy Center, the Union of Concerned Scientists, the Solar Energy Industries Association and Vote Solar.

	Construction Jobs	Ongoing Operating/Maintenance Jobs
DTE Proposed Plant	520	35
Clean Portfolio Total	5,642	137
Wind	2,649	119
Solar	2,335	18
Energy Efficiency	658	

BW Research also assessed the number of indirect jobs that would be created by the clean energy portfolio. Indirect jobs are those that are created in the supply chain to serve the initial (direct) job creation. We estimate that there would be another 2582 indirect jobs created in Michigan if DTE were to build the wind, solar and efficiency portfolio suggested by the Clean Energy Intervenors.

Finally, BW Research estimated the number of induced jobs that would be created as a result of this clean energy investment by DTE at 7721 jobs. Induced jobs are those created in the economy as a result of wage spending from the direct and indirect jobs resulting from the project.

	Direct	Indirect	Induced	Total
Wind Construction Jobs	2,649	1,517	5,009	9,175
Wind O&M Jobs	119	66	237	422
Solar Construction Jobs	2,335	824	2,282	5,441
Solar O&M Jobs	18	4	22	44
Energy Efficiency Jobs	658	171	448	1,277

The study also found that in addition to significant jobs potential from solar, wind, and energy efficiency capacity additions, the economic impact of this work would also generate significant tax revenue. In total, the proposed renewable production and efficiency savings would generate $213.5 million in local and state taxes and $41.1 million in federal taxes.

A complete explanation of our sources of data, assumptions and methodology, and the implications of our findings follows below.

Introduction

BW Research was commissioned by Vote Solar and the Union of Concerned Scientists to produce an economic impact analysis of the direct, construction and operations jobs associated with approximately 2,500 megawatts (MW) of renewable power plant production and efficiency savings in the State of Michigan. BW Research applied proprietary labor efficiency data produced from years of studying clean economies in the region to calculate the direct impact of the added energy capacity and savings. Vote Solar and the Union of Concerned Scientists provided the total MW of proposed wind, distributed solar, and utility-scale solar energy capacity, and the total proposed MW associated with added energy efficiency capacity for the State of Michigan. BW Research used these proposed MW of added energy capacity and energy efficiency to calculate the following:

- Construction jobs associated with wind energy capacity addition
- Operations and maintenance jobs associated with wind energy capacity addition
- Construction jobs associated with solar energy capacity addition
- Operations & maintenance (O&M) jobs associated with solar energy capacity addition
- Industry jobs associated with the added energy efficiency capacity

BW Research applied Economic Modelling Specialists (EMSI) multipliers to these inputs to determine the number of indirect and induced jobs and related fiscal impacts associated with the new capacity additions. This report provides the results of these analyses.

VOTE SOLAR

About Vote Solar

Since 2002, Vote Solar has been working to lower solar costs and expand solar access. A 501(c)3 non-profit organization, Vote Solar advocates for state policies and programs needed to repower our electric grid with clean energy.

Learn more at **votesolar.org**.

[bw]
RESEARCH
PARTNERSHIP

About BW Research

BW Research Partnership is a full-service applied research firm that is focused on supporting clients with economic & workforce research, customer & community research, as well as strategic planning and evaluation services. BW Research has extensive qualifications in energy-related research.

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Union of Concerned Scientists

About the Union of Concerned Scientists

The Union of Concerned Scientists puts rigorous, independent science to work to solve our planet's most pressing problems. Joining with people across the country, we combine technical analysis and effective advocacy to create innovative, practical solutions for a healthy, safe, and sustainable future.

Energy Jobs - Methodology

This research study calculates the economic impact of potential energy capacity added to the State of Michigan. It includes a hypothetical addition of 1,100MW of wind energy, 1,100 MW of solar energy (200MW of distributed generation and 900MW of utility-scale solar energy), and 87MW of savings from energy efficiency. BW Research applied proprietary labor efficiency data produced from years of studying renewable energy and energy efficiency employment in the region to calculate jobs per MW of energy capacity.

WIND ENERGY JOBS

Wind energy construction and operations jobs were calculated using research conducted by BW Research for a variety of clients over the past several years, including labor market analyses for the National Renewable Energy Laboratory (https://www.nrel.gov/docs/fy13osti/57512.pdf; https://www.nrel.gov/docs/fy14osti/61251.pdf) and the Natural Resources Defense Council (https://www.nrdc.org/sites/default/files/american-wind-farms-IP.pdf). These findings were used to develop a custom model for the number of jobs associated with each MW of added wind energy capacity, including the number of construction and operations & maintenance jobs associated with a MW of wind energy generation. The total employment impact for 1,100 MW of wind energy generation is 2,649 jobs[2]. This phase includes site identification and assessment, project development, project permitting, and on-site civil workers, mechanical assembly, and electrical work. Operations and maintenance of these 1,100 MW requires an additional 119 workers on an annual basis.

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[2] In this study a job is any position in which a worker provides labor in exchange for monetary compensation, including those who work as employees for businesses (i.e. "wage and salary" employees) and proprietors who work for themselves. Jobs are shown as annual job averages and include both full- and part-time jobs, which are counted equally (job counts are not adjusted to full-time equivalents). Geographically, payroll jobs are always reported by the place of work rather than the worker's place of residence and self-employed and proprietors jobs are always reported by their place of residence.

SOLAR ENERGY JOBS

Distributed generation installation workers per MW installed was generated from primary data collected from Michigan firms regarding typical installations (using 1,850 hours as a full-time worker equivalent) and large installation firm (multiple locations), total installation workforce divided by total annual MW installed. Both methodologies returned estimates of over 5 workers per MW; the 5.19 jobs per MW represents an average of the two figures.

Utility generation installation (construction) workers per MW installed was generated from secondary data sources for total man hours at Michigan solar utility projects. The largest project currently in operation in Michigan, the 60 MW DTE Energy Solar Farm in Lapeer, used 160,000 total man hours, or approximately 86.49 full-time equivalent installation workers (using 1,850 hours as a full-time worker equivalent), or 1.44 installation workers per MW.

Utility-scale installed capacity solar is currently approximately 80 MW in Michigan. The Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW) currently estimates <10 workers at solar electric power generation establishments (operations and maintenance positions). Secondary data sources report up to five full-time O&M workers at solar farms ranging from 60 (60 MW DTE Energy Solar Farm in Lapeer, MI) – 250 MW in the United States (various utility-scale arrays). We estimate that 18 O&M workers would be employed at a 900 MW combined utility-scale project using a straight curve from 250 MW ((900/250)*5).

ENERGY EFFICENCY JOBS

BW Research used secondary data sources to determine the number of jobs associated with 87 MW of energy efficiency measures in the State of Michigan. The American Council for an Energy-Efficient Economy's (ACEEE) findings (provided in the report "*What Will It Cost? Exploring Energy Efficiency Measure Costs over Time*") show a $1 cost associated with 1 Watt of energy reduced by energy saving-measures. Thus, to achieve a goal of 87 MW of energy savings, a total of approximately $87 million would have to be spent on energy efficiency measures.

BW Research created four models for the following energy efficiency-related industries: residential remodelers, electrical contractors, plumbing and HVAC contractors, and commercial and Institutional Building Construction. The average results for those four models show that 87 MW of energy savings are associated with 658 direct jobs in the State of Michigan.

Energy Jobs - Results

The economic impact analyses were developed using EMSI's input-output model, a model that traces spending and infrastructural developments through the economy. The cumulative effects of the initial spending and jobs created are measured monetarily and the results are categorized into direct, indirect, and induced effects. Direct effects show the change in the economy associated with the initial spending, or how the industry experiences the change (e.g. jobs created by the added energy capacity). Indirect effects include all the backward linkages, or the supply chain responses and local employment as a result of the initial jobs created or spending. Lastly, induced effects refer to household spending and are the consequence of workers who are responsible for the direct and indirect effects spending their wages in the region. Jobs in this analysis include full- and part-time wage and salaried jobs and self-employed jobs. Full- and part-time jobs are counted equally, i.e. job counts are not adjusted to full-time equivalents.

The input-output model also calculates the fiscal impact of the initial change in the economy (e.g. jobs created) by estimating the taxes on production and imports (TPI). These taxes consist of tax liabilities, such as general sales and property taxes, that are chargeable to business expenses. TPI is comprised of state and local taxes—primarily non-personal property taxes, licenses, and sales and gross receipts taxes—and Federal excise taxes on goods and services. The results of the economic analyses are presented below.

THE IMPACT OF WIND JOBS

BW Research calculated the impact of adding 2,649 construction jobs and 119 O&M jobs associated with 1,100 MW of wind energy generation. The jobs associated with the construction phase include site identification and assessment, project development, project permitting, and on-site civil workers, mechanical assembly, and electrical work. The operations jobs include the typical positions necessary to operate and maintain a wind energy plant such as technicians, engineers, and professional staff. The industries included in these two phases are engineering services and wind electric power generation. The results are provided below.

Wind Construction Jobs

A total of 9,175 direct, indirect, and induced jobs are created in the State of Michigan from adding 1,100 MW of wind energy generation. 1,517 indirect jobs are created in the supply chain (i.e. other industries required for the wind energy generation to occur, such as construction, manufacturing, and wholesale trade) as a result of the initial 2,649 wind jobs created and a significant 5,009 induced jobs are created as a result of the wages that were generated by the direct and indirect jobs and that are spent in the region's economy. The multipliers presented in Table 1 refer to the ripple effect in the economy of the initial, i.e. direct, jobs created. This means that for every direct job created, 0.57 indirect (supply chain) and 1.89 induced jobs (jobs created as a result of wage spending from the direct and indirect jobs) are created in the economy. Lastly, all this job creation and spending results in a fiscal impact of over $181 million in local and state taxes and nearly $33 million in federal taxes (Table 2).

Table 1: Construction Jobs associated with adding 1,100MW of Wind Energy to the State of Michigan

	Direct	Indirect	Induced
Jobs	**2,649**	**1,517**	**5,009**
Multipliers		**0.57**	**1.89**

Table 2: Effect on Taxes on Production and Imports

Local Taxes	State Taxes	Federal Taxes
$100,274,155	**$80,927,395**	**$32,994,757**

Wind O&M Jobs

A total of **422 O&M direct, indirect, and induced jobs** are created in the State of Michigan from adding 1,100 MW of wind energy generation. 66 indirect jobs are created in the supply chain as a result of the initial 119 wind jobs created and 237 induced jobs are created as a result of the wages that are spent in the region's economy. To note that the induced jobs are nearly twice the direct jobs, meaning that salary spending as a result of the direct and indirect jobs has a significant impact in the region's economy. Lastly, fiscal impact is a little over $9 million in local and state taxes and $1.67 million in federal taxes.

Table 3: Operations & Maintenance Jobs associated with adding 1,100MW of Wind Energy to the State of Michigan

	Direct	Indirect	Induced
Jobs	**119**	**66**	**237**
Multipliers		**0.55**	**1.99**

Table 4: Effect on Taxes on Production and Imports

Local Taxes	State Taxes	Federal Taxes
$5,098,804	**$4,113,968**	**$1,672,932**

THE IMPACT OF SOLAR ENERGY JOBS

The proposed added capacity for the state is 1,100 MW of solar energy, of which 200 MW are distributed generation and 900 MW are utility-scale energy generation. The impacts of this added capacity are presented below.

Impacts of 200 MW of distributed generation

Construction

The industry included in the model to determine the construction jobs for distributed generation was electrical contractors and other wiring installation contractors. Results show that a total of 2,237 direct, indirect, and induced jobs are created in the State of Michigan as a result of the 200 MW added capacity (Table 5). The fiscal impacts include $7.3 million in local and state taxes and $2 million in federal taxes (Table 6).

Table 5: Construction Jobs associated with 200MW of distributed generation

	Direct	Indirect	Induced
Jobs	**1,038**	**331**	**868**
Multipliers		**0.32**	**0.84**

Table 6: Effect on Taxes on Production and Imports

Local Taxes	State Taxes	Federal Taxes
$32,983,036	**$26,654,490**	**$11,009,304**

Impacts of 900 MW of utility-scale solar energy

The added 900 MW of utility-scale solar energy is responsible for 1,297 direct, construction jobs and 18 direct, O&M jobs. The impacts of these jobs are presented below.

Construction

The industry included in the model to determine the construction jobs for utility-scale energy generation was power and communication line and related structures construction. Results show that a total of **3,203 direct, indirect, and induced jobs** are created in the State of Michigan as a result of the 900 MW of utility-scale energy capacity (Table 7). The fiscal impacts include $11.57 million in local and state taxes and $3.24 million in federal taxes (Table 8).

Table 7: Construction Jobs associated with 900MW of utility-scale solar energy

	Direct	Indirect	Induced
Jobs	**1,297**	**493**	**1,414**
Multipliers		**0.38**	**1.09**

Table 8: Effect on Taxes on Production and Imports

Local Taxes	State Taxes	Federal Taxes
$6,254,596	**$5,314,380**	**$3,243,671**

Operations and Maintenance

The industry included in the model to determine the O&M jobs for utility-scale energy generation was solar electric power generation. Results show that a total of **44 direct, indirect, and induced O&M jobs** are created in the State of Michigan as a result of the 900 MW of utility-scale energy capacity (Table 9). The fiscal impacts include $827,660 in local and state taxes and $152,789 in federal taxes (Table 10).

Table 9: O&M Jobs associated with 900MW of utility-scale solar energy

	Direct	Indirect	Induced
Jobs	**18**	**4**	**22**
Multipliers		**0.24**	**1.21**

Table 10: Effect on Taxes on Production and Imports

Local Taxes	State Taxes	Federal Taxes
$457,745	**$369,916**	**$152,789**

IMPACTS OF 87MW OF ENERGY EFFICIENCY IN MICHIGAN

The industries included in the model to determine the jobs associated with energy efficiency measures were residential remodelers, electrical contractors, plumbing and HVAC contractors, and commercial and institutional building construction. Based on averaged results for these four industries, a total of 1,277 direct, indirect, and induced jobs are created in the State of Michigan as a result of the 87 MW of energy savings (Table 11). The fiscal impacts include $3.77 million in local and state taxes and $1.04 million in federal taxes (Table 12).

Table 11: Jobs associated with 87MW of energy efficiency measures

	Direct	Indirect	Induced
Jobs	**658**	**171**	**448**
Multipliers		**0.26**	**0.68**

Table 12: Effect on taxes on production and imports

Local Taxes	State Taxes	Federal Taxes
$2,039,400	**$1,728,029**	**$1,036,291**

Conclusions

BW Research conducted an economic impact analysis of the direct, construction and O&M jobs associated with nearly 2,500 megawatts (MW) of renewable power plant production and efficiency savings in the State of Michigan (1,100 MW of wind energy, 1,100 MW of solar energy, and 87 MW of energy efficiency measures).

Results show that a total of **9,597 wind jobs** (9,175 construction and 422 O&M jobs), **5,485 solar jobs** (5,441 construction jobs and 44 O&M jobs), and **1,277 energy efficiency-related jobs** are created in the State of Michigan from adding 2,200 MW of renewable power plant production and 87 MW of energy savings in the state (Table 13).

Table 13: Total Job Creation of Added Energy Capacity

	Direct	Indirect	Induced	Total
Wind Construction Jobs	2,649	1,517	5,009	9,175
Wind O&M Jobs	119	66	237	422
Solar Construction Jobs	2,335	824	2,282	5,441
Solar O&M Jobs	18	4	22	44
Energy Efficiency Jobs	658	171	448	1,277

Regarding the ripple effects of job creation across the state, wind O&M jobs have the highest multiplier (i.e., for every direct wind O&M job created, additional 2.55 jobs are created in the economy), followed by wind construction jobs (2.46), solar O&M jobs, and solar construction jobs (Table 14). This may be driven by a multitude of factors, including the wages of the direct jobs created, the availability of resources and suppliers in the region, and the size and cost of the required energy infrastructures and technologies.

Table 14: Jobs multipliers per job type

	Indirect Jobs	Induced Jobs	Total
Wind Construction Jobs	**0.57**	**1.89**	**2.46**
Wind O&M Jobs	**0.55**	**1.99**	**2.55**
Solar Construction Jobs	**0.35**	**0.98**	**1.33**
Solar O&M Jobs	**0.22**	**1.22**	**1.44**
Energy Efficiency Jobs	**0.26**	**0.68**	**0.94**

PV Valuation Methodology

Recommendations for

Regulated Utilities in Michigan

February 23, 2016

Prepared for:

Midwest Renewable Energy Association

Prepared by:

Ben Norris, Clean Power Research

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CPR's Solar Valuation Background

CPR holds a unique position in the solar valuation field, having developed the first value of solar tariff offered in North America. Austin Energy approved CPR's value-based pricing presented in a 2011 study, and offered it as a new form of compensation to its solar customers. CPR had performed an earlier valuation study for Austin Energy in 2006.

In 2014, CPR worked with utilities and stakeholders in Minnesota to develop the first detailed, public methodology to be used by utilities in setting rates. This methodology, guided by state legislative requirements, was approved by the Minnesota Public Utilities Commission for utilities seeking a value-based compensation tied to the costs and benefits of distributed solar generation. It is the only such Commission-approved methodology in North America.

In April 2015, CPR published a comprehensive market-based value of solar study that was commissioned by the Maine Public Utilities Commission. This study was also a stakeholder-driven process, and included a wide set of scenarios and assumptions for the purpose of informing public policy. It included three detailed studies for three utility regions.

CPR has performed a number of related studies, including net metering cost/benefit studies and solar fleet shape modeling for Duke Energy, We Energies, Portland General Electric, USD/San Diego Gas and Electric, Solar San Antonio, and NYSERDA/ConEdison. CPR has also worked with solar industry organizations, such as the Solar Electric Power Association (SEPA) and the Solar Energy Industries Association (SEIA) to evaluate other value-based compensation schemes, such as annual versus levelized VOS, long-term inflation-adjusted VOS, value of export energy, and others.

Contents

PART 1 - INTRODUCTION

Introduction

Clean Power Research (CPR) was engaged by the Midwest Renewable Energy Association to develop a methodology for valuing distributed solar energy resources. Many studies have been performed by CPR and others over recent years in which methodologies have been developed to perform these valuations.

Distributed solar differs from conventional generation in several respects. First, it is not dispatchable and therefore requires a means for evaluating its “effective” capacity to put it on a comparable economic footing with in-market resources.

Second, it is distributed, meaning that it avoids the losses associated with long-distance transmission, voltage step down at distribution substations, and the distribution lines. This requires that a loss savings factor be incorporated into the study.

Third, its production profile varies considerably, depending upon the orientation (azimuth and tilt angle) of the system and its location. As a practical approach, the concept of an aggregate “fleet” of resources is introduced to address this, and the valuation is designed to value output of the fleet.

Finally, solar provides a number of societal benefits, such as the ability to produce energy without harmful air emissions and protection against uncertainty in fuel price fluctuations. These benefits are “out of market” in the sense that the societal costs of conventional generation are not included in conventional ratemaking. It is left to the user of the methodology as to whether such benefits should be included in a valuation study.

Purpose

This report describes in general terms a methodology that may be used for such a valuation. For readability, the report is devoid of detailed equations and tables, and it does not include an actual valuation example based on this methodology. However, it does incorporate the lessons learned in a number of such valuation studies performed by CPR over the years.

In addition to the methodology, the report describes some options for implementation. These include the use of the methodology in evaluating existing net energy metering cross-subsidies, considerations for community shared solar, the adaptation of methods for energy exports and other DER technologies, and the use of results in value-based compensation schemes.

It is hoped that such a valuation exercise could be conducted using the methods described here.

Overview of Methodology

The methodology is described in three major parts. The first is a technical analysis where many of the key intermediate technical metrics are calculated. This include the definition of the study period, the rating conventions, the development of hourly fleet production profiles, the determination of "effective" capacity in relation to resource adequacy and the distribution system, and the treatment of loss savings.

The second part is the economic analysis of in-market benefits. This methodology includes avoided energy costs, avoided resource adequacy costs, avoided transmission capacity costs, and avoided distribution costs. It is important to note that this methodology incorporates some benefits that have been broken out as separate categories on other studies. For example, the energy benefit includes the economic impacts of both a change in load and a change in price. The resource adequacy benefit includes the contribution toward meeting both peak load and the planning margin.

Next, two out-of-market benefits are included. These are the benefits most commonly included in studies of this sort, and they include the avoided environmental cost and the fuel price guarantee. These benefits are more speculative and do not represent benefits for which a monetized transaction currently takes place in the energy marketplace.

PART 2 – TECHNICAL ANALYSIS

The Marginal PV Resource

The methodology incorporates in its framework the concept of a "Marginal PV Resource" for which the value of production is sought. Existing solar resources are not included in the analysis except to the extent that they shape the existing loads used in the analysis. It is understood that as the amount of solar in a system increases, the technical contribution towards capacity decreases. This is because the peak load shifts to non-daytime hours. Due to this effect, the initial solar resources (the "early adopters") provide more technical benefits than systems installed in later years (the actual value depends on other factors such as fuel prices and these may increase or decrease).

With this in mind, it is necessary to state up front which of the solar resources are being evaluated: all resources to date? All resources anticipated over the next 20 years? This methodology is based on a marginal analysis of the next PV resource of unit size to come on line.

As described below, a PV Fleet Production Profile is developed that takes into account the diversity of locations and design attributes of the distributed solar fleet. The unit output of this fleet is, in effect, the Marginal PV Resource, even though such a resource does not exist in practice. The concept is helpful because it eliminates a set of complicating value scenarios (What is the value of a west-facing system? a tracking system? a system in the southern or northern part of the service territory?) The Marginal PV Resource therefore is the next installed increment of solar capacity that represents the geographical and design diversity of the distributed PV fleet.

Load Analysis Period and Economic Study Period

There are two separate periods of interest in performing the valuation: the Load Analysis Period and the Economic Study Period. The Load Analysis Period is used to evaluate technical parameters, such as the ability of the resource to deliver energy during peak times. Such analyses require the use of historical, measured data. For example, an evaluation of effective capacity may compare a year of hourly solar production against the same year of utility load. In this case, the Load Analysis Period would be defined as the year over which this technical analysis was based. The analysis could take place over several years (e.g., three years) in order to account for year-to-year load and weather variation.

The second period of interest is the Economic Study Period. This is the period over which the two economic alternatives are evaluated: the production of energy by the Marginal Resource and the delivery of energy using conventional generation. The costs and benefits of these alternatives occur in the future, so the Economic Study Period is selected over one or more future years.

The selection of Economic Study Period is often tied to the final metrics for presenting the benefits and costs, and the assumed useful service life of the resource (e.g., the 20 to 30 year life of solar PV) may be used. For example, if a 25 year service life is assumed, the study objective may be to estimate the levelized value over 25 years. Such an analysis would take into account anticipated capacity additions over this period, expected changes in wholesale energy costs, and load growth rates.

A valuation study may be designed to calculate a one-year, or first-year, value of generation. This is in contrast to a long-term levelized rate. Such an approach offers the advantage of accuracy because it is less dependent on long term forecasts (e.g., it would require a one-year fuel price forecast rather than a 25-year fuel price forecast). In this case, the investor in renewables takes the risk of future fluctuations in value. Rather than “locking in” a 25-year rate, the rate fluctuations year to year are unknown, and this may be an important factor in the investment decisions.

In the one-year analysis approach, long term benefits that fall outside of the analysis period, such as the avoidance of future generation capacity additions, may still be included. For example, a future year capacity addition could be included by amortizing the capacity cost of the addition over its expected life, calculating the present value of the annualized avoided costs that occur during the life of the Marginal Resource, and then amortizing this value over the life of the Marginal Resource. This results in the annual value attributed to the present resource in avoiding or deferring the need for future resources.

PV System Rating Convention

The methodology requires the establishment of a rating convention to be used for the Marginal Resource. There are several rating methods available, such as DC power under “Standard Test Conditions,” DC power under “PVUSA Test Conditions” (DC-PTC), and an AC rating that includes the effect of inverter efficiency.

The selection of rating convention is somewhat arbitrary, but must be used consistently. For example, if a DC rating is used, then the Marginal Resource would have a unit rating of 1 kW DC. When determining the annual energy produced, the same convention would be used: annual energy would be expressed as AC energy delivered to the grid per kW DC. Likewise, the effective generation capacity would be expressed as the effective generation capacity per kW DC.

Load Data and PV Fleet Production Profile

The capacity-related technical metrics that follow (see sections on Effective Load Carrying Capability and Peak Load Reduction below) are heavily dependent upon the assumed production profile of the Marginal PV Resource. If there is a good match between solar production and load, then the effective capacity is high. On the other hand, if the peak load occurs during times when solar production is poor, then the effective capacity will be low. This directly affects the economic capacity value.

Before calculating the match, it is necessary to obtain the load data and develop a solar production profile. Both the load and production profile are time series with start and end times corresponding to the Load Analysis Period described above. An hourly interval is most common for studies of this type, although other intervals could be used. MISO pricing is available in hourly intervals, and this will form the basis of the energy valuation. Therefore, hourly intervals are assumed here.

Two sets of load data are required: the MISO system load data and the utility distribution load data. The system load data will be used to calculate effective generation capacity, so the load data should correspond to the MISO zone associated with the utility. The distribution load data will be used to calculate the effective distribution capacity.

In addition, a production profile representing the output of the Marginal Resource is required over the Load Analysis Period. This can be either simulated or measured from sample PV resources, but must accomplish the following:

- The data must accurately reflect the diversity of geographical locations across the utility and the diversity of design orientations (range of azimuth angles and tilt angles, etc.). Typically, this requires the aggregation of several hundred systems comprising a representative “fleet” of solar resources.
- The data must not represent “typical year” conditions, but rather must be taken from the same hours and years as the load data. It must be therefore “time synchronized” with load.
- The gross energy output of the resource is required, not the net export energy which includes on-site consumption.

The fleet comprises a large set of real or anticipated PV systems having varying orientations (different tilt angles and azimuth angles) at a large number of locations. The intention is to calculate costs and benefits for the PV fleet as a whole, rather than for a specific system with specific attributes.

Effective Load Carrying Capability (ELCC)

Distributed solar is not dispatchable in the market, but it does have an indirect effect on the amount of power that is dispatched. If distributed solar produces energy during peak load hours, then the required amount of dispatchable capacity is lowered. Therefore, it is important to quantify how effective distributed solar is in reducing capacity requirements.

Effective Load Carrying Capability (ELCC) is the metric used for this purpose. It is typically expressed as a percentage of rated capacity. For example, if solar is credited with an ELCC of 50%, then a 100 kW solar resource is considered to provide the same effective capacity as a 50 kW dispatchable resource.

MISO is working to develop a process[1] for solar accreditation and several alternatives used at other ISOs are under consideration. When such a process becomes defined, it could be used to calculate ELCC using the PV Fleet Production Profile.

Before the process is developed, it will be necessary to select an interim method, and one such method is described here. This method has been used in other studies by CPR[2] and can be used as an easily implemented method until the MISO process is available.

Under the MISO tariff, Load Serving Entities (LSEs) are required to meet both a local clearing requirement (LCR) in their local resource zone (LRZ) as well as MISO-level planning reserve margin requirement (PRMR). Both of these requirements ensure that reliability meets a 1 day in 10 year loss of load standard. Each of the two requirements is considered separately.

First, the contribution of distributed solar in meeting the LCR requirement is dependent upon the load match of solar production with the zonal load. This could be evaluated as the average of the PV Fleet Production Profile during the peak 100 hours per year in the LRZ. The contribution of these distributed resources not only reduce the required resources to meet the peak zonal load but also reserve requirements. For example, if the average production during the peak 100 hours in the LRZ was 0.5 kWh per hour per kW of rated solar capacity and if the local resource requirement per unit of peak demand was 1.1, then the effective contribution of solar would be 0.5 x 1.1 = 55% of rated capacity.

Second, the contribution of distributed solar in meeting the PRMR requirement is dependent upon the load match with the MISO system load. In this case, the contribution could be calculated by averaging the PV Fleet Production Profile during the peak 100 hours per year in the MISO footprint and applying the planning reserve margin. For example, if the load match

[1] See “MISO Solar Capacity Credit” at: https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/SAWG/2015/20150806/20150806%20SAWG%20Item%2007%20Solar%20Capacity%20Credit.pdf

[2] E.g., a 2014 valuation study for the Maine PUC.

was 40% and the margin was 7%, then the effective contribution of solar would be 0.4 x 1.07 = 43% of rated capacity.

Finally, the LSEs may use the same resource to serve both the LCR requirement and the PRMR requirement. The effective capacity, or ELCC, would be selected as the lower of the two results. Continuing the example, if the effective solar capacity was 55% for LCR but only 43% for PRMR purposes, then the overall ELCC would be 43%.

Peak Load Reduction (PLR)

The ELCC is a measure of effective capacity for resource adequacy. It is an essential input to evaluating the benefit of avoided generation capacity costs. However, it is not necessarily a good metric for evaluating avoided transmission and distribution (T&D) capacity benefits for two reasons: (1) it is based on the loads of the MISO zone, rather than the utility's distribution loads (peaks make occur at different times); and (2) it averages output over many hours, whereas distribution planning requires that the resource be there for a small number of peak hours.

Therefore, a different measure of effective capacity can be used in evaluating the distribution benefits. The Peak Load Reduction (PLR) is defined as the maximum distribution load over the Load Analysis Period (without the Marginal PV Resource) minus the maximum distribution load over the Load Analysis Period (with the Marginal PV Resource).

The distribution load is the power entering the distribution system from the transmission system (i.e., generation load minus transmission losses). In calculating the PLR, it is not sufficient to limit modeling to the peak hour. All hours over the Load Analysis Period must be included in the calculation. This is because the reduced peak load may not occur in the same hour as the original peak load.

Loss Savings Analysis

Distributed solar resources not only displace energy delivered to the load. They also avoid losses in the transmission and distribution lines. To account for this, Loss Savings Factors are calculated and incorporated into the analysis.

Loss Savings Factors depend on the benefit and cost category under evaluation. For example, one Loss Savings Factor could be determined for the avoided energy costs by determining the losses that would be incurred in the absence of PV the solar hours of a given year, and comparing this to the losses that would be incurred during those same hours if the Marginal

Resource were present. The difference could be expressed in a Loss Savings Factor associated with the avoided energy costs.

The Loss Savings Factor associated with avoided distribution capacity costs, however, would be different from the one associated with energy. This is due to two factors. First, as described in the PLR metric, only the peak distribution hours are of interest in calculating the PLR. Avoided losses during non-peak hours (e.g., mid-morning hours) are not relevant to the determination of avoided distribution capacity costs. Second, only the avoided losses in the distribution system are relevant to the distribution benefit calculation. Avoided losses in the transmission system should not be included.

Three Loss Savings Factors should be developed as shown in Table 1.

Table 1. Loss Savings Factors

Loss Savings Factor	Loss Savings Considered
Avoided Annual Energy	Avoided transmission and distribution losses for every hour of the Load Analysis Period.
ELCC	Avoided transmission and distribution losses during the 100 peak hours in each year of the Load Analysis Period.
PLR	Avoided distribution losses (not transmission) at the distribution peak.

When calculating avoided marginal losses, the analysis should satisfy the following requirements:

1. Avoided losses should be calculated on an hourly (not an annual) basis over the Load Analysis Period. This is because solar tends to be correlated with load and losses during high load periods exceed average losses.

2. Avoided losses should be calculated on a marginal basis. The marginal avoided losses are the difference in hourly losses between the case without the Marginal PV Resource, and the case with the Marginal PV Resource. Avoided average hourly losses are not calculated. For example, if the Marginal PV Resource were to produce 1 kW of power for an hour in which total customer load is 1000 kW, then the avoided losses would be the calculated losses at 1000 kW of customer load minus the calculated losses at 999 kW of load.

3. Calculations of avoided losses should not include no-load losses (e.g., corona, leakage current). Only load-related losses should be included.

4. Calculations of avoided losses in any hour should take into account the non-linear relationship between losses and load (load-related losses are proportional to the square of the load, assuming constant voltage).

PART 3 – ECONOMIC ANALYSIS

Avoided Energy Costs

Distributed solar reduces the wholesale cost of energy in two respects. First, it reduces the quantity of energy procured in the MISO market for delivery to customers. Solar production displaces energy that would have been procured at a given price in a given hour. Second, it lowers demand for energy, resulting in lower clearing prices for all transactions, an effect sometimes referred to as the "market price response."

The goal of the valuation analysis is illustrated in Figure 3, which shows the relationship between price and load in a given hour. As load increases (or decreases), the price similarly increases (or decreases). This relationship reflects the supply and demand of resources participating in the market.

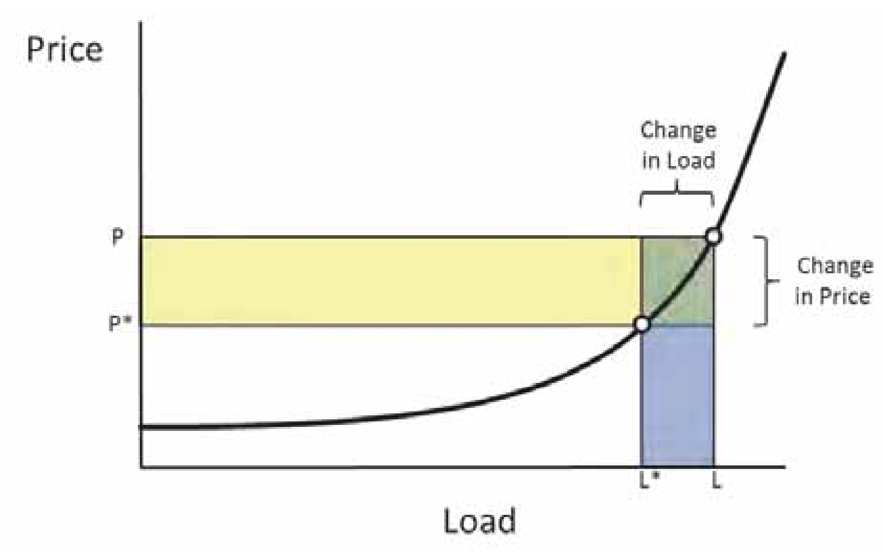

Figure 1. Avoided Energy Cost (Illustrative)

In this illustration L represents the measured load in any given hour, and P represents the corresponding price (the MISO day-ahead clearing price). The Marginal PV Resource reduces load from L to L* and price from P to P*. This reduces the total wholesale cost of energy from LP to L*P* and the savings are represented by the shaded regions.

The calculation of savings may be performed in two steps. The first step is to multiply the observed market price P by the change in load (the blue area). The change in load is the PV fleet production for the hour. This is done for each hour of a sample year and summed.

The second step is to multiply the resulting load L* by the reduction in price. This requires an estimate of the change in price which may be obtained from a model such as the one illustrated in Figure 2. This shows hourly load-price points for a given month at a sample ISO. From these points a model F may be developed as a least squares curve fit. Then, the analysis can assume that the change in price from P to P* is proportional to the change in F. The calculation is done for each hour of the year and summed.

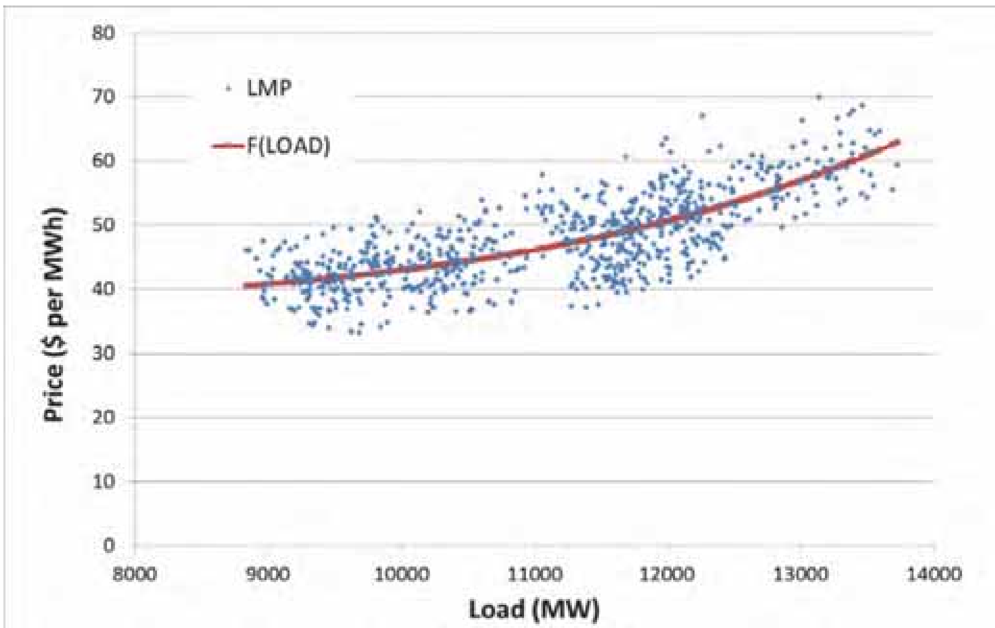

Figure 2. Load Versus Price Model F

Avoided Cost of Resource Adequacy

Part 2 described a method for calculating ELCC, a measure of the effectiveness of distributed solar resources in meeting resource adequacy requirements. The avoided cost, then, is calculated by multiplying the ELCC by the cost of new entry (CONE) for the LRZ. CONE indicates the annualized capital cost of constructing a new plant.

CONE is calculated by MISO[3] by annualizing the net present value (NPV) of the capital cost, long term O&M costs, insurance and property taxes. There are other measures of capital cost,[4] such as the MISO planning auction, but these do not necessarily correspond to the long-term (e.g., 25 year) service provided by solar.

Voltage Regulation

Distribution utilities have the responsibility to deliver electricity to customers within specified voltage windows as required by State rules. When PV or other distributed generation resources are introduced onto the grid, this can affect line voltages depending upon generator rating, available solar resource, load, line conditions, and other factors. Furthermore, at the distribution level (in contrast to transmission) PV systems are more geographically concentrated. Depending upon concentration and weather variability, PV could cause fluctuations in voltage that would require additional regulation.

In some cases, these effects will require that utilities make modifications to the distribution system (e.g., adding voltage regulation or transformer capacity) to address the technical concerns. For purposes of this methodology, it is assumed that such costs are born by the solar generator. Consequently, no cost is assumed related to interconnection costs.

Advanced Inverters

Advanced inverter technology is available to provide additional services which may be beneficial to the operation of the distribution system. These inverters can curtail production on demand, source or sink reactive power, and provide voltage and frequency ride through. These functions have already been proven in electric power systems in Europe and may be introduced in the U.S. in the near term once regulatory standards and markets evolve to incorporate them.

Based on these considerations, it is reasonable to expect that at some point in the future, distributed PV may offer additional benefits, and voltage regulation benefits may be included in a future methodology.

Avoided Transmission Capacity Cost

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[3] See “Cost of New Entry: PY 2016/17,” at: https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/SAWG/2015/20151029/20151029%20SAWG%20Item%2004%20CONE%20PY%202016-2017.pdf

[4] See “Michigan Public Service Commission Solar Working Group – Staff Report” at https://efile.mpsc.state.mi.us/efile/docs/17752/0045.pdf

Distributed PV has the potential to avoid or defer transmission investments, provided that they are made for the purpose of providing capacity, and provided that the solar production is coincident with the peak. The challenge is finding the cost of future transmission that is avoidable or deferrable as a result of distributed generation. As a proxy for this price, transmission tariffs used to recover historical costs may be used.

In the MISO footprint, network transmission service to load is provided under the Open Access Transmission Tariff (OATT) as a per-MW demand charge that is a function of monthly system peaks. Using the PV Fleet Production Profile and the hourly loads of the zone, the average monthly reduction in network load may be calculated for the Marginal PV Resource. For example, the reduction in January network load for a given year would be calculated by first subtracting the PV Fleet Production from load every hour of the month. Then, the peak load for the month without PV is compared to the peak load with PV, and the difference, if any, is considered the reduction in network load for that month. A similar analysis would be performed for the remaining 11 months of the year. For each month, the reduction in peak demand would be multiplied by the zonal network price in the OATT Schedule 9.

Avoided Distribution Capacity Cost

In calculating the avoided distribution cost, the PLR is used as the load match factor. This is multiplied by the NPV of distribution capacity over the Economic Study Period. For example, if the Economic Study Period is 25 years, then the cost of new distribution capacity within the geographical area of interest should be estimated for each year in this period.

Detailed cost estimates are generally available only for areas facing near term capacity upgrades, making it difficult to perform this analysis. Therefore future costs outside the planning horizon may be made based on a projection of costs and peak loads over a representative historical period, such as the last 10 years, and must correspond to anticipated growth rates. Costs for reliability-related purposes should not be included because they are not avoidable by distributed solar.

PART 4 – OUT OF MARKET BENEFITS

Avoided Environmental Cost

With distributed PV, environmental emissions including carbon dioxide (CO_2), sulfur dioxide (SO_2), and nitrous oxides (NO_x) may be avoided. In general, it is relatively straightforward to calculate the technical impact—for example, through the use of the Environmental Protection Agency's AVERT tool—but the estimates of avoided social costs are more difficult to quantify.

Estimates of social costs must be taken from external studies. The social cost of carbon, for example, may be based on results from the Interagency Working Group on Social Cost of Carbon.[5]

It should be noted that costs to comply with environmental standards (scrubbers, etc.) are embedded in the energy costs already described. The technical calculations of emissions should therefore already take into account the compliance measures used to reduce emissions. The social costs are therefore associated with the emissions after compliance has been met (the "net" emissions) and the costs are therefore in addition to compliance.

Fuel Price Guarantee

This value accounts for the fuel price volatility of natural gas generation that is not present for solar generation. To put these two generation alternatives on the same footing, the cost that would be incurred to remove the fuel price uncertainty may be included. This can be accomplished by estimating the natural gas displaced by PV over the Economic Study Period and determining the cost of natural gas futures required to eliminate the uncertainty.

Note that price volatility is also mitigated by other sources (wind, nuclear, and hydro). Therefore, the methodology is designed to quantify the hedge associated only with the gas that is displaced by PV.

PART 5 – IMPLEMENTATION OPTIONS

Evaluation of Existing Net Metering Programs

A valuation using the above methods would result in the avoided costs per kWh of distributed solar generation. This valuation could then be used to evaluate the question of whether solar customers under net energy metering (NEM) rates are subsidizing non-solar customers or whether non-solar customers are subsidizing NEM customers.

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[5] The annual Social Cost of Carbon values are listed in table A1 of the Social Cost of Carbon Technical Support Document, found at: http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf.

NEM customers are only billed (or credited) for the difference between their consumption charges and their generation credits. It has been argued that fixed costs recovered through volumetric rates may not be recovered equitably because NEM customers are able to reduce their monthly net consumption. On the other hand, NEM customers may provide additional benefits, resulting in savings to other customers. For example, a NEM customer may be delivering energy and capacity to the grid at times when it is most valuable. Using the methods described here can help to determine whether cost shifting is taking place and the direction of cost shifting (whether solar customers are subsidizing or being subsidized by non-solar customers, as the case may be).

Considerations for Community Shared Solar

Some customers do not have good options to install solar on their rooftops. They may not own their building (especially in the case of commercial customers), the building may be heavily shaded, or it may not lend itself to solar due to architectural considerations. For these, customers, community shared solar may be an option. Systems built for this purpose may be sited in more desirable locations with good solar access and may be built with higher ratings at lower cost per kW.

However, the methodologies described above may have to be adjusted. There are two factors that must be considered. First, the production profile of these systems will be different than that of the overall fleet as described in Part 2. These systems will be built at optimal orientation (e.g., south facing at an optimal tilt angle) in order to maximize the energy production. Therefore, the production profile associated with such an optimal design should be used rather than the fleet profile.

It should also be noted that the shared solar resource may be electrically distant from the member-customer. In a sense, the energy would have to travel from the shared resource to the customer, and this would include additional losses not accounted for in the methodology. However, the energy in practice would not be delivered to the specific customer but simply accounted for and credited through metering. The energy produced by the resource would still result in avoided losses, except that the losses would be avoided in delivering energy to non-members rather than to the members themselves. The methodology would provide a reasonable accounting of this benefit. Such would not be the case if the shared resource were outside of the service territory of the utility.

Value of Exported Solar Energy

In some studies, the value of export energy is sought rather than the value of gross solar production. This may be the case, for example, in developing a tariff in which self-consumption is used to reduce a customer's electricity bill. Such a rate would effectively provide the customer-generator with two benefit streams: the benefit of lower utility bills due to self-consumption and the benefit of a bill credits associated with the value of export energy. From the utility perspective, such a mechanism also results in two impacts: lost revenue from the self-consumption and lost revenue associated with those bill credits that are exercised.

Regardless of perspective—customer or utility—the economic analysis requires as study inputs the hourly load profile and the relative size of the solar system and the load. This data is necessary to calculate the hourly export profile, and this is a different shape and magnitude than the gross production. If solar generation is self-consumed during the daytime, the mid-day export may be low or non-existent, in contrast to the PV Fleet Production Profile described in this methodology. This means that the capacity value will be different since it is dependent upon the match of between solar and load.

Customers have a choice in sizing their systems. Depending upon size, more or less energy will be delivered to the grid as export energy. Therefore, a study of the export energy value would have to include scenarios that handle these size variations. For example, scenarios could be developed in which solar provides 100%, 75%, 50% and 25% of the annual energy.

Finally, the details of the customer load profile are important. One residential customer, for example, may have a different load profile than another. The export energy profile will therefore be different even if other factors such as system design are the same.

Including multiple scenarios of relative size and profile shape may prove impractical due to the additional technical effort to address each scenario as well as the complexity in determining which result to apply to a given customer. Therefore, the study approach might consider just one or a small number of representative scenarios as an approximation.

Qualifying Facilities Rates

Many of the methods described here could be used to help identify a solar-specific avoided cost rate for qualifying facilities under PURPA. The resulting rate would incorporate many of the solar-specific attributes, such as the hourly production profile, intermittency, and loss savings.

Applicability to Other DER Technologies

Aspects of this methodology may be used for other DER technologies, such as storage and efficiency. However, the PV Fleet Production Profile would have to be replaced with a profile suitable to the technology. For example, energy storage may have a profile that includes off-peak charging and on-peak discharging. If the profile were known, or if they were assumed in a scenario analysis, then the rest of the methodology could be used to calculate the value of these resources.

Real Time Pricing with AMI

In some cases, such as storage (a dispatchable resource), the customer has control of its operation, so the generation profiles may not be known. Value-based rates calculated using an assumed production profile might therefore not be valid for these cases.

If the goal of the valuation is to develop a mechanism for compensation, the methodology may be adapted for use in a technology-neutral value-based rate using real-time pricing. In this case, the DER profile may be determined at the conclusion of the billing month and applied against actual energy prices (e.g., LMPs). In the case of storage, the charging or discharging periods would correspond to energy charges and credits. Capacity value could be fixed for non-dispatchable resources but could require adherence to resource qualification standards similar to the MISO standards and utility control (or penalties for not dispatching during critical peaks).

Value of Solar Tariffs

Value of solar tariffs (or VOST) were introduced by Austin Energy in 2012 and by Hawaiian Electric in 2015. These tariffs intend to provide compensation for solar based on value. Austin Energy, for example, uses a methodology similar to the one described here and incorporating market-based prices in ERCOT. The Hawaiian Electric “grid supply” option provides for self-consumption and a rate for export energy based on marginal energy costs.

CONSUMERS ENERGY

Consumers Energy via Creative Commons

Consumers Energy's community solar array at Grand Valley State University.

Michigan utility plans major shift from coal to solar in coming decades

Andy Balaskovitz | June 13, 2018

The CEO of one of Michigan's largest utilities says solar is a better long-term investment than new natural gas plants.

Consumers Energy, which previously announced plans to close its coal-fired power plants by 2040, said Wednesday that — unlike other Michigan utilities (https://energynews.us/2018/04/26/midwest/as-michigan-retires-coal-natural-gas-dominates-replacement-plans/) — it won't seek to replace coal with new natural gas capacity.

Building a natural gas plant would risk stranding the company's capital in a single asset, after which there would be "no turning back," said Consumers President and CEO Patti Poppe. Instead, the company plans to bet on solar, which can be built incrementally as needed.

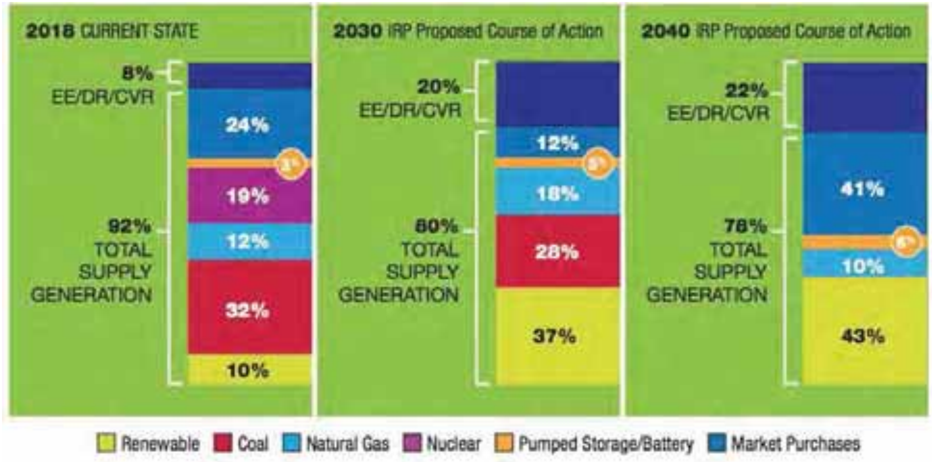
"We think we have the opportunity of a generation with this clean energy plan to reshape how energy is delivered to the state of Michigan," Poppe said, noting an emphasis on smaller, more distributed generation. "This avoids big bets on large, new fossil fuel generation plants."

The announcement comes ahead of a formal Integrated Resource Plan (IRP) that will be filed with state regulators Friday. The long-term utility forecasts are required under 2016 state energy laws and give a much-anticipated look into the role clean energy will play in meeting future demand. Plans will be filed at least every five years.

Consumers' projected portfolio looks much different in 2040 than it does today. By then, renewable energy is projected to increase from 10 percent to 43 percent of its portfolio, mostly with solar. The company also plans to increase investments in energy efficiency and demand response.

Coal makes up 32 percent of Consumers' supply today. The company plans to eliminate its coal supply by 2040, and also end power purchase agreements for nuclear and natural gas capacity. By 2040, the share of natural gas in its portfolio will drop from 12 percent to 10 percent.

The remaining 47 percent of Consumers' portfolio will come from market purchases and energy storage (6 percent).



Betting on solar

Consumers said it plans to add 550 MW of wind to meet the state's 15 percent renewable portfolio standard by 2021, but a large majority of its renewable portfolio will come from solar. The company proposed 5,000 MW of solar by 2040, which will be ramped up in the 2020s to prepare for coal retirements. Poppe said capacity would be met by company owned and contracted projects. Consumers currently has 12 MW of solar.

"Those market opportunities need to be competitively priced," Poppe said.

In a conference call with reporters, Poppe said solar is a better investment for the company and shareholders than a large natural gas plant. Two gas plants Consumers owns — along with a hydro pumped storage facility — provide enough baseload power to support more renewables, she said.

The company's long-term modeling "found renewables with cost declines and energy efficiency and demand response as more economical than natural gas plants," said Brandon Hofmeister, Consumers' senior vice president of governmental, regulatory and public affairs.

Poppe said it's about having a leaner generation network.

"Solar is available when Michigan needs it," Poppe said. "Rather than building a baseload plant that is severely underutilized, we can build the right size of solar for when it's available on peak days."

Advocates support plan

The Michigan League of Conservation Voters called Consumers' plan a "historic announcement."

"We applaud Consumers Energy for its bold commitment to clean energy and energy efficiency, and we will continue to hold the company accountable at the public service commission to ensure this plan becomes reality," Lisa Wozniak, MLCV executive director, said in a statement.

The IRP also provides a roadmap to 2040 after Consumers and DTE negotiated with activists to abandon a 50 percent clean energy standard by 2030.

The group Clean Energy Healthy Michigan agreed to drop its ballot initiative campaign after the utilities agreed to voluntarily meet the goal. Consumers pointed to its upcoming IRP for how it would get there. DTE's IRP is expected in March 2019.

Leaders of the campaign said the IRP would serve as a way to hold the companies accountable (https://energynews.us/2018/05/30/midwest/michigan-law-gives-activists-new-venue-for-holding-utilities-to-pledges/) .

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Understanding the Potential for Community Solar Power in

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DOW SUSTAINABILITY FELLOWS PROGRAM
UNIVERSITY OF MICHIGAN

Table of Contents

1. Executive Summary

Urban, poverty-stricken, and disinvested communities are struggling to reliably and affordably secure the energy services they need. At the same time, the moral and economic case for distributed renewable energy technologies promises transformative change for how electricity is created and consumed. Together, these trends enable a future where communities exercise agency over the way their energy is produced and consumed. Soulardarity, a grassroots community organization centered in Highland Park, Michigan, is working to make this vision of energy democracy a reality. The Dow Sustainability Fellowship team partnered with Soulardarity to assess the feasibility of installing a community-owned and operated solar project in Highland Park.

Community solar projects—where community members co-invest in an array of solar panels, and each receive benefits as the solar project generates electricity—are taking off around the country as the price for solar continues to decline.[i] They're proving to be a viable solution for expanding solar access to the estimated 50% of households who wouldn't otherwise be able to install solar due to renters status, inappropriate roof material, or other factors.[ii] But there are substantial barriers to community solar in Highland Park. State policies disallow group net metering and discourage third parties from being able to operate their own solar projects.

We propose that Soulardarity considers a *community power purchase agreement (community PPA)*. Rather than working directly with utility companies to manage a community solar program, a community group might buy solar panels, then partner with a host institution—like a church or a community center—and install the solar project onsite. Then the *host* institution pays the *owner*—in this case, the community group—for the energy from the solar panels. This way, the community institution gets cheaper and cleaner power, and the community group can raise money for futre projects. While community PPAs are a relatively new concept, the model has already seen success at *Maryland's University Park Solar Co-Op*.

While a community PPA is logistically feasible, it must also be *economically* feasible in Highland Park. We created a Community Solar Calculator, which models the technical, economic, and financial details of a community solar project based on user inputs. Using the Community Solar Calculator, Soulardarity can model the costs of a project, the amount of roof space needed, and the economic returns for any potential solar project. Based on preliminary research in Highland Park,

we chose three community institutions as case studies for the calculator: Nandi's Knowledge Cafe, Parker Village, and Labelle Towers.

Our case studies found that while results vary substantially based on the chosen financing model, installed cost, markdown to project host, and discount rate, community solar projects have the potential to be economically viable at low-cost financing. While launching an innovative, long-term partnership such as a community PPA requires careful legal and accounting consideration, our research indicates that the basic economics are sound: a community PPA in Highland Park will save a Highland Park institution money on their utility bills while funding Soulardarity's mission.

2. Background

2.1 Highland Park Context

2.1.1 Highland Park

Highland Park is a community in Southeast Michigan, surrounded by the City of Detroit. Its population peaked around 52,000 in the 1930's with the early automotive industry, as both Ford and Chrysler were headquartered in the city. Since the 1930's Highland Park's population has declined. The population of Highland Park is now estimated at around 10,888 (2016 population estimate).[iii] In the late 1900's Ford and Chrysler moved their headquarters instigating decades of economic decline in the community. According to The American Community Survey 2011-2015, 49.3% of the population lives below the poverty line, a number significantly above the national average of 14.7%.[iv] As seen in Figure 1, median income in Highland Park is $17,250 (the median property value is $36,000 with 36% of residents owning a home).[v]

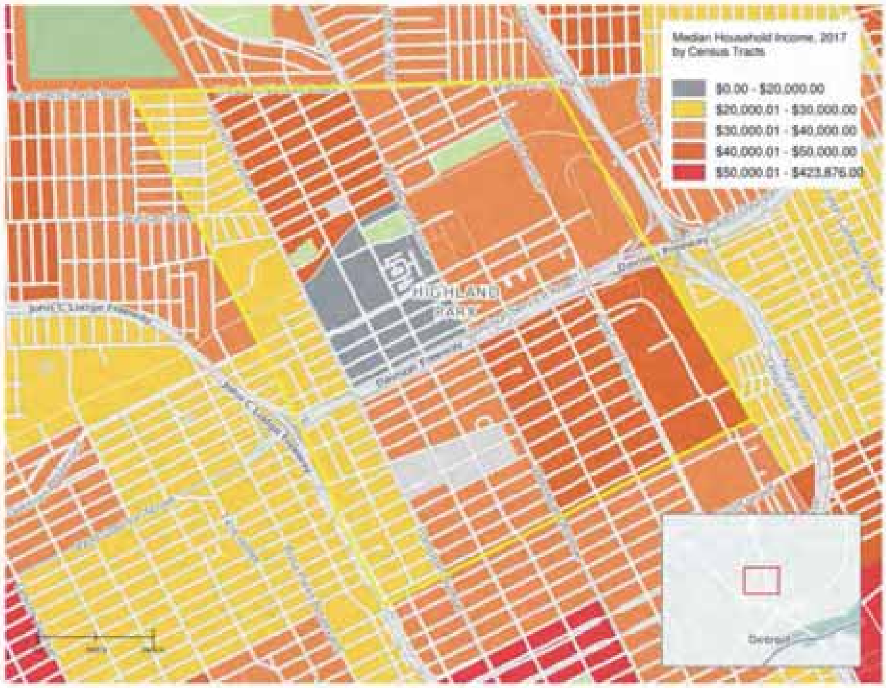

Figure 1: Median Income In Highland Park (city outlined in yellow)

According to The American Community Survey 2011-2015, 91.9% of the residents (10,203 +/- 274) identify as Black. 18.8% of the residents are between 5-18 years of age and 14.9% are between 45-54 years of age.[vi]

2.1.2 About Our Client: Soulardarity

Soulardarity's mission is *to build a brighter future in Highland Park with education, organizing, and people-powered clean energy.* Soulardarity is a membership-based 501c3 non-profit working to install solar-powered streetlights, save money on energy bills, and work together with neighboring communities to build a just and equitable energy system for all.[vii]

Jackson Koeppel co-founded the organization in 2011 in response to DTE Energy's repossession of over 1,000 streetlights from Highland Park. Soulardarity installed a pilot solar light in 2012, and has since worked with Highland Park on a proposal to erect 200 solar streetlights around the city. In the process, they've grown to over 120 members—a significant portion of Highland Park's 10,888 residents. Their vision and purpose has expanded to not simply replacing streetlights but also to reducing energy burdens on their community.

2.2 Solar Resource Potential in Highland Park

Highland Park could pursue several types of renewable energy, but based on the interest of our client, Soulardarity, and scope of the project, we assumed that solar power would be employed. To confirm that Highland Park had sufficient solar resources, we conducted an initial solar energy assessment. We used several software programs to determine the total amount of solar energy possible through both rooftop panel installation and vacant lot conversion to ground solar panel systems. Google's Project Sunroof estimates that 68% of Highland Park's buildings are viable for rooftop solar panels, and that 83,000 MWh of AC electricity could be generated annually if every available rooftop had solar panels installed.[viii] Figure 2 and 3 depict Project Sunroof's output for Highland Park specifically.

Figure 2: Google's Project Sunroof rooftop solar potential for Highland Park, MI

Figure 3: Google Project Sunroof Electricity estimations for Highland Park, MI

In addition to rooftop potential, we assumed that ground solar panel systems could be installed on vacant lots throughout Highland Park. The Motor City Mapping Highland Park Tool was used to find the total number of vacant lots available for solar power generation in Highland Park.[xi] As seen in Figure 4, vacant lots account for approximately 30% of all lots in Highland Park. To deliver a rough estimate, we assumed that 30% of total land area within Highland Park consisted of vacant lots. Using this method, an assumption of 20% panel efficiency and an average solar irradiation of 4.41 $kWh/m^2/day$, we determined that the total electricity available from vacant lot solar panel systems could reach approximately 707,400 MWh/yr.

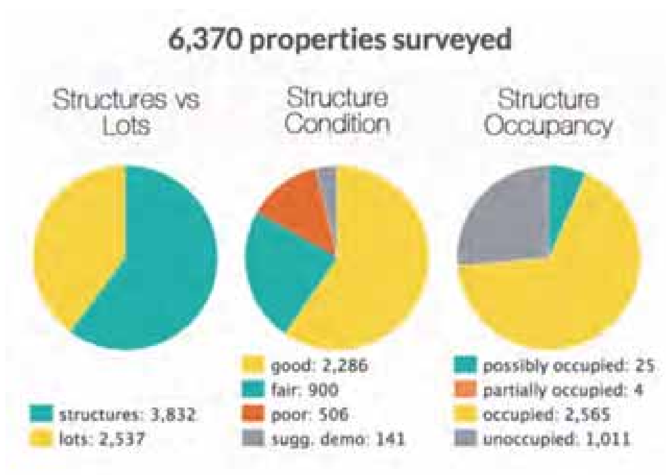

Figure 4: Output of Motor City Tool, with vacant lots in Highland Park highlighted.

The total average annual energy demand in Highland Park for residential and commercial sectors is approximately 86,200 MWh, suggesting that if all viable rooftops in Highland Park had solar panels installed, then 96% of total residential and commercial energy demand could be met.[xiii] Vacant lot solar panel systems could supply almost ten times the energy that Highland Park's residential and commercial sectors currently demand.

3. Problem Definition & Objectives

Low-income households tend to pay a higher portion of their income toward their utility bills. For the poorest households in Detroit, the percentage paid toward energy can reach over 15% of total income.[xiv] High energy burdens such as these can crowd out other payments, displace investments, or force households to choose between heating their home and other needs. Similar research has shown a discrepancy in this energy burden between white households and households of color.

As Soulardarity's membership has grown, their mission has expanded to include alleviating community energy burden. Soulardarity members believe they are being mistreated by the utilities (DTE Energy) and are interested in becoming energy sovereign. They asked us to do two things, **1) get a better sense of the problem and potential need for solar energy to address financial burden and injustice in the community through a community survey, and 2) perform a feasibility study of bringing community solar to Highland Park.** To do this, a Community Solar Calculator was developed to estimate solar capacity and rate of return on investment for specific sites. This will be discussed in greater detail in Section 5.

On July 9, 2017 Soulardarity volunteers, led by Intern Grace Brosnan, walked the neighborhoods of Highland Park to conduct a survey about the resident's experiences with energy utilities (*Appendix A: Survey Questions* and *Appendix B: Survey Results* have been redacted from the public edition of this report). The purpose of the survey was to gain a better understanding of the need for community solar from both an economic and social justice perspective. Specifically, according to "Lights Out In The Cold" Environmental and Climate Justice Program NAACP, in Michigan[xv]:

- Notice of disconnections must be provided by phone or mailing. Phone notice must be attempted two times at least one day before the scheduled disconnection. Mailed notice must be sent at least five days before the scheduled disconnection.

- November 1- March 31 there should be no disconnections for customers 65 years or older or for eligible low-income customers with entry into a payment plan where customer makes monthly payments equal to 7% of the annual bill.
- Customers with a medical certification can postpone disconnection for not more than 21 days. Certification may be renewed up to a total postponement of 63 days in a 12-month period. A utility is not required to grant postponements totaling more than 126 days per household.

The survey used convenience sampling and included 61 Highland Park residents. Given this was not a random sample; we cannot assume the responses truly represent the community. Specifically during the survey process, interviewers knocked on doors in the community and found they could not enter some apartment buildings; this resulted in a sample that skewed toward homeowners.

With that in mind, nearly 40% of respondents did express trouble paying energy (electric or gas) bills. Several respondents also self-reported illegal shut-offs as outlined above (Soulardarity leadership is following up on these instances). The survey suggests, although not statistically significant, that people of color experience more energy burden. Lastly, the survey found that people are still very concerned about the limited streetlights in Highland Park.

4. Community Solar and Energy Democracy in Highland Park

The results of Soulardarity's summer utility shutoff survey confirm what Highland Park residents and Soulardarity had already suspected: meeting energy needs is placing a heavy burden on the time, health, and budgets of Highland Park residents, and citizens have no say in how their community provides its energy. The removal of Highland Park's streetlights can be seen as a direct manifestation of the disconnect between the assets and concerns of the Highland Park community and the way that energy is produced, distributed and spent. Through solar streetlighting, Soulardarity is forwarding its core values—community ownership and energy democracy, or the ability for community members to have a say in meeting their energy needs. Streetlighting alone, though, does not solve Highland Park residents' energy burden. Soulardarity's ambition is to create and provide community-owned, community-controlled, pollution-free energy for Highland Park.

Solar-powered electricity projects allow Soulardarity to meet that ambition. Because solar energy does not require any fuel, solar projects are completely self-reliant, and Soulardarity's energy would truly be generated and used in Highland Park. With solar prices falling year after year, communities around the country and world are investing in solar energy.[xvi] And while solar projects have historically been inaccessible to households without an appropriate roof or disposable income, community solar projects are breaking down those barriers. Community solar projects are centralized solar projects where many community members can invest in and benefit from the benefits of solar energy. Especially in a community where years of disinvestment have eroded available housing stock, community solar projects unlock energy independence and democracy for Highland Park.

This report aims to provide a guide for Soulardarity and Highland Park regarding what kinds of projects currently exist and what is feasible in Highland Park. We will do that by establishing criteria for a just and effective project, proposing a model for a Soulardarity community solar project, evaluating its feasibility on technical, policy, and economic grounds, and finally providing a roadmap of how to make that project a reality. With this report, Highland Park will be better equipped than ever to pursue energy democracy.

4.1 What does a Just & Effective Community Solar Project Look Like?

To better understand what kinds of solar projects will work for Highland Park, the following criteria were established.[xvii] A just, effective community solar project for Highland Park will:

- **Contribute to energy democracy**. Building community capacity and independence is core to the mission of Soulardarity. Community solar models that are administered by local utilities or rely heavily on corporate investment and ownership do not fulfill the primary goal of establishing energy democracy.
- **Be technically & economically feasible**. Solar energy projects are inextricably linked to electricity markets, and building a community's capacity to provide their own energy means ensuring that there are financial returns on community investments.
- **Be appropriate for Highland Park's context**. Michigan state energy policy does not allow any kind of remote net metering—which means customers can only benefit from a solar project if it is co-located on their property. The implications of Michigan's net metering laws will be a major consideration.

We conducted a survey of community solar business models and resources to determine which might work best to fulfill the criteria for Soulardarity. For more information on community solar business models and case studies, see Section 8: Making Community Solar a Reality.

4.2 Proposed Business Model: Community Power Purchase Agreement (PPA)

Business models for community solar projects must define two terms: a) How the solar project generates value and b) How community members can invest. While many community solar projects are actively managed by utilities, Soulardarity's goal of increasing energy democracy means pursuing a community-owned, managed, and administered program. Essentially, owning and managing the solar project can be viewed like a business: Soulardarity invests money into equipment, then sells the energy output to customers in Highland Park. Fortunately, this approach has precedents, like the *University Park Solar Cooperative in University Park, Maryland*.[xviii]

We recommend that Soulardarity members create a Special Purpose Entity, like a co-op, partnership, or LLC, to own and manage a solar project. And because remote net metering is not possible (and individually negotiating compensation for electricity from a utility is not likely to be successful for a single project), Soulardarity should partner with a Highland Park-based Project Host with the space and energy demand appropriate for a solar array. The Project Host would pay the Special Purpose Entity (a.k.a. Soulardarity) a flat rate for the electricity generated from the solar project, then either use it on-site or export it back to the utility through net metering. The negotiated agreement between the Special Purpose Entity and Project Host is often called a Power Purchase Agreement (often shortened to PPA), and this model will be referred to in this report as a Community PPA. A diagram tracing the flows of energy and economic value is shown below in Figure 5.

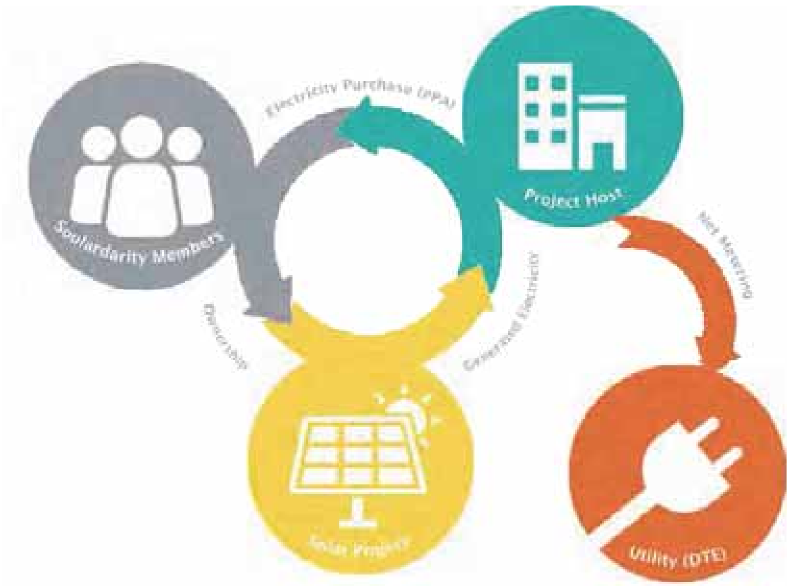

Figure 5: Community Public-Private Partnership Model

For further discussion of the Community PPA business model, refer to "A Guidebook for Community Solar Programs in Michigan Communities" from the Great Lakes Renewable Energy Association and "A Guide to Community Solar: Utility, Private, and Non-profit Project Development" from the National Renewable Energy Laboratory."

5. Methods: Community Solar Calculator

In order to assess the technical and economic feasibility of a community PPA solar project in Highland Park, we created a Community Solar Calculator. The design, including input and output descriptions, and assumptions of the Community Solar Calculator are outlined in Appendix C.

5.1 Inputs

Figure 6 and 7 are screenshots of the two input tabs of the Community Solar Calculator, built in Excel. The first tab (figure 6) includes the estimated project size (based on roof space or project capacity), building type, panel type and battery inclusion. The second tab (figure 7) includes advanced inputs such as the discount rate for the Net Present Value (NPV), other funding sources, current utility rates, the desired discount for the host and the approach to estimating upfront costs.

Community Solar Control Panel

INPUTS

Site Considerations		
Project Size Criteria:	Square Footage	*roof area or required project capacity
Roof Area (ft^2)	14,456	
Project Capacity (kW, AC)	25	
Determined project capacity (kW, AC)	**83.010**	
Desired Energy (kWh/year) (optional)	0	

Project Host Considerations		
Host Building Type	Lodging	*food service, education, religious, lodging, office
Building space (ft^2)	14,456	

Technical Requirements		
Level of Panel	Standard	*premium, standard, economy
Battery?	Yes	*yes or no

Note: These calculations do not include calculations for financing or debt. Assumed up-front cash payment.
Note: Projects over 20 kW capacity receive less credit when exported back onto the grid.
Additional model may be needed to calculate actual project revenue.

Figure 6: First tab which includes basic inputs and project criteria

Community Solar Control Panel

ADVANCED INPUTS

Project Finances		
Discount rate (incluidng inflation)	4%	
Grants or funding secured ($)	$0.00	
Project Takes ITC?	Yes	

Project Host Considerations		
Host utility service type	Residential	*Residential or commercial
Utility rate	$0.114	

Partnership Inputs	
Discount % on retail for host (from DTE price)	3%

Installed Cost Estimation for Financial Modeling	
Bottom-up estimate based on NREL Q1 2017 (~$2/W)	
Average of sample quotes from EnergySage (~$3.30/W)	X

****This calculator doesn't calculate the benefits from accelerated depreciation via MACRS.**
****This calculator doesn't model equity 'flips' or other techniques for capitalizing on the ITC and other tax incentives.**

Figure 7: Second tab which includes advanced inputs

5.2 Outputs

Once the user enters data into the input fields, the calculator will display a 25-year cash flow in both accounting and discounted terms. The fourth tab (figure 8) will show the payback graph, energy output, and emissions avoidance.

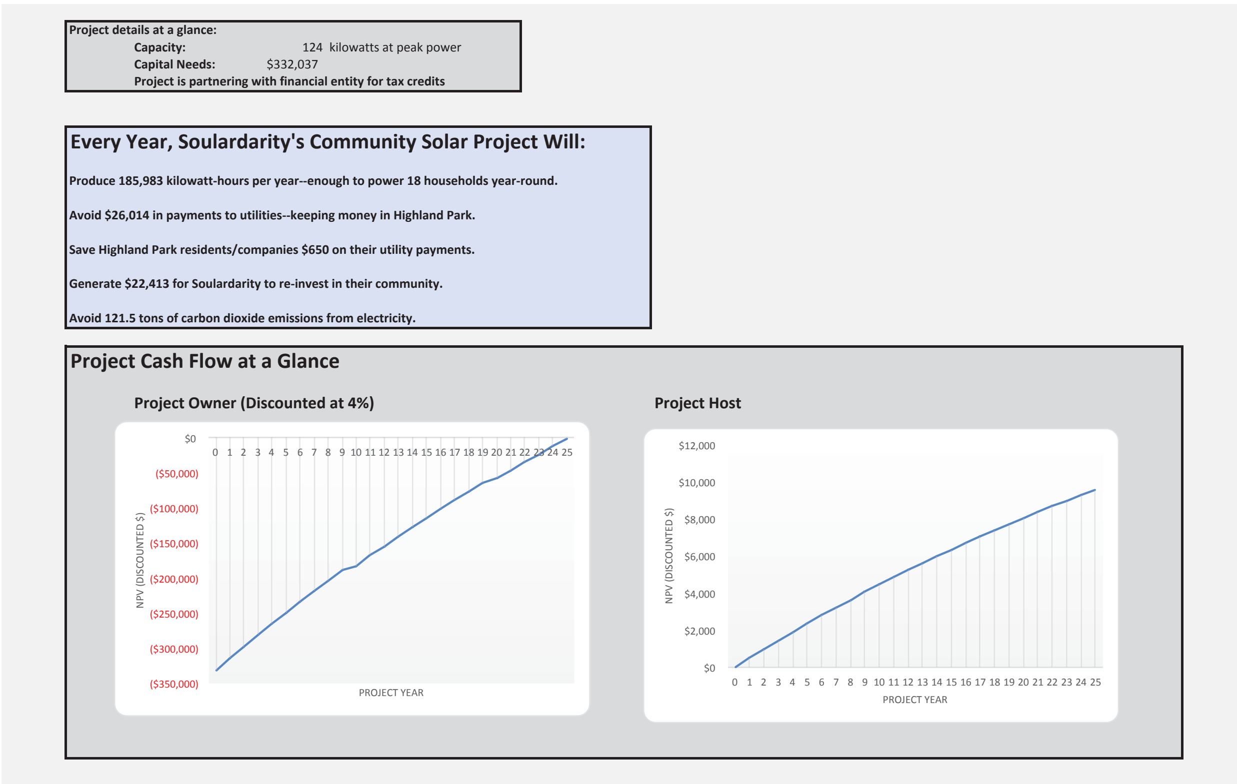

Figure 8: Fourth tab which includes an overview of project results

6. Results: Case Studies & Sensitivity Analysis

Our team used the Community Solar Calculator to assess three potential community solar sites in Highland Park: Parker Village (a community building), Labelle Towers (a senior living home), and Nandi Knowledge Cafe (a local gathering place and eatery). These sites were selected because of Soulardarity's personal interest in these locations, existing partnerships, and/or the high energy demand of these locations and their ability to take advantage of the various tax incentives when installing a commercial size PV array and partnering with a non-profit organization.

6.1 Parker Village

Parker Village is a community initiative spearheaded by one of the board members of Soulardarity. Parker Village is hoping to repurpose an abandoned space in Highland Park into a community center fully powered by renewables. The village will host businesses, offices and family homes. Parker Village is already a Soulardarity partner, and development of the community center and office space is currently underway.

Parker Village Input Assumptions:

- One story high office space
- Building square footage the same as the roof square footage
- National average electricity demand (Michigan typically has higher electricity usages due to seasonal changes)
- Standard panels
- Battery included
- 4% discount rate

6.2 Labelle Towers

Labelle Towers is a 10-story apartment building located in Highland Park specifically designed for senior living. Due to its large square footage, it has a high energy demand. Labelle Towers is operated by a non-profit organization, so while the financial aspect will differ from the other two sites, we wanted to include a space that is used for lodging to determine how it affects the decisions of planning for community solar.

Labelle Towers Input Assumptions:

- Modeled energy demand for one story of the complex
- Building square footage the same as available roof square footage
- Demand is only for organizational electricity use (tenant is responsible for utilities)
- Standard panels
- Battery included
- 4% discount rate

6.3 Nandi's Knowledge Cafe

Nandi's Knowledge Cafe is a local eatery and early Soulardarity partner. The energy demand of Nandi's will not resemble the energy profile of either Parker Village or Labelle Towers. Nandi's, while being the smallest location of the three, has a significant energy demand because they serve food. As a for-profit business Nandi's Knowledge Cafe will be able to benefit from the tax incentives offered by the government for solar development.

Nandi's Input Assumptions:

- Available roof space assumed to be entire building roof, of which Nandi's Knowledge Café represents only a portion
- Standard panels
- Battery included
- 4% discount rate

6.4 Calculator Outputs

The graph below shows the energy output of the array for each of the three case study locations. As seen in Figure 9, in each of the three cases, we maximize the use of the roof space, but it is unable to meet all the estimated demand of the locations.

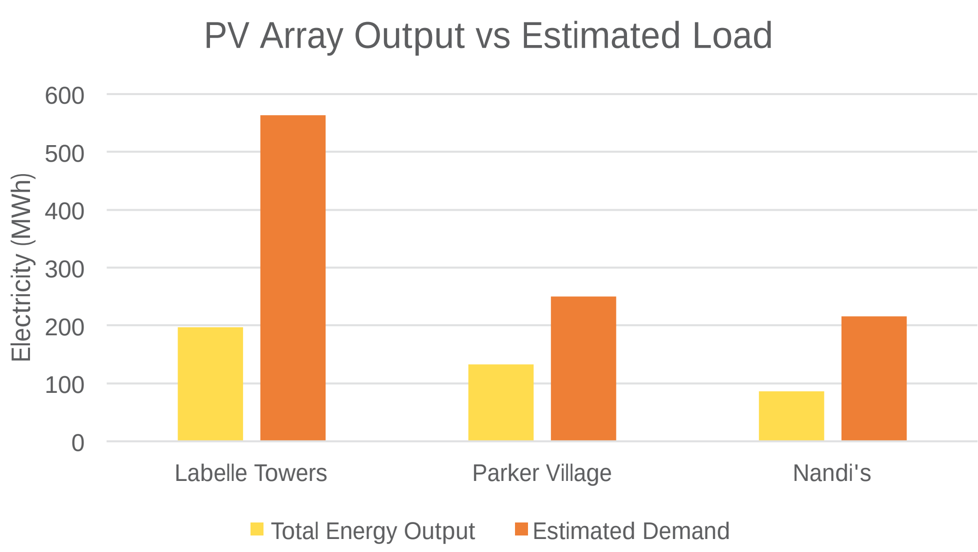

Figure 9: The three case study locations of Labelle Towers, parker Village, and Nandi Knowledge café, and the estimated PV output and energy demand.

Figure 10 shows the capital cost of each system assuming that the location went with the standard modules, a battery storage system, and utilized their entire roof space. Capital costs include the solar panels, battery, inverter, balance of systems (BOS), installation, permitting and licensing.

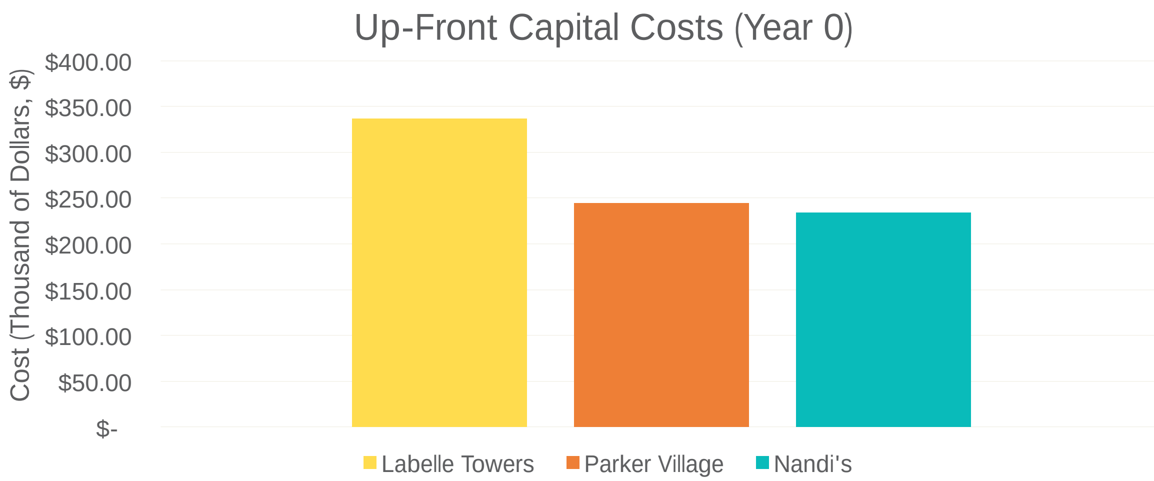

Figure 10: The total cost of each case study for Labelle Towers, 134 kW, Parker Village, 91 kW, and Knowledge Cafe, 59 kW system including battery, inverter, installation, and BOS.

6.5 Sensitivity Analysis

Conducting a feasibility study on a 25-year project requires making several assumptions about the future and each of these assumptions can greatly vary the Net Present Value (NPV) of the project and the financial feasibility. The first major consideration is whether the project should include a battery or not. Current (2017) battery technology is expensive and has a short life span (we assume every 8 years). While it does allow for energy storage and less reliance on the grid for backup, it results in a negative NPV for every project we modeled, as seen in Figure 11.

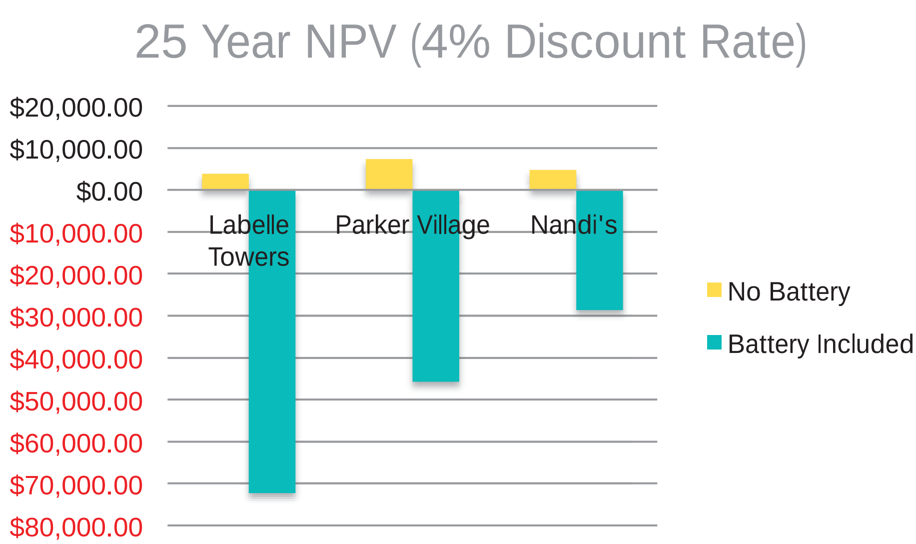

Figure 11: Sensitivity analysis for the decision to include a battery

When comparing long-term projects the final costs are compared in "todays dollar," this is done by assuming a discount rate, or a rate at which the value of money will grow over time. The true value of money growth over time depends on several macro level factors that are difficult to predict. Figure 12 shows that if we use a discount rate of 1% (typically associated with inflation) every project has a positive NPV, where as a 7% discount rate (typically associated with for-profit investment portfolios) shows that every project would have a negative NPV. At a discount rate of 4% (the calculator's default and a common value used for social investments) Parker Village has the highest NPV of the three sites.

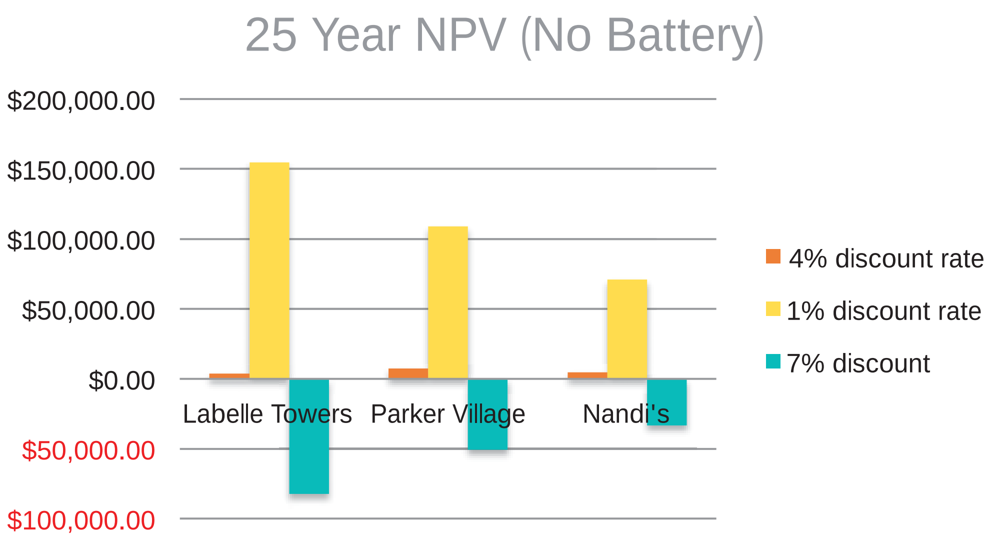

Figure 12:Sensitivity analysis for varying discount rates

The third variable we considered for the sensitivity analysis was the escalation factor, which is the rate at which we assume DTE will raise their utility rates over time. The calculator default value is 2.5%, which is the default rate used by NREL's System Advisor Model.[xix] The faster and higher DTE's utility rates climb the more economical community solar becomes. Figure 13 shows that if DTE's escalation rate is closer to 1%, the NPV of each project could be negative while a higher escalation rate, closer to 3.5% could lead to a substantial increase in every project's NPV.

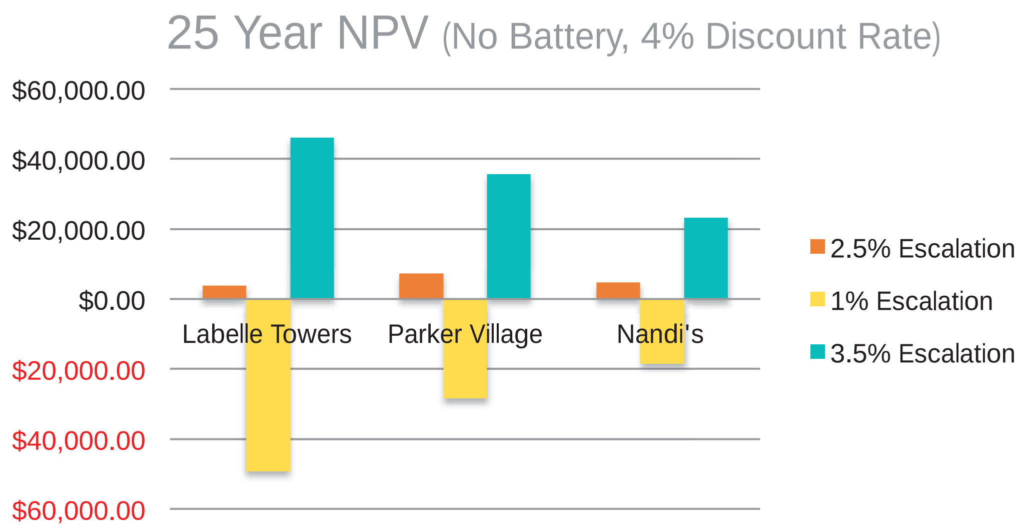

Figure 13: Sensitivity analysis for varying escalation rates

7. Policy Considerations for Community Solar

Solar projects are complex propositions that interact with financial and tax policy, clean energy incentives, rules on issuing securities, local zoning ordinances, and utility operations. As such, understanding the nature of these policies and how they pose barriers and opportunities to solar projects is critical to assessing the feasibility of community solar in Highland Park. This section provides an overview of the relevant policies at the federal, state, and utility level that will interact with the details of a community solar project, and offers guidelines on how to best take advantage of opportunities and avoid barriers. This section is not meant to be a comprehensive treatment, and any community solar project should regularly consult a lawyer and accountant to ensure that the project is set up appropriately.

7.1 Federal Policy

7.1.1 Tax Incentives

Tax incentives are the largest incentive available to solar projects, adding up to over 30 percent of the project's installed cost.[xx] The two major tax incentives are the Commercial Investment Tax Credit (ITC) and the Modified Accelerated Cost Recovery System (MACRS). The ITC allows investors to take up to 30% of the installed cost of a system off of their tax liability, and MACRS allows 5-year depreciation of the project for tax reasons.[xxi]

These tax incentives are not refundable, which means that entities can only take advantage of them to reduce their tax burden. They're also restricted to taxes on 'passive' income that doesn't come from wages or salary.[xxii] To take full advantage of these opportunities, Soulardarity should partner with a financial institution or other partner with a high passive tax burden. Partnerships with financial investors take multiple forms, but usually involve the financial partner taking full or majority ownership of a project for the initial years of operation, then 'selling back' the project to the administrators after tax incentives have been capitalized. This process adds substantial complexity to the finances of the project, but can substantially decrease its total cost (usually by over 30%). Soulardarity should decide whether partnering with a financial institution for capitalizing on tax liability is in line with the goals of the solar project.

7.1.2. Federal (and, if applicable, state) Securities Regulation.

Special purpose entities that sell interests or equity stakes in an asset (e.g. a solar project) technically qualify as securities, and as such there are policies that govern how and why securities can be sold.[xxiii] Exemptions to securities regulation are possible, and require a cap on the total amount of investors (usually 35) and their geographic location (the same state). It's recommended that Soulardarity's special purpose entity take advantage of this exemption to reduce the time, effort, and expertise required for project management.

7.2. State Policy

7.2.1. Renewable Portfolio Standard (RPS) and Renewable Energy Certificates (RECS)

Michigan's Renewable Portfolio Standard requires Michigan electricity to be made up of at least 15% renewable electricity by 2021.[xxiv] To track which energy sources are renewable, the state of Michigan certifies and issues Renewable Energy Certificates (RECs) to the owners of renewable energy generators. Then, distribution utilities are responsible for producing or purchasing enough RECs to meet the 15% RPS threshold. The result is a REC market where project owners sell their certificates of renewable energy to utility companies.[xxv]

Soulardarity's community solar project would qualify for REC certification, and the project would generate one full REC per 1,000 kWh generated. Hypothetically, Soulardarity could sell their renewable energy credits to utilities to meet their renewable portfolio standard; However, market prices for RECs are very low due to the low RPS standard and the proliferation of wind power in Michigan. Most solar project owners do not sell their RECs; the cost of entering the REC market is greater than the value generated by selling the certificates.[xxvi] Changes to the state RPS policy, like increasing from 15% or including a carve-out specifically for solar energy, might increase the project's REC value in the future.

7.2.2. Net Metering

Net metering is a utility practice that allows property owners using distributed energy to 'sell back' the electricity they produce when energy produced on-site exceeds their demand. Net metering practices are mandated by state law, but implementation across the state varies by utility. Net metering is generally only available when utility customers consume more energy than they produce each year.[xxvii]

The state of Michigan and DTE allow for 'true net metering,' or paying customers for their energy at full retail value, for projects that are up to 20 kW in capacity. For projects with greater than 20 kW of capacity, 'modified net metering' applies. 'Modified net metering' reduces the value of energy when sold back to the grid by 40%. In terms of project economics, energy produced from a large solar project and used on-site still displaces a full retail-rate kilowatt-hour, but the decreased value applies when sold back to the grid.[xxviii] As a result, accurately determining the revenue of the project becomes more uncertain. Even sites with a large amount of demand may not require high power during the afternoon, when solar projects generate the most energy.

At 150 kW of capacity or greater, projects must pay 'standby charges' when they're not generating electricity. Because generation timing is not controlled by the operator, standby charges make solar projects above the capacity cap prohibitively expensive.

7.2.3. Property Taxes

As a valuable asset, installed solar properties typically increase property taxes for the property they're installed on. Although many states have exemptions for on-site clean energy projects, Michigan's exemption for on-site clean energy projects lapsed in the 1970s. In some cases, city-level tax policies may also implement an exemption, but there is some uncertainty about how property tax would be calculated when the project host and project owner are different entities.[xxix] In any case, property tax increases should be folded into financial calculations done for a prospective solar project.

8. Making Community Solar a Reality

The initial portion of the research project assessed the feasibility of a community solar project in Highland Park, and presented a sketch of what a community solar model might look like for Soulardarity and Highland Park. One conclusion from the analysis quickly became clear: Solar projects present logistical, legal, and financial complexity, and the accessible partnership model outlined here only increases that complexity. NREL's "Guide to Community Solar" book outlines a basic checklist of project development tasks for community solar projects, which is presented in Appendix D.

Soulardarity's context in Highland Park, mission, and the proposed business structure make this project unique. University Park Solar Co-operative, an example of the community PPA we propose Soulardarity model after, took over three years to structure and launch. As Soulardarity staff move forward with a community solar installation, they should take the following steps over the next few years:

8.1 Setting project objectives

Community solar projects are a long-term investments and lasting partnerships between Soulardarity staff, Soulardarity members, Highland Park community members, project hosts, and financial partners. In the process of crafting this partnership, Soulardarity staff will be presented with a vast array of options and considerations for how exactly the project will be implemented. In some cases, options and considerations may ask Soulardarity to make trade-offs between outcomes (e.g. Should the project save more money for the host or generate more money for Soulardarity?). Although planning, forethought, and good project design should prevent surprising events or circumstances along the project's lifetime, Soulardarity staff may have to make difficult decisions along the life of the project.

Defining project objectives at the outset can provide clarity when choices present themselves, and they allow multiple staff members to coordinate on a single principle. If the goals are public, they might also present a consistent principle for project partners. Project development means juggling levels of risk and returns on investment alongside Soulardarity's own mission objectives like enhancing energy democracy, ensuring accessibility, and raising Soulardarity funding.

8.2 Forming a Special Purpose Entity:

Soulardarity has multiple options when it comes to the development of a special purpose entity for the community solar project, each with their own strengths and weaknesses. NREL's "A Guide to Community Solar" includes a concise explanation of the most common business arrangements as seen in Figure 11.[xxx]

Entity Type	Liability for Owners	Taxation	Primary Advantages	Primary Disadvantages
General Partnerships	Personal liability	Pass-through	Ease of formation; pass-through taxation	Personal liability of partners
Limited Partnerships	Personal liability for general partners; limited liability for limited partners	Pass-through	Pass-through taxation; limited liability for limited partners	No liability shield for general partner
Limited Liability Companies	Limited Liabaility	Usually pass-through	Pass-through taxation; fewer formalities to maintain the LLC structure than corporations	Relatively new structure; may be harder to get financing
Cooperatives	Limited Liability	Seprate tax entity	Cooperative principles	Inflexible Structure
"S" Corporations Limited Liabaility	Limited Liability	Pass-through	Liability shield; ease of investment; ease of transfer of shares in larger, non-close corporations	Limitations on number and identity of members
"C" Corporations	Limited Liability	Seprate tax entity	Liability shield; ease of investment; ease of transefer of shares in larger non-close corporations	Complexity; double taxation
Non-Profit Entities	Limited Liability	Seprate tax identity; tax exempt	Tax-exempt; tax deduction for donors	No return for donors; business purpose are limited; no voting rights for donors

Figure 11: NREL's "A Guide to Community Solar"

Appendix D.1 and Appendix D.2 include a charter and formation document for a limited-liability corporation, identical to that used by University Park Solar Co-operative.

8.3 Building relationships with potential partners.

Soulardarity needs several partners to make the community PPA a reality. Bringing together a diverse set of partners helps to forward Soulardarity's mission of uniting their community through energy provision, while expanding the total available pool of resources for the project. And because a large solar project requires substantial land, a large energy demand (to meet net metering rules), and a lot of up-front capital, Soulardarity should be intentional about seeking out partners who can further their mission and provide the necessary resources for the project. In particular, Soulardarity should identify **project hosts** and **financial partners**.[xxxi] Below are suggested criteria for evaluating potential project hosts:

- **Investment in Highland Park and Complementary Missions:** Part of Soulardarity's mission is to drive down the costs of energy for the community. Although a community PPA should generate returns for the project investors (including Soulardarity), it only directly reduces energy costs for the project host. For this project to further Soulardarity and decrease energy burdens in Highland Park, the project host should be an open, community-serving institution.
- **Space for a solar project:** Appropriate solar sites are easily accessible for maintenance, near existing electrical circuits, generally clean (not in risk of accumulating debris) and have uninterrupted access to sunlight. Even tall buildings around a potential solar site can have an impact on solar production. To reduce roof maintenance costs is done just before solar panels are installed and roofs should be inspected by an expert before any commitments are made.
- **Financial Stability:** Solar energy projects are, by nature, long time-horizon partnerships. Initial estimates for this project put a simple payback period at over 15 years, and typical estimates of solar lifetime for modern solar panels place them at 25 years or more. Soulardarity should be confident that their partner is likely to continue to own and operate the property over the long haul, or at the very minimum have procedures in place for a transfer of building ownership. In some cases, potential financial liabilities and risks that might cause the entity to move or sell the property should be evaluated. For this reason, common solar partners include churches and civic buildings. Although energy payments should represent a discount for the project host compared to their hypothetical utility prices, regular payment should still be an expectation, especially if the Special Purpose Entity takes on debt to finance the project.

8.4 Getting Legal & Accounting Support

For many projects, setting up the legal and financial structures that will serve the project are the most costly and time-consuming portions of a community solar project.[xxxii] University Park Solar Co-operative, for instance, spent over two years developing their business plan before moving forward with the project. They relied on pro-bono work from the Maryland Intellectual Property Resource Center, alongside $12,000 for other legal and accounting expenses. Soulardarity should examine its options closely when it comes to setting up a community solar business and financial structure. Documents provided in Appendix D to this report can form the basis for financial & legal structures for Soulardarity.

9. Discussion and Conclusions

Across our case studies in Highland Park, the community solar calculator found that community solar projects could flourish and meet their goals of providing access to solar, reducing energy burdens, raising money for Highland Park, and increasing the Highland Park community's autonomy when it comes to providing energy. We believe this is an incredible opportunity for the Highland Park community to achieve energy democracy, and we excitedly await the future of Highland Park's electricity grid.

The Community Solar Calculator relies on a number of industry averages and assumptions to generate reasonably accurate technical and economic outputs. The detail provided here should allow users to further customize the calculator to meet their needs and the specifics of their developer and installation. Especially as solar equipment and 'soft' costs continue to drop, it's critical to remember that the model represents 2017 industry averages and details should be updated as pertinent information becomes available. Nevertheless, the calculator provides a solid foundation for estimating the technical and economic feasibility for a solar project. While every case study we explored could be a financially viable option, there are many uncertain factors included in the calculator and the best option will depend on Soulardarity's relationships and a formal analysis by solar developers.

For Highland Park and Soulardarity, the major barriers left to community solar are 1) Crafting a business and policy framework for Soulardarity and Highland Park and 2) Securing low-cost financing that will not put a high burden on Soulardarity.

While these barriers are surmountable by Soulardarity, they absolutely dampen access to affordable, renewable energy for those who need it most. Soulardarity's journey toward community solar demonstrates the viability of these projects to help people on the ground as well as the difficulty in making these projects a reality. In many states, legislation and policy have stepped in to increase access to community solar and allow residents greater autonomy in how they provide their own energy.[xxxiii] Our recommendation and hope is that the State of Michigan follow suit.

The way the world provides its electricity is changing. As the business and moral case for renewable energy shifts the fundamental nature of how we produce and consume energy, it's up to us to ensure that the benefits of clean and affordable energy accrue to everyone. Community solar in Highland Park will help achieve that mission, and Soulardarity's project might set an example for how communities facing high-energy burdens might join together, create something new, and become more free.

Appendices

Appendix A: Survey Design*
Appendix B: Survey Results*
Appendix C: Community Solar Calculator Design and Assumptions
Appendix D: Resources*
- **Appendix D.1: Generic Maryland Operating Agreement**
- **Appendix D.2: Generic Maryland Power Purchase Agreement**
- **Appendix D.3: Community PPA Checklist**

**For intellectual property and privacy reasons, these appendices have been redacted from the public report.*

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Appendix A

Opening

Surveyor Name

Introduction for Soulardarity Survey

(bolded = essential to say)

- **Hello! I'm (first name)** How are you doing?
- **I'm a volunteer with the Highland Park-based organization Soulardarity**
- **We're doing a survey in HP about people's experiences with electric and gas shutoffs**
- Soulardarity works for energy democracy in HP
- Energy democracy is the idea that those most impacted by energy decisions should have the most say in those decision
- Soulardarity has put up 6 solar street lights in HP (but not the ones by the basketball court)
- HP has historically been at the will of outside sources, this survey and Soulardarity are opportunities for Highland Parkers to take control and push their city towards greater democracy and energy independence
- This survey is important because it will inform us about the impacts of shutoffs in HP
- It will help us organize for power in HP
- It will support us in advocating and working for energy democracy in HP
- Your information is essential in doing this work
- **It's completely confidential**
- It will only take 10 minutes

Do you have time to take the survey right now? It'll only take about 10 minutes and your responses will be confidential.

- ◯ Yes
- ◯ No

Energy Use

What is your household energy source?

- Electricity Only
- Gas Only
- Both Gas and Electric

Electricity

Electricity Usage

Do you have trouble paying your electricity bills?

Yes	No
◯	◯

Have you ever received an electricity shutoff **notice**?

Yes	No
◯	◯

How many electricity shutoff notices have you received while living at this location?

	0	4	8	12	16	20	24	28	32	36	40
Slide											

Have you ever had your electricity **shutoff**?

Yes	No
◯	◯

How many times has your electricity been shutoff at this location?

0 2 4 6 8 10 12 14 16 18 20

Slide

Did you receive a notice(s) before the most recent electricity shutoff?

- Yes
- No

During the most recent electricity shutoff, in what form(s) did you receive notices?

- Mail
- In Person
- Email
- Phone
- Flyer
- Other

During the most recent electricity shutoff, how many days passed between the first notice and the shutoff date?

0 10 20 30 40 50 60 70 80 90 100

Slide

What time of year did the most recent electricity shutoff happen?

Nov 1st - Mar 31st	April 1st - Oct 31st
○	○

How long did the most recent electricity shutoff last?

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less than 1 day	1-2 days	3 days- 1 week	1-2 weeks	2 weeks to 1 month	Over a month
○	○	○	○	○	○

During the most recent electricity shutoff, how many people in each age category where living in the house?

	0	1	2	3	4	5	6
Age 0-3 yr							
Age 4-12 yr							
Age 65 or Over							
User of electric medical equipment							

Did you use any other sources of power during the electricity shutoff?

- ☐ Candle
- ☐ Wood stove
- ☐ Generator
- ☐ Batteries
- ☐ ________ Other

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Gas

Gas Utility

Do you have trouble paying your gas bills?

Yes	No
◯	◯

Have you ever received a gas shutoff **notice**?

Yes	No
◯	◯

How many gas shutoff **notices** have you received in this location?

	0	4	8	12	16	20	24	28	32	36	40
Slide											

Have you ever had your gas **shutoff**?

Yes	No
◯	◯

How many times has your gas been shutoff at this location?

	0	2	4	6	8	10	12	14	16	18	20
Slide											

Did you receive a notice(s) before the most recent gas shutoff?

◯ Yes

◯ No

During the most recent gas shutoff, in what form(s) did you receive notices?

- [ ] Mail
- [ ] In Person
- [ ] Email
- [ ] Phone
- [ ] Flyer
- [ ] ________ Other

During the most recent gas shutoff, how long after the notice were you shutoff? (days)

	0	10	20	30	40	50	60	70	80	90	100
Slide											

What time of year did the most recent gas shutoff happen?

Nov 1st - Mar 31st	April 1st - Oct 31st
○	○

How long did the most recent gas shutoff last?

less than 1 day	1-2 days	3 days- 1 week	1-2 weeks	2 weeks to 1 month	Over a month
○	○	○	○	○	○

During the most recent gas shutoff, how many people in each category where living in the house?

	0	1	2	3	4	5	6
Age 0-3 yr							
Age 4-12 yr							
Age 65 or Over							
User of electric medical equipment							

Did you use any other sources of power during the gas shutoff?

- [ ] Candle
- [ ] Wood stove
- [ ] Generator
- [ ] Electric heater
- [ ] Batteries
- [ ] ____________ Other

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Programs

Michigan Low Income Household Energy Assistance Program (LIHEAP) *also referred to as THAW*

	Yes	No
Have you heard of this program?	○	○
Have you used this program?	○	○
Did you find the program helpful?	○	○

Home Heating Credit

	Yes	No
Have you heard of this program?	○	○
Have you used this program?	○	○

	Yes	No
Did you find the program helpful?	◯	◯

iHeal

	Yes	No
Have you heard of this program?	◯	◯
Have you used this program?	◯	◯
Did you find the program helpful?	◯	◯

Winter Protection Plan

	Yes	No
Have you heard of this program?	◯	◯
Have you used this program?	◯	◯
Did you find the program helpful?	◯	◯

Are there any other assistance programs that you've used?

What community issue is your highest priority?

- ◯ Water
- ◯ Unemployment
- ◯ Housing
- ◯ Education

- Utilities
- Drug use
- Wages
- Food Security
- Other

Demographics

Which best describes you?

- I rent my home
- I own my home
- I am a residential landlord

What is your gender identity?

- Male
- Female
- Other

What is your age?

	0	10	20	30	40	50	60	70	80	90	100
Age											

What is your racial identity/ethnicity?

- White
- Black or African American
- American Indian or Alaska Native
- Asian
- Native Hawaiian or Pacific Islander

◯ ________ Other

What is your marital status?

◯ Single
◯ Married
◯ Divorced
◯ Widowed
◯ ________ Other

How many dependents do you have (under 18)?

	0	1	2	3	4	5	6	7	8	9	10
Dependents											

WTP

At Soulardarity, members are integral to our work. As a member, you can elect the board of directors, participate in committees to direct different aspects of our work, and steer the organization towards our mission of energy democracy in Highland Park. Your membership dues also sustain our operations and help us maintain autonomy and focus on our mission of energy democracy. Membership also gives you access to low-interest financing for purchasing solar products through our PowerUP program.

Would you be willing to pay $10 per year for a Soulardarity membership?

◯ Yes
◯ No

Would you be willing to pay $20 per year for a Soulardarity membership?

◯ Yes
◯ No

Would you be willing to pay $30 per year for a Soulardarity membership?

- Yes
- No

Would you be willing to pay $40 per year for a Soulardarity membership?

- Yes
- No

Would you be willing to pay $50 per year for a Soulardarity membership?

- Yes
- No

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Contact Information

Would you like Soulardarity to contact you with more information regarding:

- PowerUP (bulk buying of solar products)
- Membership (give sheet explaining membership)
- Educational Events
- Annual Meeting
- Solar streetlights in HP
- Your shutoff experience
- ________ Other

Contact Information

Name	
Email	
Phone Number	
Street Address	

Closing Comments

Any other comments about this interview

Availability

Is there another convenient time we can contact you?

SOULARDARITY
Organizing for Infrastructure in Highland Park, MI

Powered by Qualtrics

Appendix B: Community Survey July 2017

On July 9, 2017 Soulardarity volunteers, led by Intern Grace Brosnan walked the neighborhoods of Highland Park to conduct a survey about the resident's experiences with energy utilities. The purpose of the survey was to get a better understanding of the need for community solar from both an economic and social justice perspective. Specifically, according "Lights Out In The Cold" Environmental and Climate Justice Program NAACP, in Michigan:

- Notice must be provided by phone or mailing. Phone notice must be attempted two times at least one day before the scheduled disconnection. Mailed notice must be sent at least five days before the scheduled disconnection.

- November 1- March 31 No disconnections for customers 65 years or older. No disconnections for eligible low-income customers with entry into a payment plan where customer makes monthly payments equal to 7% of the annual bill.

- Postponement of disconnection for not more that 21 days with medical certification. Certification may be renewed up to a total postponement of 63 days in a 12-month period. A utility is not required to grant postponements totaling more that 126 days per household.

The survey used convenience sampling and included 61 citizens. Given this was not a random sample, we cannot assume the responses truly represent the community but they do provide some insight into the utility burden. Specifically during the survey process, interviewers knocked on doors in the community and found they could not enter some apartment buildings, this resulted in a sample that skewed toward homeowners as seen in the demographic comparison.

The survey was designed in Qualtrics (see Appendix AX) and surveyors accessed the survey from their smart phones. The online survey allowed us to include skip-logic, for example if people only had electricity and no gas, they would only answer questions about electricity. This sped up the survey process but also resulted in varying number of respondents for each question. The survey was administered verbally, the 13 surveyors were trained in advance on how to ask the questions and use the mobile survey tool.

Demographics

At the end of the survey we asked a series of demographic questions to analyze differences among groups, identify potentially illegal activity and see how our voluntary sample compared to the true makeup of Highland Park.

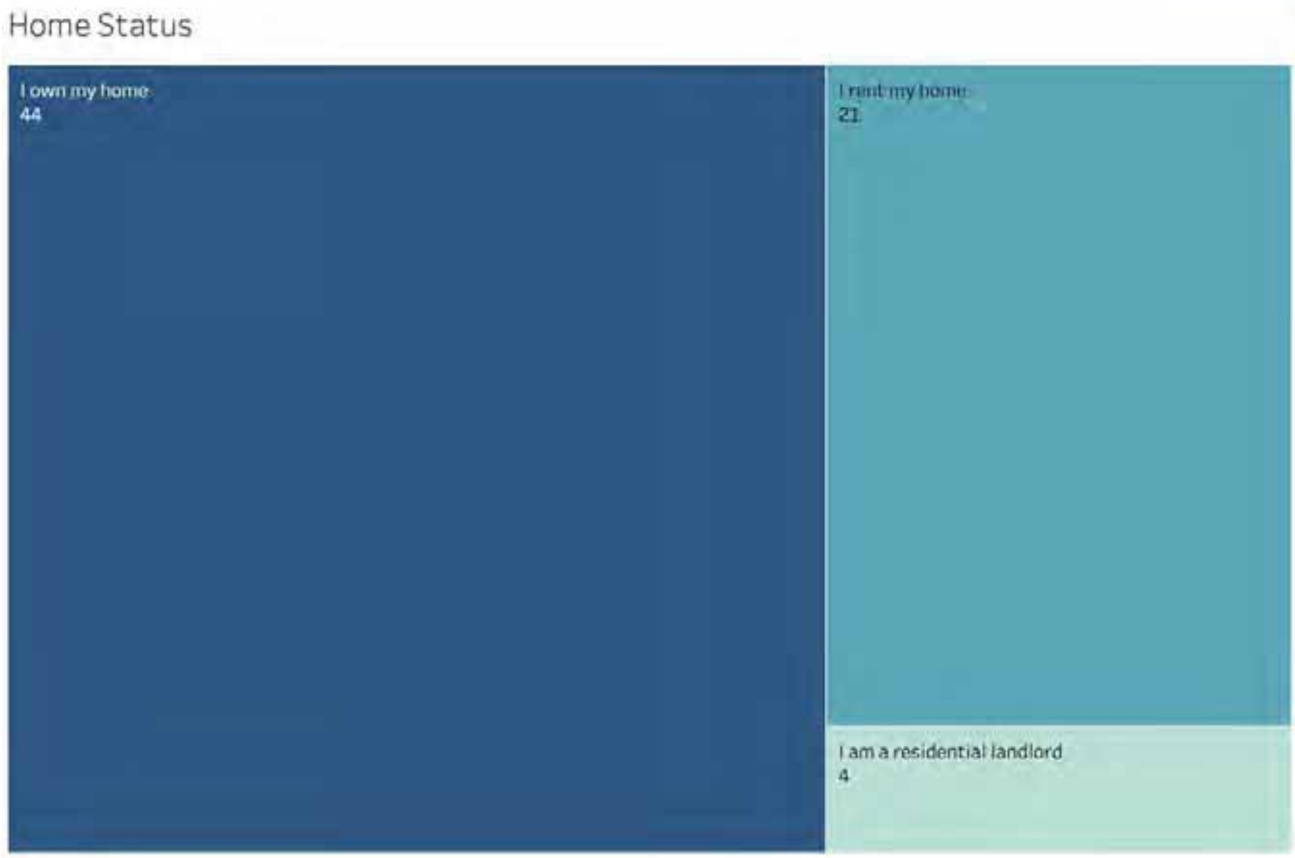

Figure 1: 64% of our sample owned their home. In Highland Park, MI in 2015, 36% of housing units were owner-occupied. This means our data is biased towards homeowners in the community and is not representative of the entire community.

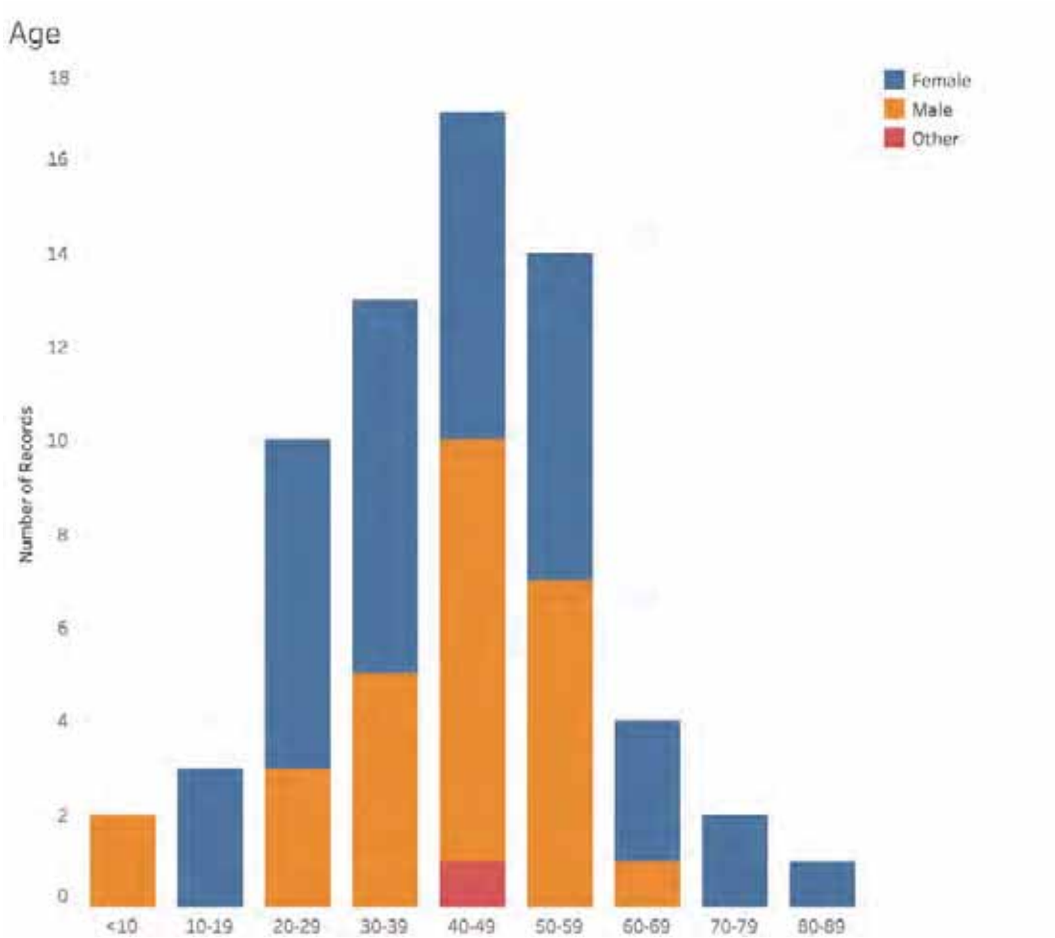

Figure 2: We recorded the age and gender identity of the respondent. According to the 2011-2015 American Community Survey 5-Year Estimates, the median age in Highland Park is 41.7.

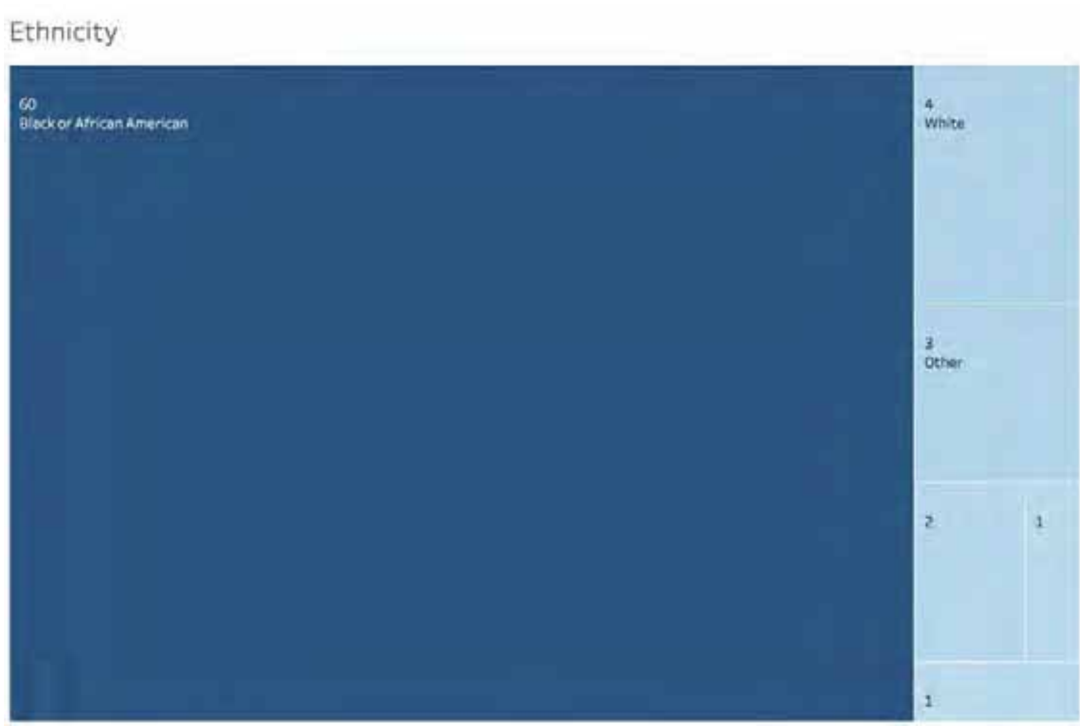

Figure 3: 84.5% of our sample identified as black with the next largest identifying as white, in 2015, 91.9% of Highland Park was black, with white making up the next largest segment.

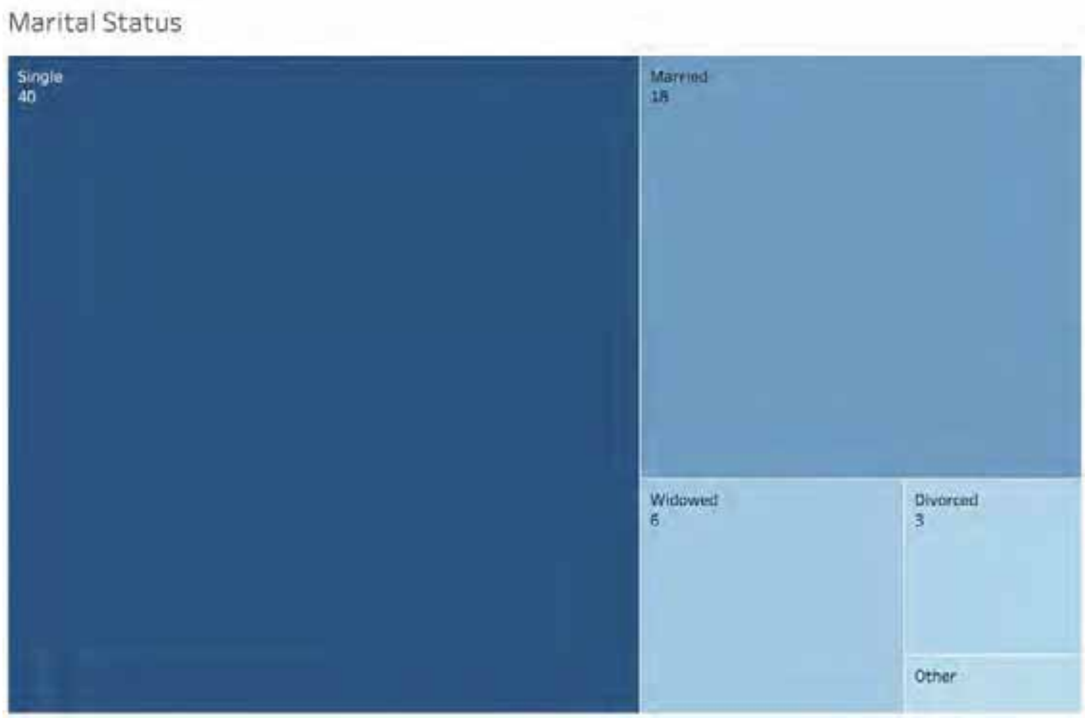

Figure 4: Data on Marital Status in Highland Park is Unavailable, 58.8% of our sample respondents were single

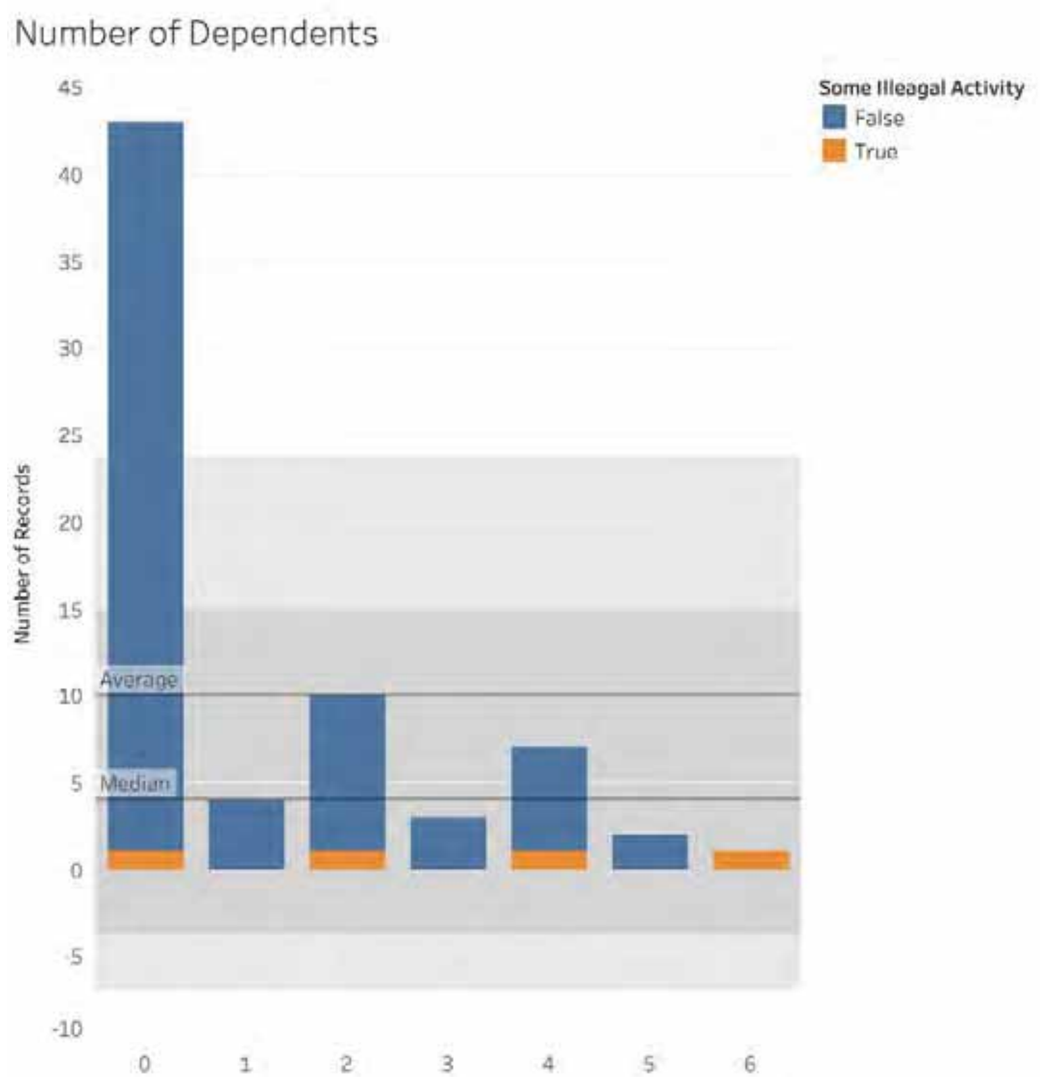

Figure 5: Number of dependents (<18 years) in the household by illegal activity

Energy Use Data

What is your household energy source?

- Electricity Only: 67 (94%)
- Gas Only: 1 (1.41%)
- Both Gas and Electric: 3 (4.23%)

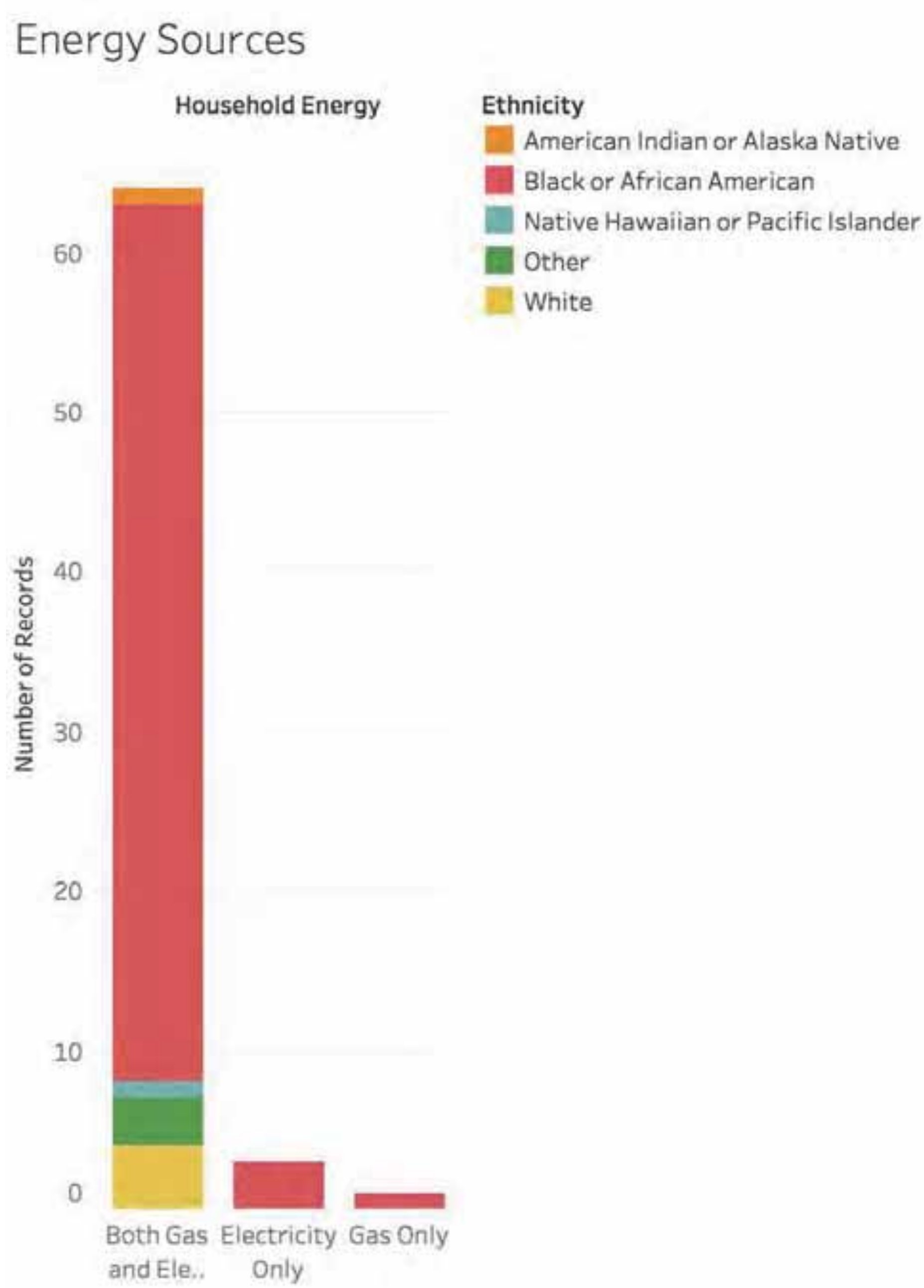

Figure 6: Most residents of Highland Park use gas and electric energy in their household

Electricity

Do you have trouble paying your electricity bills? 28 (40%) responded “Yes”

Have you ever received and electricity shutoff notice? 31 (44%) responded “Yes”

How many electricity shutoff notices have you received while living at this location? 3 respondents received at least 1 notice, one responded reported receiving 10 notices (max).

Have you ever had your electricity shutoff? 15 (21%) responded “Yes”

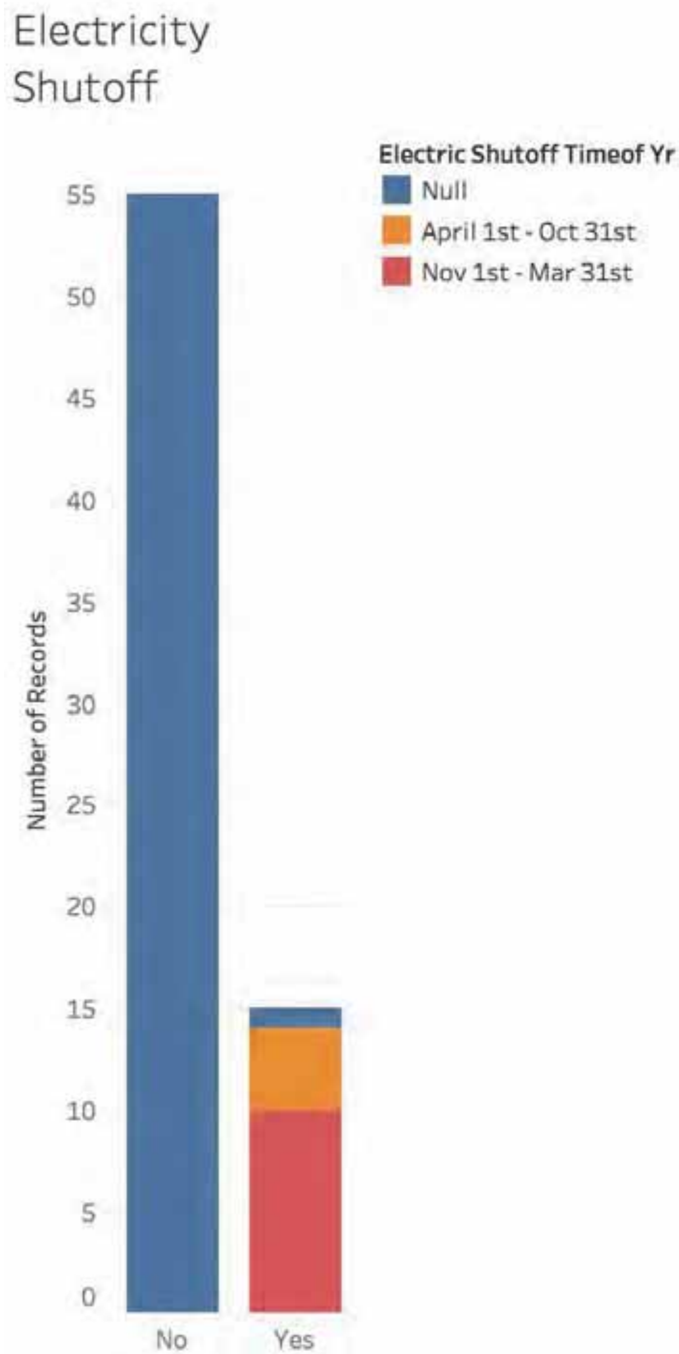

Figure 7: Proportion of respondents who have experienced electricity shutoff by time of year

How many times has your electricity been shutoff at this location? Average 3.545

Did you receive a notice(s) before the most recent electricity shutoff? 10 responded "Yes," 4 responded "No"

During the most recent electricity shutoff, in what form(s) did you receive notices? Mail, In person, email, phone, flyer, other

- Mail: 9
- In person: 1
- Phone :1

During the most recent electricity shutoff, how many days passed between the first notice and the shutoff date? Average: 11.33, max: 30, min:0

What time of year did the most recent electricity shutoff happen?
- ☐ Nov 1st- Mar 31st : 10- 71%
- ☐ April 1st-Oct 31st : 4-19%

How long did the most recent electricity shutoff last?
- ☐ Less then 1 day: 1
- ☐ 1-2 days: 5
- ☐ 3 days- 1 week: 3
- ☐ 1-2 weeks: 1
- ☐ 2 weeks to one month: 1
- ☐ Over a month: 3

During the most recent electricity shutoff, how many people in each age category where living in the house?
- ☐ 0 to 3: 0.666 (average, nulls excluded)
- ☐ 4 to 12: 1.066 (average, nulls excluded)
- ☐ 65+: 0.6 (average, nulls excluded)
- ☐ Persons with Medical needs: 0.533 (average, nulls excluded)

Did you use any other sources of power during the electricity shutoff?
- ☐ Generator: 3
- ☐ Woodstove: 2
- ☐ Candle: 5
- ☐ Batteries: 1
- ☐ Other: 4 (write in: Flash lights and leaving)

Gas

Do you have trouble paying your gas bills? 26 (38.8%) responded "Yes"

Have you ever received a gas shutoff notice? 27 (40.29%) responded "Yes"

How many gas shutoff notices have you received in this location? 4 (average of those who received notices)

Have you ever had your gas shutoff? 13 responded "Yes"

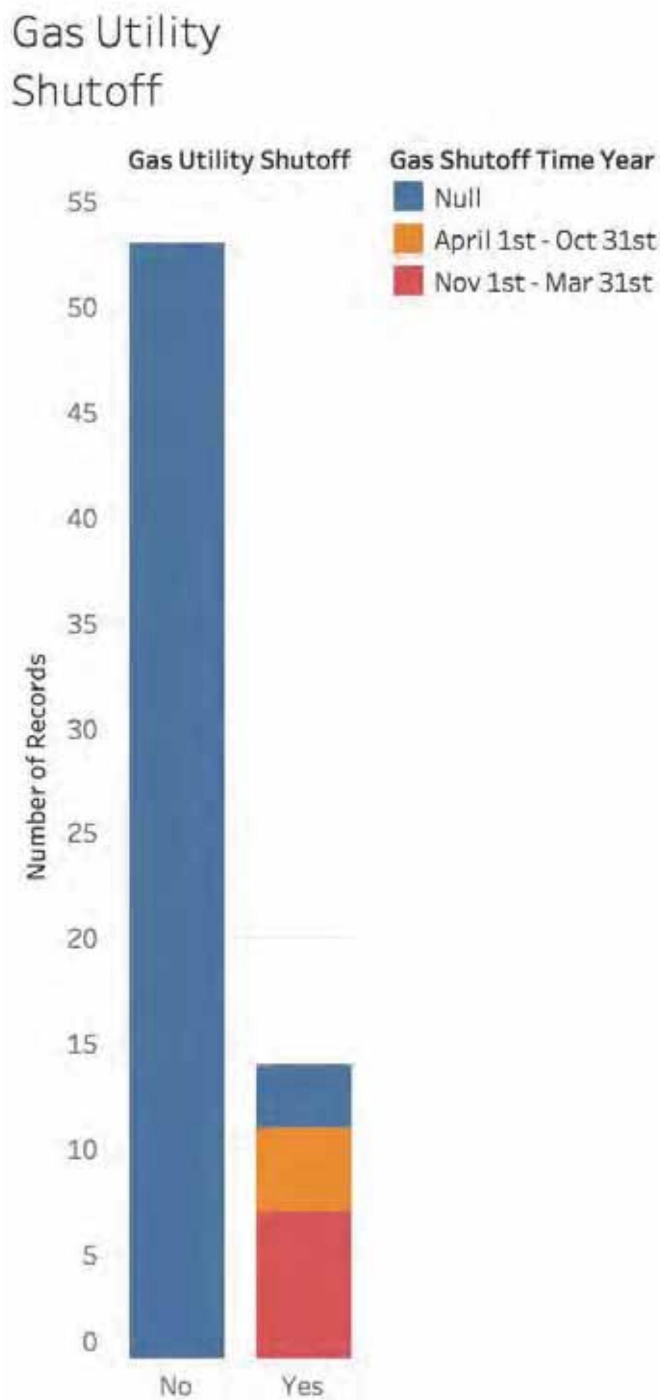

Figure 8: Proportion of respondents who have experienced gas utility shutoff by time of year of shutoff

How many times has your gas been shutoff at this location? 1.8 (average of those who has gas shutoffs)

Did you receive a notice(s) before the most recent gas shutoff?

- Yes: 9
- No: 4

During the most recent gas shutoff, in what form(s) did you receive notices?

- Mail: 5
- In Person: 1
- Phone: 2

- Email: 1

During the most recent gas shutoff, how long after the notice were you shutoff? (days) Average: 12.33, Max: 30, Min: 1

What time of year did the most recent gas shutoff happen?
- Nov 1st - Mar 31st: 7
- April 1st - Oct 31st : 4

How long did the most recent gas shutoff last?
- 1-2 days : 3
- 3 days- 1 week: 3
- 1-2 weeks: 1
- 2 weeks to 1 month: 2
- Over a month: 2

During the most recent gas shutoff, how many people in each category where living in the house?
- 0 to 3: 1.5 (average, nulls excluded)
- 4 to 12: 1.6 (average, nulls excluded)
- 65+ 2: (average, nulls excluded)
- medical: 1 (average, nulls excluded)

Did you use any other sources of power during the gas shutoff?
- Candle 3
- Batteries 3
- Wood Stove 2
- Generator 1
- Other- fireplace 1

Assistance Programs

Michigan Low Income Household Energy Assistance Program (LIHEAP) also referred to as THAW
- Yes 55 (80.8%) respondents have heard of the program
- 12 respondents have used the program
- 9 respondents found it helpful

Home Heating Credit
- Yes 49 (72.05%) respondents have heard of the program
- 32 respondents have used the program
- 26 respondents found it helpful

iHeal
- 1 respondent had heard of the program

Winter Protection Plan
- Yes 41 (61.1%) respondents have heard of the program
- 12 respondents have used the program
- 9 respondents found it helpful

Are there any other assistance programs that you've used? (open response)

- Shutoff protection programs
- LSP through DTE
- Rebate for new furnace.
- Budgetwise
- Senior program
- Wayne Metro
- United Way

Community Priorities

What community issue is your highest priority? The responses to "other" are in the word cloud, street lights was the most popular.

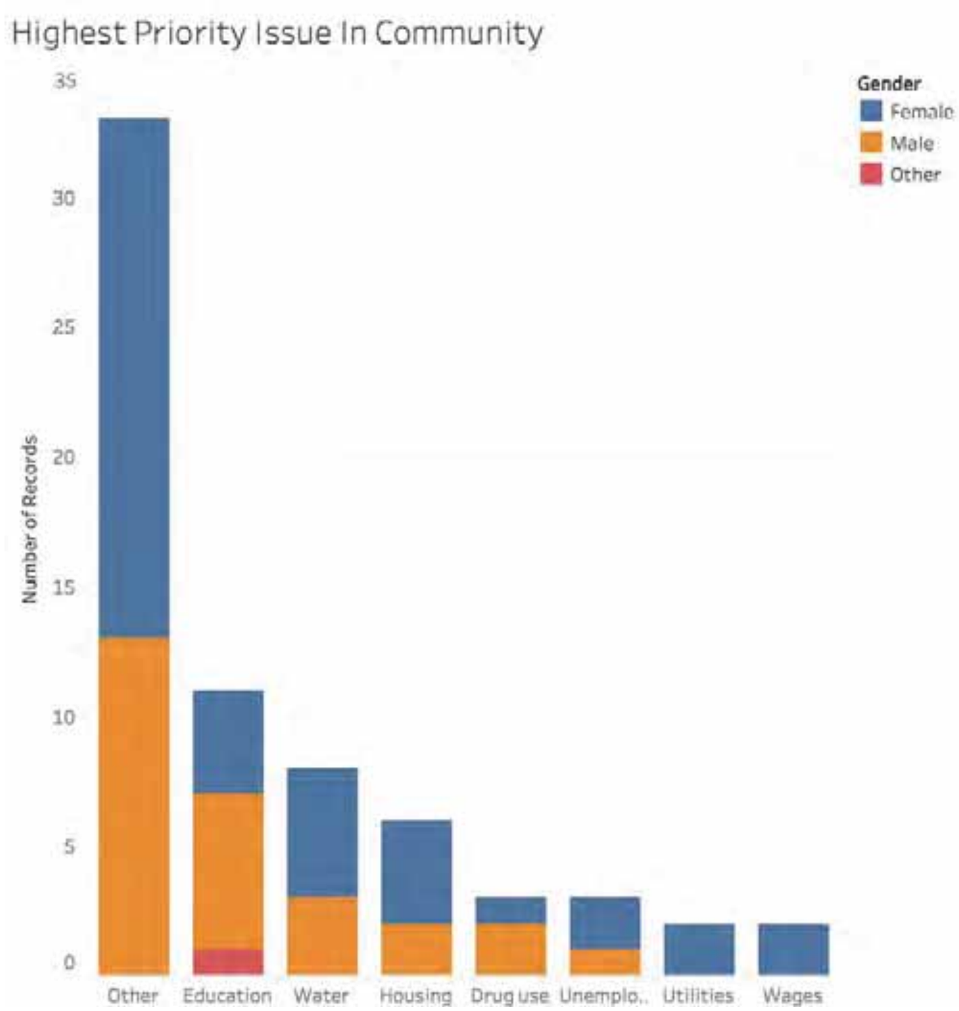

Figure 9: High priority issues in the community by gender

Figure 10: Word cloud made from the write in responses for "highest priority issue"

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i https://datausa.io/profile/geo/highland-park-mi/#housing

ii https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml?src=bkmk

iii https://datausa.io/profile/geo/highland-park-mi/#category_age

Appendix C: Community Solar Calculator Design and Assumptions

To create the calculator, we made assumptions regarding the infrastructure of the panel system itself, the solar resource in the area of Highland Park, the types of buildings being powered, and the project costs and credits. The following section will detail these assumptions as well as outline the way in which these aspects were incorporated into the calculator.

C.1 Solar Panel System

We considered three components of a photovoltaic solar panel system: the array (composed of individual modules), the inverter, and the battery. The module is a planar structure that consists of a number of photovoltaic cells that convert light into electrical energy. Each module can then be compiled into an array. The total photovoltaic system includes the inverter and battery. An inverter converts the electrical energy from direct current to alternating current, which is the type of current needed for the electricity grid. Batteries can be integrated into solar panel systems to store electrical energy that is produced that exceeds the demand of the electricity.

C.1.1 Module

Today there exist many manufacturers and models of solar panels or modules on the market, and the type of module that is appropriate for a project depends on project constraints such as budget and power requirements. In our calculator, users have the option to select one of three types of panels based on budget and efficiency constraints:[i]

- **Economy panels**: Least costly but have the lowest ranking in several categories including performance, quality, durability, and warranties.
- **Standard panels**: Dominate the market, and they have good power ratings, efficiencies, and performance characteristics.
- **Premium panels:** Most efficient and help to maximize energy production, and have the best durability, quality, and warranty, but they are also the most expensive.

Efficiency for each module classification was determined by averaging industry data reported by EnergySage for each module class. Refer to Table 1 below for the assumed efficiency of each module category.

Table 1: Assumed efficiency for each module type in solar power calculator.

Module Type	Efficiency
Economy	14.8%
Standard	16.0%
Premium	20.0%

Along with these efficiencies, we assumed panel dimensions measuring 77 inches in length and 39 inches in width, the industry average.[ii]

C.1.2 Inverter

Similarly to modules, there are many manufacturers and models of inverters. We used industry averages were used to define inverter characteristics: inverter loading ratio (ILR), efficiency, and replacement year. ILR refers to the ratio of DC electricity to AC electricity. Refer to Table 2 below for the values used in the calculator.

Table 2: Values for inverter characteristics using industry averages.

Characteristic	Value
Inverter Loading Ration (ILR)	1.15
Efficiency	0.92
Replacement Year	10

Solar aray diminsions are used to size the inverter (which indicates the ILR specific to the site). The inverter is typically undersized from the reported DC output to achieve maximum output from the inverter. Since the system site is meant to be a variable in the Community Solar Calculator, an industry average was used for the ILR instead of relying on the site load curve.[iii, iv, v] The efficiency and replacement year were also averaged from industry values for the same reason.[xv,xvi] The replacement year is an important consideration, because it affects total system cost and payback period. The inverter will need to be replaced several times during the project lifetime, which adds additional cost.

While our model assumes we will only use one inverter at a time, systems often utilize several smaller inverters. The benefit of having fewer modules connected to each small inverter to create the entire array which is that it allows for systems that are more resilient to power outages. A microinverter can also be wired individually to each module. These methods result in higher costs, therefore we assumed that only one inverter would be used for a project funded primarily by a non-profit and lower-income community.

C.1.3 Battery

The design of a battery system is highly dependent on the specific solar panel site. Generally, batteries are used in off-grid sites and can be used to offset electricity prices in areas with Time-of-Use (TOU) rates, neither of which are within the scope of this project (the local utility, DTE Energy, does not use TOU rates).[vi] Despite this, the inclusion of a battery is still attractive as it can be used in times of power outage as well as to store excess energy. The assumptions related to the battery are included below in Table 3. Lead-acid batteries are advantageous over other battery technologies because they are typically the cheapest option and are easily replaceable with over-the-shelf products.[vii,viii]

Table 3: Battery system characteristics using industry averages

Characteristic	Value
Type of Battery	Lead-acid
Lifetime[ix]	9 years
Roundtrip Efficiency[x]	82%

C.2 System Planning

After determining the necessary characteristics of each component of the system, they must be integrated to create an optimal and effective system for the businesses of Highland Park. Panels can be electrically wired depending on whether a desired voltage (series) or current (parallel) is more important. Other components of a photovoltaic system were not modeled individually as they will not influence energy generation but simply affect the total installation cost which is referenced in sections below. However, the design factors important to the entire solar panel system are included below in Table 4. Most of these assumptions were made based on information provided in the book *Renewable and Efficient Electric Power Systems*, except for the shading derate factor, which was obtained from NREL's solar calculator PVWatts.[xi]

Table 4:Assumptions for PV systems characteristics based on optimization for Highland Park

Assumption Variable	Value
Collector Tilt	40°
Axis Tracking	No, fixed tilt
Ground Cover Ratio	0.42
Shading Derate Factor	0.975
Azimuth Angle	180°

C.3 Solar Availability

The first step to calculating the amount of power a solar panel system can generate is to determine the solar availability inherent to the system's location based on latitude. Solar availability of a region refers to the amount of solar energy radiating from the surface of the sun to that area and includes beam and diffuse radiation. Beam radiation is the dominant source of solar radiation, and passes in a direct line from the sun to the panel. Diffuse radiation refers to the light that has been scattered by molecules and aerosols in the atmosphere. For this model, we used NREL's solar energy and cost calculator, PVWatts to estimate solar availibility .[xii] Based on Highland Park's latitude of 42.42°N, PVWatts reports hourly solar irradiation in W/m^2. PVWatts defaults to the closest TMY2 (typical meteorological year) weather data, which for Highland Park, is data collected from Detroit, MI. The data was collected between 1961 to 1990. Solar irradiation is also influenced by the tilt of the array (assuming fixed tilt) as well as the azimuth angle of the array (cardinal direction that it is facing). As stated in the previous section, we assumed that the array was fixed at a 40° tilt and faced directly south (azimuth angle of 180°).

Based on these assumptions and averaged TMY2 data, we compiled the solar availability in W/m^2 for Highland Park on an hourly basis for each day of the year and calculated the average monthly irradiation. Table 5 displays the specific average irradiance used in the calculator to determine potential power output (multiply the average irradiation by total panel area and total hours of sunlight per month).

Table 5: Irradiance and monthly output data for latitude 42.42 deg N, obtained from PVWatts.

Month	Average Irradiance (W/m²)
January	117
February	145
March	172
April	203
May	232
June	234
July	227
Ausgust	238
September	209
October	164
November	106
December	87

C.4 Estimated Building Load

To determine the significance of the solar array output, it is important to compare output to a site's estimated load. In the instance that the user does not know the building load, the user can input building characteristics such as building type/activity and dimensions, and the model will report an estimated building load. This estimation is based on electricity consumption data from the EIA, which is reported by principal building activity[xiv]. Table 6 below lists the rate of electricity used per square foot for a variety of building types. The model therefore reports what percentage of total monthly building load is satisfied through the solar panels. If the user does not input building dimensions, the average building size for that building type (as suggested by the EIA) is assumed.

Table 6: Building Type and rate of electricity per square foot

Building Type	Rate of Electricity Used (kWh/ft^2)
Religious	5.3
Office	15.9
Lodging	15.3
Food Service	45.1
Education	10.9

While there are more options studied from EIA, Highland Park and Soulardarity's potential partners are stemming mostly from these categories. To estimate the monthly building load, data was collected from EIA for monthly electricity consumption in the commercial sector.[xv] Using this data, a trend for monthly usage was calculated and used to model electricity demand given by the user or estimated through assumptions from EIA.

C.5 Energy Output by Area

After determining the solar availability in W/m^2, the next step in calculating total power output of the system was to consider the system size, for which ground cover ratio is required. Ground cover ratio (GCR) is defined as the ratio of collector area to total ground area covered by the panel. GCR takes into account the fact that the tilt angle of the panel decreases the surface area capable of receiving sunlight. Figure 1 can be used to estimate the ground cover ratio for various solar panel configurations based on shading derate factor. Assuming a shading derate factor of 0.975 and a fixed 40 deg tilt collector configuration, we determined that the GCR for the proposed system in Highland Park would be 0.42. We then calculated the collector area (which is the physical area of the panel capable of collecting solar energy) using the equation below from the ground area (model input) and assumed GCR.

$$Collector\ Area\ (ft^2) = GCR \times Ground\ Area\ (ft^2)$$

To determine the hourly solar availability in kWh, we multiplied the insolation value in W/m^2 by the collector area. The hourly array output for the system was then determined by multiplying the solar availability by the efficiency of the panel. As highlighted earlier, the user has three panel types to choose from, with efficiencies ranging from 14.8% to 20%. The higher the efficiency, the greater the power output from the array. We summed the hourly array output over the total days of each month to determine the monthly array output. In order to obtain the annual array output in DC, the temperature derate needed to be accounted for. The temperature derate factor accounts for the fact that solar panels have optimal operating temperatures, and an increase in the ambient temperature will cause the panel to generate less electricity.[xvi] The Community Solar Calculator accounts for this effect by determining a temperature derate factor for each month, based on the average temperature of each month, provided by U.S. Climate Data.[xvii] We used the following equations to calculate the temperature derate factor assuming a standard temperature of 25°C, an average normal operating condition temperature (NOCT) of 45.6°C, and an average temperature coefficient of -0.34%/°C.

$$Cell\ Temp\ (°C) = Avg.Monthly\ Temp\ (°C) + \frac{(NOCT - 20)°C}{0.8} * S$$

$$Temp.Derate = 1 + Avg.Temp\ Coeff.(\%/°C) \times [Cell\ Temp\ (°C) - 25°C]$$

To determine the adjusted monthly output we multiplied the monthly derate factor (which actually produced an increase in power generation for months September through May due to temperatures colder than the standard temperature (25°C)) by the respective monthly array output. These monthly adjusted output values could then be summed to determine the annual power output produced by the array in DC. Then using the ILR, the electricity produced in AC could be determined. The model will also report the required system size, reported in kW, which is useful for cost estimations.

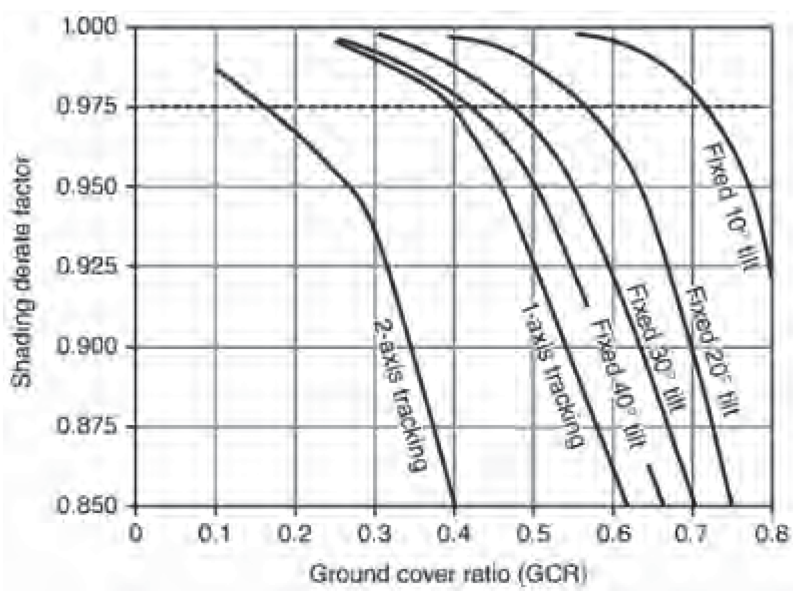

Figure 1: Shading derate factor versus GCR for a variety of solar panel configurations.

C.6 Area Output by Energy Demand

To determine the amount of additional system area required to meet a desired energy demand (input by user), the model simply followed the reverse process described above to calculate the energy produced from array area. Assumptions related to tilt angle, ground cover ratio, and efficiency were held constant between Energy Output by Area and Area Output by Energy Demand calculations. We determined the annual amount of additional energy required by subtracting the produced amount of energy (from the available ground area) from the desired energy. We then proportioned out this annual amount by month after dividing out the temperature derate factor, and then by hour within each month. To calculate the hourly required solar availability in kWh we divided the hourly required array output by the panel efficiency, and then collector area could be calculated by dividing the hourly required solar availability (in kWh) by the solar insolation data provided by PVWatts. In the output tab, the calculator reports the required additional ground area required, which was determined by dividing out the assumed GCR of 0.42 from the collector area.

C.7 Environmental Factors and Project Lifetime

The Community Solar Calculator assumes that there will be no losses from shading or soiling of the panels, but it does account for partial shading of the project by overlapping panel shadows when the sun is very low in the sky. It also calculates efficiency impacts of ambient temperature. Given Michigan's colder climate, panels are expected to work more efficiently than standard test conditions.

The calculator uses National Renewable Energy Lab (NREL) industry standards to estimate panel degradation over time and panel lifetime. A recent NREL survey of studies found a median 0.5% degradation rate among panels, which is used within the calculator.[xix] The NREL's Annual Technology Baseline specifies solar PV project economic lifetimes (the time over which the initial capital investment is paid off) at 20 years and its technical lifetime (the time over which the project is reliably functional) at 30 years.[xx]

C.8 Financial Considerations

The community PPA model represents a partnership between project hosts and project owners, where both expect to receive a financial benefit from the generation of electricity. To be feasible, the project must not only produce energy; it must also generate value for the project owner and project host.. A 'Cash Flow' tab within the calculator specifies annual costs and benifits for each entity over the lifetime of the project.

C.8.1 Time Value of Money and Net Present Value

Whenever capital is invested in a project, there are *opportunity costs*, or the other benefits that capital could've produced if it were used elsewhere. To determine whether a project would be a wise investment, investors often compare the estimated benefits of a proposed project against the benefits of a place-holder investment with average returns. For social projects, analysts might assume that a successful project would return 4% of the amount investment every year.[xxi] They could use this 4% figure against any proposed investment to evaluate whether the investment is wise or not. These placeholder project return rates are called discount rates.[xxii]

Comparing against an average yearly return is particularly helpful when costs and benefits are sustained at different time scales—for example, a project with a high up-front cost and long, drawn-out benefits. By comparing the benefits and costs of a project across its entire lifetime against the performance of a placeholder project with an average return rate, we can calculate a *net present value,* which clarifies with a quick glance whether a project would produce more or less value than a placeholder project.

The Community Solar Calculator compares the proposed community solar project against a 4% discount rate, which is between the 3% social discount rate and 7% market discount rate suggested by EPA.[xxiii] The sections of the 'Cash Flow' tab labelled 'Discounted' use the 4% discount rate, compounded annually. The totals at the bottom of the ledger represent net present value for both the project host and owner. Because discount rates tend to discount values further in the future greater than values in the near future, discounted projects will take longer to break even and show less total benefits.

C.8.2 Host

The calculator estimates the total annual electricity production over the project's lifetime, and estimates a typical utility retail electricity rate by starting with DTE-reported retail rates and applying a 2.5% annual inflationary factor. Using the annual estimated production and the retail price, the calculator estimates total avoided payment to the utility. Then, using a user-specified markdown rate, the project host pays the project owner for the electricity based on total electricity production. The difference between avoided payment to the utility and payment to the project owner represents the host's annual benefit from solar.

C.8.3 Owner

The project owner is assumed to be an entity formed by several investors, including Soulardarity's Special Purpose Intity and potentially its members. The project owner is responsible for paying the up-front and operations & maintenance (O&M) costs for the project, but they also receive payment from the project host over the lifetime of the project.

While solar production over time is easier to model, it is difficult to accurately predict the costs of equipment and installation because of the wide variance between regions and vendors and the influence of 'soft' costs like developer overhead and installation labor. To account for that uncertainty, the calculator offers multiple options for estimating solar costs. The first is bottom-up cost based on the NREL's 2017 first-quarter solar pricing benchmark.[xxiv] This benchmark includes individual estimates for cost of the solar panel system (modules, inverter, battery), installation, and operation and maintenance (O&M). Module options for the NREL model include 'economy,' 'midrange,' and 'premium' standards, which have different respective costs and energy conversion efficiencies. The 'soft' costs refer to expenses that incurred during the installation and life of a solar panel system that aren't directly associated with equipment. According to the NREL, depending on the size of the system, extra costs have a range of \$1.29/kW (for 500-1000 kW systems) to \$1.58/kW (for systems less than 100 kW in size).[xxv] Table 7 below summarizes the assumed costs for each of the components described above.

Table 7: Cost for solar panel system components

Variable	Cost
Module[xxvi]	0.32-0.44 (\$/W)
Inverter[xxvii]	0.1 (\$/W)
Battery (lifespan of 9 years)[xxviii]	147 (\$/kWh)
Operation and Maintenance[xxix]	15 (\$/kW)
Extra Costs (installation, EPC overhead, etc.)[xxx]	1.29-1.58 (\$/kW)

The second approach to estimating costs is a composite based on a number of sample quotes from the *EnergySage* solar marketplace for Highland Park's zipcode (48203). EnergySage offers a simulation of what actual installed cost quotes from local solar developers might be, based on previous quotes by actual solar developers. An initial Highland Park query got quotes at around $3.30 per installed Watt of capacity. Additional versions of the Community Solar Calculator could include additinal options for pricing, including user-input pricing.

The total installed cost for each of these components is determined by multiplying the price per capacity($/Watt) by the specified system size. The owner is responsible for all upfront payment related to purchasing the panel components discussed above as well as installation, which all occur in "year zero," indicating panel operation has not started. Total cost to the owner in "year zero" is therefore equal to the capital cost less the Federal Solar Investment Tax Credit (ITC), which here was assumed to be equal to 30% of the total upfront cost. In the first year of operation, O&M costs begin as well as payments from the host, and so total annual cash flow for the first year is payment from the host less the cost of O&M. This continues for every year after, except after every nine years of operation, it is assumed a new battery must be purchased, which reduces the net cash flow for those years. The 25 year cashflow is then discounted into today's dollars. The calculator shows in which year the owner will break even.

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[v] Ibid
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[xxviii] Battery Storage Technology Improvements and Cost Reductions to 2030: A Deep Dive . 2017, Battery Storage Technology Improvements and Cost Reductions to 2030: A Deep Dive .
[xxix] Fu, Ran, et al. U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017 . 2017, U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017 .
[xxx] Ibid

Appendix D

_____________ Community Solar LLC
Operating Agreement

This Operating Agreement (this "Agreement"), dated as of ______________, 2013, of ___________Community Solar LLC, a Maryland limited liability company (the "Company"), is made and entered into by and among the parties listed on Exhibit B attached to this Agreement.

RECITALS

A. The parties hereto have agreed to organize and operate a limited liability company in accordance with the terms of, and subject to the conditions set forth in, this Agreement in order to fund a solar electric generating system and to demonstrate that a community effort can make a contribution to reducing carbon emissions, increasing options for renewable energy sources, and capturing financial incentives for the benefit of all.

B. In accordance with subscription agreements between the parties hereto and the Company, the parties hereto have agreed to make certain investments in the Company pursuant and subject to the terms and conditions set forth therein.

C. The parties hereto desire to enter into this Agreement to regulate the affairs of the Company, the conduct of its business and the relations of the Members with respect thereto.

NOW, THEREFORE, in consideration of the foregoing recitals, the mutual agreements contained herein and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the parties hereto, intending legally to be bound, hereby agree as follows:

Article 1
Defined Terms

Capitalized terms used in this Agreement shall, unless the context otherwise requires, have the meanings set forth in Exhibit A attached hereto.

Article 2
Formation and Name; Office; Purpose; Term

2.1 Organization. The parties hereto have formed the Company as a limited liability company pursuant to the Act and, for that purpose, caused the Articles of Organization to be filed with SDAT.

2.2 Name of the Company. The name of the Company shall be "_________ Community Solar LLC." The Company may do business under that name and under any other name or names upon which the Members agree. If the Company does business under a name other than that set forth in its Articles of Organization, then the Company shall file a trade name certificate as required by Applicable Law.

2.3 Purpose. The Company is organized to organize, develop, install, construct, own, operate, manage and sell community based solar projects and to do any and all things necessary, convenient, or incidental to that purpose.

2.4 Powers. Subject to all of the terms, agreements, conditions and limitations contained in this Agreement, the Company shall have all of the powers provided for in the Act, including all power and authority to enter into and perform contracts of any kind, and borrow money and issue evidences of indebtedness, whether or not secured by a mortgage, deed of trust, pledge or other lien.

2.5 Principal Office. The principal office of the Company in the State of Maryland shall be located at ________________, ________, Maryland __________, or at any other place within the State of Maryland as the Members may from time to time designate in accordance with the Act. The Company may also maintain offices and places of business at such other place or places within or outside the State of Maryland as the Members deem advisable.

2.6 Resident Agent. The name and address of the Company's resident agent in the State of Maryland shall be _________________, ________________, _________________, Maryland ________. The Members may from time to time change the Company's registered agent in accordance with the Act.

2.7 Members. The name, present mailing address, taxpayer identification number, Capital Contribution and Percentage Interest of each Member are set forth in Exhibit B. The Management Committee shall update Exhibit B from time to time as necessary to reflect changes to the information therein. An amendment or revision to Exhibit B made in accordance with this Agreement shall not be deemed an amendment to this Agreement. Any reference in this Agreement to Exhibit B shall be deemed a reference to Exhibit B as amended and in effect from time to time

Article 3
Capital; Capital Accounts

3.1 Initial Capital Contributions. The Members shall each make a Capital Contribution to the Company of cash in the amount of at least _________ Dollars ($______.00).

3.2 No Other Capital Contributions Required. No Member shall be required to contribute any additional capital to the Company, and except as set forth in the Act, no Member shall have any personal liability for any obligations of the Company.

3.3 No Interest on Capital Contributions. Interest Holders shall not be paid interest on their Capital Contributions.

3.4 Return of Capital Contributions. Except as otherwise provided in this Agreement, no Interest Holder shall have the right to receive the return of any Capital Contribution.

3.5 Form of Return of Capital. If an Interest Holder is entitled to receive a return of a Capital Contribution, the Company may distribute cash, notes, property, or a combination thereof to the Interest Holder in return of the Capital Contribution.

3.6 Capital Accounts. A separate Capital Account shall be maintained for each Interest Holder.

3.7 Loans. Any Member may, at any time, make or cause a loan to be made to the Company in any amount and on those terms upon which the Company and the Member agree.

3.8 Avoidance of Publicly-Traded Partnership Status.

3.8.1 To permit the Company to qualify for the benefit of a "safe harbor" under Code Section 7704, notwithstanding anything to the contrary in this Agreement, no Transfer of all or any portion of a Member's Interest shall be permitted or recognized by the Company (within the meaning of Regulation Section 1.7704-1(d)), and the Company shall not issue any Interest if and to the extent that the Transfer or issuance would cause the Company to have more than one hundred (100) partners (within the meaning of Regulation Section 1.7704-1(h), including the look-through rule in Regulation Section 1.7704-1(h)(3)).

3.8.2 Notwithstanding anything to the contrary in this Agreement, no Interest may be Transferred, and the Company may not issue any Interest, unless (i) the Transfer or issuance, as the case may be, shall not affect the Company's existence or qualification as a limited liability company under the Act, (ii) the Transfer or issuance, as the case may be, shall not cause the Company to be classified as other than a partnership for United States federal income tax purposes, (iii) the Transfer or issuance, as the case may be, shall not result in a termination of the Company under Code Section 708, unless the Members determine that a termination will not have a material adverse impact on the Members and (iv) the Transfer or issuance, as the case may be, shall not cause the application of the tax-exempt use property rules of Code Sections 168(g)(1)(B) and 168(h) to the Company or the Members.

Article 4
Distributions

4.1 Distributions of Cash Flow. Cash Flow for each taxable year of the Company shall be distributed to the Interest Holders in proportion to their Percentage Interests no later than seventy-five (75) days after the end of the taxable year. All distributions shall be made to the Persons shown on the records of the Company to have been Interest Holders as of the last day of the taxable year for which the distribution is to be made.

4.2 Timing of Distributions. Subject to Section 4.1, the timing and amount of all distributions shall be determined by the Management Committee.

4.3 Amounts Withheld. All amounts withheld by the Company pursuant to the Code or any provision of Applicable Law with respect to any payment, distribution or allocation to any Interest Holder shall be remitted to the appropriate Governmental Authority, treated as amounts distributed to that Interest Holder pursuant to this Article 4 for all purposes under this Agreement and shall accordingly reduce by a corresponding amount distributions the Interest Holder would otherwise receive pursuant to this Article 4 or Article 8. Each Interest Holder agrees to furnish the Company with such certifications and forms as shall reasonably be requested by the Company to assist it in determining the extent of, and in fulfilling its withholding obligations.

4.4 Distributions in Kind. If any assets of the Company are distributed in kind to the Interest Holders, those assets shall be valued on the basis of their fair market value, and any Interest Holder entitled to any interest in those assets shall receive that interest as a tenant-in-common with all other Interest Holders so entitled. Unless the Members otherwise agree, the fair market value of the assets shall be determined by an independent appraiser who shall be selected by the Members.

4.5 Distributions upon Liquidation. Distributions made in conjunction with the final liquidation of the Company shall be applied or distributed as provided in Article 8.

Article 5
Allocations of Profits and Losses

5.1 Book Allocations. Unless otherwise provided in this Agreement, an allocation to a Member of a share of Profits or Losses and receipts from grants shall be treated as an allocation of the same share of each item of income, gain, grant, loss or deduction that is taken into account in computing Profits or Losses. After giving effect to the special allocations set forth in Section 5.2 and Section 5.3 and subject to Section 5.4 and Section 5.5, Profits, Losses and receipts from grants for any Allocation Year shall be allocated as follows:

(a) All items of Loss shall be allocated as follows:

(1) First, to the Members in the same manner and proportions as Profits and receipts from grants were previously allocated under Section 5.1(b)(2) to the extent of the aggregate Profits allocated pursuant to Section 5.1(b)(2) for all periods over the aggregate Losses allocated pursuant to this Section 5.1(a)(1) for all prior periods; and

(2) Second, to the Members in proportion to their Percentage Interests.

(b) All items of Profit and receipts from grants shall be allocated as follows:

(1) First, to the Members in the same manner and proportions as Losses were previously allocated under Section 5.1(a)(2) to the extent of the aggregate Losses allocated pursuant to Section 5.1(a)(2) for all periods over the aggregate Profits and receipts from grants allocated pursuant to this Section 5.1(b)(1) for all prior periods; and

(2) Second, to the Members in proportion to their Percentage Interests.

5.2 Special Allocations. The following special allocations shall be made in the following order:

(a) Company Minimum Gain Chargeback. Except as otherwise provided in Regulations Section 1.704-2(f), notwithstanding any other provision of this Article 5, if there is a net decrease in Company Minimum Gain during any Allocation Year, each Member shall be allocated items of Company income and gain for such Allocation Year (and, if necessary, subsequent Allocation Years) in an amount equal to such Member's share of the net decrease in Company Minimum Gain, determined in accordance with Regulations Section 1.704-2(g). Allocations pursuant to the previous sentence shall be made in proportion to the respective amounts required to be allocated to each Member pursuant thereto. The items to be so allocated shall be determined in accordance with Regulations Sections 1.704-2(f)(6) and 1.704-2(j)(2). This Section 5.2(a) is intended to comply with the minimum gain chargeback requirement in Regulations Section 1.704-2(f) and shall be interpreted consistently therewith.

(b) Member Minimum Gain Chargeback. Except as otherwise provided in Regulations Section 1.704-2(i)(4), notwithstanding any other provision of this Article 5, if there is a net decrease in Member Nonrecourse Debt Minimum Gain attributable to a Member Nonrecourse Debt during any Allocation Year, each Member who has a share of the Member Nonrecourse Debt Minimum Gain attributable to such Member Nonrecourse Debt, determined in accordance with Regulations Section 1.704-2(i)(5), shall be allocated items of Company income and gain for such Allocation Year (and, if necessary, subsequent Allocation Years) in an amount equal to such Member's share of the net decrease in Member Nonrecourse Debt Minimum Gain, determined in accordance with Regulations Section 1.704-2(i)(4). Allocations pursuant to the previous sentence shall be made in proportion to the respective amounts required to be allocated to each Member pursuant thereto. The items to be so allocated shall be determined in accordance with Regulations Sections 1.704-2(i)(4) and 1.704-2(j)(2). This Section 5.2(b) is intended to comply with the minimum gain chargeback requirement in Regulations Section 1.704-2(i)(4) and shall be interpreted consistently therewith.

(c) Qualified Income Offset. In the event any Member unexpectedly receives any adjustments, allocations, or distributions described in Regulations Section 1.704-1(b)(2)(ii)(d)(4), Section 1.704-1(b)(2)(ii)(d)(5), or Section 1.704-1(b)(2)(ii)(d)(6), items of Company income and gain shall be allocated to such Member in an amount and manner sufficient to eliminate, to the extent required by the Regulations, the Adjusted Capital Account Deficit of the Member as quickly as possible, provided that an allocation pursuant to this Section 5.2(c) shall be made only if and to the extent that the Member would have an Adjusted Capital Account Deficit after all other allocations provided for in this Article 5 have been tentatively made as if this Section 5.2(c) were not in the Agreement.

(d) Gross Income Allocation. In the event any Member has a deficit Capital Account at the end of any Allocation Year that is in excess of the sum of the amount such Member is expressly obligated to restore pursuant to this Agreement and the amount such Member is deemed to be obligated to restore pursuant to Regulations Section 1.704-1(b)(2)(ii)(c) or either of the penultimate sentences of Regulations Sections 1.704-2(g)(1) and 1.704-2(i)(5), such Member shall be allocated items of Company income and gain in the amount of such excess as quickly as possible, provided that an allocation pursuant to this Section 5.2(d) shall be made only if and to the extent that such Member would have a deficit Capital Account in excess of such sum after all other allocations provided for in this Article 5 have been made as if Section 5.2(c) and this Section 5.2(d) were not in the Agreement.

(e) Nonrecourse Deductions. Nonrecourse Deductions for any Allocation Year shall be allocated to the Members in proportion to their respective Percentage Interests.

(f) Member Nonrecourse Deductions. Any Member Nonrecourse Deductions for any Allocation Year shall be allocated to the Member who bears the economic risk of loss with respect to the Member Nonrecourse Debt to which such Member Nonrecourse Deductions are attributable in accordance with Regulations Section 1.704-2(i)(1).

(g) Section 754 Adjustments. To the extent an adjustment to the adjusted tax basis of any Company asset, pursuant to Code Section 734(b) or Section 743(b) is required, pursuant to Regulations Section 1.704-1(b)(2)(iv)(m)(2) or Section 1.704-1(b)(2)(iv)(m)(4), to be taken into account in determining Capital Accounts as the result of a distribution to a Member in complete liquidation of such Member's interest in the Company, the amount of such adjustment to Capital Accounts shall be treated as an item of gain (if the adjustment increases the basis of the asset) or loss (if the adjustment decreases such basis) and such gain or loss shall be allocated to the Members in accordance with their interests in the Company in the event Regulations Section 1.704-1(b)(2)(iv)(m)(2) applies, or to the Member to whom such distribution was made in the event Regulations Section 1.704-1(b)(2)(iv)(m)(4) applies.

5.3 Curative Allocations. The allocations set forth in Sections 5.2 and 5.4 (the "Regulatory Allocations") are intended to comply with certain requirements of the Regulations. It is the intent of the Members that, to the extent possible, all Regulatory Allocations shall be offset either with other Regulatory Allocations or with special allocations of other items of Company income, gain, loss, or deduction. Therefore, notwithstanding any other provision of this Article 5 (other than the Regulatory Allocations), the Management Committee shall make (or cause to be made) such offsetting special allocations of Company income, gain, loss, or deduction in a manner so that, after such offsetting allocations are made, each Member's Capital Account balance is, to the extent possible, equal to the Capital Account balance such Member would have had if the Regulatory Allocations were not part of the Agreement and all Company items were allocated pursuant to Section 5.1.

5.4 Loss Limitation. Losses allocated pursuant to Section 5.1 shall not exceed the maximum amount of Losses that can be allocated without causing any Member to have an Adjusted Capital Account Deficit at the end of any Allocation Year. In the event some but not all of the Members would have Adjusted Capital Account Deficits as a consequence of an allocation of Losses pursuant to Section 5.1, the limitation set forth in this Section 5.4 shall be applied on a Member by Member basis and Losses not allocable to any Member as a result of such limitation shall be allocated to the other Members in accordance with the positive balances in such Members' Capital Accounts so as to allocate the maximum permissible Losses to each Member under Regulations Section 1.704-1(b)(2)(ii)(d).

5.5 Other Allocation Rules.

5.5.1 For purposes of determining the Profits, Losses, or any other items allocable to any period, Profits, Losses, and any such other items shall be determined on a daily, monthly, or other basis, as determined by the Management Committee using any permissible method under Code Section 706 and the Regulations thereunder.

5.5.2 The Members are aware of the income tax consequences of the allocations made by this Article 5 and Article 8.

5.5.3 Solely for purposes of determining a Member's proportionate share of the "excess nonrecourse liabilities" of the Company within the meaning of Regulations Section 1.752-3(a)(3), the Members' interests in Company profits are in proportion to their Percentage Interests.

5.6 Tax Allocations; Code Section 704(c).

5.6.1 Except as otherwise provided in this Section 5.6, each item of income, gain, loss and deduction of the Company for federal, state, local and foreign tax purposes shall be allocated among the Members in the same manner as such items are allocated for book purposes under this Article 5 and Article 8. Any tax credits of the Company shall be allocated to the Members in proportion to their Percentage Interests.

5.6.2 In accordance with Code Section 704(c) and the Regulations thereunder, income, gain, loss, and deduction with respect to any property contributed to the capital of the Company shall, solely for tax purposes, be allocated among the Members so as to take account of any variation between the adjusted basis of such property to the Company for federal income tax purposes and its initial Gross Asset Value (computed in accordance with the definition of Gross Asset Value) using the method described under Treasury Regulation Section 1.704-3(b).

5.6.3 In the event the Gross Asset Value of any Company asset is adjusted pursuant to subparagraph (ii) of the definition of Gross Asset Value, subsequent allocations of income, gain, loss, and deduction with respect to such asset shall take account of any variation between the adjusted basis of such asset for federal income tax purposes and its Gross Asset Value in the same manner as under Code Section 704(c) and the Regulations thereunder using the allocation method described under Treasury Regulation Section 1.704-3(b).

5.6.4 Except as otherwise provided in Section 5.6.2 and 5.6.3 above, any elections or other decisions relating to the allocations described in this Section 5.6 shall be made by the Tax Matters Partner in any manner that reasonably reflects the purpose and intention of this Agreement. Allocations pursuant to this Section 5.6 are solely for purposes of federal, state, local, and foreign taxes and shall not affect, or in any way be taken into account in computing, any Member's Capital Account or share of Profits, Losses, other items, or distributions pursuant to any provision of this Agreement.

5.6.5 To the extent the Code and the Regulations or other Applicable Law require allocations for tax purposes that differ from the foregoing allocations, the Tax Matters Partner, in its reasonable discretion, may determine the manner in which such tax allocations shall be made so as to comply more fully with the Code and such Regulations or other Applicable Law and, at the same time, preserve the economic relationships among the Members as otherwise set forth in this Agreement.

5.7 Tax Status; Tax Elections; Tax Matters Partner.

5.7.1 No election shall be made by the Company or any Member to have the Company excluded from the application of Subchapter K, Chapter 1 of Subtitle A of the Code or from any similar provisions of any other Applicable Law.

5.7.2 At the first meeting of the Members, the Members shall appoint one of the Members to be "Tax Matters Partner" of the Company under the Code and in any similar capacity under Applicable Law. If such Person ceases to be a Member, the Members shall promptly appoint a new Tax Matters Partner. The Tax Matters Partner shall cause the Company's accountants to prepare all federal, state and local tax returns of the Company for each year for which such returns are required to be filed and shall cause such returns to be timely filed. To the extent not otherwise provided in this Agreement, the Tax Matters Partner shall have the authority to make all tax elections and other tax decisions on behalf of the Company; provided that the Tax Matters Partner shall follow the instruction of each Member with respect to the tax treatment of such Member's distributive share of any cancellation of indebtedness income in case the Company makes an election under Code Section 108(i), in accordance with Revenue Procedure 2009-37 and any similar guidance issued by the Internal Revenue Service. The Tax Matters Partner shall have the right to extend the statute of limitations for assessment of tax deficiencies against the Members with respect to adjustments to the Company's federal, state, local, or foreign tax returns; and (ii) to the extent provided in Code Sections 6221 through 6234 and similar provisions of other Applicable Law, represent the Company and the Members before taxing authorities or courts of competent jurisdiction in tax matters affecting the Company or the Members in their capacities as members, and file any tax returns and execute any agreements or other documents relating to or affecting such tax matters, including agreements or other documents that bind the Members with respect to such tax matters or otherwise affect the rights of the Company and the Members and shall provide timely notice of any such action to the Members. The Tax Matters Partner is further authorized and required to represent the Company in connection with all examinations of the Company's affairs by tax authorities, including resulting administrative and judicial proceedings, and to expend Company funds for professional services and costs associated therewith. The Members agree to cooperate with the Tax Matters Partner and to do or refrain from doing any or all things reasonably required by the Tax Matters Partner to conduct such proceedings. Any reasonable direct out-of-pocket expense incurred by the Tax Matters Partner in carrying out its obligations hereunder shall be allocated to and charged to the Company as an expense of the Company for which the Tax Matters Partner shall be reimbursed.

5.7.3 Each Member agrees that if it (i) treats, on its tax returns, any item of income, gain, loss, deduction, credit or expense relating to its Membership Interest in the Company in a manner inconsistent with the treatment of such item by the Company as reflected on the Company's Internal Revenue Service Form 1065, the Internal Revenue Service Form 1065 (Schedule K-1) issued to such Member, or other information statement furnished by the Company to such Member for use in preparing such Member's tax returns or (ii) files any claim for refund relating to any such item based on, or that would result in, such inconsistent treatment, it shall notify the Tax Matters Partner of such action within ninety (90) days after the filing of such relevant returns or refunds.

5.7.4 If so requested by any Member in a written notice to the Company (which notice may be delivered at any time prior to the filing of the U.S. federal income tax return for the last taxable year in which such Member is a Member of the Company), the Tax Matters Partner shall cause the Company to make an election under Section 754 of the Code.

5.7.5 The provisions of this Section 5.7 regarding tax matters shall survive the termination of this Agreement and the Transfer or termination of any Member's Interest in the Company.

Article 6
Management: Rights, Powers, and Duties

6.1 Management.

6.1.1 The Company shall be managed by the Members as group, who shall have the full, and complete discretion, power, and authority, subject to the other provisions of this Agreement and the requirements of Applicable Law, to manage, control, administer, and operate the business and affairs of the Company for the purposes herein stated and to make all decisions concerning its business and affairs.

6.1.2 The provisions contained in this Section 6.1 supersede any authority granted to individual Members pursuant to Section 4A-401 of the Act. Any Member who takes any action or binds the Company without authorization by the Members or the Management Committee, as applicable, shall be solely responsible for any loss or expense incurred as a result of the unauthorized action and shall indemnify and hold the Company harmless with respect to the loss or expense.

6.2 Meetings of and Voting by Members

6.2.1 Annual meetings of the Members shall be held on such date, at such time and at such place as may be designated by the Management Committee, except that the first annual meeting of the Members shall be held at ______ p.m. on _______, _____, at the Company's principal office. At each annual meeting, the Members shall elect a Management Committee and may transact such other proper business as may come before the meeting.

6.2.2 Special meetings of the Members may be called at any time in the interval between annual meetings, by any Member. Special meetings of the Members shall be held at the Company's principal office or at any other reasonable place in ________, Maryland, designated by the Member calling the meeting. Not less than ten (10) nor more than ninety (90) days before each meeting, the Member calling the meeting shall give written notice of the meeting to each Member. The notice shall state the time, place, and purpose of the meeting. Notwithstanding the foregoing provisions, each Member waives notice if before or after the meeting the Member signs a waiver of the notice which is filed with the records of Members' meetings, or is present at the meeting in person or by proxy unless such attendance is solely for the express purpose of objecting, at the beginning of such meeting, to the transaction of any business because the meeting is not lawfully called or convened.

6.2.3 At a meeting of Members, the presence in person or by proxy of Members holding not less than one third of the total number of Members constitutes a quorum. A Member may vote either in person or by written proxy signed by the Member or by the Member's duly authorized attorney in fact. Membership Rights in multiple names have one vote and only one vote and any one or more of the owners of such Membership Rights shall be deemed one person for the purposes of a quorum.

6.2.4 The affirmative vote of a majority of Members in attendance in person or by proxy shall be required to approve any matter coming before the Members at any meeting.

6.2.5 In lieu of holding a meeting, the Members may vote or otherwise take action by a written instrument indicating the consent of a simple majority of the Members.

6.2.6 If any vote is required on any matter under this Agreement, and there are neither sufficient votes to approve nor disapprove of the matter, then a Member may require that the matter be submitted to arbitration by three arbitrators in Baltimore County, Maryland, in accordance with the rules of the American Arbitration Association.

6.3 Personal Services. No Member shall be required to perform services for the Company solely by virtue of being a Member. Unless approved by the Members, no Member shall be entitled to compensation for services performed for the Company. However, upon substantiation of the amount and purpose thereof, the Members shall be entitled to reimbursement for expenses reasonably incurred in connection with the activities of the Company.

6.4 Duties of Members.

6.4.1 A Member shall not be liable, responsible, or accountable in damages or otherwise to the Company or to any other Member for any action taken or any failure conferred on the Member by this Agreement or by Applicable Law, unless the action taken or omission was made fraudulently or in bad faith or unless the action or omission constituted gross negligence.

6.4.2 Except as otherwise expressly provided in Section 6.4.3, nothing in this Agreement shall be deemed to restrict in any way the rights of any Member to conduct any other business or activity whatsoever, and no Member shall be accountable to the Company or to any other Member with respect to that business or activity even if the business or activity competes with the Company's business. The organization of the Company shall be without prejudice to the Members' respective rights (or the rights of their respective Affiliates) to maintain, expand, or diversify such other interests and activities and to receive and enjoy profits or compensation therefrom. Each Member waives any rights the Member might otherwise have to share or participate in such other interests or activities of any other Member or the Member's Affiliates.

6.4.3 Each Member understands and acknowledges that the conduct of the Company's business may involve business dealings and undertakings with Members and their Affiliates. In any of those cases, those dealings and undertakings shall be at arm's length and on commercially reasonable terms.

6.5 Management Committee.

6.5.1 Delegation to Management Committee. Day-to-day operation of the business of the Company shall be delegated to a management committee made up of Members elected as Representatives by the Members in accordance with Section 6.5.2 (the "Management Committee"); provided, that the Management Committee shall carry out such day-to-day operations in a manner consistent with (a) any and all other Member-approved budgets, and (b) otherwise in accordance with the terms of this Agreement; and provided, further, that the Members shall oversee and manage the performance by the Management Committee and shall ultimately direct any powers which are to be exercised by the Management Committee; and provided, also, that if no Management Committee shall have been elected by the Members, then the Members shall manage the operations and business of the Company.

6.5.2 Number. The Management Committee shall consist of seven (7) of the Members (each, a "Representative"). At the first meeting of the Members and at each annual meeting thereafter, the Members shall elect Representatives to hold office until the next annual meeting or until their successors are elected and qualify, or until they sooner die, resign or are removed. At each annual meeting of Members, at which a quorum is present, the persons receiving a plurality of the votes cast shall be the Representatives.

6.5.3 Resignation; Removal; Vacancies. A Representative may resign as such by delivering written notice to that effect to the Members at least thirty (30) days prior to the effective date of such resignation. A Representative may be removed at any time and for any reason by the Members. In the event a vacancy on the Management Committee occurs as a result of the death, disability, resignation, removal or otherwise of a Representative, a meeting of the Members shall be held to elect a replacement and the person receiving a plurality of the votes cast at such meeting shall be the replacement Representative.

6.5.4 Chair. The chairperson of the Management Committee will be one of the appointed Representatives and will serve for a term of one (1) year and until his or her successor is appointed or until his or her earlier death, incapacity, resignation or removal. The chair shall be elected by the Management Committee, shall preside at all meetings of the Management Committee and shall have the same voting rights as any other Representative.

6.5.5 Quorum and Manner of Acting. Unless otherwise provided by Applicable Law, the presence of a majority of the Representatives then in office shall constitute a quorum for the transaction of business and the vote of a majority of the Representatives present at any meeting at which a quorum is present shall be the act of the Management Committee, except as may be otherwise specifically provided by Applicable Law or by the Articles of Organization. The Management Committee may hold meetings, both regular and special, at such place or places within or outside __________, Maryland as the Management Committee may from time to time determine.

6.5.6 Action by Written Consent. Any action may be taken without a meeting and without a vote if a consent in writing, setting forth the action so taken, shall be signed by all of the Representatives. Any action taken by the written consent of the Representatives shall have the same force and effect as if taken by the Representatives at a meeting.

6.5.7 Telephonic Meetings. Representatives may participate in any meeting of the Management Committee by means of a conference telephone or similar communication equipment by which all Representatives participating in the meeting can hear and speak to each other at the same time. Such participation shall constitute presence in person at the meeting.

6.5.8 Proxy. Any Representative may execute a written proxy in favor of any other Representative permitting such other Representative to vote at the Management Committee on behalf of such first Representative. In the event that a Representative is represented by proxy at any meeting of the Management Committee, such Representative shall be deemed to be present and voting in person for purposes of this Agreement.

6.5.9 Compensation of Representatives. Representatives shall not be entitled to compensation or remuneration. However, upon substantiation of the amount and purpose thereof, Representatives shall be entitled to reimbursement for expenses reasonably incurred in connection with the activities of the Company. The Representatives shall not be employees of the Company or entitled to receive any other compensation from the Company.

6.6 Matters Requiring Members Approval. Without limiting the generality of Section 6.5.1, decisions in connection with all of the following matters shall be determined by the Members pursuant to Section 6.2:

(a) amending, modifying or restating the Articles of Organization or this Agreement;

(b) selling, exchanging, leasing or otherwise transferring any assets of the Company except as set forth in a budget approved by the Members;

(c) admission of any new Member to the Company;

(d) entering into transactions with any Member or such Member's Affiliate;

(e) participating in any mergers, consolidations, or other similar business combination;

(f) dissolving or winding up the Company;

(g) filing a voluntary bankruptcy petition on behalf of the Company;

(h) approving budgets;

(i) expenditures by the Company in excess of the amounts set forth in a budget approved by the Members;

(j) incurring indebtedness on behalf of the Company, including Member loans pursuant to Section 3.7 and financings, refinancings or creating Liens on any Company Assets;

(k) entering into or terminating agreements with legal, tax, financial advisors, auditors, and insurance agents;

(l) investing or lending any funds, other than liquid short-term (not more than 180 days) investments of working capital or reserves using such financial institutions and instruments as have been approved by the Members and in amounts not to exceed $25,000;

(m) electing and removing Representatives;

(n) commencing or settling any litigation, arbitration or similar proceeding;

(o) establishing, increasing or decreasing any reserves;

(p) hiring or terminating any employee of the Company;

(q) entering into, amending or terminating Contracts;

(r) entering into a new business or market, changing the scope or nature of the existing business or the creation of any subsidiaries;

(s) agreeing to any confession of judgment against the Company;

(t) accepting or rejecting an Offer;

(u) any other matter that this Agreement provides is subject to the approval of the Members.

6.7 Liability and Indemnification.

6.7.1 Limitation on Liability. No Member or Representative shall be liable, responsible, or accountable, in damages or otherwise, to any other Member or to the Company for any act performed by the Member or Representative with respect to Company matters, except for fraud, gross negligence, or an intentional breach of this Agreement.

6.7.2 Indemnification. The Company shall indemnify, defend and hold harmless the Members and the Representatives and the heirs, executors, successors and assigns of each thereof (collectively, the "Indemnified Parties") to the full extent permitted by Applicable Law from and against any and all losses, claims, demands, costs, damages, liabilities, joint and several, reasonable expenses of any nature (including reasonable attorneys' fees and disbursements), judgments, fines, settlements and other amounts arising from any and all claims, demands, actions, suits or proceedings, civil, criminal, administrative or investigative, in which such Indemnified Party may be involved, or threatened to be involved, as a party or otherwise, relating to acts or omissions of such Indemnified Party except for fraud, gross negligence, or an intentional breach of this Agreement.

6.7.2.1 The indemnification obligations contained in Section 6.7.2 will survive any dissolution of the Company until its affairs have been fully wound up and all of its properties and assets distributed in accordance with this Agreement.

6.7.2.2 If the Company is obligated hereunder to indemnify any Indemnified Party from any claim, suit, action or proceeding brought by any third party (a "Third Party Claim"), the Indemnified Party shall give notice as promptly as is reasonably practicable to the Indemnified Party of such Third Party Claim; provided that the failure of the Indemnified Party to give notice shall not relieve the Company of its obligations under this Section 6.7.2, except to the extent (if any) that the Company shall have been materially prejudiced thereby. The Company will have the right to control the defense and settlement of such Third Party Claim with counsel reasonably acceptable to the Indemnified Party, provided that (i) such Indemnified Party may retain counsel at its expense to assist in the defense and settlement of such Third Party Claim, and (ii) no settlement of any Third Party Claim will contain terms or provisions requiring the Indemnified Party to take any action or perform any undertaking, or prohibit or restrain the Indemnified Party from taking any action, without the written consent of the Indemnified Party.

6.7.2.3 Without the prior written consent of the Company, the Indemnified Party shall not accept any settlement or compromise of any claim, suit, action or proceeding of the nature referred to in 6.7.2.2 above.

6.7.2.4 Expenses incurred by an Indemnified Party in defending any claim, demand, action, suit or proceeding subject to this Section 6.7.2 shall be advanced by the Company prior to the final disposition of such claim, demand, action, suit, or proceeding upon receipt by the Company of a written commitment by or on behalf of such Indemnified Party to repay such amount if it shall be determined that such Indemnified Party is not entitled to be indemnified as authorized in this Section 6.7.2.

6.7.2.5 Notwithstanding the foregoing provisions, this Section 6.7.2 shall be enforced only to the maximum extent permitted by Applicable Law and no Indemnified Party shall be indemnified from any liability for fraud, gross negligence, or an intentional breach of this Agreement.

6.7.2.6 The provisions of this Section 6.7.2 are for the benefit of the Indemnified Parties only and shall not be deemed to create any rights for the benefit of any other Person.

6.7.2.7 In no event may an Indemnified Party subject the Members to personal liability by reason of the indemnification provisions of this Agreement.

Article 7
Transfer of Interests and Withdrawals of Members

7.1 Transfers.

7.1.1 No Person may Transfer all or any portion of or any interest or rights in such Person's Membership Rights or Interest unless all of the following conditions ("Conditions of Transfer") are satisfied:

(a) the Transfer will not require registration of Interests or Membership Rights under any federal or state securities laws;

(b) the Transfer will not result in the termination of the Company pursuant to Code Section 708;

(c) the Transfer will not result in the Company being subject to the Investment Company Act of 1940, as amended or any additional federal or State securities laws or regulations;

(d) the transferor or the transferee delivers the following information to the Company: (i) the transferee's taxpayer identification number, and (ii) the transferee's initial tax basis in the Transferred Interest;

(e) the Transfer is permitted in accordance with Section 3.8;

(f) the transferor complies with the provisions set forth in Section 7.1.3; and

(g) the transferee delivers to the Company a written agreement to be bound by the terms of this Article 7.

7.1.2 Each Member hereby acknowledges the reasonableness of the prohibition contained in this Section 7.1 in view of the purposes of the Company and the relationship of the Members. The Transfer of any Membership Rights or Interests in violation of the restrictions contained in this Section 7.1 shall be deemed invalid, null and void, and of no force or effect. Any Person to whom Membership Rights are attempted to be transferred in violation of this Section shall not be entitled to vote on matters coming before the Members, be elected as a Representative or otherwise participate in the management of the Company, act as an agent of the Company, receive distributions from the Company, or have any other rights in or with respect to the Membership Rights.

7.1.3 <u>Right of First Refusal</u>.

7.1.3.1 If a Member (individually, a "<u>Transferor</u>") receives a bona fide written offer that the Member desires to accept (the "<u>Transferee Offer</u>") from any other Person (a "<u>Transferee</u>") to purchase all or any portion of or any interest or rights in the Transferor's Membership Rights (the "<u>Transferor Interest</u>"), then, prior to any Transfer of the Transferor Interest, the Transferor shall give the Company written notice (the "<u>Transfer Notice</u>") containing each of the following:

(a) the Transferee's identify;

(b) a true and complete copy of the Transferee Offer; and

(c) the Transferor's offer (the "<u>Offer</u>") to sell the Transferor Interest to the Company for a price equal to that contained in the Transferee Offer (or the US dollar equivalent if such price is not in US dollars) (the "Transfer Purchase Price") and on the terms and conditions set forth in the Transferee Offer.

7.1.3.2 The Offer shall be and remain irrevocable for a period (the "Offer Period") ending at 11:59 P.M., local time at the Company's principal office, on the sixtieth (60th) day following the date the Transfer Notice is given to the Company. At any time during the Offer Period, the Company may accept the Offer by giving written notice to the Transferor of its acceptance (the "Offeree Notice"). The Transferor shall not be deemed a Member for the purpose of the vote on whether the Company shall accept the Offer. If the Company accepts the Offer, the Offeree Notice shall fix a closing date (the "Transfer Closing Date") for the purchase, which shall not be earlier than thirty (30) or more than ninety (90) days after the expiration of the Offer Period.

7.1.3.3 If the Company accepts the Offer, the Transfer Purchase Price shall be paid in immediately available funds on the Transfer Closing Date unless the Company elects prior to or on the Transfer Closing Date to pay the Transfer Purchase Price on an installment basis, in which event the Company shall evidence the obligation to pay the Transfer Purchase Price by executing and delivering a promissory note to the Transferor. The terms of such promissory note shall be for no more than five (5) equal installments to be paid annually, with simple interest computed at the Prime Rate as of the date the promissory note is signed.

7.1.3.4 If the Company rejects the Offer or fails to accept the Offer within the time and in the manner specified in Section 7.1.3.2, then the Transferor shall be entitled, for a period of thirty (30) days after the expiration of the Offer Period (the "Free Transfer Period"), to Transfer the Transferor Interest to the Transferee, for the same or greater price and on the same terms and conditions as set forth in the Transfer Notice. The Transfer shall be subject to the Conditions of Transfer (other than 7.1.1(f)).

7.1.3.5 Any Transfer by the Transferor after the last day of the Free Transfer Period or without strict compliance with the terms, provisions, and conditions of this Section and the other terms, provisions, and conditions of this Agreement shall be null and void and of no force or effect.

7.1.4 Admission of Transferee as Member. If the Conditions of Transfer are satisfied, then the transferee shall be admitted as a Member and shall be entitled to exercise the rights of a Member after the consent of a majority of Members, other than the Member whose Interest is being transferred.

7.2 Voluntary Withdrawal. No Member shall have the right or power to Voluntarily Withdraw from the Company.

7.3 Involuntary Withdrawal. Immediately upon the occurrence of an Involuntary Withdrawal, the successor of the withdrawn Member shall thereupon become an Interest Holder but shall not become a Member. The successor Interest Holder shall have all and only the rights of an Interest Holder. The withdrawn Member shall not be entitled to receive the fair value of the withdrawn Member's Membership Rights as of the date of Involuntary Withdrawal under Section 4A-606.1 of the Act.

Article 8
Dissolution, Liquidation, and Termination of the Company

8.1 Limitations. The Company may be dissolved, liquidated, and terminated only pursuant to the provisions of this Article 8 and the Members hereby irrevocably waive any and all other rights they may have to cause a dissolution of the Company or a sale or partition of any or all of the Company Assets.

8.2 Exclusive Causes. Notwithstanding the Act, the following and only the following events shall cause the Company to be dissolved, liquidated, and terminated:

(a) the unanimous consent of the Members;

(b) entry of a decree of judicial dissolution of the Company under Section 4A-903 of the Act; and

(c) the sale of all or substantially all of the Company Assets.

The bankruptcy or dissolution of a Member, or the occurrence of any other event that terminates the continued membership of a Member in the Company, shall not cause a dissolution of the Company.

8.3 Effect of Dissolution. The dissolution of the Company shall be effective on the day on which the event occurs giving rise to the dissolution, but the Company shall not terminate until it has been wound up and its assets have been distributed as provided in Section 8.5. Notwithstanding the dissolution of the Company, prior to the termination of the Company, the business of the Company and the affairs of the Members, as such, shall continue to be governed by this Agreement.

8.4 Deficit Capital Accounts. Each Member shall look solely to the Company Assets for all distributions with respect to the Company, its Capital Contribution thereto, its Capital Account and its share of Profits, Losses or grants, and shall have no recourse therefore (upon dissolution or otherwise) against any other Member. If any Member has a deficit balance in its Capital Account, such Member shall have no obligation to make any contribution to the capital of the Company with respect to such deficit, and such deficit shall not be considered a debt owed to the Company or to any other Person for any purpose whatsoever.

8.5 Liquidation. Upon dissolution of the Company, the Management Committee (or, in the event there are no remaining members of the Management Committee, any Person designated by the Members) shall act as "Liquidator" of the Company. The Liquidator shall liquidate the assets of the Company, and after allocating (pursuant to Article 5) all income, gain, loss, deductions, and credits resulting therefrom, shall apply and distribute the proceeds thereof and all other Company Assets, including available cash, as follows:

(a) First, to the payment of the obligations of the Company, to the expenses of liquidation, and to the setting up of any reserves for contingencies which the Liquidator may consider necessary.

(b) Thereafter, the then remaining Company Assets, including cash and cash equivalents, shall be distributed to the Members in proportion to the positive balances in the Members' respective Capital Accounts, determined after taking into account all Capital Account adjustments for the Company Allocation Year during which such liquidation occurs (other than the distributions made pursuant to this Section 8.5(b)), by the end of the Allocation Year in which such liquidation occurs or, if later, within 90 days after the date of the liquidation.

8.6 Compliance with Certain Requirements of Regulations. In the event the Company is "liquidated" within the meaning of Regulations Section 1.704-1(b)(2)(ii)(g), distributions shall be made in accordance compliance with Section 8.5. In the discretion of the Liquidator, a pro rata portion of the distributions that would otherwise be made to the Members pursuant to this Article 8 may be distributed to a trust established for the benefit of the Members for the purposes of liquidating Company assets, collecting amounts owed to the Company, and paying any contingent or unforeseen liabilities or obligations of the Company. The assets of any such trust shall be distributed to the Members from time to time, in the reasonable discretion of the Liquidator, in the same proportions as the amount distributed to such trust by the Company would otherwise have been distributed to the Members pursuant to Section 8.5.

8.7 Deemed Contribution and Distribution. In the event the Company is "liquidated" within the meaning of Regulations Section 1.704-1(b)(2)(ii)(g) but no event of dissolution has occurred, the assets shall not be liquidated, the Company's debts and other liabilities shall not be paid or discharged, and the Company's affairs shall not be wound up. Instead, solely for tax purposes, the Company shall be deemed to have contributed all assets and liabilities to a new limited liability company in exchange for an interest in such new limited liability company and, immediately thereafter, the Company will be deemed to liquidate by distributing interests in the new limited liability company to the Members.

8.8 Character of Liquidating Distributions. All payments made in liquidation of the Membership Interest of a Member in the Company shall be made in exchange for the interest of such Member in property pursuant to Code Section 736(b)(1), including the interest of such Member in Company goodwill.

8.9 Filing of Articles of Cancellation. If the Company is dissolved, the Liquidator shall file Articles of Cancellation with SDAT.

Article 9
Books, Records, Accounting, and Tax Elections

9.1 Bank Accounts. All funds of the Company shall be deposited in a bank account or accounts opened in the Company's name. The Management Committee shall determine the institution or institutions at which the accounts will be opened and maintained, the types of accounts, and the Persons who will have authority with respect to the accounts and the funds therein.

9.2 Books and Records. The Management Committee shall keep or cause to be kept complete and accurate books and records of the Company and supporting documentation of the transactions with respect to the conduct of the Company's business. The books and records shall be maintained in accordance with sound accounting principles and practices and shall be available at the Company's principal office for examination by any Member or the Member's duly authorized representative at any and all reasonable times during normal business hours.

9.3 Annual Accounting Period. The annual accounting period of the Company shall be its taxable year. The Company's taxable year shall be selected by the Members, subject to the requirements and limitations of the Code.

9.4 Reports. Within seventy-five (75) days after the end of each taxable year of the Company, the Management Committee shall cause to be sent to each Person who was a Member at any time during the taxable year then ended a complete accounting of the affairs of the Company for the taxable year then ended. In addition, within seventy-five (75) days after the end of each taxable year of the Company, the Management Committee shall cause to be sent to each Person who was an Interest Holder at any time during the taxable year then ended, that tax information concerning the Company which is necessary for preparing the Interest Holder's income tax returns for that year. At the request of any Member, and at the Member's expense, the Management Committee shall cause an audit of the Company's books and records to be prepared by independent accountants for the period requested by the Member.

Article 10
General Provisions

10.1 Further Assurances. Each Member shall execute all such certificates and other documents and shall do all such filing, recording, publishing, and take such other acts as the Members deem appropriate to comply with the requirements of Applicable Law for the formation and operation of the Company and to comply with any laws, rules, and regulations relating to the acquisition, operation, or holding of the property of the Company.

10.2 Notifications. Any notice, demand, consent, election, offer, approval, request, or other communication (collectively, a "notice") required or permitted under this Agreement must be in writing and either delivered personally or sent by certified or registered mail, postage prepaid, return receipt requested. A notice must be addressed to an Interest Holder at the Interest Holder's last known address on the records of the Company. A notice to the Company must be addressed to the Company's principal office. A notice delivered personally will be deemed given only when acknowledged in writing by the person to whom it is delivered. A notice that is sent by mail will be deemed given three (3) business days after it is mailed. Any party may designate, by notice to all of the others, substitute addresses or addressees for notices; and, thereafter, notices are to be directed to those substitute addresses or addressees.

10.3 Governing Law. This Agreement shall be construed and interpreted in accordance with the internal law of the State of Maryland, excluding its conflict of laws rules

10.4 Jurisdiction and Venue. Any suit involving any dispute or matter arising under this Agreement may only be brought in the United States District Court for the District of Maryland or any Maryland State Court having jurisdiction over the subject matter of the dispute or matter. All Members hereby consent to the exercise of personal jurisdiction by any such court with respect to any such proceeding.

10.5 WAIVER OF RIGHT TO JURY TRIAL. TO THE FULLEST EXTENT PERMITTED BY APPLICABLE LAW, AND AS SEPARATELY BARGAINED-FOR CONSIDERATION, THE COMPANY AND EACH INTEREST HOLDER HEREBY WAIVES ANY RIGHT TO TRIAL BY JURY IN ANY ACTION, SUIT, PROCEEDING, OR COUNTERCLAIM OF ANY KIND ARISING OUT OF OR RELATING TO THIS AGREEMENT.

10.6 Specific Performance. The parties recognize that irreparable injury will result from a breach of any provision of this Agreement and that money damages will be inadequate to fully remedy the injury. Accordingly, in the event of a breach or threatened breach of one or more of the provisions of this Agreement, any party who may be injured (in addition to any other remedies which may be available to that party) shall be entitled to one or more preliminary or permanent orders (i) restraining and enjoining any act which would constitute a breach or (ii) compelling the performance of any obligation which, if not performed, would constitute a breach.

10.7 Complete Agreement. This Agreement, including its Exhibits, and the subscription agreements referenced in the recitals hereto, constitute the complete and exclusive statement of the agreement among the Members with respect to the subject matter hereof, and supersede all prior written and oral statements, including any prior representation, statement, condition, or warranty, with respect to such subject matter.

10.8 Headings and Construction. No rule of construction will be applied to the disadvantage of a party because that party was responsible for the preparation of this Agreement or any part hereof. The Article and Section headings in this Agreement are for convenient reference only, and will be given no substantive or interpretive effect. With respect to all terms used in this Agreement, words used in the singular include the plural and words used in the plural include the singular. The word “including” means “including, without limitation,” and the words “herein”, “hereby”, “hereto” and “hereunder” refer to this Agreement as a whole. Unless the context otherwise requires, references herein: (i) to Articles, Sections and Exhibits mean the Articles and Sections of and the Exhibits attached to this Agreement; (ii) to an agreement, instrument or other document means such agreement, instrument or other document as amended, supplemented and modified from time to time, to the extent provided by the provisions thereof and by this Agreement; and (iii) to a statute or a regulation mean such statute or regulation as amended from time to time.

10.9 Binding Provisions. This Agreement is binding upon, and inures to the benefit of, the parties hereto and their respective heirs, executors, administrators, personal and legal representatives, successors, and permitted assigns.

10.10 Separability of Provisions. Each provision of this Agreement shall be considered separable; and if, for any reason, any provision or provisions herein are determined to be invalid and contrary to any existing or future law, such invalidity shall not impair the operation of or affect those portions of this Agreement which are valid.

10.11 Counterparts. This Agreement may be executed simultaneously in two or more counterparts each of which shall be deemed an original, and all of which, when taken together, constitute one and the same document. The signature of any party to any counterpart shall be deemed a signature to, and may be appended to, any other counterpart.

10.12 No Third Party Beneficiaries. It is expressly understood that the provisions of this Agreement do not impart enforceable rights in anyone who is not a party or a successor or permitted assign of a party hereto.

IN WITNESS WHEREOF, the parties have executed, or caused this Agreement to be executed, under seal, as of the date set forth hereinabove.

WITNESS:	MEMBERS:
____________________ Name:	____________________ Name:
____________________ Name:	____________________ Name:
____________________ Name:	____________________ Name:
____________________ Name:	____________________ Name:
____________________ Name:	____________________ Name:
____________________ Name:	____________________ Name:
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Name:	Name:

_____________Community Solar LLC
Operating Agreement
Exhibit A
Defined Terms

"Act" means the Maryland Limited Liability Company Act, as amended from time to time.

"Adjusted Capital Account Deficit" means, with respect to any Interest Holder, the deficit balance, if any, in the Interest Holder's Capital Account as of the end of the relevant taxable year, after giving effect to the following adjustments:

(i) deficit shall be decreased by the amounts which the Interest Holder is deemed obligated to restore pursuant to Regulation Sections 1.704-2(g)(1) and (i)(5) (i.e., the Interest Holder's share of Minimum Gain and Member Minimum Gain); and

(ii) the deficit shall be increased by the items described in Regulation Section 1.704-1(b)(2)(ii)(d)(4), (5), and (6).

" Affiliate" means, with respect to a specified Person, any other Person that, directly or indirectly through one or more intermediaries, controls, is controlled by or is under common control with the Person specified. For purposes of this Agreement, the term "control" (including its correlative meanings, "controlled by" and "under common control with") shall mean possession, directly or indirectly, of the power to direct or cause the direction of management or policies (whether through ownership of securities or partnership or other ownership interests, by contract or otherwise).

"Agreement" means the Operating Agreement of the Company, as amended from time to time.

"Allocation Year" means (i) the period commencing on the date of this Agreement and ending on December 31, 20__, (ii) any subsequent twelve (12) month period commencing on January 1 and ending on December 31, (iii) any portion of the periods described in clause (i) or (ii) for which the Company is required to allocate Profits, Losses, and other items of Company income, gain, loss, deduction, or credit pursuant to Article 5 or 8, or (iv) for the final Allocation Year, the period commencing on the day after the end of the previous Allocation Year and ending on the date of liquidation of the Company.

"Applicable Law" means any statute, law, ordinance, executive order, rule, or regulation (including a regulation that has been formally promulgated in a rule making proceeding but, pending final adoption, is in proposed or temporary form having force of law); guideline, or notice having force of law; or approval, permit, license, franchise, judgment, order, decree, injunction, or writ of any Governmental Authority applicable to a specified Person or specified property, as in effect from time to time.

"Articles of Organization" means the Articles of Organization of the Company prepared, executed and filed with SDAT on _______, _______, as amended by Articles of Amendment executed and filed with SDAT on _______, _______.

"Capital Account" means, with respect to any Member, the Capital Account maintained for such Member in accordance with Regulations Section 1.704-1(b)(2)(iv), which includes, among other things, the following rules:

(i) To each Member's Capital Account there shall be credited (A) such Member's Capital Contribution, (B) such Member's distributive share of Profits allocated pursuant to Section 5.1 and any items in the nature of income or gain that are specially allocated to such Member pursuant to Section 5.2 or Section 5.3, and (C) the amount of any Company liabilities assumed by such Member or that are secured by any property distributed to such Member;

(ii) To each Member's Capital Account there shall be debited (A) the amount of money and the Gross Asset Value of any property distributed to such Member pursuant to any provision of this Agreement, (B) such Member's distributive share of Losses allocated pursuant to Section 5.1 and any items in the nature of expenses or losses that are specially allocated to such Member pursuant to Section 5.2 or Section 5.3, and (C) the amount of any liabilities of such Member assumed by the Company or that are secured by any property contributed by such Member to the Company;

(iii) In the event Membership Interests (or any portions thereof) are transferred in accordance with the terms of this Agreement, the transferee shall succeed to the Capital Account of the transferor to the extent it relates to the transferred Membership Interests (or portions thereof); and

(iv) In determining the amount of any liability for purposes of subparagraphs (i) and (ii) above there shall be taken into account Code Section 752(c) and any other applicable provisions of the Code and Regulations.

The foregoing provisions and the other provisions of this Agreement relating to the maintenance of Capital Accounts are intended to comply with Regulations Section 1.704-1(b) and shall be interpreted and applied in a manner consistent with such Regulations. In the event the Members Committee shall determine that it is prudent to modify the manner in which the Capital Accounts are maintained, or any debits or credits thereto (including, without limitation, debits or credits relating to liabilities that are secured by contributed or distributed property or that are assumed by the Company or any Members), the Members Committee may make such modification, provided that it is not likely to have a material effect on the amounts distributed to any Person pursuant to Article 8 upon the liquidation of the Company. The Management Committee also shall (a) make any adjustments that are necessary or appropriate to maintain equality between the Capital Accounts of the Members and the amount of capital reflected on the Company's balance sheet, as computed for book purposes, in accordance with Regulations Section 1.704-1(b)(2)(iv)(q) and (b) make any appropriate modifications if unanticipated events might otherwise cause this Agreement not to comply with Regulations Section 1.704-1(b).

"Capital Contribution" means the total amount of cash and the fair market value of any other assets contributed (or deemed contributed under Regulation Section 1.704-1(b)(2)(iv)(d)) to the Company by a Member, net of liabilities assumed or to which the assets are subject.

"Cash Flow" means all cash funds derived from operations of the Company (including interest received on reserves), without reduction for any noncash charges, but less cash funds used to pay current operating expenses and to pay or establish reasonable reserves for future expenses, debt payments, capital improvements, and replacements as determined by the Members. Cash Flow shall be increased by the reduction of any reserve previously established.

"Company Assets" means all direct and indirect interests in real and personal property owned by the Company from time to time, and shall include both tangible and intangible property (including cash).

"Company Minimum Gain" has the same meaning as the term "partnership minimum gain" in Regulations Sections 1.704-2(b)(2) and 1.704-2(d).

"Conditions of Transfer" has the meaning set forth in Section 7.1 of the Agreement.

"Contract" means any agreement, contract, understanding, lease, sublease, easement, license, obligation, promise, or undertaking (whether written or oral and whether express or implied) that is legally binding, including any responses to request for proposals, applications for permits, approvals and licenses, any binding or non-binding letter of intent, memorandum of understanding or letter of intent and any and all change orders and amendments to the foregoing.

"Member" means each Person signing this Agreement as a Member and each Person who subsequently is admitted as a Member.

"Code" means the Internal Revenue Code of 1986, as amended, or any corresponding provision of any succeeding law.

"Company" means the limited liability company organized in accordance with the Agreement.

"Depreciation" means, for each Allocation Year, an amount equal to the federal income tax depreciation, amortization, or other cost recovery deduction allowable with respect to an asset for such Allocation Year, except that (i) with respect to any asset the Gross Asset Value of which differs from its adjusted tax basis for federal income tax purposes, which difference is being eliminated by use of the "remedial method" pursuant to Regulations Section 1.704-3(d), Depreciation for such year shall be the amount of book basis recovered for such Allocation Year under the rules prescribed by Regulations Section 1.704-3(d)(2), and (ii) with respect to any other asset the Gross Asset Value of which differs from its adjusted basis for federal income tax purposes at the beginning of such Allocation Year, Depreciation shall be an amount that bears the same ratio to such beginning Gross Asset Value as the federal income tax depreciation, amortization, or other cost recovery deduction for such Allocation Year bears to such beginning adjusted tax basis; provided, however, that if the adjusted basis for federal income tax purposes of an asset at the beginning of such Allocation Year is zero, Depreciation shall be determined with reference to such beginning Gross Asset Value using any reasonable method selected by the

Members Committee. Any such calculation of Depreciation shall be in accordance with and as allowed under the Company's FERC tariff rate.

"Free Transfer Period" has the meaning set forth in Section 7.1 of the Agreement.

"Governmental Authority" means any national, state, District of Columbia or local government, any political subdivision thereof or any other governmental, quasi-governmental, judicial, public or statutory instrumentality, authority, body, agency, department, bureau, commission or entity, or any arbitrator with authority to bind a party at law.

"Gross Asset Value" means with respect to any asset, the asset's adjusted basis for federal income tax purposes, except as follows:

(i) The Gross Asset Values of all Company assets shall be adjusted to equal their respective gross fair market values (taking Code Section 7701(g) into account), as determined by the Management Committee, as of the following times: (A) the acquisition of an additional interest in the Company by any new or existing Member in exchange for more than a de minimis Capital Contribution; (B) the distribution by the Company to a Member of more than a de minimis amount of Company property as consideration for an interest in the Company; (C) the liquidation of the Company within the meaning of Regulations Section 1.704-1(b)(2)(ii)(g); and (D) at such other times described in Regulations Section 1.704-1(b)(2)(iv)(f)(5); provided that an adjustment described in clauses (A), (B), and (D) of this paragraph shall be made only if the Management Committee reasonably determines that such adjustment is necessary to reflect the relative economic interests of the Members in the Company;

(ii) The Gross Asset Value of any item of Company assets distributed to any Member shall be adjusted to equal the gross fair market value of such asset on the date of distribution as determined by the Management Committee; and

(iii) The Gross Asset Values of Company assets shall be increased (or decreased) to reflect any adjustments to the adjusted basis of such assets pursuant to Code Section 734(b) or Code Section 743(b), but only to the extent that such adjustments are taken into account in determining Capital Accounts pursuant to (A) Regulations Section 1.704-1(b)(2)(iv)(m) and (B) subparagraph (vi) of the definition of "Profits" and "Losses" or Section 5.2(g); provided, however, that Gross Asset Values shall not be adjusted pursuant to this subparagraph (iv) to the extent that an adjustment pursuant to subparagraph (ii) is required in connection with a transaction that would otherwise result in an adjustment pursuant to this subparagraph (iv).

If the Gross Asset Value of an asset has been determined or adjusted pursuant to subparagraph (i), (ii), or (iv), such Gross Asset Value shall thereafter be adjusted by the Depreciation taken into account with respect to such asset, for purposes of computing Profits and Losses.

"Interest" means a Person's share of the Profits, Losses and receipts from grants of, and the right to receive distributions from, the Company.

"Interest Holder" means any Person who holds an Interest, whether as a Member or as an unadmitted assignee of a Member.

"Involuntary Withdrawal" means, with respect to any Member, the occurrence of any of the events set forth in Act Section 4A-606(3) through (9).

“Lien” means any lien, mortgage, pledge, security interest, charge or encumbrance of any kind (including any conditional sale or other title retention agreement, any lease in the nature thereof, and any agreement to give any lien or security interest).

"Management Committee" has the meanings set forth in Section 6.5 of the Agreement.

"Member Minimum Gain" has the meaning set forth in Regulation Section 1.704-2(i) for "partner nonrecourse debt minimum gain."

"Member Nonrecourse Debt" has the same meaning as the term "partner nonrecourse debt" in Regulations Section 1.704-2(b)(4).

"Member Nonrecourse Debt Minimum Gain" means an amount, with respect to each Member Nonrecourse Debt, equal to the Company Minimum Gain that would result if such Member Nonrecourse Debt were treated as a Nonrecourse Liability, determined in accordance with Regulations Section 1.704-2(i)(3).

"Member Nonrecourse Deductions" has the same meaning as the term "partner nonrecourse deductions" in Regulations Sections 1.704-2(i)(1) and 1.704-2(i)(2).

"Membership Rights" means all of the rights of a Member in the Company, including a Member’s: (i) Interest, (ii) right to inspect the Company’s books and records, and (iii) right to participate in the management of and vote on matters coming before the Company.

"Minimum Gain" has the meaning set forth in Regulation Section 1.704-2(d). Minimum Gain shall be computed separately for each Interest Holder in a manner consistent with the Regulations under Code Section 704(b).

"Offer" has the meaning set forth in Section 7.1 of the Agreement.

"Offer Period" has the meaning set forth in Section 7.1 of the Agreement.

"Offeree Notice" has the meaning set forth in Section 7.1 of the Agreement.

"Percentage Interest" means, with respect to each Member, the percentage set forth opposite such Member’s name on Exhibit B, as such percentage interest may be adjusted in accordance with the terms hereof from time to time.

"Person" means and includes an individual, corporation, partnership, association, limited liability company, trust, estate, or other entity.

"Profit" and "Loss" means, for each taxable year of the Company (or other period for which Profit or Loss must be computed), the Company's taxable income or loss determined in accordance with Code Section 703(a), with the following adjustments:

(iv) all items of income, gain, loss, deduction, or credit required to be stated separately pursuant to Code Section 703(a)(1) shall be included in computing taxable income or loss;

(v) any tax-exempt income of the Company, not otherwise taken into account in computing Profit or Loss, shall be included in computing taxable income or loss;

(vi) any expenditures of the Company described in Code Section 705(a)(2)(B) (or treated as such pursuant to Regulation Section 1.704-1(b)(2)(iv)(i)) and not otherwise taken into account in computing Profit or Loss, shall be subtracted from taxable income or loss;

(vii) gain or loss resulting from any taxable disposition of Company property shall be computed by reference to the adjusted book value of the property disposed of, notwithstanding the fact that the adjusted book value differs from the adjusted basis of the property for federal income tax purposes;

(viii) in lieu of the depreciation, amortization, or cost recovery deductions allowable in computing taxable income or loss, there shall be taken into account the depreciation computed based upon the adjusted book value of the asset; and

(ix) notwithstanding any other provision of this definition, any items which are specially allocated pursuant to Section 5.3 of the Agreement shall not be taken into account in computing Profit or Loss.

"Regulation" means the income tax regulations, including any temporary regulations, from time to time promulgated under the Code.

"Regulatory Allocations" has the meaning set forth in Section 5.3 of the Agreement.

"Representative" has the meaning set forth in Section 6.5 of the Agreement

"SDAT" means the State Department of Assessments and Taxation of Maryland.

"Tax Matters Partner" means the Member designated as Tax Matters Partner pursuant to this Agreement.

"Transfer" means, when used as a noun, any voluntary sale, hypothecation, pledge, assignment, attachment, or other transfer, and, when used as a verb, means voluntarily to sell, hypothecate, pledge, assign, or otherwise transfer.

"Transfer Closing Date" has the meaning set forth in Section 7.1 of the Agreement.

"Transfer Notice" has the meaning set forth in Section 7.1 of the Agreement.

"Transfer Purchase Price" has the meaning set forth in Section 7.1 of the Agreement.

"Transferee" has the meaning set forth in Section 7.1 of the Agreement.

"Transferee Offer" has the meaning set forth in Section 7.1 of the Agreement.

"Transferor" has the meaning set forth in Section 7.1 of the Agreement.

"Transferor Interest" has the meaning set forth in Section 7.1 of the Agreement.

"Voluntary Withdrawal" means a Member's dissociation with the Company by means other than a Transfer or an Involuntary Withdrawal.

____________Community Solar LLC
Operating Agreement
Exhibit B
List of Members and Capital

Name	Address	Taxpayer I.D.	Capital Contribution	Percentage Interest

POWER PURCHASE AGREEMENT

between

___________ COMMUNITY SOLAR LLC

and

HOST Site

Dated as of ________________, 20__

TABLE OF CONTENTS

Exhibits.

This Agreement includes the following Exhibits, which are specifically incorporated herein and made a part of this Agreement.

Exhibit A	Solar Energy rates applicable in each contract year
Exhibit B	Description of the Site, Premises and the Facility
Exhibit C	Insurance Policy
Exhibit D	Contract between Solar installer and ________LLC w/invoice
Exhibit E	Operating Agreement of _________ LLC
Exhibit F	Operations and Maintenance Service Plan

SOLAR POWER PURCHASE AGREEMENT

PREAMBLE:

We, the _______ Community Solar LLC and the Host Site, do hereby enter into this solar power purchase agreement in order to further the development of solar electric energy generating capacity in our community and to demonstrate the financial practicality and systems feasibility of a model through which private citizens and private organizations, even on a small scale, may join to this end.

This Solar Power Purchase Agreement (this "Agreement") is made and entered into as of this ______ day of _________, 2013 (the "Effective Date") between ______Community Solar LLC ("Seller"), a Maryland limited liability company, and the - ("Host"), a for- profit incorporated under the laws of the State of Maryland(each a "Party" and together, the "Parties").

WITNESSETH:

WHEREAS, Host desires that Seller install, maintain and operate a solar electric generating facility with an aggregate nameplate capacity of approximately ___ kilowatt (kW) – DC, 10.0 kW – AC, and with an estimated annual output of ______ kilowatt hours (the "Facility") on the roof of the Host's property located at ____________ MD, (the "Site") and sell electric energy produced by the Facility and utilized by the Host; and

WHEREAS, Seller desires to sell, and Host desires to purchase, the solar energy from the Facility (as more particularly defined herein) for the Site, consisting of Metered monthly production of energy from the Facility pursuant to the terms and conditions set forth herein;

NOW THEREFORE, in consideration of the mutual promises set forth below, and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the Parties agree as follows:

ARTICLE 1 - DEFINITIONS AND RULES OF INTERPRETATION

1.1 Rules of Construction. The capitalized terms listed in this Article 1 shall have the meanings set forth herein whenever the terms appear in this Agreement, whether in the singular or the plural or in the present or past tense. In addition, the following rules of interpretation shall apply:

(A) The masculine shall include the feminine and neuter.

(B) The words "hereof", "herein", and "hereunder" and words of similar import shall refer to this Agreement as a whole and not to any particular provision of this Agreement.

(C) References to "Articles," "Sections," or "Exhibits" shall be to articles, sections, or exhibits of this Agreement.

(D) The Exhibits attached hereto are incorporated in and are intended to be a part of this Agreement; *provided*, that in the event of a conflict between the terms of any Exhibit and the terms of this Agreement, the terms of this Agreement shall take precedence.

(E) This Agreement was negotiated and prepared by both Parties with the advice and participation of counsel for Host. The Parties have agreed to the wording of this Agreement and none of the provisions hereof shall be construed against one Party on the ground that such Party is the author of this Agreement or any part hereof.

(F) The Parties shall act reasonably and in accordance with the principles of good faith and fair dealing in the performance of this Agreement.

(G) Use of the words "include" or "including" or similar words shall be interpreted as "include without limitation" or "including, without limitation".

(H) References to any statute, code or statutory provision are to be construed as a reference to the same as it may have been, or may from time to time be, amended, modified or reenacted, and include references to all bylaws, instruments, orders and regulations for the time being made thereunder or deriving validity therefrom unless the context otherwise requires.

(I) In the event of a conflict, a mathematical formula describing a concept or defining a term shall prevail over words describing a concept or defining a term.

(J) References to any amount of money shall mean a reference to the amount in United States Dollars.

1.2 Definitions. The following terms shall have the meanings set forth herein:

"***Agreement***" means this Power Purchase Agreement between Seller and Host, including the Exhibits attached hereto.

"***Business Day***" means any calendar day that is not a Saturday, Sunday. A Business Day shall open at 8:00 a.m. Prevailing Time and close at 5:00 p.m. Prevailing Time.

"***Commercial Operation Date***" means, with respect to the Facility, the date on which (a) the Facility is capable of producing and delivering Solar Energy to the Delivery Point; and (b) Seller has obtained all necessary Permits required in order for the Facility to deliver Solar Energy to the Delivery Point.

"***Commercial Operation Year***" means, with respect to the Facility, any consecutive twelve (12) Month period during the Term of this Agreement, commencing with the first Day of the Month following the Commercial Operation Date of such Facility, and each anniversary of such date thereafter.

"***Day***" means a period of twenty-four (24) consecutive hours beginning at 00:00 hours Prevailing Time on any calendar day and ending at 24:00 hours Prevailing Time on the same calendar day.

"***Delivery Point***" means, with respect to the Facility, the Meter, as further specified by Seller prior to the Commercial Operation Date.

"***Dispute***" shall have the meaning set forth in Section 18.1.

"***Effective Date***" shall have the meaning set forth in the Preamble.

"***Environmental Attributes***" means any and all current or future credits, benefits, emissions reductions, environmental air quality credits, emissions reduction credits, renewable energy credits, offsets and allowances, attributable to the Solar Facility, or otherwise attributable to the generation, purchase, sale or use of Solar Energy from or by the Solar Facility during the Term, howsoever entitled or named, resulting from the avoidance, reduction, displacement or offset of the emission of any gas, chemical or other substance, including without limitation any of the same arising out of legislation or regulation concerned with oxides of nitrogen, sulfur or carbon, with particulate matter, soot or mercury, or implementing the United Nations Framework Convention on Climate Change (UNFCCC) or the Kyoto Protocol to the UNFCCC or crediting "early action" emissions reduction, or laws or regulations involving or administered by the Clean Air Markets Division of the United States Environmental Protection Agency, or any state or federal entity given jurisdiction over a program involving transferability of Environmental Attributes, and any rights to such Environmental Attributes, including the Maryland Public Utility Commission.

"***Event of Default***" shall have the meaning set forth in Section 21.1.

"Excess Production Volume" shall have the meaning set forth in Section 5.2.

"Expected Commercial Operation Date" has the meaning set forth in Section 3.1.

"***Facility***" shall have the meaning set forth in the Preamble.

"***Fair Market Value***" shall have the meaning set forth in Section 9.1.

"***Force Majeure***" shall have the meaning set forth in Section 22.1.

"***Governmental Authority***" means any federal, state, local or municipal governmental body; any governmental, quasi-governmental, regulatory or administrative agency, commission, body or other authority exercising or entitled to exercise any administrative, executive, judicial, legislative, policy, regulatory or taxing authority or power; or any court or governmental tribunal; *provided*, *however*, that "Governmental Authority" shall not in any event include any Party.

"***Host***" shall have the meaning set forth in Preamble

"***Host Energy Needs***" shall have the meaning set forth in Section 5.1.

"***Initial Period***" shall have the meaning set forth in Section 3.1.

"***Installer***" shall have the meaning set forth in Section 4.3.

"Installed Capacity" means, the aggregate nameplate capacity of all installed Solar Panels of the Facility expressed in kilowatts (peak "***Invoice***" shall have the meaning set forth in Section 7.1.

"**kWh**" shall mean a kilowatt-hour, or the delivery of one-thousand watts of energy over one hour.

"***Material Adverse Effect***" means any event, occurrence, change or effect of whatever nature (or events, occurrences, changes or effects, taken together) that (i) is, or is reasonably likely to be, materially adverse to the present or future business, operations, assets, liabilities, properties, results of operations or condition (financial or otherwise) of the Project or, including the design, development, construction or operation of the Facility as currently contemplated, or (ii) prevents or materially impairs or delays, or is reasonably likely to prevent or materially impair or delay, either Party's ability to perform its obligations under this Agreement or to consummate the transactions contemplated hereby or thereby.

"***Meter***" shall mean the meter installed by Seller that measures the Solar Energy produced by the Facility as well as the energy consumed by the Host, and which meets the requirements of Article 20.

"***Month***" means a calendar month commencing at 00:00 Prevailing Time on the first Day of such month and ending at 24:00 Prevailing Time on the last Day of such month.

"***Net Metering Payment"*** shall have the meaning set forth in Section 5.3.

"Operations Period" shall have the meaning set forth in Section 2.3

"***Party***" ***or*** "***Parties***" shall have the meaning set forth in the Preamble and includes any permitted assignee of a Party.

"***Parties' Representatives***" shall have the meaning set forth in Section 18.1.

"***Permits***" means all material permits, consents, licenses, approvals, or authorizations from any Governmental Authority, required to own, construct, operate or maintain the Solar Facility, make available Solar Energy at the Delivery Point, and otherwise sell and transfer Solar Energy to Host.

"***Prevailing Time***" means Eastern Standard Time or Eastern Daylight Savings Time.

"***Purchase Price***" shall have the meaning set forth in Section 6.1.

"***Seller***" shall have the meaning set forth in the Preamble.

"***Site***" shall have the meaning set forth in the Preamble.

"***Solar Energy***" means the instantaneous electrical energy output (in kWh), intermittent and variable within the hour, made available from the Facility after the Commercial Operation Date at the Delivery Point, as measured by the Meter installed at the Delivery Point.

"***Solar Panels***" means those photovoltaic solar electric generating devices powered by the sun and related equipment necessary for the production of electric energy that are included in the Facility.

"***SRECs***" shall have the meaning set forth in Section 8.3.

"***Term***" means the period of time during which this Agreement shall remain in full force and effect, and which is further described in Article 2.

ARTICLE 2 - TERM AND TERMINATION

2.1 Term. The term of this Agreement shall consist of an initial period and an operations period, both as defined below (the "***Term***").

2.2 Initial Period. The Initial Period shall begin on the Effective Date and end on the Commercial Operation Date (the "***Initial*** Period"). During the Initial Period Seller shall confirm the feasibility of the Facility. Seller may terminate this Agreement during the Initial Period, but upon such termination shall remove all structures that is has installed and shall restore the roof to its full integrity at its full sole expense.

2.3 Operations Period. The Operations Period shall began on the Commercial Operations Date and shall end (TO BE DETERMINED) years after the Commercial Operations Date, unless terminated before such date pursuant to this Agreement (the "***Operations Period***").

ARTICLE 3- FACILITY & OWNERSHIP

3.1 Commercial Operation Date. The expected commercial operation date of the Facility is _________ (date), 20__ (year) the "Expected Commercial Operation Date"). Seller shall notify Host in writing when Commercial Operation has been achieved and declared for the Facility by Seller. If Seller fails to fully install the Facility by the Expected Commercial Operation Date, then Host shall have the right to terminate this Agreement, Seller shall remove the Facility, and Host shall be relieved of all obligations related to this Agreement.

3.2 Facility Description. The Facility shall be a solar electric generating facility with an Installed Capacity estimated to be approximately _____ kilowatt (kW) to be located on the roof of Host of the Site. Exhibit B to this Agreement provides a general description of the Facility, including a good faith estimate of the approximate amount of Solar Energy that the Facility is expected to produce. The Parties acknowledge and agree that Exhibit B may be updated by Seller prior to the Commercial Operation Date.

3.3 Legal Ownership. Seller will be the legal and beneficial owner of the Facility at all times. Seller will pledge the facility as collateral security in connection with any construction finances or permanent financing.

ARTICLE 4– CONSTRUCTION, ACCESS & OPERATION

4.1 Contracting. Seller shall use licensed North American Board of Certified Electric Professionals (NABCEP) certified contractors to oversee the work of installing, operating, and maintaining the Facility. Seller will advise Host of the contractors being hired. Host shall have no contractual relationship with the contractors.

4.2 Permitting. Seller shall obtain all Permits for the Facility and shall design, install, operate, and maintain the Facility so as to keep it in good condition and repair, in compliance with law and with the generally accepted practices of the electric industry, in general, and the solar generation industry, in particular. Such work shall be at Seller's sole expense.

4.3 Seller & Installer Access. Host shall grant Seller and its designees, including Seller's installation contractor (to be determined) (the "***Installer***"), access to the Premises by lease or license for the purposes of designing, installing, operating, and maintaining the facility.

4.4 Time of Work. Except for emergency situations, Seller shall perform all work between the hours of 7:00 am and 7:00 pm, Monday through Saturday, in a manner that minimizes interference with Host.

4.5 Security. Host will provide security for the Facility as part of its normal security procedures for the Site and will advise Seller immediately upon observing any damage to the Facility.

4.6 Site Modification. Host will agree not to modify the Site in such a way as to interfere with the construction, operation or maintenance of, or solar access of, the Facility.

4.7 Emergency Repairs. Seller will be permitted to shut down the Facility at any time in order to perform emergency repairs.

4.8 Maintenance Shutdowns. Seller shall give Host five (5) day notice of maintenance shutdowns. Seller shall not have any obligation to reimburse Host for costs of purchasing electricity which would have been produced by the Facility but for such a maintenance shutdown. Seller shall not schedule maintenance shutdowns during peak periods of electric generation and periods when peak energy and demand prices are charged by Host's backup electric service provider.

4.9 Site Condition Shutdowns. In addition to the right of Seller to shut down the Facility for emergencies or maintenance, Seller may shutdown the Facility if Seller reasonably believes Site conditions or activities of persons on the Site, which are not under the control of Seller, whether or not under the control of Host, may interfere with the safe operation of the Facility. Seller shall give Host notice of the shutdown immediately upon becoming aware of the potential for such conditions or activities.

4.10 Host Shutdown. Host from time to time may request Seller to temporarily stop operation of the Facility for reasons related to Host's activities in maintaining and improving the Site. To the extent that this period of time is greater than seven (7) days in any one calendar year, Host shall pay Seller the following for any and all days in excess of this seven (7) day period:

(A) Payments that Host would have made to Seller for electric energy that would have been produced during the period of the shutdown based upon estimates provided by PV Watts as per Exhibit B;

(B) Revenues from Environmental Attributes that Seller would have received with respect to electric energy that would have been produced during the period of the shutdown; as calculated in accordance with Seller's long-term SREC Purchase and Sale Agreement if such an agreement exists, or if no such agreement exists, the value of the SRECs during such a period as verified by a third party SREC broker.

ARTICLE 5 – PURCHASE & SALE OF ELECTRICITY

5.1 Electricity Purchase. During the Operations Period, Host shall buy from Seller all of the Solar Energy produced by the Facility. Seller shall not guarantee that any particular amount of electric energy will be produced by the Facility for any hourly, daily, monthly, annual or other period.

5.2 Net Metering. To the extent that Net Metering is available, Host will participate in the local utilities, state, or regional net metering program. If Host is provided with a payment pursuant to net metering (a "***Net Metering Payment***") by the local utility, it shall provide Seller with payment equal to the Net Metering Payment within ten (10) Business Days of receipt of such Net Metering Payment.

5.3 Supplemental Energy. During periods when the Facility is unable to meet the Host Energy Needs, Host will purchase electricity from the local electric utility or another electric service provider as stated in Section 8.

ARTICLE 6– ELECTRICITY PURCHASE PRICE

6.1 Rate Schedule. Host shall pay Seller for each kilowatt-hour of Solar Energy purchased from Seller pursuant to this Agreement (the "***Purchase Price***"). The Purchase Price is set annually each December at one cent per kWh below the full rate charged by ____________, the local electric utility company, as set out in Exhibit A, for grid-supplied electricity to Host.

ARTICLE 7- BILLING AND PAYMENT

7.1 Billing Invoices. The billing period shall be monthly. No later than ten (10) Business Days after the end of each Month, Seller shall provide to Host an invoice equal to the amount of Solar Energy actually delivered to the Delivery Point by Seller to Host multiplied by the Purchase Price during the Monthly billing period (the "***Invoice***"). Seller shall transmit each invoice by fax, first class mail or as otherwise mutually agreed by the Parties in writing. Each invoice shall include sufficient detail to allow Host to verify such invoice.

7.2 Payments. Payments due under this Agreement shall be due and payable thirty (30) Days after receipt of the Invoice.

7.3 Account Information. Payment from Host to Seller shall be made by direct deposit to the following account:

__________ Community Solar LLC
_________ Bank
Account Number:
Routing Number:

or by check to: ___________ Community Solar LLC

℅ treasurer
Address

7.4 Records; Auditing.

(A) Each Party shall maintain complete and accurate records in accordance with generally accepted accounting standards and as may be necessary for the purpose of ascertaining the accuracy of all relevant data, estimates or statements of charges submitted hereunder.

ARTICLE 8 – SUPPLEMENTAL POWER, INCENTIVES, SRECS

8.1 Excess Needs. Host shall be responsible for obtaining all of its requirements for electric energy in excess of the amounts produced by the Facility and shall pay for such service pursuant to contracts with or applicable tariffs of the local electric utility or other electric service provider. Seller shall have no obligation to obtain or pay for such supplemental or back-up electricity.

8.2 Incentives. Seller shall receive all payments available under any state solar incentive program and any other federal, state or local programs applicable to renewable energy sources.

8.3 SRECS. Seller shall be the owner of any solar renewable energy certificates ("***SRECs***") or other environmental attributes which may arise as a result of the operation of the Facility.

8.4 Capacity. Seller shall be entitled to receive any payments for electric capacity or ancillary services which may become available to the Facility, or any other similar payments in connection with the ownership of generation capacity.

8.5 Required Information. Upon reasonable request, Host shall provide Seller with information required for preparing documents necessary for Seller to receive the foregoing.

ARTICLE 9

9.1 Purchase Option. At the end of the operation year when the Seller has broken even on the initial investment the Seller will donate the facility to the Host site. From this date forward all electricity produced by the facility will be used by the Host at no cost. All operations and maintenance of the facility will become the responsibility of the Host.

ARTICLE 10 - CLOSURE OF PREMISES

In the event the Premises are closed as a result of an event not related to Force Majeure, Host shall nevertheless continue to pay Seller for all electricity produced by the Facility.

ARTICLE 11– DECOMMISSIONING & REMOVAL

If, at the end of the Operations Period, Host does not exercise its option to receive the donated Facility and the Parties do not agree to any extension of the Agreement, then Seller, at its sole expense, shall decommission and remove the Facility from the Site. Seller shall not be obligated, however, to remove any support structures for the Facility which are affixed to Host's structures or any below grade structures, including foundations and conduits, or any roads.

ARTICLE 12 – PERMITS & APPROVALS

12.1 Consents & Approvals. Seller shall be responsible for obtaining, and paying for, any and all consents or approvals from the local electric utility which are necessary for the construction, commissioning, and operation of the Facility.

12.2 Government Approvals. Seller shall also pay for and obtain all approvals from governmental entities necessary for the construction and operation of the Facility, including but not limited to land use permits, building permits, and demolition and waste disposal permits.

12.3 Host Consents. Host shall pay for and obtain all consents required for it to execute this Agreement and perform its obligations under this Agreement from its lenders, tenants and any other persons with an interest in the Site. These consents shall include estoppel certificates which recognize the rights of Seller under this Agreement.

ARTICLE 13 – TAXES

13.1 Facility Tax Liabilities. Seller shall be responsible for all income taxes associated with payments from Host to Seller pursuant to this Agreement.

13.2 Facility Tax Assets. Seller, as owner of the Facility, shall be entitled to all tax benefits under federal and state income tax laws with respect to the Facility.

13.3 Taxes on Electricity. Host shall be responsible for all taxes, fees, and charges, including sales, use and gross receipts taxes, imposed or authorized by any Governmental Authority on the sale of electric energy by Seller to Host, provided however, that Seller shall be responsible for paying any and all taxes associated with energy sold from the Facility through net metering.

13.4 Ad Valorem & Property Taxes. Host shall be responsible for all ad valorem personal property or real property taxes levied against the Site and its improvements and personal property located at the Site, except that Seller shall be responsible for ad valorem personal property or real property taxes levied against the Facility.

ARTICLE 14 – INSURANCE

14.1 Insurance Requirements. The insurance requirements for the Facility are set forth in Exhibit C to this Agreement. The Parties shall cooperate to ensure that both Parties meet any insurance requirements specified by, the utility interconnect agreement, or by other requirements set forth in Maryland or by local rules or regulations. Host shall insure the Facility by adding its value to existing building coverage. Seller shall be responsible for all costs and expenses associated with insurance for the Facility, including any additional premium rate increases that might be incurred by Host due solely to a claim made because of damages to the Facility.

ARTICLE 15 – INDEMNIFICATION

Each party shall indemnify, defend and hold harmless the other party from and against any claims arising from or out of any event, circumstances, active incident first occurring or existing on such Party's side of the Delivery Point. Each party shall indemnify, defend and hold harmless the other party against any governmental charges for which such party is responsible. Seller warrants that it shall deliver to Host energy free and clear of all liens, security interests, claims and encumbrances or any interests therein or thereto by any person arising prior to the Delivery Point.

ARTICLE 16 – LIMITATION ON DAMAGES

EXCEPT AS OTHERWISE PROVIDED IN THIS AGREEMENT THERE IS NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, AND ANY AND ALL IMPLIED WARRANTIES ARE DISCLAIMED. LIABILITY SHALL BE LIMITED TO DIRECT ACTUAL DAMAGES ONLY, SUCH DIRECT ACTUAL DAMAGES SHALL BE THE SOLE AND EXCLUSIVE REMEDY AND ALL OTHER REMEDIES OR DAMAGES AT LAW OR IN EQUITY ARE WAIVED UNLESS EXPRESSLY HEREIN PROVIDED. NEITHER PARTY SHALL BE LIABLE FOR CONSEQUENTIAL, INCIDENTAL, PUNITIVE, EXEMPLARY OR INDIRECT DAMAGES, LOST PROFITS OR OTHER BUSINESS INTERRUPTION DAMAGES, BY STATUTE, IN TORT OR CONTRACT, UNDER ANY INDEMNITY PROVISION OR OTHERWISE. UNLESS EXPRESSLY HEREIN PROVIDED, AND SUBJECT TO THE PROVISIONS OF SECTION 16 (INDEMNIFICATION), IT IS THE INTENT OF THE PARTIES THAT THE LIMITATIONS HEREIN IMPOSED ON REMEDIES AND THE MEASURE OF DAMAGES

BE WITHOUT REGARD TO THE CAUSE OR CAUSES RELATED THERETO, INCLUDING THE NEGLIGENCE OF ANY PARTY, WHETHER SUCH NEGLIGENCE BE SOLE, JOINT OR CONCURRENT, OR ACTIVE OR PASSIVE

ARTICLE 17 – DISPUTE RESOLUTION

17.1 Dispute Negotiation. In the event of any dispute arising under this Agreement (a "***Dispute***"), within ten (10) Days following the delivered date of a written request by either Party, (1) each Party shall appoint a representative (individually, a "***Party Representative***", together, the "***Parties' Representatives***"), and (2) the Parties' Representatives shall meet, negotiate and attempt in good faith to resolve the Dispute quickly, informally and inexpensively.

17.2 Non-Binding Mediation. In the event the Parties' Representatives cannot resolve the Dispute within thirty (30) Days after commencement of negotiations pursuant to Section 18.1, the Parties shall submit to non-binding mediation.

17.3 Arbitration. In the event that the Parties are unable to resolve their dispute through non-binding mediation pursuant to Section 18.2 within thirty (30) Days following the initiation of such mediation, either Party may seek binding arbitration.

ARTICLE 18 – REPRESENTATIONS AND WARRANTIES

18.1 Mutual Representations and Warranties. Beginning on the Execution Date (Initial Period), each Party represents and warrants to the other Party that:

(A) It is duly organized, validly existing and in good standing under the laws of the jurisdiction of its formation;

(B) The execution, delivery and performance of this Agreement is within its powers, have been duly authorized by all necessary action and do not violate any of the terms and conditions in its governing documents, any contracts to which it is a party or any law, rule, regulation, order or the like applicable to it;

(C) This Agreement and each other document executed and delivered in accordance with this Agreement constitutes its legally valid and binding obligation enforceable against it in accordance with its terms;

(D) It is not bankrupt and there are no proceedings pending or being contemplated by it or, to its knowledge, threatened against it which would result in it being or becoming bankrupt;

(E) There is not pending or, to its knowledge, threatened against it or any of its affiliates any legal proceedings that could materially adversely affect its ability to perform its obligations under this Agreement;

(F) It is acting for its own account, has made its own independent decision to enter into this Agreement and as to whether this Agreement is appropriate or proper for it based upon its own judgment, is not relying upon the advice or recommendations of the other Party in so doing, and is capable of assessing the merits of, and understands and accepts, the terms, conditions and risks of this Agreement.

(G) It shall continue to be duly organized, validly existing and in good standing under the laws of the jurisdiction of its formation;

(H) It shall maintain (or obtain from time to time as required, including through renewal, as applicable) all regulatory authorizations necessary for it to legally perform its obligations under this Agreement; and

(I) It shall perform its obligations under this Agreement in a manner that does not violate any of the terms and conditions in its governing documents, any contracts to which it is a party or any law, rule, regulation, order or the like applicable to it.

ARTICLE 19 - DELIVERY AND METERING

19.1 Delivery. The electric energy from the Facility shall be delivered from Seller to Host at the Delivery Point, as set forth in Exhibit B and otherwise in compliance with all requirements of the local electric utility.

19.2 Title and Risk of Loss. As between the Parties, Seller shall be deemed to be in control of the Solar Energy up to and until the Delivery Point, and Host shall be deemed to be in control of such Solar Energy at and after the Delivery Points.

19.3 Metering.

(A) Seller shall install, own, operate and maintain all metering and data processing equipment capable of the measurement, recordation and transmission of information regarding both the Solar Energy generated by the Solar Facility and the energy utilized by the Host (collectively, the "***Meter***").

(B) Seller shall install a meter capable of remote monitoring via the internet and shall provide Host with remote online access to the Meter via a dedicated website.

19.4 Testing at Request of Host. The output of the Facility shall be measured by the Meter. Seller shall test the Meter in accordance with industry standards. In the event of a discrepancy between actual Meter readings and accurate readings, billing adjustments shall be made retroactively to the date of and the previous testing date of the meter (not to exceed 180 days).

19.5 Additional Testing. Host shall pay for any independent testing of the meter(s) in excess of such minimum testing schedule that Host deems necessary. But if any meter test shows the meter to be in error by more than 2%, (1) Seller shall pay for the cost of the test and (2) billing adjustments shall be made retroactively to the date of and the previous testing date of the meter (not to exceed 180 days).

ARTICLE 20- DEFAULT AND REMEDIES

20.1 Events of Default.

(A) Any of the following shall constitute an Event of Default ("**Event *of Default***") on the part of either Party upon its occurrence and no cure period shall be applicable:

(1) Either Party's actual fraud or willful misconduct in connection with this Agreement;

(2) Either Party's assignment of this Agreement or assignment of any of its rights hereunder for the benefit of creditors; and

(3) Either Party's filing of a petition in voluntary bankruptcy or insolvency or for reorganization or arrangement under the bankruptcy laws of the United States or under any insolvency act of any state, or Seller voluntarily taking advantage of any such law or act by answer or otherwise.

(4) The failure of either Party to comply with any material obligation under this Agreement which would have a Material Adverse Effect on the other Party

(B) If any representation or warranty made by either Party in this Agreement proves to have been false or misleading in any material respect when made or ceases to remain true during the Term if such cessation would reasonably be expected to have a Material Adverse Effect on the other Party, it shall constitute an Event of Default unless cured within thirty (30) Days after the date of written notice.

(C) The filing of an involuntary case in bankruptcy or any proceeding under any other insolvency law against either Party as debtor that could materially impact the other Party's ability to perform its obligations hereunder shall constitute an Event of Default; *provided, however*, that such a Party does not obtain a stay or dismissal of the filing within one hundred eighty (180) Days.

20.2 Damages and Termination. Upon the occurrence of an Event of Default that occurs at any time during the Term, the non-defaulting Party shall have the right to pursue all available legal or equitable remedies available to it, including the right to collect damages.

20.3 Waiver and Exclusion of Other Damages.

(A) THE PARTIES CONFIRM THAT THE EXPRESS REMEDIES AND MEASURES OF DAMAGES PROVIDED IN THIS AGREEMENT SATISFY THE ESSENTIAL PURPOSES HEREOF. IF NO REMEDY OR MEASURE OF DAMAGES IS EXPRESSLY HEREIN PROVIDED, THE OBLIGOR'S LIABILITY SHALL BE LIMITED TO DIRECT, ACTUAL DAMAGES ONLY.

20.4 Duty to Mitigate. Each Party agrees that it has a duty to mitigate damages and covenants that it shall use reasonable efforts to minimize any damages it may incur as a result of the other Party's performance or non-performance of this Agreement.

ARTICLE 21 – FORCE MAJEURE

21.1 Definition of Force Majeure. An event of Force Majeure means any act of God, labor disturbance, act of the public enemy, war, insurrection, riot, fire, storm or flood, explosion, any curtailment, order, regulation or restriction imposed by a court or governmental military or lawfully established civilian authorities, or any other cause beyond a Party's control. A Force Majeure event does not include an act of negligence or intentional wrongdoing. Neither the Host nor Seller shall be considered in default as to any obligation under the PPA if prevented from fulfilling the obligation due to an event of Force Majeure.

ARTICLE 22– NOTICES

Notices shall, unless otherwise specified herein, be in writing and may be delivered by hand delivery, United States mail, overnight courier service, facsimile or electronic messaging (e-mail). Whenever this Agreement requires or Permits delivery of a "notice" or requires a Party to "notify"), the Party with such right or obligation shall provide a written communication in the manner specified below. A notice sent by facsimile transmission or email will be recognized and shall be deemed received on the day on which such notice was transmitted if received before 5 p.m. Eastern prevailing time (and if received after 5 p.m., on the next day) and a notice by overnight mail or courier shall be deemed to have been received two (2) days after it was sent or such earlier time as is confirmed by the receiving Party unless it confirms a prior oral communication, in which case any such notice shall be deemed received on the day sent. A Party may change its addresses by providing notice of same in accordance with this provision. All written notices shall be directed as follows:

To Seller:

___________Community Solar LLC
Address

To Host:

____
_________St.
_________MD _____

ARTICLE 23 – MISCELLANEOUS

23.1 Change of Law. Any provision declared or rendered unlawful by any applicable court of law or regulatory agency or deemed unlawful because of a statutory change will not otherwise affect the remaining lawful obligations that arise under this Agreement; and provided, further, that if such an event occurs, the Parties shall use their best efforts to reform this Agreement in order to give effect to the original intention of the Parties.

23.2 Continuing Effect. Notwithstanding anything to the contrary in this Agreement, applicable provisions of this Agreement, including all indemnity rights, audit rights and confidentiality obligations, shall continue in effect after termination of this Agreement, including early termination, to the extent necessary to enforce or complete the duties, obligations or responsibilities of the Parties arising prior to such termination and, as applicable, to provide for final billings and adjustments related to the period prior to such termination, repayment of any money due or owing to either Party pursuant to this Agreement, repayment of principal and interest associated with security funds, if any, and the indemnifications specified in this Agreement.

23.3 Governing Law. This Agreement and the rights and duties of the parties hereunder shall be governed by and construed, enforced and performed in accordance with the laws of the State of Maryland.

23.4 Assignment. Neither Party shall assign this Agreement or its rights hereunder without the prior written consent of the other Party, which consent shall not be unreasonably withheld; provided, however, either Party may, without the consent of the other Party.

23.5 Waiver. The failure of either Party to enforce or insist upon compliance with or strict performance of any of the terms or conditions of this Agreement, or to take advantage of any of its rights thereunder, shall not constitute a waiver or relinquishment of any such terms, conditions, or rights, but the same shall be and remain at all times in full force and effect.

23.6 Relationship of the Parties. This Agreement shall not be interpreted to create an association, joint venture, or partnership between the Parties nor to impose any partnership obligation or liability upon either Party. Neither Party shall have any right, power, or authority to enter into any agreement or undertaking for, or act on behalf of, or to act as an agent or representative of, the other Party.

23.7 Severability. In the event any of the terms, covenants, or conditions of this Agreement, its Exhibits, or the application of any such terms, covenants, or conditions, shall be held invalid, illegal, or unenforceable by any Governmental Authority, all other terms, covenants, and conditions of the Agreement and their application not adversely affected thereby shall remain in force and effect; *provided*, *however*, that Host and Seller shall negotiate in good faith to attempt to implement an equitable adjustment in the provisions of this Agreement with a view toward effecting the purposes of this Agreement by replacing the provision that is held invalid, illegal, or unenforceable with a valid provision the economic effect of which comes as close as possible to that of the provision that has been found to be invalid, illegal or unenforceable.

23.8 Complete Agreement; Amendments. The terms and provisions contained in this Agreement constitute the entire agreement between Host and Seller with respect to the Solar Facility and shall supersede all previous communications, representations, or agreements, either verbal or written, between Host and Seller with respect to the sale of Solar Energy from the Solar Facility. This Agreement may be amended, changed, modified, or altered, *provided* that such amendment, change, modification, or alteration shall be in writing and signed by both Parties hereto and the Financing Party, if any.

23.9 Headings. Captions and headings used in this Agreement are for ease of reference only and do not constitute a part of this Agreement.

23.10 Counterparts. This Agreement may be executed in any number of counterparts, including in facsimile and electronic formats (including portable document format (.pdf)), each of which is an original and all of which constitute one and the same instrument.

IN WITNESS WHEREOF, each Party has caused this Agreement to be duly executed by its authorized representatives as of the date of last signature provided below.

____________________ ______________________

Name:___________ Name: _____________

Date: Date:

Title: President Title: Treasurer

________ Community Solar LLC __________Community Solar LLC

____________________ ______________________

Date: Date:

Title: President Title: ________________

_____________Host site _____________ Host site

EXHIBIT A
PPA ELECTRICITY RATES

Electric energy rates effective in each Commercial Operation Year between _________ Community Solar LLC and __________,Host site. The Operation Period is for ____ years. Rates to be determined based on the current rate paid the electric power provider.

EXHIBIT B
DESCRIPTION OF PV SITE, PREMISES, AND THE PV SYSTEM SPECIFICATION ("PV WATTS")

ATTACHED TO PPA

EXHIBIT C
INSURANCE POLICY

ATTACHED TO PPA

EXHIBIT D
CONTRACT BETWEEN THE SOLAR INSTALLER AND ______ LLC W/INVOICE

ATTACHED TO PPA

EXHIBIT E
OPERATING AGREEMENT OF _______ LLC

ATTACHED TO PPA

EXHIBIT F
OPERATIONS AND MAINTENANCE SERVICE PLAN

__________Community Solar LLC

___________, the solar installer. offers an annual Operations and Maintenance plan after the first year of operation. The O & M consists of preventive maintenance and troubleshooting for the purpose of providing services that would otherwise not be covered under warranty. The individuals conducting O & M shall conform to all site safety regulations, including wearing of personal protective equipment and ability to shut off the array safely as needed.

Operations and Maintenance consists of the following (every 12 months):

- A visual inspection of all the mechanical, electrical, and PV components.
- All open air wire (USE-2) and Multi Contact "MC" connectors at the array are visually inspected for excessive drooping, abrasion, disconnection or any other hazard.

- The PV modules are inspected for damage and soiling. Excessive soiling is removed by using a mild water based detergent (i.e. dishwashing liquid) by hand or an alternate non-high pressure method that complies with the panel warranty.
- The inverter cooling system is inspected and cleaned per manufacturers' recommended procedure. Filters are inspected and replaced according to schedule.
- All electrical screw type fittings located at Combiner Boxes, and Inverters. Disconnects and other electrical components are checked for proper torque and are marked with a permanent marking device.
- Check fuse continuity for each DC circuit in each combiner box. Replace defective fuses accordingly.
- Any potential problems and damage are identified and brought to the attention of the Host site and ___________Solar LLC for review.
- ___________, the solar installer, will complete and provide a "Work Completion" certificate after the work is complete. Upon successful completion of the O&M actions and "Acceptance" of all of the work, the responsible manager will countersign the Work Completion certificate.

O&M Service Plan Fee: $___________ per year

DOW SUSTAINABILITY FELLOWS
UNIVERSITY OF MICHIGAN

March 2017

LIGHTS OUT IN THE COLD

Reforming Utility Shut-Off Policies as If Human Rights Matter

Environmental and Climate Justice Program, NAACP

LIGHTS OUT IN THE COLD: Reforming Utility Shut-Off Policies as If Human Rights Matter

March 2017

Created by the NAACP Environmental and Climate Justice Program
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The National Consumer Law Center

The Michigan Welfare Rights Organization

The Committee to End Utility Shut Offs

Public Utility Law Center

EXECUTIVE SUMMARY

As a part of a broader consumer protection arrangement, the adoption of utility disconnection policies acknowledges the problems faced by customers who are vulnerable to having their utilities disconnected. Unfortunately, the interests of these customers often compete with the interests of utility companies, regulators, and other utility customers. This poses an obstacle to the design of appropriate disconnection policies that recognize the necessity of utility services and the rights of utility customers. A "disconnection policy" describes the justifications, procedures, and consumer protections with which a utility must comply before terminating service to a customer. Although a utility typically maintains the right to disconnect a customer for a variety of reasons, there are more problematic issues with disconnection because of nonpayment.[1]

Aftermath of a space heater fire in Prince George's County, MD
Source: http://patch.com/maryland/bowie/space-heaters-cause-bedroom-fires-twice-week-0

This report provides a comprehensive overview of common disconnection protections and policies employed by utilities nationwide, explores critical issues that should be considered in the development of disconnection policies, and calls for concrete action toward establishing policies that protect the well-being of all utility customers and the eventual **ELIMINATION OF UTILITY DISCONNECTIONS**. The need to incorporate human rights into the utility business model is a key component of the larger reform of the extractive energy economy and movement toward energy justice. The energy justice movement upholds that all individuals have the right to: safe, sustainable energy production; resilient and updated energy infrastructure; affordable energy; and uninterrupted energy service.[2]

This report discusses common disconnection protections across all types of utilities, but focuses on those set for Investor-Owned Utilities (IOU's). Issues with existing disconnection practices and state level model policies are explored. Recommendations for the establishment of a right to utility service are put forward to ensure the future protection of utility customers.

EXISTING STATE POLICIES

PROCEDURAL PROTECTIONS AND CONSIDERATIONS:

- All states require utility companies to provide a written, phone, or personally delivered notice before a disconnection.

- There is a wide range of disconnection limitations. Some states will not disconnect during certain hours of days of the week, while other states will not disconnect before or during a holiday.
- Fifteen states do not specify policies for utility reconnection fees.

SEASONAL PROTECTIONS:

- Date-based protections take place during the colder months, usually between the months of November and March or April. Temperature protections are based on various ranges of hot and cold temperatures that could place residents in danger. Most of the states will not disconnect when temperatures are below 32°F or above 95°F, but the offering of this protection varies by state.
- Nine states do not provide any state regulated seasonal protections for utility customers. These states include: Alaska, California, Colorado, Connecticut, Florida, North Dakota, Oregon, Tennessee, and Virginia.

PAYMENT ASSISTANCE

- Most states offer a payment plan option to avoid disconnections and charge a fee to reconnect to utility services.

PROTECTIONS FOR SOCIALLY VULNERABLE GROUPS

- Medical protections are generally offered for disabled or elderly customers. Generally, a medical certificate is required to postpone a disconnection for various amounts of time.
- Eight states do not have regulations establishing standard protections for socially vulnerable groups. Among these states are: Alaska, Arkansas, Colorado, Florida, Kentucky, North Carolina, North Dakota, and Rhode Island.

THE RIGHT TO UNINTERUPTED ENERGY SERVICE

The establishment of a universal **right to uninterrupted energy service** would ensure that provisions are in place to prevent utility disconnection due to non-payment and arrearages.[3] Toward establishing such a right, we call for all utility companies to advocate for and incorporate the following foundational principles into their models, operations, and policies:

1. Secure **ACCESS** to utility services for all households;
2. Ensure **INCLUSION** of all customers in the development of utility policies and regulations;
3. Create full **TRANSPARENCY** of the information and actions of utility companies, regulating bodies, legislatures, and utility affiliated organizations;
4. Guarantee the **PROTECTION** of the human and civil rights of all customers; and
5. Advance programs that help **ELIMINATE POVERTY**, so that all customers can pay utility bills.

While the end goal is clear—**to prioritize utility policies that place a moratorium on utility service disconnections**—these principles can be furthered through the following practices:

PROCEDURAL PROTECTIONS

1. Require multiple attempts at both written and telephonic or in-person contact before disconnection;
2. Secure notification of disconnection by mail;
3. Require a post-disconnection notice to all customers;
4. Provide additional notice provisions for customers who can be disconnected remotely;
5. Restrict disconnections to times between 8:00am-2:00pm on days when the utility has employees available to reconnect utility services;
6. Provide notice and utility disconnection policies in multiple languages;
7. Remove all policies allowing utilities to charge disconnection and reconnection fees;
8. Cease the collection of deposits for utility service activation and/or reconnection;

SEASONAL PROTECTIONS

9. Include seasonal protections with both temperature and date-based solutions;
10. Set disconnection arrearage minimums for customers who use utility services as the primary source of heating or cooling during periods of seasonal protection;
11. Provide utility services during extreme weather events that fall outside of seasonal protection periods;

PAYMENT ASSISTANCE

12. Allow budget payment plans to distribute utility costs throughout the year;
13. Allow partial payment plans to customers to prevent disconnections;
14. Provide connections to social services and case management resources for households with arrearages;

PROTECTIONS FOR THE SOCIALLY VULNERABLE

15. Establish simple procedures for socially vulnerable groups to apply and be registered for protection from disconnection;
16. Implement customer surveys in advance of extreme weather seasons to screen for socially vulnerable individuals;
17. Ensure active outreach to socially vulnerable customers and households for inclusion in protection programs; and
18. Registration into these programs should be complimented with a notification to local and/or state emergency relief agencies and safety responders.

The policies and protections detailed in this report represent stop-gap measures to lessen harms on utility customer wellbeing. In advancing energy justice, all individuals have the right to: safe, sustainable energy production; resilient and updated energy infrastructure; affordable energy; and uninterrupted energy service.[4] The NAACP calls for the development of policies and utility structures that improve energy efficiency throughout the energy continuum, advance clean and renewable energy production, encourage and enable the development of distributed generation, and protect human life and wellbeing. These aspects are components of the larger utility system change that we must build.

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FOREWORD: A CALL TO MORALITY—*BY JACQUELINE PATTERSON, NAACP ENVIRONMENTAL AND CLIMATE JUSTICE PROGRAM DIRECTOR*

I will never forget the sound of fear in my father's voice on the phone or the look of desperation in his eyes when I walked through the door. I was home to take care of my Dad in what turned out to be his last days on earth. I had gone out to get some items that he needed. My cell phone rang and it was him on the other end saying that the power had gone out and he didn't know how long his respirator would run without it. I raced home and as I opened the door, my Dad was just standing in the middle of the living room, attached to his respirator, looking desperate. It turned out to just be that I needed to flip the switch on the circuit breaker. But it brings home the reliance that so many have on electricity to sustain life.

As many of us were enjoying turkey, ham, or tofurkey with loved ones, exchanging presents, and engaging in holiday festivities, for some of us, all was not merry and bright. Too many are shivering in the deep freeze that had assailed a large swath of the nation, huddled around space heaters or open oven doors in homes lit by candles or kerosene lamps, because they could not pay their electricity/heating bills and were thus without this vital resource. The stories over the years are too many to list, but each one alone represents a moral imperative for systems reform of the utility business model because no life should be lost for lack of the basic human right to safe shelter, in a land of plenty:

- A Maryland man in dire straits after having his electricity disconnected, resorted to using a generator to power the home where he was raising his seven children.[5] Carbon monoxide released by the generator killed the entire family as they slept.[6] Also in MD, a fire swept through a row house killing 10 people, including 7 children aged 7 months, 5 , 7 , 11 and 12 years, and two 3 year olds, as well as 3 adults, after the termination of the electricity caused residents to begin using candles and a kerosene lamp for electricity.[7]
- In Michigan, John Skelley, a 69-year-old man, passed away in his home from hypothermia and other causes, several days after his gas service was disconnected.[8] Also in Michigan, a fire sparked by a space heater being used to heat the home after utilities had been shut off took the lives of three people.[9]
- In New York, three young boys, ages 4 months, 2 years, and 5 years died in a fire caused by a candle used for light after the utility company disconnected service for non-payment.[10]In another New York incident, a child died in a fire started by a candle, in a home where service was scheduled to be reconnected 24 hours after the desperate measures took his life.[11]
- In California, five children, ages 4, 1 and two 2 year olds, lost their lives when their electricity had been disconnected and their mothers, who were sisters living together, used candlelight to light their home, resulting in a fire. [12]

Too often these tragedies are chalked up to the inevitable consequences of poverty and implicitly relegated to being sad, but acceptable losses, with an unspoken notion that "We can't save them all!" However, every one of these losses was preventable and we cannot, in good conscience, stand by and watch more when we have the means to ensure access for all.

The cost of extreme poverty should not be a death sentence.

Whether it is extremes in heat, extremes in cold, or the need for electricity to power life saving devices like respirators or medicines requiring refrigeration not to mention just providing light, electricity/heating/cooling is essential, not just for quality of life, but also for maintenance of life!

We've shared a small sampling of illustrative stories of the consequences of inaction on utility shut-offs that have spanned decades. Yet, with relative inaction, in terms of system reform, so many more are in harm's way now, with the potential for dire circumstances resulting in desperate and possibly deadly actions. As of December 15, 2015, in Pennsylvania alone, at least 9,169 households had no central heating and 414 households were using potentially unsafe heating sources.[13] In Michigan, ravaged by the post-industrial economic downturn, from January to September 2013, DTE Energy--a utility company formerly known as Detroit Edison--reported 169,407 shut-offs, while another utility company, Consumers Energy (CMS), reported 118,203 shutoffs. Disconnections in Michigan have increased dramatically since the crash of 2008, with DTE completing two and half times as many shutoffs in 2011 than in 2007.[14] This trend is observable on a national scale.

The headlines today heralding the "winter weather blast" with 99 million people in the US under a winter weather advisory[15] highlight the proven fatal cocktail being mixed with the ingredients being harsh weather and lack of protection for thousands of vulnerable households who are struggling with making ends meet, placing them in a vice that can result in resorting to hazardous means of lighting and heating.

Science has spoken and so has Mother Nature as she continues respond to our abuse in the form of the polluting ways we employ to generate energy. Climate change is already resulting in weather extremes from extreme heat to extreme cold to extreme storms.[16] As such, we are seeing more days where air conditioning or at least a fan is required and days of extreme cold requiring heat, and greater amounts of snow to such an extent that even if someone wanted to leave an unheated home in search of warmth elsewhere, this may not be an option. Besides which, the ongoing crisis of homelessness finds the most vulnerable communities without available shelter space, or any alternatives if their homes are unsafe.[17]

Nationwide, annual temperatures have been rising over the past 50 years.[18] The hottest parts of the country, including Texas, the Southwest, and Florida have already experienced large increases in extreme heat days, including days over 90°F, 95°F, and 100°F. Extreme heat when paired with rising humidity levels, make blistering hot days more dangerous. Cities in these states are facing the greatest projected increases in dangerous heat over the next several decades.[19] With more than 80 percent of Americans living in cities, urban heat islands, combined with greenhouse gas heat trapping, can have serious health effects for hundreds of millions of people during the hottest months of the year. Heat is already the number one weather-related killer in the U.S., triggering asthma attacks, heart attacks, and other serious health impacts.[20] The National Center for Disaster Preparedness of Columbia University in New York, projects that about 3,000 people in the U.S. could die each year from heat waves under current climate warming patterns. This estimate is a combination of various factors, including exposure to the higher greenhouse gas emissions, higher urban-based populations, and impeded climate adaptation and mitigation efforts.[21]

Winter storms have also increased in frequency and intensity since the 1950s, and their tracks have shifted and power intensified in the U.S. Other trends in severe storms, including the intensity and frequency of tornadoes, hail, and damaging thunderstorm winds, are being studied intensively for their relationship to climate change.[22] Loss of internal temperature control, due to extreme heat and cold, can result in a variety of illnesses, including heat cramps, heat exhaustion, heatstroke, and hyperthermia when exposed to extreme heat, and hypothermia and frostbite when exposed to extreme cold. Exposure to temperature extremes can worsen chronic health conditions.[23]

There are utilities, such as the Roanoke Rural Electric Co-Op in North Carolina, that are being intentional about designing a business model that is human rights based, protective of the environment, yet financially sound. At the same time, other utilities are driving our continued slide towards catastrophic climate change by denying science, and in some cases, intentionally obscuring science as well as by their refusal to aggressively pursue energy efficiency, embrace the transition to clean energy, and/or allow/facilitate distributed generation of clean energy.[24] [25] [26] And some of the most aggressive utilities are the ones behind the highest numbers of shutoffs where there is record keeping. These utilities obstinately defend the practices of fossil fuel based energy production, disproportionately polluting the very same communities, with the highest rates of shut-offs, to produce the very electricity to which they do not have access.

> *In Dayton Texas, Sam Houston Electric Cooperative has disconnected the utilities of vulnerable households in areas impacted by the Cedar Power Project, which operated three trash burning incinerators until 2008.[27] The air pollution produced by incinerators is known to contribute to the development of chronic diseases like chronic obstructive pulmonary disease (COPD) as well as many other serious health problems.[28]*

Given that low-income communities, communities of color, and vulnerable persons, including people who are elderly, pay the highest proportion of their incomes to energy and they are most vulnerable to shut off and most likely to suffer from the pollution from energy production, this is a prime example of the deep injustices in the extractive economy.

As detailed in this report, there are utilities that have managed to reform in such a way that provides protections for low-income customers. Yet too many companies and their trade associations use their influence on the Public Utilities Commissions and Public Service Commissions[29] to push back on the protections communities need.[30] We must put pressure on utility companies that have refused to innovate despite the models being out there for operating utilities in a humane way that maintains operations and uphold human rights. Not only do we need pro-people policies to reform utility company practices in the short term, but in the long term we need a people led movement to seize the reins of our utilities sector, including water, another essential resource that befalls a similar fate of being withheld from those suffering from extreme poverty.

The NAACP is a part of building the new economy that puts power in the hands of the people, literally and figuratively. However, in the meantime, we have developed this study that chronicles the best and worst of utility policies and practices with the aim of uplifting examples of the most humane policies, and providing a blueprint for reform for those who continue to sacrifice the lives of vulnerable communities for profit. We are issuing a call to legislators, regulators, utility companies, researchers, and advocates for us all to step up our efforts in reforming what we have now, even while we as people's advocates push for total-systems change. Until we have transformed to the new, people led, economy, we must all take responsibility for pushing for the reforms that protect the lives of those who are most vulnerable. We particularly issue a call to conscience to the legislators, regulators, and the companies that have used the profits from the electricity and heating bills that we pay every day, to suppress human rights through anti-customer protection, anti-regulatory, anti-clean energy, anti-energy efficiency, anti-distributed generation lobbying while staunchly maintaining practices that have taken lives.

While we build a new economy with foundational principles of human rights, community ownership and control, participatory democracy, and shared wealth and wellness, through this effort, the NAACP, its units, and its partners and allies will work to ensure that utilities, regulators, and legislators are held accountable to executing policies and practices that ensure that right to the commons, resources essential for life, are upheld for all!

LIGHTS OUT IN THE COLD:

REFORMING UTILITY SHUT-OFF POLICIES AS IF HUMAN RIGHTS MATTER

INTRODUCTION

Disconnection policies consist of the justifications, procedures, and consumer protections with which a utility must comply before terminating service to a customer. Unfortunately, the interests of these customers often compete with the interests of other stakeholders. This poses an obstacle for the design of appropriate disconnection policies that recognize the necessity of utility services and the rights of vulnerable customers. The need to incorporate human rights into the utility business model is apparent.

Disconnection policies are implemented by legislatures and regulators, and vary widely from state to state. Some policies are protective of consumers, while others lack safeguards. The right to uninterrupted energy service must be established and upheld for the protection of human life. In the long term, the termination of households from utility services must be eliminated, in the interim, it is critical to ensure the absolute highest level of protections for vulnerable households facing disconnection.

This report discusses common disconnection protections across all types of utilities, but focuses on those set for Investor-Owned Utilities (IOU's). Issues with existing disconnection practices and state level model policies are also explored. Financial options are presented as a short-term solution to reduce a household's risk of disconnection, however, the report sets forth broad principles and specific recommendations for stakeholders as we move towards a shared vision of an energy democracy. While the report highlights disconnection practices mandated by state legislatures and authorized regulatory bodies, the issues and impacts outlined can, and have, applied to Publicly-Owned Utilities (POU's) as well.

TYPES OF UTILITY COMPANIES

Investor Owned Utilities (IOUs)

Investor-owned utilities are privately-owned, for-profit electric utility whose stock is publicly traded. It is rate regulated and authorized to achieve an allowed rate of return. Traditionally, the investor-owned utilities own generation, transmission, and distribution assets. These utilities are regulated by state legislatures and the regulatory bodies to which they delegate authority. Customer rates are set and regulated by the Public Utility Commission through public process that includes some customer participation.

Publicly Owned Utilities (POUs)/Consumer owned utilities (COUs)

Publicly owned utilities are under public control and regulation. These utilities are organized in various forms, such as municipal owned, rural cooperatives, public utility districts. COUs have varied regulatory structures. Customer rates are set by each utility's governing body-board or city council in a public forum.

Municipally owned: A municipally or city-owned utility is a non-profit electricity provider that is owned and operated by the municipality it serves. Municipals may or may not have their own generation facilities. For municipals without their own generation often develop a contract with another company to generate electricity. Since the customers are local, the municipals do not need to transmit electricity over high-voltage power lines. Generally, municipal-owned utilities are controlled by the City Council or a special board or committee.

Rural Electric Co-ops: Rural Electric Cooperatives are operated by and for the people of the community. The Electric Co-ops were formed to bring electricity to rural households that investor-owned utilities do not serve. They are divided into distribution cooperatives or generation and transmission cooperatives. Distribution co-ops provide end-users with electricity. Generation and transmission co-ops are usually owned and managed by several distribution co-ops to sell wholesale power to distribution co-ops. The consumers of the utility elect a board to manage and make decisions for the Cooperative.

Public Utility Districts (PUDs): Public Utility Districts are utility-only government agencies that provide things like electricity, natural gas, sewage treatment, waste collection/management, telecommunications, or water. The utility districts are created by the local government bodies. PUDs are regulated by a board or commission that is elected by the voters of that district.

No longer should the narrative be, poor people making bad choices and paying the consequences for their bad choices. The principles and actions promoted by this report apply to all utilities. It is time that utility companies are held accountable for the lives and families that they endanger, and that we all transition to the mindset that access to energy and utility services is a human right. The right to uninterrupted energy service must be established and upheld for the protection of human life. In the long term, the termination of households from utility services must be eliminated, in the interim, it is critical to ensure the absolute highest level of protections for vulnerable households facing disconnection.

THE HUMAN COST OF UTILITY DISCONNECTION

"These companies are getting rich while we freeze to death."

-Bernard, resident of Detroit, MI

The following is a collection of true stories about real people whose lives were cut short, or nearly cut short, by utility companies who were willing to pull the plug to protect profits.

THE PEOPLE OF DETROIT, MICHIGAN

"DTE [Energy] changes my rates practically every month. They're constantly trying to squeeze every penny out of us. I keep my gas nearly at zero and they are still charging me an arm and a leg."

-Daryl, resident of Detroit, MI

In 2010, utility shutoffs by DTE Energy resulted in several deadly house fires in Detroit that caused several deaths, including the deaths of two wheelchair-using brothers on Dexter Avenue and three children on Bangor Street. In response, DTE tried to preserve a favorable image by misdirecting attention away from its responsibility for the tragedies, making an outcry to bring "energy thieves" to justice—unidentified people who the company accused of illegally connecting houses to DTE power lines. With the support of the Michigan state government, DTE called for the arrest of "energy thieves" and launched a spying campaign against Detroit residents, which included the use of invasive aerial infrared photography to determine which households still had heat after having their power disconnected for nonpayment.

Meanwhile, DTE also launched a publicity campaign to promote its charity, the Heat and Warmth Fund (THAW), as well as its Winter Protection Plan (WPP) program. Not only do these programs protect only seniors from utility shutoffs during the winter, but they also place families into payment plans that essentially keep them in a state of permanent debt to the company. In many cases, families cannot afford to stay on track with the payment plans that are offered and end up having their power disconnected anyway.

After visiting a DTE office to make a payment, a Detroit resident named Bernard commented, "I came in here to pay $236. That was the minimum amount they said would stop them from shutting off our utilities. They wanted me to pay $560, but I just don't have the money. People on my block are using whatever they have—space heaters, stovetops, anything they can think of. Finding an alternative way to keep warm has become necessary to survive. And you know the company is making good money. These companies are getting rich while we freeze to death."

At the same DTE office, a Detroit resident and mother of three named Tametria said, "They set me up on a payment plan, where I was supposed to pay $300 every month. I kept up with most of the payments, but when I lost my job, they still shut us off. I have three kids, and now we've had to move in with a friend. I came in today and they said I have to pay $2,600 to get my house turned back on. It's unbelievable. We can't move back into our house because we can't afford those thousands of dollars."[31]

ROBERT ROBERTS – OVERLAND PARK, KANSAS

In 2016, a senior living in Overland Park, KS had his electricity shut off by his utility company even though he needed a nebulizer and oxygen to breathe. Robert A. Roberts, Sr. was already struggling to pay medical bills that piled up because of his health problems, including multiple sclerosis and chronic obstructive pulmonary disease (COPD).

A concerned neighbor, Randen Smith, decided to help Mr. Roberts by powering his medical equipment with an extension cord that was connected to Mr. Smith's home. Kansas City Power & Light (KCP&L) said it was "unsafe" to provide electricity to Mr. Roberts through the extension cord and ordered Mr. Smith to pull the plug, threatening to also shut off his power if he refused. Mr. Smith refused to stop helping Mr. Roberts. "I don't want someone dying on my hands," Smith said. "Maybe KCP&L doesn't mind, but it bothers me that someone needs help and electricity and oxygen to live, so I'm going to help."

Mr. Roberts had been living with his son and grandchildren in Overland Park since 1989.[32] The family lives less than one mile away from an incinerator used to burn medical waste, which has been operated by Shawnee Mission Medical Center since 2008.[33] The air pollution produced by incinerators is known to contribute to the development of chronic diseases like COPD, as well as many other serious health problems.

MARVIN SCHUR – BAY CITY, MICHIGAN

In 2009, a 93-year-old man named Marvin Schur froze to death in his home after his utility company restricted his electricity because of an unpaid bill. The official cause of his death was hypothermia, which was determined by a medical examiner who called it "a slow, painful death." Mr. Schur owed more than $1,000 and, as a penalty, the utility company installed a "limiter" to restrict his use of electricity, resulting in his death.

A utility bill was found on Mr. Schur's kitchen table with a large amount of money attached to it—a sign that he was trying to save up to pay his bill. The utility company was owned by Bay City, Michigan. Bay City manager Robert Bellerman stated that he did not believe the company did anything wrong.[34]

JESSE WYANT – EUDORA, KANSAS

"That's premeditated murder—if you know a person is on life-sustaining oxygen, and you pull the plug and you kill them."*-Ms. Wyant, resident of Eudora, KS*

In Eudora, KS in 2011, Beverly and Jesse Wyant were notified by the city that their electricity would be shut off if they did not pay their bill, even though Jesse, age 86, was terminally ill and needed an oxygen concentrator to survive. The couple was having difficulty making ends meet after a fire destroyed much of their home. Since then, they struggled to pay for refurbishments and other expenses so they could cope with the damage. The city refused to wait a mere five days for Beverly's state pension payment to come in; instead, they set up a turnoff time. Luckily, their daughter could pay the bill for them to keep the electricity on, but many families are not fortunate enough to have the resources to do this.[35]

LESTER BERRY – DAYTON, TEXAS

Although Lester Berry, a 70-year-old resident of Liberty County, TX, was only $129.62 behind on his electricity bill, his utility company cut off his power, resulting in his death. Mr. Berry had congestive heart failure and COPD, which meant that he needed constant power to his oxygen concentrator to survive. When Sam Houston Electric Cooperative disconnected his electricity, Mr. Berry very painfully suffocated to death.

Mr. Berry was found with his hand inches away from his phone, which needed electricity to work, leading his son to believe that he tried to call for help just before he died. Mr. Berry's family said the electric power provider was well informed about his need for electricity to power his life-sustaining medical equipment, so they had no reason to assume his power would be disconnected for nonpayment of a mere $129.62.[36]

Dayton, TX, where Lester Berry died, was home to the Cedar Power Project, which operated three trash burning incinerators until 2008.[37] The air pollution produced by incinerators is known to contribute to the development of chronic diseases like COPD, as well as many other serious health problems.

The instances of customer endangerment illustrated in the above stories highlight the need for change. With the myriad of protections, programs, and policies that exist for utility customers at risk of disconnection due to nonpayment there is no reason for undue suffering. In the interest of protecting the rights of utility customers, it is necessary to understand how utilities protect against disconnections due to nonpayment, and where there is opportunity for improvement.

DISCONNECTION POLICIES AND THEIR REGULATION

WHAT IS A DISCONNECTION POLICY?

A "disconnection policy" describes the justifications, procedures, and consumer protections with which a utility must comply before terminating service to a customer. Although a utility typically maintains the right to disconnect a customer for a variety of reasons, there are particular considerations with disconnection as a result of nonpayment.[38] Disconnection policies may be found in whole or in part in state statutes, regulations, public utility commission orders, and utility tariffs, but are most frequently established in regulations.[39] Regulators and other policymakers determine which elements to include or omit in disconnection polices, leading some disconnection policies to be more protective of consumers than others.[40] Some components that are commonly found in disconnection policies include:

1. Required notice to the customer that the utility intends to disconnect service;
2. Limitations on disconnections during certain times of year or in extreme weather;
3. Limitations on the day or time of day when a disconnection may occur;
4. Protections for customers who have disabilities, are elderly, or seriously ill; and
5. The availability of payment plans for customers who have trouble affording their bills.[41]

A disconnection notice
Source: Benefits Learning Network

HOW ARE DISCONNECTION POLICIES REGULATED?

Unlike other businesses, public utilities are bound by the public's interest because they are "of public consequence, and affect the community at large."[42] Many public utilities are even granted monopolies in exchange for what is supposed to be tight regulation in the public's interest. It is within the powers of legislatures to both regulate public utilities and define what it means for that utility to act in the public interest.[43] Traditionally, this has meant the protection of the health, safety, and general welfare of the public.[44]

Legislatures delegate their authority to directly oversee public utilities to officials who serve in public utility commissions or other regulatory agencies.[45] Despite this delegation of regulatory authority, the legislatures retain the right and the duty to define the "public interest" which utilities must adhere to and which utility regulators must protect.[46] Legislatures and regulators exercise broad power over public utilities, but the role of regulators is limited by the legislature's definition of the public interest.

Public utility commissions and legislatures are able to control market entry for new utility providers, set rates, set standards for the quality and safety of service, and prevent the utility from taking undue financial risks.[47] While public utility commissions are free to regulate utilities in accordance to the public interest, they may be limited in their ability to confront new challenges that fall outside of the scope of the traditional public interest goals.[48] Among these challenges include climate change, rising energy costs, air pollution, new technologies, and racial discrimination.[49]

Absent a clear public interest basis to tackle these challenges, commissions may enact regulations that go against the interests of customers.[50] Alternatively, this lack of clarity could cause commissions to be leery of taking action, or leave them unwilling to take on challenges, even if they would be permitted to do so.[51] Thus, it is important for legislatures to provide utility commissions with a clear public interest mandate to authorize and encourage the commission to regulate on emergent challenges or topics. This lack of clarity allows for continued violations of customers' rights by public utilities.

How Utility Companies are Regulated

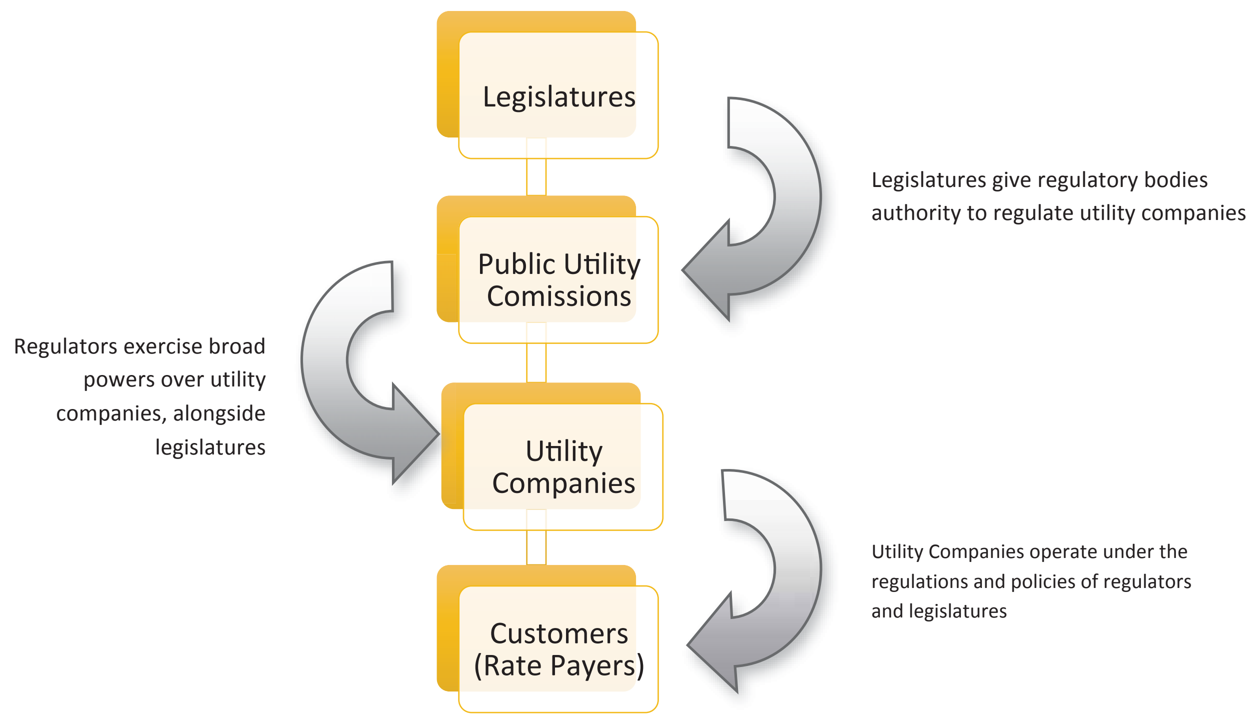


Figure 1. How Utility Models are Regulated: The Traditional Model

COMPETING INTERESTS

There are multiple stakeholders who may have competing interests regarding disconnection policies that must be considered when endeavoring to reform the utility system to solve the problems faced by those who experience utility disconnections. Figure 2 depicts some of the stakeholders who may have an interest in disconnection policies.[52] The interest of the following groups typically come into play: utility customers, those at risk and not at risk of disconnection; utility companies; and legislators and regulators. Within each of these groups are individuals that are directly and indirectly impacted by utility disconnections and other actions.

CUSTOMERS

Consumers who are at risk of being disconnected have an interest in maintaining their service under protective disconnection policies. In contrast, consumers who are not at risk of being disconnected may be asked to subsidize those customers who are unable to pay; therefore, they may want less protective policies to keep their own rates lower. This additional burden on customers in-good-standing is a form of cost shifting—when a utility charge higher rates or other fees for services to one group than another less reliable group. Such cost shifting practices undermine the ability of more customers to pay their utility bills. Too often cost shifting is practiced in instances where a utility has the ability and capacity to absorb the costs of customers at risk of nonpayment.[53]

All utility customers have an interest in disconnection policies, as disconnection from utility services for any reason directly impacts customer wellbeing and security. Often families are put at risk when utility services are denied. In most states, lack of proper and safe heating and lighting sources can be a catalyst for social service and child protective services investigations. Lack of proper heating and lighting can be designated as housing safety and physical environment hazards for children.[54] This potential of the separation of families due to utility service disconnections is not only traumatic, but frequently hinders households from seeking help when in already vulnerable positions.[55]

UTILITIES

Utilities have an interest in earning a profit, so they may prefer a less protective disconnection policy that allows them to disconnect customers more quickly once an account becomes delinquent;[56] however, utilities likely also wish to avoid putting their customers at risk, out of humanitarian concern, or, in some cases, if only to save themselves from negative press and public perception.[57]

Stakeholders in Public Utility Disconnections

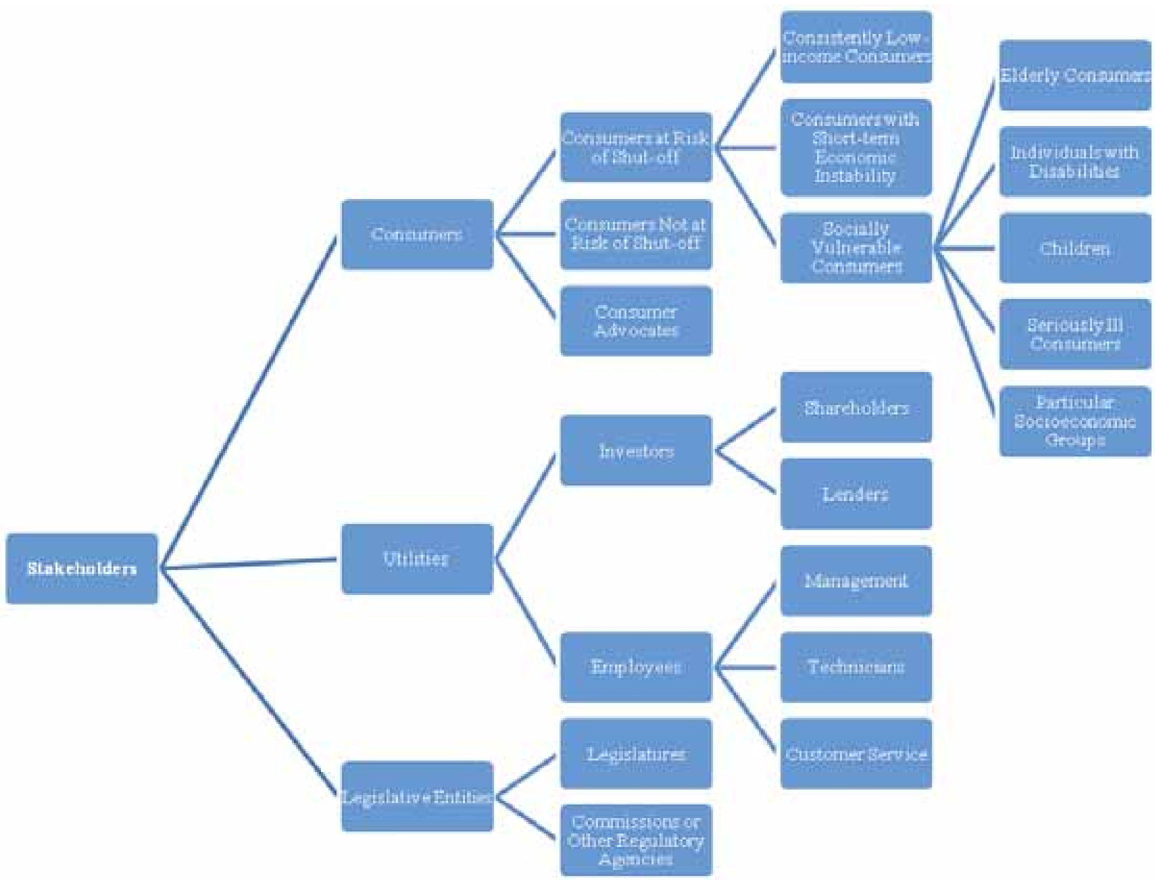


Figure 2. Stakeholders in utility disconnections

LEGISLATORS AND REGULATORS

Legislators and regulators share in the interests of both the utilities and the consumers, and they may have their own political or professional interests, but they ultimately must select a disconnection policy that will work best for the people in their state or jurisdiction.[58] In the face of these potentially competing interests, it is critical that regulators are engaged in determining how they can align the views of different stakeholders to create effective and socially-conscious disconnection policy.

DISPROPORTIONATE ENERGY BURDENS

"Something like electricity, that's really just an essential of living a normal life."

-Rudy Sylvan[59]

There are many issues with the way utilities construct and apply disconnection policies in the United States. Utility disconnections can have a discriminatory impact on low income people, people of color, elderly people, people with special health needs, and other socially vulnerable utility customers who disproportionately face potential violations of human rights. Utility companies, regulators, and legislatures have developed suites of protections, which if implemented appropriately can remediate several critical concerns for vulnerable populations. These concerns include:

1. Customers with limited income bear a disproportionate burden of energy bills;
2. Disconnections have a disparate impact on low income communities and communities of color;
3. Customers may be reliant on utility services for medical devices and life-supporting systems; and
4. Vulnerable customers' use of hazardous heating, cooling, and lighting measures can have harmful and even fatal results.

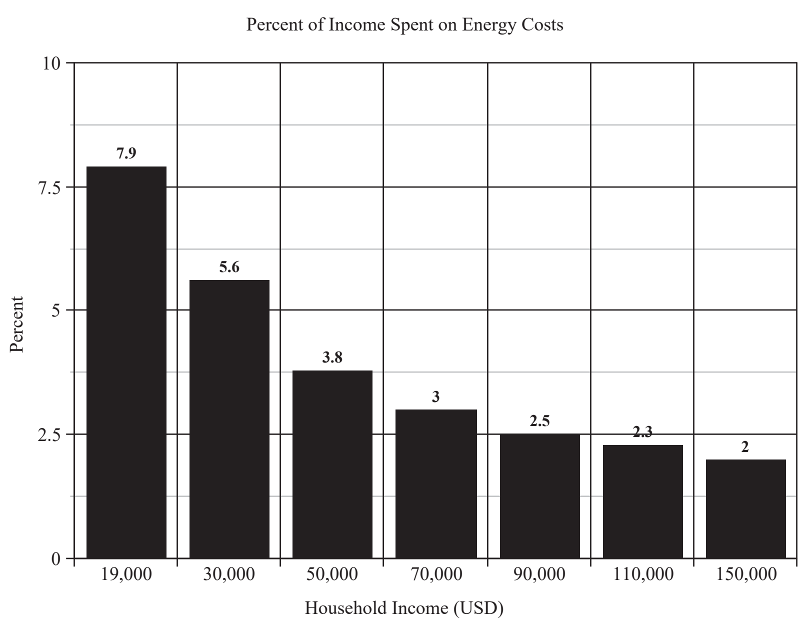


Figure3. Household Energy Burdens by household income

ENERGY BURDEN ON LOW-INCOME HOUSEHOLDS

About 48% of American families (approximately 59 million households) have pre-tax annual incomes of $50,000 or less, with an average after-tax income among these households of $22,732—less than $1,900 per month. Since families of color and seniors have comparatively lower median incomes, these groups are among the people who are most vulnerable to rising energy costs. “Median income” can be considered the midpoint, where one-half of households have incomes above this amount, and one-half have incomes below it. In 2015, the U.S. median household income was about $51,939. Table1 provides a summary of the median incomes of especially vulnerable households compared to the U.S median.[60]

Utility customers with limited income are at a higher risk of having their utilities disconnected due to nonpayment. This is due, in part, to the nature of utility payments. Utility costs often make up a larger portion of expenses for households with limited extra income (Figure 3,[61] and these costs can change throughout the year as increased heating or cooling is needed.[62] Energy costs are consuming as much of the incomes of America’s lower- and middle-income families as the cost of other basic needs, such as housing, food and health care. Additionally, households with limited extra income may live in older homes that are less energy efficient, and they may not have the financial ability to pay for efficiency upgrades.[63] Customers having trouble affording electric service may also be struggling to maintain cell phone or internet service. Many existing policies around disconnection procedures ignore this and provide notice solely through electronic means.

Table 1. Mean Income for Vulnerable Groups in the United States vs. the National Median Income

Household Type	Percentage of U.S. Households	Median Income	Amount Lower than U.S. Median Income
African-American	13%	$45,186.93	-$6,752.07
Latino/Hispanic	13%	$45,186.93	-$6,752.07
Age 65+	23%	$39,993.03	-$11,945.97

Table 2. Utility disconnections in Cleveland, OH 2014-2015

Total Service Disconnections for Nonpayment Jun 2014 – May 2015	
Cleveland Electric Illuminating Company	14,594
Columbia Gas of Ohio	92,313
Dominion East Ohio	62,398
Orwell Natural Gas	$216
Total	**169,521**

Table 3. Unpaid bills for disconnections in Cleveland, OH 2014-2015

Total Number of Unpaid Bills for Disconnections Jun 2014 – May 2015	
Cleveland Electric Illuminating Company	12,306,545
Columbia Gas of Ohio	62,593,567
Dominion East Ohio	63,585,403
Orwell Natural Gas	86,447
Total	**138,571,962**

The cost of energy is not dramatically different for households that have significantly different incomes, which increases the likelihood that customers with little extra income will fall behind on utility payments and risk disconnection due to nonpayment. Utility cost remain significantly unchanged over all income groups is because: [64]

1. Electricity and other utility services are a basic human need, not a luxury, making it relatively inelastic to income compared to consumer goods;

2. Even if low-income families do use less electricity, there is an energy efficiency gap, in terms of housing and access to the proper technology; and
3. A significant portion of electricity bills are paid via fixed costs, which means it doesn't matter how much electricity you use or don't.

In 2009, households with incomes of less than $20,000 spent an average of $1,571 on utilities while households with incomes of $100,000–$119,999 spent an average of $2,572.[65] While these customers' relative incomes increased by more than 500%, the price they pay for utilities increases by only 163.7%. The reasons listed above have contributed to this pattern.

Disconnections due to nonpayment occur in significant amounts, and are on the rise in some areas.[66] In Ohio, four gas and electric companies serving the Cleveland area reported 169,521 service disconnections due to nonpayment during the twelve months between June of 2014 and May of 2015 (Table 2).[67] These disconnections equate to approximately $138,571,962 in unpaid utility bills, which averages to just over $800 per disconnection (Table 3).[68]

> **"The cost benefit analysis of how the utility business model is structured around utility shut offs in the face of such wealth building focus means a choice of life and death for some and the choice between a Porsche and an Audi for others.''**
>
> *-Jacqueline Patterson, Director, NAACP Environmental and Climate Justice Program*

PROFITEERING OF UTILITY COMPANIES

When considering that utility company executives make millions of dollars in bonuses and pay increases, annually, that exceed the amount of revenue lost to nonpayment is a further sign of injustice. First Energy, the parent company of Cleveland Electric Illuminating Company, made over $16 million *in performance bonuses alone* at the end of 2016, more than enough to cover the debt of disconnected customers from the previous year (Table 4). Disparities such as this are common, and even more drastic in other regions of the U.S. As shown in Appendix A, Ohio, as well as many other states, have electric affordability indexes above the national average (2.5%). Tennessee, South Carolina, Mississippi, Alabama, and Hawaii all have energy affordability indexes equal to or more than 3.5%. In these states, the average customer faces a higher energy burden. A burden that is deeply felt by low income and socially vulnerable populations. The stark contrast between the amount of money utility companies spend on executive bonuses and unnecessary infrastructure, illuminates the larger issue of profiteering within the energy industry.

DTE Headquarters in Detroit, MI
Source: U.S. Department of Energy

Detroit, MI Residences in the DTE Service Territory
Source: Fireplace Chats

Table 4. First Energy Executive Compensation FY 2015-2016

Cleveland Electric Illuminating Company (First Energy) 2015-2016			
Executive	Base Salary	Total Compensation	Pay Increase
1	$ 1,118,558.00	$ 4,238,701.00	$ 3,120,143.00
2	$ 636,154.00	$ 2,339,431.00	$ 1,703,277.00
3	$ 510,231.00	$ 7,054,125.00	$ 6,543,894.00
4	$ 752,789.00	$ 3,004,793.00	$ 2,252,004.00
5	$ 599,176.00	$ 2,135,552.00	$ 1,536,376.00
6	$ 552,404.00	$ 2,017,272.00	$ 1,464,868.00
Total	$ 4,169,312.00	$ 20,789,874.00	$ 16,620,562.00

DISPARATE IMPACT ON LOW INCOME COMMUNITIES AND COMMUNITIES OF COLOR

African Americans spend a significantly higher amount of their total incomes on energy—including electricity, heating, fuel, and the energy used to produce, package, transport and sell goods—than the general U.S. population, except in higher income groups. The American Association of Blacks in Energy argues that this occurs for two reasons:[69]

1. African Americans are more than twice as likely to live in poverty as non-African Americans. Low income households pay similar amounts for electricity and heating as high income households; and
2. African Americans spend a significantly higher fraction of their household income on electricity and heating than non-African Americans who spend more on energy used in the production and consumption of goods.

In general, low income populations spend a significantly higher fraction of expenditures on energy purchases than the middle-class and the wealthy: 13% of expenditures in the lowest income groups as opposed to just 5% of household income in the highest income groups.[70] The higher percentage of low income African Americans exacerbates the vulnerability of African Americans to high energy prices and in turn utility disconnections. This helps explain why increases in energy prices are likely to negatively impact African Americans more significantly than the general population.[71] In addition to the economic burden of high prices, to the extent that low income customers, low income African Americans customers in particular, choose to forgo or trade-off energy use with other necessities such as food and health care, high energy prices can represent a significant health hazard.[72] The choice between utility services and other necessities is not an easy choice. In a 2011 survey, lower-income households reported the following reactions to high energy bills:

- 24% went without food for at least one day;
- 37% went without medical or dental care;
- 34% did not fill a prescription or took less than the full dose; and.
- 19% had someone become sick because their home was too cold.[73]

While having limited extra income puts individuals at higher risk for being disconnected due to nonpayment, a customer's race may also influence how likely an individual is to be disconnected from utility service. Data from the 2009 United States Energy Information Administration's Residential Energy Consumption Survey indicates that even among financially similar customers, African Americans experienced disconnections more frequently.[74] Among all households at or below 150% of the federal poverty level, 11.3% of African American headed households were shut off in contrast to 5.5% of Caucasian headed households.[75] While every region of the United States reflected this disparity, it was most prominent in the southern region, where 16% of African American headed households at or below 150% of the poverty level were disconnected compared to approximately 6% of Caucasian headed households.[76] In this case, intentional discrimination can be difficult to prove without concrete data and research of the differences between groups in the prioritization of energy bills over other expenses. These disparities may be the result of institutional racism; uneven levels of consumer education; differences in savings, available income, or outside assistance; and geographic density of customers based on race.[77]

"Regardless of whether it's shut off or simply that bills are so high that people voluntarily limit usage, several things happen. People use space heaters, kerosene heaters, that increase risk of fire and carbon monoxide poisoning. And people limit use of electricity. They light the home with candles, which are often too close to something combustible."

-David Fox of the National Low-Income Energy Consortium (NLIEC)

USE OF HAZARDOUS HEATING METHODS

Despite the significant costs of utilities on customers with limited extra income, the use of utility services remains necessary. Heating and cooling homes accounts for 47.7% of all residential energy consumption, with 41.5% of all residential consumption going solely to heating.[78] Customers use more energy in months when heating is necessary, and customers with little extra income may be especially vulnerable to disconnection during these more costly months.[79] For customers who live in colder climates, or who experience unusually extreme weather, the consequences of being disconnected throughout the winter months are potentially severe.

A family sits and waits as emergency respondents extinguish the flames
Source: Denver Post

Customers take risks when they turn to alternative heating or light sources, such as space heaters, candles or generators, which can cause fires or emit toxic carbon monoxide.[80] As noted, there have been publicized deaths that resulted from the disconnection of a heat-utility during the winter months. ***According to the National Fire Protection Association, while only 32 percent of home heating fires involve space heaters, heaters are involved in 79 percent of home heating fire deaths.***[81] Customers face additional health hazards throughout the year particularly when they are left without air conditioning in extreme heat, and when electricity is disconnected from customers who rely on the service to power their medical devices.[82]

TYPES OF DISCONNECTION POLICIES

The policies and protections outlined in this section are common among all types of utility companies. But these are particularly measures outlined by state legislatures and authorized regulatory bodies (i.e. Public Utility Commissions, Public Service Commissions, and other bodies) for the regulation of IOUs. Many of these protections are also used by Publically-Owned Utilities (POUS) and Customer Owned Utilities (COUs).

PROCEDURAL PROTECTIONS AND CONSIDERATIONS

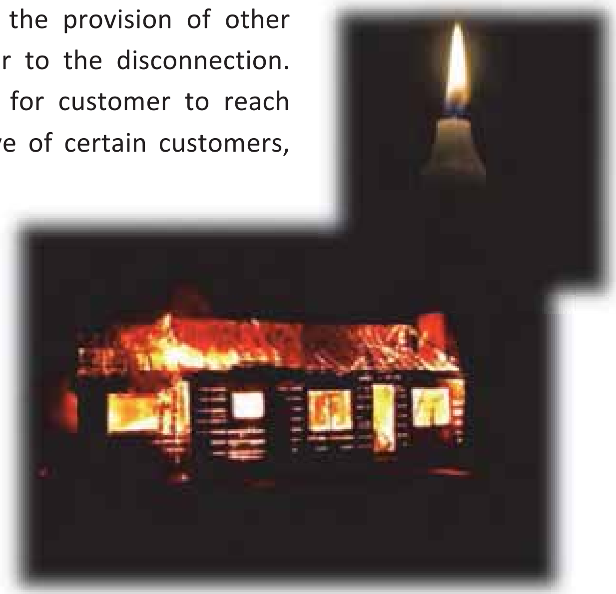
Procedural protections that are commonly included in disconnection policies include adequate notice prior to disconnection of the utility service and limitations on when disconnections may occur. An additional procedural option often used by states is the imposition of fees for disconnecting or reconnecting a utility service to a customer. Utility services can be disconnected and reconnected in person and remotely, depending on the type of meter or infrastructure onsite. Producers for in person or automated disconnection and reconnections have varying policies in several states. This includes differences in notice and associated fees.

Louisville, KY November 15, 2016: House Fire caused using space heater
Source: [WLKY, Kentucky]

Notice: Is a constitutionally assured procedural right that must be given to all customers before termination of utility service.[83] In addition to being constitutionally required, providing a robust notice to customers ensures that customers are aware that they are delinquent in their payments. This not only protects the customer from being disconnected, but it alerts customers of their duty to pay for the utility service. Though a minimum level of notice is required before any utility may be disconnected for nonpayment, the length of notice and notice procedures vary widely in different states. Typically, notice is given by mail, by posting of the notice at the customer's home, by delivery to the customer, by phone, or, in limited states, by email.[84] Some states require that notice be provided in multiple languages.[85]

Limitations on Disconnection: Many states choose to limit the days and times when utilities may disconnect a customer from service. Enacting these limitations often protects customers from being disconnected at a time when they would be unable to quickly remedy the disconnection. Most states will, at minimum, limit disconnections to business hours on days when the utility is open and available to receive a customer's payment.[86] Some states offer more customer protection by allowing disconnection only during limited hours of the business day. If a state requires personal notice before a disconnection, the state may be more lenient with the hours and days on which a disconnection may take place.

Disconnection and Reconnection Fees: Almost every state explicitly authorizes reconnection fees.[87] Reconnection fees are authorized to allow a utility to collect additional payment for the acts of disconnection and reconnection, and the provision of other customer service interactions with the customer prior to the disconnection. Reconnection fees are often adopted as a deterrent for customer to reach disconnected status.[88] Other states are more protective of certain customers, such as the elderly or low-income customers for whom a fee would prevent reconnection.[89] Some states also authorize the collection of a fee for disconnection.[90] The fee amounts and procedures for disconnection and reconnection vary among states. The Public Utility Commission, of Ohio provides a Winter Reconnect Order for residential customers under the threat of disconnection or who have been disconnected to file for have their service reconnected or maintained for the winter months. Customers filing an order must pay a $175 fee to retain service and an additional reconnection fee of $36 to reconnect service.[91] Some states, including Arkansas, do not charge disconnection fees, but may still allow for utilities to charge reconnection fees.[92]



House fires can start from even a lit candle when used for heating and light in a home

In most cases disconnection and reconnection fees are still applied for remote disconnections and reconnections—remote connections can be made simply by flipping a switch. Disconnection and reconnection fees are another obstacle for customers at risk of disconnection, as well as those who have already been disconnected. Utility companies that offer these fees as disincentives for customers do not recognize that disconnections themselves are disincentives for most customers. These administrative polices do not help any customer, but further endanger customer well-being.

Deposits and Guarantees: In some states, new utility customers or customers with poor payment history, utility companies can require payment of a deposit or the submission of a letter of guarantee from a third party able to pay in lieu of the customer. Many PCU's and other utility regulatory bodies set minimums and maximums on deposit amounts and prescribe payment installment programs for paying deposits more than a set amount.[93] Deposits are often required on top of reconnection fees and arrears.[94] Deposit amounts vary from state to state and have been reported in excess of $150.[95]

SEASONAL PROTECTIONS


Resident reveals the duct taped windows in her Claremont Houses apartment in the Bronx, NY.
Source: David Wexler, New York Daily News

Seasonal protections are included in the disconnection policies of many states. Seasonal protections are generally date-based, temperature-based, or include a combination of both protections. Most seasonal protection policies apply to winter months or cold temperatures, but some also apply to summer months and extreme heat. Seasonal protections are usually implemented to protect customers from the health risks associated with having a utility disconnected during periods that could be especially dangerous to health.

Date-Based Protections: These protections set specific dates of when customers cannot, without due diligence, be disconnected from a utility service. Dates typically span the late fall to early spring months, when temperatures are at their lowest. Though less common, some states implement date-based protection periods for the summer months as well.[96]

Temperature-Based Protections: Many states have a temperature-based protection plan to protect customers from extreme cold weather. These protections acknowledge the dangers that customers face when they are disconnected from a utility that may be providing them with heat during periods of cold weather.

PAYMENT ASSISTANCE

"[S]ome energy companies will offer the bare minimum in assistance. Many application assistance locations are inaccessible to disadvantaged populations... [P]rogram applications require multiple sources of documents and are so lengthy, complex and intrusive that needy applicants are discouraged from completing them. The process of applying for energy bill payment assistance should not cause added humiliation."

-Katherine Egland, Member, National NAACP Board of Directors

Many states require utilities to offer payment plans that may allow a customer to avoid disconnection or to more easily afford their bills throughout the course of the year. These plans can take many forms. One common option allows for all customers to enter a "budget billing" or "leveled plan." These plans are typically available to any eligible customer, and it allows a customer to divide a yearly bill evenly over twelve months.[97]A second common option is offered only to customers who are at risk of having their utility disconnected. These customers are given a chance to pay the amount due in portions rather than all at once, which allows a customer to expedite reconnection to the utility service.[98] Payment plans are also frequently required to avoid disconnection during seasonal protective periods.[99]

PROTECTIONS FOR SOCIALLY VULNERABLE GROUPS

Most states offer protection for groups that may be considered especially vulnerable to the risks and hazards associated with utility disconnections. Traditionally, this category includes protection for people who are elderly, people with special health conditions, and individuals with disabilities. Most states only require utilities to offer protections to socially vulnerable customers who register with the utility; however, for some of these groups, registration may be a barrier that prevents them from being protected under the applicable laws.

STATE DISCONNECTION PROTECTION POLICIES

Disconnection protections vary significantly by state. The combination of protections provided by utilities is ideally fit to the context of that state and its definition of public interest, however, these considerations do not result in adequate protections in all cases. To truly uphold human rights, in the public interest, the ultimate aim is to eliminate disconnections altogether and, pending broader system reform, ensure the absolute highest level of protection for vulnerable households facing disconnection. Table 5 illustrates how different protection policies and prescriptions are state by state.

Table 6 indicates the general utility disconnection policies for each state. Most states require utility companies to provide a written, phone, or personally delivered notice before a disconnection. Date based protections take place during the colder months, usually between the months of November and March or April. Temperature protections are based on various ranges of hot and cold temperatures that could place residents in danger. Most of the states will not disconnect when temperatures below 32F or above 95F, but the offering of this protection varies by state. Most the states offer a payment plan option to avoid disconnections and charge a fee to reconnect to utility services. Medical protections are generally offered for disabled or elderly customers. Generally, a medical certificate is required to postpone a disconnection for various amounts of time. There is a wide range of disconnection limitations. Some states will not disconnect during certain hours of days of the week, while other states will not disconnect before or during a holiday. A detailed compilation of utility disconnection protections can be found in Appendix B.

MODEL STATE POLICIES

The following polices are key examples of what utilities can do to provide more protective disconnection polices. These policies represent a step toward a more human rights based utility structure.

NOTICE

- In Oregon, a utility must provide a written notice by mail or delivery at least fifteen days before the scheduled disconnection.[100] A second notice must then be mailed or delivered five days before the scheduled disconnection.[101] The utility must attempt to make personal contact with the customer immediately before the disconnection, and if this attempt is unsuccessful, the utility must post a notice at the customer's residence.[102] Additionally, Oregon requires special notice protections following a disconnection when a utility is able to disconnect a customer remotely without making personal contact.[103]
- Some states require that notice be provided in multiple languages, as in Colorado where a utility must provide notice in English and "languages other than English where the utility's service territory contains a population of at least ten percent who speak a specific language other than English as their primary language as determined by the latest U.S. Census information."[104]

LIMITATIONS ON DISCONNECTION

- In Iowa, a customer may only be disconnected between the hours of 6:00am and 2:00pm, which ensures that a customer has an opportunity to be reconnected the same day that the disconnection takes place.[105]
- Most states provide avenues for renters to address situations where landlords fail to pay utility bills. In these instances, if a landlord fails to provide a utility, they can be held in violation of state and local housing codes and penalized. Many states have provisions which provide tenants with remedies against utility disconnections including: transferring of rental properties to tenant control; paying utility bills in place of landlords and deducting the amount from rent payments; and/or avenues for legal action and court involvement. [106]

DISCONNECTION AND RECONNECTION FEES

- Arkansas does not charge disconnection fees for water, gas, or electric utilities.[107]

SEASONAL PROTECTIONS

- Rhode Island has one of the most protective date-based winter seasonal protection plans. The regulation was recently passed, and became effective on November 2, 2016.[108] During the period from November 1–April 15, utilities are severely restricted in their ability to disconnect a customer for nonpayment. Customers who use a utility for their primary heating service may not be terminated unless they have arrearages greater than $500. [109] While customers who have delinquencies greater than this amount may be disconnected, the utility must first file an affidavit with the state's Division of Public Utilities and Carriers at least forty-eight hours before the scheduled disconnection. [110] Additionally, there are no disconnections allowed for any customer who has a protected status with the utility.[111]
- In Pennsylvania, utilities are required to distribute a survey in preparation for the winter protection period.[112] The purpose of the survey is to connect utilities with the customers who have been disconnected prior to the winter protection period. Utilities are encouraged to enter payment agreements with these customers so that they may be reconnected before the winter period begins.[113]

Small children, the elderly, and those with medical conditions and disabilities are particularly vulnerable to exposure to extreme weather
(Child) Source: [Olkbridge Family]
(Woman) Source: [Persimmon Hollow]

PAYMENT ASSISTANCE

- Rhode Island's Henry Shelton Act of 2011 (amended in 2016) establishes an arrearage forgiveness program for customers eligible for Low Income Home Energy Assistance Program (LIHEAP) who have had their utility services disconnected for non-payment or who have been scheduled for disconnection. Participating customers have one-twelfth of their arrearage forgiven for every month of successful payment, for up to $1,500 of forgiveness in a year.[114] This system is based on a similar model in Massachusetts.[115]

PROTECTIONS FOR SOCIALLY VULNERABLE GROUPS

- Massachusetts offers expansive protection for individuals who are seriously ill, elderly, and have disabilities, but the state also requires that utilities take steps to protect young children.[116] No disconnections are allowed for households with children under twelve-months, or for households where the only residents are aged sixty-five or older and minor children.[117]
- To combat barriers to registration for protection programs, North Dakota implemented a utility survey that must be distributed to all new customers and all current customers on an annual basis. This survey questions all customers about any members of the household who qualify for protection due to age, illness, or disability.[118]

Table 5. Survey of State utility customer disconnection protections

State	Procedural Protections	Seasonal Protections	Payment Assistance	Protections for Vulnerable Groups
Alabama	Provide customers with a written notice five days before scheduled disconnection Requires a reconnection charge	When the temperature is forecasted to be 32°F or below for that calendar day, the utility cannot be disconnected	The utility does not have a payment plan option and	Special consideration based on age, disability, medical conditions or other circumstances is granted, but not required
Alaska	Customers receive an initial notice fifteen days before scheduled disconnection, and a second notice is provided in person, by telephone or by posting three days before a disconnection Disconnections can occur Monday-Thursday between 8:00am-5:00pm	Does not require seasonal protections	Deferred payment agreement with the utility to pay their outstanding balance in installments over a period not to exceed 12 months	A customer, who is elderly, ill, dependent on life support systems, or disabled, can have their disconnection postponed for fifteen days
Arkansas	Initial notice to be mailed eight days or delivered five days before the disconnection, Disconnections can only occur during normal business hours No reconnection charges	Disconnections are not permitted between November 1-March 31 Gas utilities may not disconnect for low-income customers When the temperature is 95f or above, disconnections are not allowed for elderly or disabled customers	Offer payment plans for customers, who qualify as low-income, during winter protection period	Customers, who are elderly or have disabilities, must have two notice attempts at least 72 hours before shut off
Kansas	Written notice to be sent ten days before scheduled disconnection and the utility must call two times at least two days before disconnection	Disconnections are not permitted between November 1-March 31 If temperature drops below 35F in the following 48-hour period, disconnections are not permitted	Customers must enter into negotiated payment plan, pay 1/12 of arrearage, 1/12 of current bill and disconnection, reconnection and deposit if applicable and apply for energy assistance funds to avoid disconnection	Customers with a medical certification must also provide proof of inability to pay the bill in full
Tennessee	Requires only a reasonable notice to be provided Does not specify a period for disconnections	Does not offer date based or temperature based protection	Offers payment plans for customers	A thirty day disconnect delay can be granted if physician, public health official or social service official certifies that a household member's health would be adversely affected

Table 6. Disconnection Protection Polices in the United States

State	Notice	Date Based Protection	Temp. Based Protection	Payment Plans	Reconnection Fee	Medical Protections	Disconnection Limitations
Alabama	X		X		X	X	
Alaska	X			X	X		X
Arizona	X		X		X		
Arkansas	X	X	X	X			X
California	X					X	
Colorado	X						
Connecticut	X			X	X	X	
Delaware	X	X	X	X		X	X
D.C.	X		X		X	X	X
Florida	X				X		X
Georgia	X	X	X	X	X	X	X
Hawaii	X					X	X
Idaho	X	X		X		X	X
Illinois	X	X	X	X		X	X
Indiana	X	X		X	X	X	
Iowa	X	X		X	X	X	X
Kansas	X	X	X	X	X	X	
Kentucky	X	X		X			X
Louisiana	X	X	X	X	X	X	X
Maine	X	X		X	X	X	X
Maryland	X	X	X	X		X	X
Massachusetts	X	X		X		X	X
Michigan	X	X		X	X	X	X
Minnesota	X	X	X	X	X	X	X
Mississippi	X	X	X	X	X	X	
Missouri	X	X	X	X	X	X	
Montana	X	X	X	X		X	X
Nebraska	X	X		X	X	X	X
Nevada	X		X	X	X	X	X
New Hampshire	X	X		X	X	X	X
New Jersey	X	X	X	X		X	
New Mexico	X	X		X	X	X	X
New York	X	X		X		X	X
North Carolina	X	X		X	X		X
North Dakota	X			X	X		X
Ohio	X	X		X	X	X	X
Oklahoma	X	X	X	X	X	X	X
Oregon	X			X	X	X	
Pennsylvania	X	X		X	X	X	X
Rhode Island	X	X	X	X	X		X
South Carolina	X	X		X	X	X	X
South Dakota	X	X		X		X	X
Tennessee	X			X		X	
Texas	X		X	X	X	X	X
Utah	X	X		X	X	X	X
Vermont	X	X	X	X	X	X	X
Virginia	X				X	X	X
Washington	X	X		X	X	X	X
West Virginia	X	X		X	X	X	X
Wisconsin	X	X	X	X	X	X	X
Wyoming	X	X	X	X	X	X	X

FINANCING TO REDUCE AND ELIMINATE DISCONNECTIONS

There are financing models that can help reduce the burden of utility costs on at-risk customers. These options are only steps toward a broader vision. It bares emphasis that the injustices of many utility practices are fundamental wrongdoings that contribute to the creation and continuation of poverty. The big picture is economic justice and equity, virtues that are thwarted by current utility business models regardless of strategies to reduce household energy burdens. Bill assistance programs, energy efficiency and weatherization programs, and inclusive financing models are resources that can and should be used in the short term to prevent and reduce the risk of utility disconnection. These approaches are band-aids applied to the symptoms of deep systemic roots of poverty. While they are positive and useful models and resources, they are merely a step toward the ideal.

BILL ASSISTANCE PROGRAMS

Bill assistance programs provide financial assistance for households to pay their immediate home energy bills. There are many federally funded bill assistance programs, the main programs include the: Low Income Home Energy Assistance Program (LIHEAP), the primary federal bill assistance program; Emergency Food and Shelter Program (EFSP), funded by the Federal Emergency Management Agency; and Residential Assistance for Families in Transition (RAFT), provided by the U.S. Department of Housing and Community Development. Federal Bill assistance programs, as well as those operated by non-profits, often have social service and case management resources for households.

Bill assistance programs are often the first solution at risk customers use to avoid utility disconnections
Source: La Casa De Don Pedro

LIHEAP provides funding to states, which is then distributed to qualified households. The funds dispersed by states can be direct bill assistance (the majority of funds), crisis assistance, support for weatherization programs, or other forms of aid to reduce household energy needs. Across most states, household eligibility is established between 150% and 110% of the federal poverty line, or 60% of the state median income.[119] The program also provides direct payments to tenants, who meet income eligibility requirement for fuel assistance, whose heat is included in the rent.[120]

EFSP grants are allocated at the county and regional levels. EFSP tends to pays for only one month’s utility bill and requires that the household has received a shut-off notice. In many states, the same agency that processes LIHEAP applications also administers EFSP funds. The Department of Housing and Community Development's RAFT program provides substantial help with utility and heating bills. Unlike other federal bill assistance programs, RAFT's requirements and regulations tend to change with each fiscal year. Often to qualify for RAFT assistance, households must have at least one dependent child under the age of 21 and at risk of homelessness. Utility bill payments will be made only as part of family re-housing or stabilization plans. RAFT funds are administered by regional non-profit agencies.[121]

Although many bill assistance programs exist, there is still limited federal funding available in most states for low-income residents, and some funding is available from utilities in some states. Many state programs also have trouble reaching their target populations. Even in states with more successful bill assistance programs (e.g. California, New York, Illinois, etc.), only about 1% of the eligible population are reached annually.[122] Although many households receive assistance and can avoid disconnection through bill assistance programs, they are not an effective long term solution.

WEATHERIZATION AND ENERGY EFFICIENCY PROGRAMS

Through upgrading the efficiency of homes, households can reduce the burden of their energy bills. Programs that focus on weatherization and energy efficiency fund longer term solutions to household energy burdens by cutting wasted energy, improving comfort, and lowering costs.[123] Weatherization and energy efficiency retrofits are multi-benefit approaches to alleviating many consequences of living in poverty. When done holistically, the infrastructure and ventilation improvements and use energy efficient appliances that characterize these programs can save a household from undue energy burdens and environmental health hazards.[124] Low income households, the same that are most at risk of utility disconnections, are more often living in sick buildings, homes, and communities with poor environmental health conditions.[125]

Weatherization programs install energy efficiency upgrades aimed at improving the physical space between the interior and exterior of a building, such as weather-stripping doors and windows, air sealing (as seen in the picture above), and installing insulation. Weatherization programs also fund upgrades or repairs to heating and cooling systems.[126] The most effective weatherization and energy efficiency programs address the largest household energy uses with the longest sustained savings (e.g. heating and cooling), which often have the greatest impact on reducing energy burdens.[127]

Weatherization of homes is easy and effective way to reduce energy use
Source: Habitat for Humanity, Prince William County, VA

Unlike bill assistance and most weatherization programs, utility energy efficiency programs can include a variety of program strategies. Some utility energy efficiency programs operate in tandem with local or statewide weatherization efforts, using similar channels to reach customers. The most common low-income energy efficiency approaches are whole-building weatherization, and the installation of low-cost energy efficiency measures (e.g., efficient lighting, high-efficiency showerheads and faucet aerators, and air infiltration reductions). Some utilities operate direct-install programs targeting multifamily rental buildings as part of their low-income program offerings.[128] Building upgrades through weatherization and energy efficiency programs are the primary way of reducing the likelihood of non-payment that most households can employ.

Reductions in energy bills often equal reductions in the risk of disconnection. Even still, investment in energy efficiency and weatherization programs is an underutilized strategy.[129]

INCLUSIVE FINANCING MODELS

Programs that help utility customers pursue home improvements can reduce monthly utility bills. With energy efficiency measures alone, customers are predicted to save $2 trillion by 2030. Inclusive financing programs use a utility tariff rather than a loan to finance cost effective energy upgrades, and they break down the barriers to access so that these savings can be realized. [130] These models are providing an avenue for access for utility customers who may not qualify for direct install programs for low-income customers yet still struggle to make ends meet and keep the lights on.

Utilities that offer inclusive financing can remove major barriers to energy efficiency and renewable energy development by allowing customers to opt into a tariff that authorizes the utility (1) to make site-specific investments in cost effective energy upgrades and (2) to recover its costs with a charge on the bill that is significantly less than the estimated savings. Where inclusive financing programs exists, they are open to all utility customers regardless of their income, credit score, or renter status.[131] Figures 4 and 5, from the Institute for Local Self-Reliance's Energy Democracy Initiative, illustrates the how inclusive financing works in the utility space. Utilities provide contractors with the upfront funding for onsite energy efficiency, weatherization, and renewable energy projects. The resulting savings from those projects is more than the costs added to the utility bill as payment for the project installation and infrastructure. The result is lower monthly utility bills. No utility offering inclusive financing based on the Pays As You Save®(PAYS®) system has reported a single disconnection for non-payment among program participants.

Many utility cooperatives have seen inclusive financing models work. At Roanoke Electric, a utility cooperative in a persistent poverty area of North Carolina, the Upgrade to $ave program has invested in upgrades at more than 300 homes. The estimated average monthly net savings for participating customers

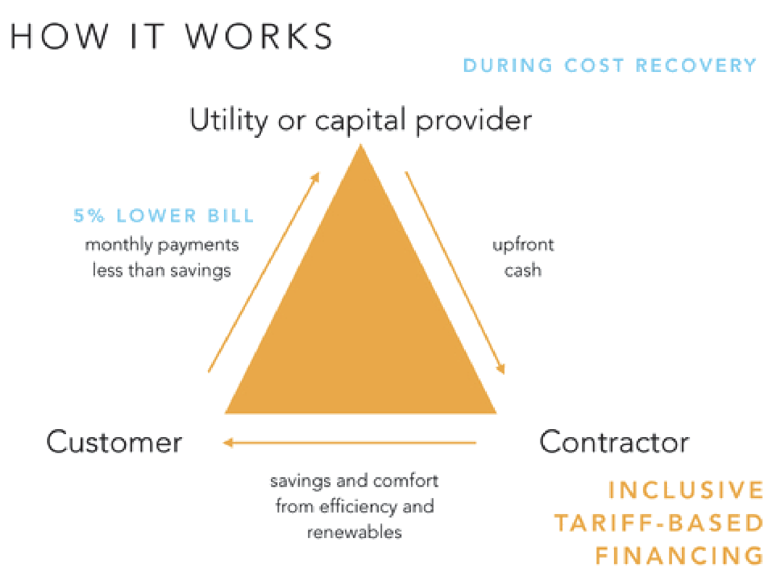


Figure4. Inclusive Financing Model, Source: Local Self-Resilience Energy Democracy Initiative

is around $50, as they pay the monthly program service charge that is capped at 75% of the estimated savings - so the customer net savings from the beginning. [132] With these savings, inclusive financing models have the express potential to reduce and eliminate utility disconnections and provide critical services to vulnerable populations.

Figure 5. Simple overview of how inclusive financing works

THE NEED FOR UNINTERRUPTED SERVICE

"What kind of world do we live in where children can die a fiery death and there is no massive outcry?...We call on everyone opposed to this constant inhumanity against poor people to join us...and demand an immediate moratorium on gas and light shutoffs,"

-Maureen Taylor, State Chairperson, Michigan Welfare Rights Organization

The establishment of a universal **right to uninterrupted energy service** would ensure that provisions are in place to prevent utility disconnection due to non-payment and arrearages.[133] Toward establishing such a right, we call for all utility companies to advocate for and incorporate the following foundational principles into their models, operations, and policies:

1. Secure **ACCESS** to utility services for all households;
2. **INCLUSION** of all customers in the development of utility policies and regulations;
3. **TRANSPARENCY** of the actions of and information held by utility companies, regulating bodies, legislatures, and utility affiliated organizations;
4. **PROTECTION** of the human and civil rights of all customers; and
5. Advance programs that help **ELIMINATE POVERTY**, so that all customers can pay utility bills.

Maureen Taylor of the Michigan Welfare Right Organization
Source: Wiley Price

The policies and protections detailed in this report represent stop-gap measures to lessen harms wrought by a system that is predicated on amassing profits without regard to the impacts on people. In advancing energy justice, all individuals have the right to: safe, sustainable energy production; the resilient and updated energy infrastructure; affordable energy; and uninterrupted energy service.[134] The NAACP calls for the development of policies and utility structures that improve energy efficiency throughout the energy continuum, advance clean and renewable energy production, encourage and enable the development of distributed generation, and protect human life and wellbeing. We further call for a system that puts power in the hands of the people, literally and figuratively. These aspects are components of the larger utility system change that we must build.

Source: People over Profit, twitter.com

There are proven pathways for change. As demonstrated, improved energy efficiency would lower energy bills and make it less likely for utility customers to fall into arrears.[135] The same is true of distributed generation, particularly when paired with Pay As You Save (PAYS) models that would allow households to pay very little for electricity.[136] With greater energy independence and reliance on renewable sources, the entire energy system would be less vulnerable to market fluctuations, which would stabilize costs.[137] Through reducing emissions from fossil fuel based energy production, climate change mitigation goals would also benefit from these shifts. Therefore, the tremendous expense of disaster related outages, which are increasing and have real impacts on utilities' budgets,[138] would be reduced—protecting customers from yet another hazardous outage that is outside of their control.

Utility customers who are disconnected due to non-payment should not face the potential of death and suffering when viable solutions exist. Much action is needed to cease this needless endangerment. Now is the time to expand the research and evidence surrounding the impacts and issues of utility disconnections, as well as reform how we manage and operate the entities that supply these critical services.

IMPROVED DATA COLLECTION, RESEARCH, AND TRANSPARENCY

"For some customers, there is "a permanent level of unaffordability built into the rates.''

-William Yates, Senior Financial Analyst, Public Utility Law Project of New York.

There is a need for more extensive and transparent data and research concerning utility disconnections, nationwide. Until this information is more readily documented, shared, and analyzed our message will be more easily ignored. Where this information does exist, it needs to be made publicly available, especially to customers of utilities.

RECCOMENDATIONS FOR UTILITY COMMISSIONS, REGULATORS, AND UTILITIES

It is the responsibility of utility companies and those who regulate them to ensure that records and data of disconnections are documented and made publicly available, at minimum, to its customer base. In accordance with the rights, principles, and actions previously discussed, we advise public utility commissions, regulators, and utility companies to:

1. Set strict record keeping standards of the entire disconnection/ termination of service process;
2. Conduct studies on the financial and human costs of utility disconnections;
3. Make records of disconnection publicly available on commission, utility, or government websites; and
4. Use this information to evaluate and improve disconnection protection policies and safeguards.

Members of the Committee Against Utility Shutoffs (CAUS) speaking at a community event
Source: CAUS

RECCOMENDATIONS FOR GOVERNMENT AGENCIES AND ORGANIZATIONS

Several federal and state agencies and organizations collect, analyze, and release data and reports regarding the U.S. energy industry at multiple scales (e.g. U.S. Energy Information Administration). To the extent that utility disconnections are a part of these analyses is currently unknown, however, moving forward, it is imperative that this information be included and made publicly available. In accordance with the rights, principles and actions previously discussed, we advise these government agencies and organizations to:

1. Maintain extensive and up to date databases containing disconnection data provided by utility companies and regulatory sources;
2. Obtain, analyze, and make transparent aggregate utility disconnection data in U.S. energy sector reports; and
3. Hold public utility commissions, regulators, and utility companies accountable for providing complete datasets for assessment and dissemination.

RECCOMENDATIONS FOR UNIVERSITY AND NON-PROFIT RESEARCHERS

As a society, we rely on academic and professional research for input into policy development. Thus, researchers from universities and organizations with research capacity (e.g. National Consumer Law Center and the Consumer Federation of America) must also be aware of these issues and conduct studies that foster better understanding of the connections between utility disconnections, their impacts on households, and other industries and sectors. We are asking researchers from colleges, universities, and capable non-profit organizations, particularly those with strong environmental and energy justice programs, to:

1. Expand research on socially conscious utility and energy models;

2. Advance research that impacts all parts of society, particularly vulnerable populations;
3. Partner with communities in and promote community participatory research models; and
4. Use expanded data in accordance with the principles and rights outlined.

UPHOLDING HUMAN RIGHTS IN THE SHORT TERM

"**Utilities are a social right. People have a right not to freeze to death! They have the right not to live on the bare edge of survival. To realize this right, however, we must fight for it. And this demonstration is an initial stage in this fight.**"

-Lawrence Porter, CAUS chairman and SEP Assistant National Secretary[139]

While the end goal is clear—**to prioritize utility policies that place a moratorium on utility service disconnections**— these principles can be furthered through the following practices:

PROCEDURAL PROTECTIONS

1. Require multiple attempts by phone, in writing, and, in person contact before disconnection;
2. Secure notification of disconnection by mail;
3. Require a post-disconnection notice to all customers;
4. Provide additional notice provisions for customers who can be disconnected remotely;
5. Restrict disconnections between 8:00am-2:00pm (or during hours of operations, and not later than 2 hours before close of business) on days when utilities have employees available for reconnections;
6. Provide notice and utility disconnection policies in multiple languages;
7. End policies surrounding disconnection and reconnection fees;
8. Cease the collection of deposits for utility service activation and/or reconnection;
9. Ensure that renters retain access to energy services when nonpayment is the fault of the landlord or other third party;

SEASONAL PROTECTIONS

10. Include seasonal protections with both temperature and date-based solutions;
11. Set disconnection arrearage minimums for customers who use utility services as the primary source of heating or cooling during periods of seasonal protection;
12. Provide utility services during extreme weather events that fall outside of seasonal protection periods;

Committee Against Utility Shutoffs (CAUS) Utility Shut-off Demonstration in Detroit, MI
Source: CAUS

PAYMENT ASSISTANCE

13. Allow budget payment plans to distribute utility costs throughout the year;

14. Allow partial payment plans to customers to prevent disconnections;
15. Provide connections to social services and case management resources for households with delinquent bills (i.e. budgeting, food assistance, and other social services);

PROTECTIONS FOR HOUSEHOLDS THAT ARE SOCIALLY VULNERABLE

16. Establish simple procedures for socially vulnerable groups to apply and be registered for protection from disconnection;
17. Implement customer surveys in advance of extreme weather seasons to screen for socially vulnerable individuals;
18. Ensure active outreach to socially vulnerable customers and households for inclusion in protection programs; and
19. Registration into these programs should be complimented with a notification to local and/or state emergency relief agencies and safety responders.

RECCOMENDATIONS FOR UTILITY COMPANIES

With the intent to incorporate human rights into existing utility business models, we advise Utility Companies and affiliate organizations to:

1. Operate according to the principles and practices of human rights; and
2. Cease investments and lobbying practices that undermine the right to uninterrupted utility services.

RECCOMENDATIONS FORPUBLIC UTILITY COMMISSIONS AND REGULATORS

With the intent to incorporate human rights into existing utility business models, we advise Public Utility Commissions, and regulators to:

1. Enforce and adhere to the principles and practices of a human rights based utility model;
2. Hold public hearings to investigate the extent and nature of disconnections in services areas;
3. Mandate exploration and implementation of energy efficiency, clean energy, and distributed generation programs and technologies;
4. Ensure that regulatory processes, meetings, and proceedings are accessible to all customers; and
5. Hold themselves and utility companies accountable to the concerns of customers.

INVESTOR-OWNED UTILITY ENGAGEMENT

While every state has different regulation rules, it is a common practice to contact the utility as the first step to engagement. Investor-owned utilities are regulated by the Public Service Commission (PSC)/Public Utility Commission (PUC). Generally, PSC/PUC deal with problems or issues that the consumer feels were not solved by the utility, such as,

- Service installation and line extensions
- High bills
- Quality of service
- Meter tests
- Reasonable payment arrangements
- Outages
- Incorrect rates or tariffs
- Unauthorized switching of utility service from one

RECCOMENDATIONS FOR LEGISLATURES

With the intent to incorporate human rights into existing utility business models, it is critical that legislatures:

1. Amend legal definitions of "public interest" to incorporate additional aspects of human rights;
2. Establish policies mandating the principles and practices of the right to uninterrupted utility service;
3. Pass legislation that enables the advancement of energy efficiency and clean energy programs and technology;
4. Pass legislation that enables the advancement of energy independence;
5. Provide utility commissions with a clear public interest mandate to authorize and encourage commissions to regulate on new challenges and topics including climate change, rising energy costs, air pollution, new technologies, and racial discrimination.

Traditional and innovative public interests related to disconnection policies could include: the health, safety, and welfare of the public; consumer protection from monopoly market power; protection of low-income members of society; protection of socially vulnerable groups; protection of socioeconomic group who are disproportionately impacted by utility disconnections; enabling consumers to pay for utilities.

RECCOMENDATIONS FOR UTILITY CUSTOMERS AND CONSUMER ADVOCATES

As customers and advocates, our goal in the short term is to stop the suffering of vulnerable communities and those who face utility disconnection now. We as advocates who seek to secure disconnection policies that fall outside of traditional regulations and protect the right to uninterrupted utility services must:

1. Directly engage state and local legislatures before a commission will pass regulations;
2. Demand legislatures pass specific authorizations for these regulations;
3. Petition utilities and public utility commissions to adopt these principles;
4. Hold utilities accountable for supporting the human rights of customers by documenting and building the evidence of how human and civil rights are violated;
5. Partner with research institutions to conduct community participatory research;
6. Demand improved access to Public Utility Commission and regulatory meetings and proceedings;
7. Demand increased transparency of the operations of utility companies and their affiliates; and
8. Enforce the demand for policies and practices that protect human life through grassroots advocacy (e.g. consumer education, direct negotiations, lobbying, direct action, media campaigns, and litigation where necessary, etc.)

By recognizing energy as a basic need and human right, households would ideally be protected by moratoriums whereby energy services would remain available indefinitely, particularly for vulnerable households and customers. However, right now the goal is to end the current suffering of households that are energy insecure by adopting these principles. In advancing more humane disconnection practices, we must recognize that protections do not curb utility debt accumulation or provide indefinite protections from suffering. Households who experience chronic energy insecurity are not only subjected to shut-offs, but also face increased financial liabilities, exposure to additional health risks, and residential and economic instability.[140] The policies and strategies outlined here represent a movement toward a more humanistic utility model, however, we must exemplify the change we want to see. We must develop community solar gardens and engage in community aggregated choice, while advocating for policies that move communities toward energy sovereignty (e.g. energy efficiency, clean energy, distributed generation, local hire provisions, disadvantaged business enterprise, etc.).

Advocates of the George Wiley Center, RI
Source: George Wiley Center

BUILDING ON THE LEGACY OF CHANGE

In solidarity with organizations and initiatives nationwide, we seek to advance the conversation and action around the creation of utility models that work for consumers and the environment. We stand with those who have worked for decades before us to remove the ills of utility disconnections, including TURN: The Utility Reform Network in California, the George Wiley Center in Rhode Island, the Utility Reform Project in Oregon, New York's Utility Project in New York, the Committee Against Utility Shutoffs (CAUS) and Michigan Welfare Rights Organization (MWRO) in Michigan, and national organizations like the National Consumer Law Center, and the Consumer Federation of America, among others. The work of these and other organizations have saved lives and secured the safety of so many in the states and regions in which they advocate and beyond.

Members of the George Wiley Center have successfully secured the strongest child protection in the country. In Rhode Island, there are guaranteed utility service protections for households in financial hardship with children under two years old. The Center has also challenged the State's Division of Public directly through collective community action to institute Emergency Restoration of utility service to medically vulnerable

LEADING DISCONNECTION PROTECTION WORK NATIONWIDE

TURN-: The Utility Reform Network [CA]advocates for customers and assists them with understanding their bills and utility practices. The group holds utility corporations accountable by demanding fair rates, cleaner energy and strong consumer protections.

http://www.turn.org/

George Wiley Center [RI] organizes people from low-income communities to advocate for systematic change. One of the major campaigns is based on utility justice. The "Know Your Utility Rights" clinics educate consumers on their rights and how to challenge the Division of Public Utilities.

http://www.georgewileycenter.org/utilities

Utility Reform Project [OR]is asking for a reform of the entire utility system. The group wants the control of electric utilities to be in the hands of customers and their elected officials. They want just utility rates and fair billing practices.

http://utilityreform.org/index.htm

New York Utility Project [NY] is advocating for universal service, affordability, and customer protection for New York State utility consumers.

http://utilityproject.org/

Committee Against Utility Shutoffs (CAUS) [MI] is asking for the stop to utility shut offs and for DTE Energy's top executives and government regulators to be held accountable for utility related fires.

https://www.facebook.com/stopshutoffs/

households. These are protections all states should have in place.

In December 2015, New York's Utility Project filed an amicus brief in the United States Supreme Court in Hughes v. PPL EnergyPlus, LLC. The organization sought answers to the following:

> *Whether, when a seller offers to build generation and sell wholesale power on a fixed-rate contract basis, the Federal Power Act field-preempts a state order directing retail utilities to enter into the contract; and whether the Federal Energy Regulatory Commission's (FERC's) acceptance of an annual regional capacity auction preempts states from requiring retail utilities to contract at fixed rates with sellers who are willing to commit to sell into the auction on a long-term basis.*[141]

The Utility Project frequently engages in such legal action to ensure that utility action is in accordance with customer interests and rights.

The NAACP stands with these organizations in the pursuit of the elimination of the practice of utility service disconnection. While establishing and expanding protections is pressing, advocates must remember that the goal is much larger. Utility companies and their associates must be held accountable and be leaders in the transformation of the energy sector. Equity will not be achieved overnight. It will only be achieved through hard work on the part of us all.

LONG TERM VISION

It is crucial to remember that the reforms we are calling for and the tactics we use to achieve them are in the short term to address the emergency circumstances in which all too many households find themselves. In the long term, we must continue to push for systems change, including distributed generation and people owned, human rights centered utilities. It is time to not only eliminate the harmful utility practices, but to correct the extractive economy that we currently face.

Each of the deaths and suffering detailed in this report is an indictment against the companies who wielded power and ignored the cries for mercy in the heartless pursuit of profits, and against the legislators and regulators who failed to provide adequate leadership. In the short term, we can push for the reforms as detailed above. But they've had their chance and it's time for a total system revolution.

The fight against the extractive economy is not about making things better for people who are poor; it is about eliminating poverty, racism, and other social and structural inequities that render households vulnerable. In 2015, the U.S. energy sector made $178 billion from residential energy use alone. As we focus on eliminating poverty while ensuring energy security, one way of doing this is to reform the energy sector, a $6 trillion sector, by transitioning power to the people and anchoring the change in increased energy efficiency distributed generation of clean energy.

There is an opportunity to reinvent this sector, to create a shared economy and keep this money in the hands of citizens. Some individuals, households, and communities have begun to move toward energy sovereignty. Stories such as Amy Mays, (see story on Page 33, *From Persecuted by My Utility to Powered and Empowered by the SUN!)*, provide an example of what can be. It is time for a Just Transition to localized economies, grounded in ecological stewardship, community wellbeing, democratic decision-making, and locally control resources (Figure 6). [142]

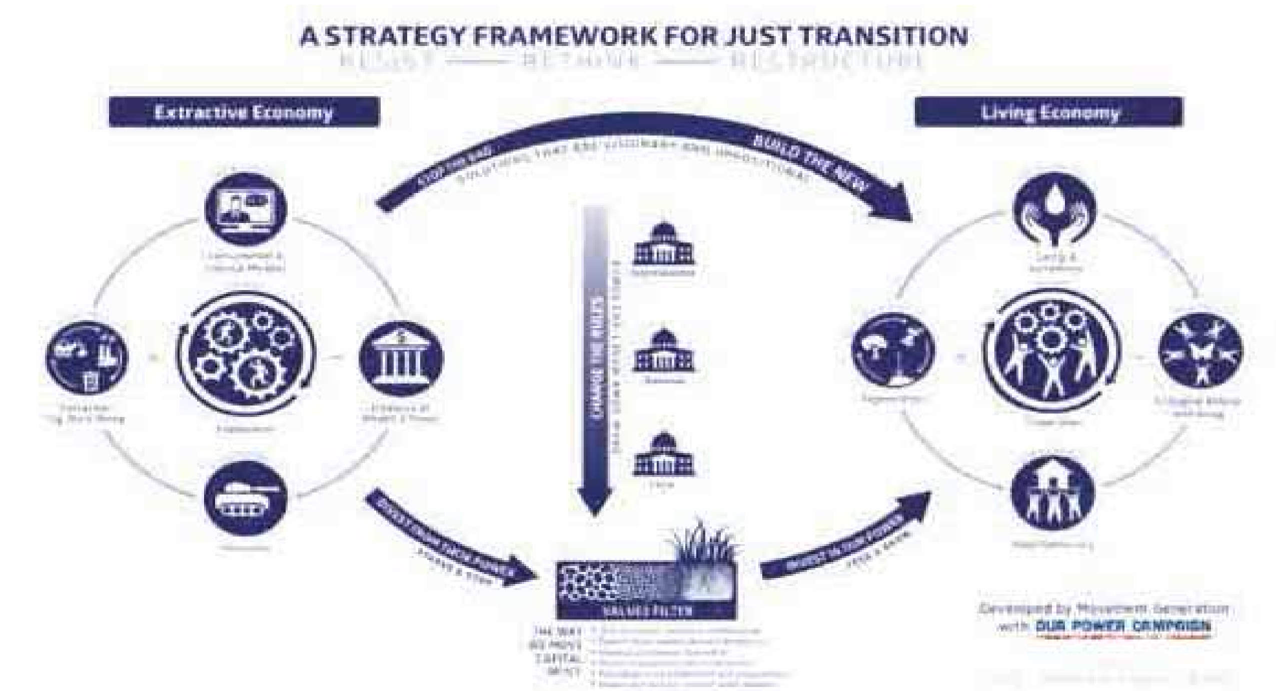


Figure 6. A Just Transition, Source: Our Power Campaign, Climate Justice Alliance

VISION IN ACTION

Amy Mays telling her story at an NAACP Energy Justice Training in 2016

FROM PERSECUTED BY MY UTILITY TO POWERED AND EMPOWERED BY THE SUN! - AMY MAYS, ARIZONA

My story began in 1994 when I opened a beauty shop for my daughter. After we had been in business for four years, my troubles began with the local utility company, Salt River Project (SRP), when they required that I pay an additional deposit to continue to receive electricity services. I fought, but eventually ended up paying the additional deposit. Then, in June 2003, the utility company demanded a further deposit, even though I was current on all payments.

I contacted the Arizona State NAACP office and they convinced the utility company to reconnect the electricity if I paid a portion of the deposit. However, in August 2003, SRP again disconnected the electricity requesting the remainder of the deposit. We did not have the money so they turned off the electricity, which resulted in the closing of our nearly ten-year old business. Even though our service was terminated, with all payments up to date, the utility company inexplicably continued to demand payment for this completely illegitimate "bill."

Since that bill from my closed business went "unpaid," to add insult to injury, the utility company disconnected the electrical power to my home on April 8, 2004.From 2004 to 2006 I suffered without electricity, living out of my ice chest.

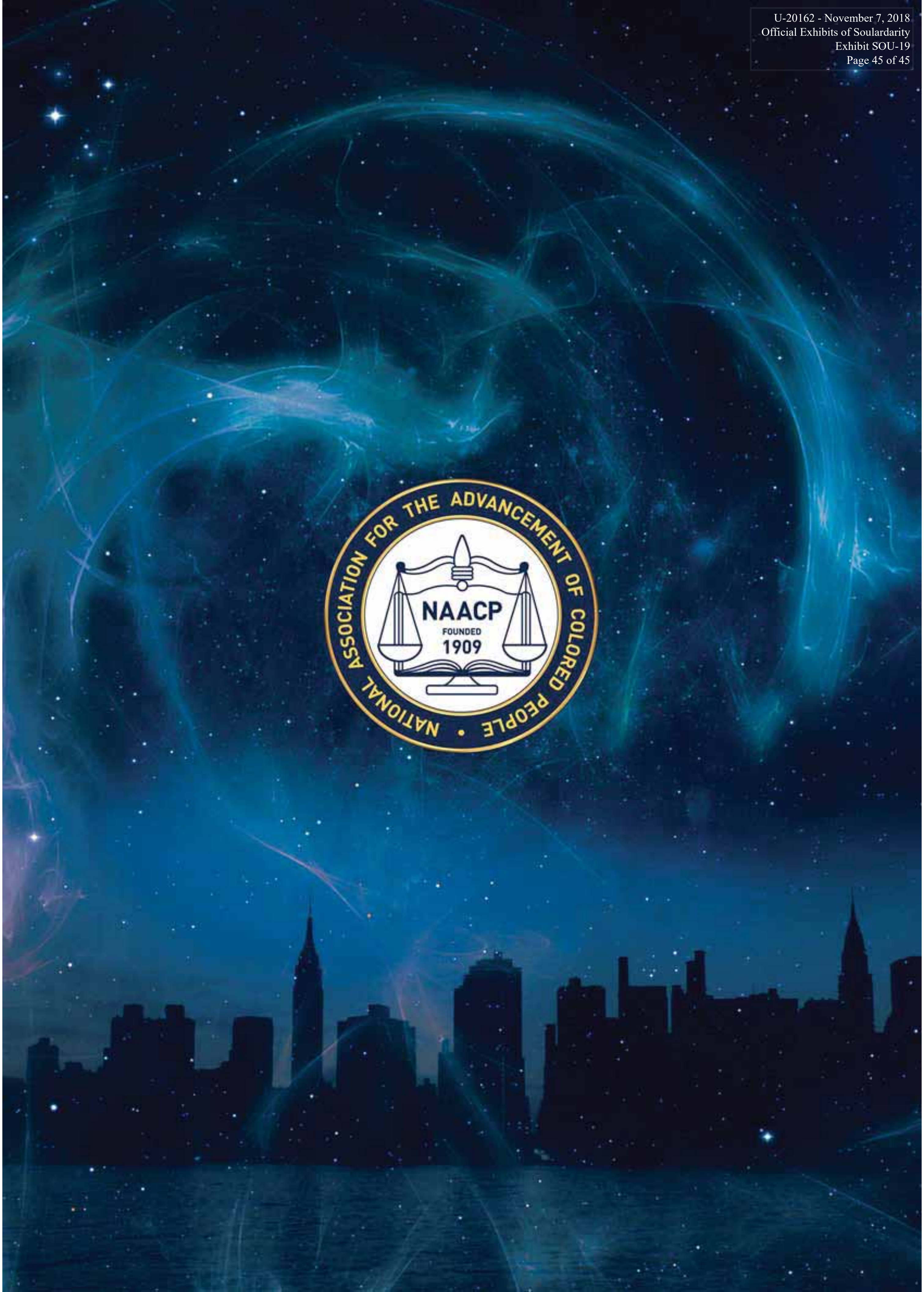
When I first heard about solar panels in 2006 I began reading everything I could about them. I searched online until I located a solar system designed for off-grid cabins. I ordered my first solar system for $5,000. As a trained electrician, I had the skills to install the panels myself. I purchased additional solar panels one or two panels at a time, and the necessary equipment for installation, until I had accumulated enough for an additional system, which I also installed myself. As I've gotten older, I've trained another electrician to help maintain my solar panel system.

Ten years later, now in 2016, my home is still not connected to the utility-operated grid. I haven't paid an electricity bill since 2004, and the savings I have experienced as a result have been tremendous. Without an electricity bill to pay every month, my solar panels paid for themselves and I've been saving money ever since. I will never go back to the utility connection. Through my own rooftop solar panels, I have been liberated from the high rates the utility companies demand and the control they held over me!

With life threatening, high heat temperatures in Arizona, solar has literally saved my life!

I share my story with everyone I meet. In fact, my doctor was so inspired by my story that he recently had solar panels installed on his home. He, too, has been thrilled with his experience going solar and told me that last month his electricity bill has gone down to a mere $30.

It feels good to control my own power and not have to rely on the utility company for anything. I want people to know that if I can find independence through solar, then other people can do the same. The power from the sun is already there and always will be. Now people just need to find ways to use it!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Targeting energy justice: Exploring spatial, racial/ethnic and socioeconomic disparities in urban residential heating energy efficiency

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H I G H L I G H T S

- Develops statistical model to predict block group (BG) residential heating energy use intensity (EUI), an energy efficiency proxy.
- Bivariate and multivariate analyses explore racial/ethnic and socioeconomic relationships with heating EUI.
- BGs with more racial/ethnic minority households had higher heating EUI.
- BGs with lower socioeconomics had higher heating EUI.
- Mapping heating EUI can facilitate effective energy efficiency intervention targeting.

A R T I C L E I N F O

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A B S T R A C T

Fuel poverty, the inability of households to afford adequate energy services, such as heating, is a major energy justice concern. Increasing residential energy efficiency is a strategic fuel poverty intervention. However, the absence of easily accessible household energy data impedes effective targeting of energy efficiency programs. This paper uses publicly available data, bottom-up modeling and small-area estimation techniques to predict the mean census block group residential heating energy use intensity (EUI), an energy efficiency proxy, in Kansas City, Missouri. Results mapped using geographic information systems (GIS) and statistical analysis, show disparities in the relationship between heating EUI and spatial, racial/ethnic, and socioeconomic block group characteristics. Block groups with lower median incomes, a greater percentage of households below poverty, a greater percentage of racial/ethnic minority headed-households, and a larger percentage of adults with less than a high school education were, on average, less energy efficient (higher EUIs). Results also imply that racial segregation, which continues to influence urban housing choices, exposes Black and Hispanic households to increased fuel poverty vulnerability. Lastly, the spatial concentration and demographics of vulnerable block groups suggest proactive, area- and community-based targeting of energy efficiency assistance programs may be more effective than existing self-referral approaches.

1. Introduction

Climate change concerns highlight a number of serious social and environmental inequalities that can be traced to energy consumption. These concerns form the foundation of a growing field of scholarship, and activism, on energy justice. For instance, Hernández (2015) issued "*A Call for Energy Justice*," which acknowledged four basic human rights to energy: the right to a healthy, sustainable energy production; the right to best available energy infrastructure; the right to affordable energy; and the right to uninterrupted energy service. For the many US households suffering in fuel poverty, nearly 14 million with unpaid utility bills and 2.2 million with disconnected utilities, these rights are unfulfilled promises (Seibens, 2013). Fuel poverty (also known as energy poverty or energy insecurity) is the inability of households to afford energy services for adequate heating and cooling resulting in uncomfortable indoor temperatures, material deprivation, and accumulated utility debt (Li et al., 2014, Hernández 2013, Buzar, 2007; Boardman, 2012). More than a matter of mere comfort, indoor temperatures that are too cold in winter or too hot in summer have detrimental mental and physical health impacts, including death, for vulnerable populations like children, the elderly, and racial/ethnic minorities (Anderson et al., 2012; Liddell

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and Morris, 2010, Howden-Chapman et al., 2009, Howden-Chapman et al., 2007, Klinenberg, 2002; Taylor et al., 2001). A key measurement of fuel poverty is the proportion of gross income spent on home energy costs, or the energy burden. Low-income US households have an average heating energy burden of 4.7% that is more than double the 2.3% national average and more than four times the 1.1% average burden for high-income households (US Department of Health and Human Services [HHS] 2011). Analysts consider a heating energy burden greater than 2% unaffordable (Fisher et al., 2014).

However, fuel poverty is more than a straightforward relationship between household income and energy costs. The concept became prominent in the 1980s and has been well-studied in the UK (see special issue Volume 49 of this journal) and even codified in law with the passage of the Warm Homes and Energy Conservation Act of 2000. Investigations of fuel poverty, including those beyond the UK, demonstrate that a pure financial assessment of its prevalence does not account for the variety of factors and relationships that produce and sustain it. Buzar (2007) advocated a "relational approach" to studying fuel poverty, one that combines understanding energy policy, housing infrastructures, and the lived experience of the fuel poor. Hernandez and Bird (2010) found the incidence of high inner-city energy burdens was due in part to a lack of energy assistance funding, a lack of housing and energy policy coordination, and a lack of understanding the social and economic benefits of energy conservation and efficiency. Harrison and Popke (2011) suggested fuel poverty be understood "as a geographical assemblage of networked materialities and socioeconomic relations" determined by household socioeconomic characteristics, material conditions of the home, and the structure that defines the provision of energy.

The conceptualization of fuel poverty as an energy justice concern speaks to the energy-related distribution, procedure, and recognition of "what constitutes the basic rights and entitlements of sufficient and healthy everyday life" (Walker and Day, 2012). Consequently, fuel poverty violates the basic principle of distributive justice. Distributive justice is the idea that all members of society have the right to equal treatment, and that outcomes should be fairly distributed, and provides moral guidance for the political processes and structures that affect the distribution of economic benefits and burden across and within society (Rawls, 1971; Sen, 1999 Schlosberg, 2013). As a distributive injustice, fuel poverty results from three interconnected inequalities: income inequality, inequality in energy prices, and inequalities in housing and energy efficiency (Walker and Day, 2012). Although fundamentally, fuel poverty is a problem of distributional injustice, its production and persistence are also the result of an injustice in recognition of the specific energy-related needs of vulnerable populations, and procedural injustice related to access to information, meaningful participation in decision-making, and access to legal processes for achieving redress or challenging decision-making processes (Walker and Day, 2012).

Addressing the distributive injustice of fuel poverty requires first determining what should be fairly distributed. Since inequalities in income and energy prices require larger social and economic solutions, residential energy efficiency retrofits have become a key fuel poverty intervention strategy (Howden-Chapman et al., 2007, Howden-Chapman et al., 2009, Bird and Hernández 2012, Gibson et al., 2011, Harrison and Popke, 2011). However, the absence of easily accessible data on individual household energy consumption and efficiency, and an incomplete understanding of the spatial distribution of vulnerability presents an impediment to effectively targeting those most in need (Walker et al., 2013; Sefton, 2002). Recently, scholars have conducted small-scale, area-based studies using readily available public data and geographic information systems (GIS) to offer visualizations of spatial disparities in the distribution of fuel poverty vulnerability and energy consumption to facilitate policymaking and intervention targeting (Pereira and de Assis, 2013; Walker et al., 2013; Fahmy et al., 2011; Morrison and Shortt, 2008).

In the US, while fuel poverty is neither recognized colloquially or politically, a few studies have modeled the spatial distribution of residential energy consumption, including socioeconomic and demographic control variables in their models (Howard et al., 2012; Min et al., 2010; Heiple and Sailor, 2008). Others have explored the socioeconomic and demographic relationships of national residential energy consumption patterns (Health and Human Services [HHS] 2011; Steemers and Yun, 2009; Ewing and Rong, 2008; Adua and Sharp, 2011; Newman and Day, 1975). Generally, these studies concluded that, all else being equal, low-income households consume less energy. This broad assessment of consumption rather than efficiency, tends to mask fuel poverty vulnerability. Instead, when analyzing energy use intensity (EUI), or energy consumption normalized by building square area, as a proxy for energy efficiency, national data from the US Energy Information Administration (EIA) show that low-income household, on average, are less efficient, with an EUI 27% greater than high-income households. The spatial distribution of energy efficiency is further complicated by a persistent system of racial and income residential segregation that defines housing development and consumption patterns in many US metropolitan areas. A substantial amount of research is aimed at understanding the causes and consequences of residential segregation, primarily from the fields of sociology and public health (Sampson, 2012; Sharkey, 2011; Anthopolos et al., 2011; Sampson and Wilson, 1995; Wilson, 1987). But very little of this research is connected to energy-related research in meaningful ways that illustrates the critical importance of place to the presence of energy efficiency disparities and fuel poverty vulnerability.

This paper uses publicly available data to model residential heating energy efficiency, as a function of various housing and household characteristics for a tri-county metropolitan area. The study extends previous energy consumption and social justice oriented research by predicting small-area estimation of end use energy efficiency, and then examining racial/ethnic and socioeconomic relationships. This analysis not only furthers our understanding of the dynamics and distribution of energy efficiency disparities, it has practical applications that may assist policymakers and practitioners with developing and implementing more equitable, efficient, and effective targeting of energy assistance programs and weather-related vulnerability prevention activities. This study seeks to answer two research questions. First, does residential heating energy efficiency vary within a metropolitan area? And if so, what are the spatial characteristics of that variation? Second, what are the patterns of association between residential heating energy efficiency and racial/ethnic, and socioeconomic characteristics? The remainder of the paper summarizes the modeling and mapping of residential heating energy efficiency and analysis of the spatial, racial/ethnic, and socioeconomic patterns. Section 2 describes the study area, and methods for developing a model for heating energy efficiency and small-area predictions. Section 3 presents the results of the geographic and statistical analyses. Section 4 concludes with policy implications.

2. Methodology

2.1. Description of study area

Kansas City is the largest city in the State of Missouri and lies mostly in Jackson, Clay, and Platte counties (see Fig. 1). This tri-county region also represents the service area for United Services,

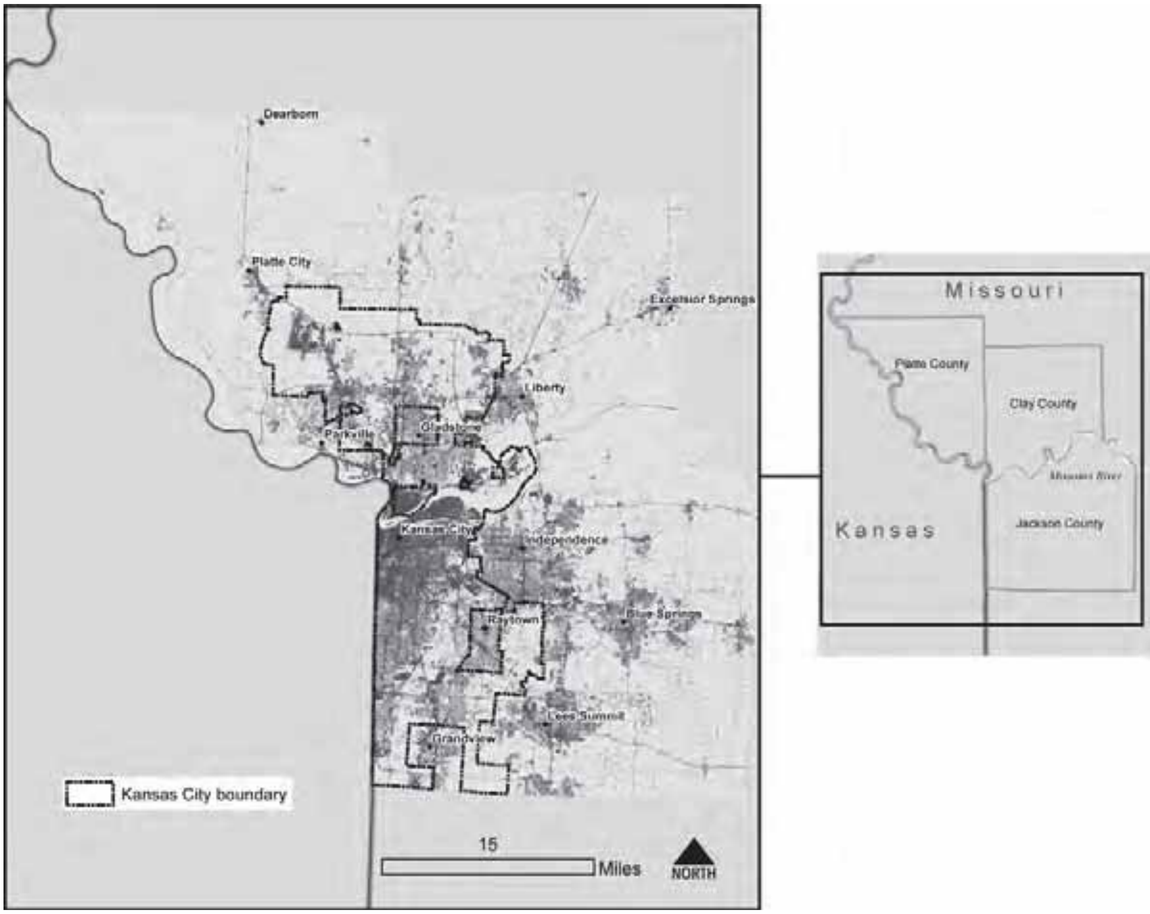

Fig. 1. Study area: Kansas City, Missouri (Jackson, Clay and Platte counties).

one of nation's roughly 1000 Community Action Agencies (CAAs). CAAs are mostly nonprofit, anti-poverty social service organizations covering nearly 96% of US counties. CAAs are responsible for administering federal low-income energy assistance programs, such as, the Department of Health and Human Services Low-income Home Energy Assistance Program which provides utility bill assistance and the Department of Energy Weatherization Assistance Program which provides no-cost energy efficiency retrofits. According to Building America, which determines building practices based on climate zones to achieve the most energy savings in a home, the counties are located in Climate Zone 4, which has a range of 4000–5499 heating degree days (HDDs) annually, and where the average monthly outdoor temperature drops below 47 °F (7 °C) during the winter (U.S. Department of Energy, 2015).[1] Hence, homes in the area exhibit relatively high usage of heating equipment. In fact, space heating accounts for 41% of total household energy consumption in Missouri. The main heating fuel sources are natural gas (52%) and electricity (35%). Overall, the average Missouri household total energy consumption is roughly 100 million BTUs per year, approximately 12% more than the national average (EIA, 2013a).

According to the 2010 decennial census, the counties had a total population of 985,419 in 398,124 households. The area covers urban, suburban, and rural landscapes. In addition to the urbanization gradient, socioeconomic characteristics in the area vary greatly. Median block group income ranged from $14,250 to $154,250. The household racial composition included 77.1% White households, 17.3% Black households, and 5.2% Hispanic households, as identified by the head of household. Kansas City is consistently identified as one of the nation's twenty-five most racially segregated metropolitan areas due to its high placement on a range of housing segregation indices, most recently ranking 23rd based on black-white segregation (Logan and Stults, 2011; Denton, 1994; Massey and Denton, 1993). Kansas City also exhibits a high, and increasing, level of residential segregation by income. According to Pew Research on Social and Demographic Trends, Kansas City's Residential Income Segregation Index score increased from 38 in 1980 to 47 in 2010 (Fry and Taylor, 2012).

2.2. Data

In the absence of detailed individual household energy data, the EIA's Residential Energy Consumption Survey (RECS) provides household-level energy consumption data for a representative sample of occupied, primary residences in the US. The RECS employs a multi-stage area probability design to ensure the selection of a representative sample of housing units, carefully controlled at specified levels of precision, to allow analysis of housing unit characteristics and energy consumption and expenditures at the following geographic levels: national, census region, census division, groups of states within a census division, and individual

[1] Climate zones range from 1 (warmest) to 7 (coldest). Heating degree days (HDDs), commonly used in calculations relating to the energy consumption required to heat buildings, is a measurement of the difference in temperature between the mean outdoor temperature, over a 24-h period, and a given base temperature for if a building's indoor temperature fell below would require heating, typically 65 °F (18 °C) in the US. For example, if the mean outdoor temperature for a day is 35 °F, the HDDs measurement for that day is 65 − 35 = 30. Essentially, areas with a larger number of HDDs have colder outdoor temperatures and require more energy for heating.

states (EIA, 2013b). The RECS, first conducted in 1978, collects data on energy consumption, expenditure and behavior along with a number of household demographics and housing unit characteristics. In the past, the RECS sample size has not been particularly useful for analyzing energy patterns at spatial scales lower than the census region, except for the most populous US states; California, Texas, New York, and Florida. The 13th iteration of the survey, conducted in 2009 and released in 2013, nearly tripled in sample size to 12,083 housing units (up from 4382 in 2005) representing the US Census Bureau's statistical estimate of 113.6 million occupied primary residences. Subsequently, the 2009 RECS allows for additional state-level analysis with the collection of representative samples in 12 additional states, including Missouri. A sample of 686 households were surveyed to represent the 2.35 million occupied housing units in Missouri. For geographic domain estimation purposes, base sampling weights were applied to each housing unit, which was the reciprocal of the probability of selection into the sample and is the number of households in the population each observation represents (EIA, 2013b). Each sampling weight value was used as a weighting factor in the weighted regression model.

Data for spatial modeling and mapping of the study area were obtained from the U.S. Census Bureau 2006–2010 American Community Survey (ACS) 5-year estimates. The census block group was used as the unit of analysis for this research. Census block groups are a contiguous cluster of blocks within a census tract and generally consist of between 600–3000 people. The census block group is the smallest spatial resolution for which household and housing unit characteristics similar to RECS variables are publically available from the U.S. Census Bureau. In addition, it is assumed that physical and social homogeneity are more likely at the smaller block group level than larger spatial levels, such as, census tracts or zip codes. A GIS data layer of census block groups for the study area was created by clipping data from the U.S. Census Bureau TIGER/Line Shapefiles with demographic and economic data from the 2006–2010 ACS 5-year estimates. Block groups were retained for analysis only if data values for both population and number of occupied housing units were greater than zero. Subsequently, 757 of 763 block groups in the three-county study area were included in this analysis.

The RECS microdata set can be used to develop a bottom up statistical model. Bottom up statistical models use input data at a granular level, such as a sample of individual households, for extrapolation to a geographic area of interest. These statistical models have been used to establish relationships between various characteristics of household energy consumption (i.e. specific end use consumption, total consumption, energy use intensity) while controlling for exogenous variables such as housing unit characteristics, household characteristics, urban form and climatic conditions (Min et al., 2010; Ewing and Rong, 2008; Tso and Yau, 2007). Min et al. (2010) developed a statistical framework for modeling residential space heating (and other end use) consumption at a zip code- level resolution using the 2005 RECS microdata. Their results were validated against residential energy sales data. This study extends their framework to estimate residential heating efficiency by creating a state-level regression model using the Missouri sample of housing units in the 2009 RECS microdata set and exploring small-area spatial, racial/ethnic, and socioeconomic patterns. Since many of the variables identified in the RECS can also be found in the Census ACS, relationships derived from the statistical model, known as direct estimators, can be applied to the block group level dataset as indirect estimators for constructing small-area estimates, under the assumption that the small areas have the same characteristics as the large areas (Rao and Molina, 2015). The next two sections detail this process.

2.3. *Specifying a robust regression model for heating energy efficiency*

The ordinary least square (OLS) method was used to analyze how housing unit and household characteristics influence residential heating energy efficiency. Heating energy efficiency is operationalized as annual heating energy use intensity (EUI). Generally, a lower EUI signifies relatively efficient performance. The EUI is defined as the quantity of energy used in producing a given level of service, expressed as energy consumed per unit of output. The heating EUI (kBtu/m^2) was calculated for each RECS observation by dividing the total annual heating consumption (kBtu) by the housing unit square area (m^2). Trained interviewers use a standardized method for measuring and collecting the dimensions of the housing unit. Total annual heating consumption is the aggregation of a household's space heating consumption from all fuel types (i.e. natural gas, electricity, liquefied petroleum gas (LPG), fuel oil, and/or kerosene). The RECS captures consumption data from actual utility bills. Of the Missouri RECS sample, 676 observations had total annual heating consumption greater than zero kBtu. Another observation was dropped as it was the only housing unit in the sample reporting fuel oil/kerosene as the primary heating source. Fuel oil/kerosene are not major sources of heat in the tri-county area; only 0.09% of homes use fuel oil/kerosene as their primary heating source (US Census 2016). Upon testing for outliers, an additional observation was dropped that exhibited an extremely high EUI for a relatively small footprint. The final data set consisted of a sample of 674 Missouri housing units.[2]

The OLS model can be formulated as,

$$\ln E = \beta_0 + \sum_{i}^{n} \beta_i^{*} \chi_{i,RECS} + \varepsilon$$

where E is the annual heating EUI, and $\chi_{i,RECS}$ is the predictor variable χ_i from the RECS dataset (Min et al., 2010). The dependent variable was natural logged to better fit the nonlinear relationship between heating EUI and the independent variables (Min et al., 2010; Ewing and Rong, 2008).

Since many of the predictors of heating EUI are themselves correlated, it is important to consider their simultaneous effects using multivariate analysis techniques. This approach therefore requires determining the best subset of predictors of heating EUI. Initial selection of independent variables was guided by previous studies using OLS to understand residential energy consumption. The two major themes on factors that contribute to residential energy consumption are categorized as the physical-technical-economic model (PTEM) and the lifestyle and social-behavior tradition (LSB) (Adua and Sharp, 2011). Many models include variables from the PTEM perspective which explains energy consumption as a result of housing unit characteristics, or the building's physical structure and equipment characteristics, and economic and environmental factors. These variables include: type of home, year home built, home size, household income, price of energy, geographic location, and climate variables (Ewing and Rong, 2008; Min et al., 2010; Adua and Sharp, 2011, Valenzuela et al., 2014). The LSB tradition draws on the importance of human occupants to energy consumption, or household characteristics. LSB-related variables often include: race/ethnicity, household size, age of householder, and sex of householder (Ewing and Rong, 2008; Min et al., 2010; Adua and Sharp, 2011, Valenzuela et al.,

[2] A sample size of 674 can predict with accuracy at a 95% confidence interval and ±4 confidence level, for 2,339,684 housing units (population size). Based on the assigned sampling weights, the final sample represents 2,286,868 housing units.

Table 1
OLS regression model for small-scale heating EUI estimation.

DV = ln (EUI_{heat})	Coeff.	Robust Std. Err.
Type of Housing		
Multi-Family	Reference	
Mobile Home	0.68***	0.09
Single Family Dettached	–	
Single Family Attached	–	
Decade Constructed		
Before 1950	Reference	
1950s	–	
1960s	-0.24***	0.07
1970s	-0.18**	0.07
1980s	-0.34***	0.08
1990s	-0.26***	0.07
2000s	-0.29***	0.07
Primary Heat		
Natural Gas	Reference	
Electricity	-1.10***	0.05
Wood	-2.07***	0.23
Liquid Petroleum Gas	–	
Control Variables		
Household Income	-0.03*	0.01
Home ownership	-0.15**	0.05
No. of rooms	-0.09***	0.01
Model Statistics		
Intercept	6.57***	0.08
N	674	
F (11, 662)	85.9***	
Adjusted R^2	0.62	
RMSE	0.523	

-dropped from stepwise regression
* Significance $p < 0.05$.
** Significance $p < 0.01$.
*** Significance $p < 0.001$.

2014). For this model, variables representing housing unit characteristic included three dummy-coded variables for housing type (mobile home, single family detached, and single family attached, with multifamily as the reference category), six dummy-coded variables for decade constructed (1950s through 2000s, with homes built before 1950 as the reference category), and three dummy-coded variables for primary heating fuel (liquid petroleum gas (LPG), electricity, and wood, with natural gas as the reference category). Household characteristic variables included one interval variables for number of rooms, one categorical variable for household income (divided into eight categories), and one dummy-coded variable for home ownership coded as "1", otherwise "0". Final model selection of independent variables was based upon backward stepwise selection.

2.4. Utilizing census data for small area heating EUI estimation

Since the goal of this study is to explore heating energy efficiency at a geographical domain smaller than the RECS microdata (collected with adequate precision at the state-level), the second step involves using the model above to estimate and map heating EUI for Kansas City. This technique, known as small-area estimation, combines individual level data (i.e. household surveys) and spatial characteristic estimates (i.e. Census data). There have been significant theoretical advances in small-area estimation methodologies for modeling and mapping (Fay and Herriot, 1979; Fahmy et al., 2011; Rao and Molina, 2015). To accomplish this, resultant weights derived from the regression model are applied to spatial data (e.g., housing units by type, housing units built in each decade, housing units using each fuel type for heating, median household income), from the US Census 2006–2010 ACS 5-year estimates. The derived regression weights are therefore intended to reflect the observed pattern of influence at the household level, which is essential to the small area estimation. Regression coefficients β_i are applied to block group level data, $\chi_{i,CENSUS}$, for each of the 757 block groups in the study area (Min et al., 2010), using ARCMap (v.10.3.1) software (ESRI, Inc) to predict block group level heating EUI estimates $\hat{E}$:

$$\hat{\ln}E = \hat{\beta}_0 + \sum_i \hat{\beta}_i^* \chi_{i,CENSUS}.$$

Since this modeling approach involves matching two different datasets (RECS and ACS), these sources must first be harmonized with respect to their measurement and weighting. Each census variable was weighted by the percentage (or ratio) of its presence in the Census block group. For example, if the number of housing units heated by electricity in census block group 1 is 100 and the block group has 200 housing units, the variable is standardized as 100/200=0.5, which is comparable to the binary variable for whether or not an observation in the RECS data set uses electricity as its primary heating source. The ratio for each block group is then multiplied by the coefficient for electricity from the regression model.

Lastly, to simply exponentiate the log-linear model, $\hat{\ln}E$, will systematically underestimate the expected value of EUI, thus the scaling value $exp\left(\frac{RMSE^2}{2}\right)$ is needed (Wooldridge, 2009: 211). RMSE is the root mean square error of the model. From the estimated log values $\hat{\ln}E$, the actual estimated EUI is obtained by the equation

$$\hat{E} = \exp\left(\frac{RMSE^2}{2}\right)^* \exp(\hat{\ln}E).$$

2.5. Statistical analysis

The relationships between the predicted mean block group heating EUI and measures of race/ethnicity, and socioeconomic status are examined using bivariate and multivariate analyses. First, correlation analysis was conducted between heating EUI and demographic and socioeconomic characteristics. Next multivariate regression was used to explore the relationship between predicted heating EUI and block group racial/ethnic and socioeconomic characteristics. Lastly, logistic regression was used to model how the proportion of racial/ethnic minority headed households, and other block group socioeconomic characteristics affect the probability of block group vulnerability, thus prime for energy efficiency intervention targeting.

3. Results

The final regression model for estimating annual heating EUI, expressed as natural log, is presented in Table 1. The final model consisted of 11 statistically significant variables representing housing unit type, decade housing unit was constructed, primary heating fuel, and control variables for household income, home ownership, and housing unit size. The model explained a considerable proportion of variability in heating EUI (R^2=0.62, F(11, 662)=85.9, $p < 0.001$). Based on the F value of the model, the final sample size of 674 is large enough to make the model significant. Cross-sectional studies are at greater risk of exhibiting heteroskedasticity. Weighted regression is one method to correct residuals and the model's residual versus fit plot exhibits a constant variance and shows no evidence of heteroskdasticity. Additionally, robust standard errors were used and are reported in Table 1

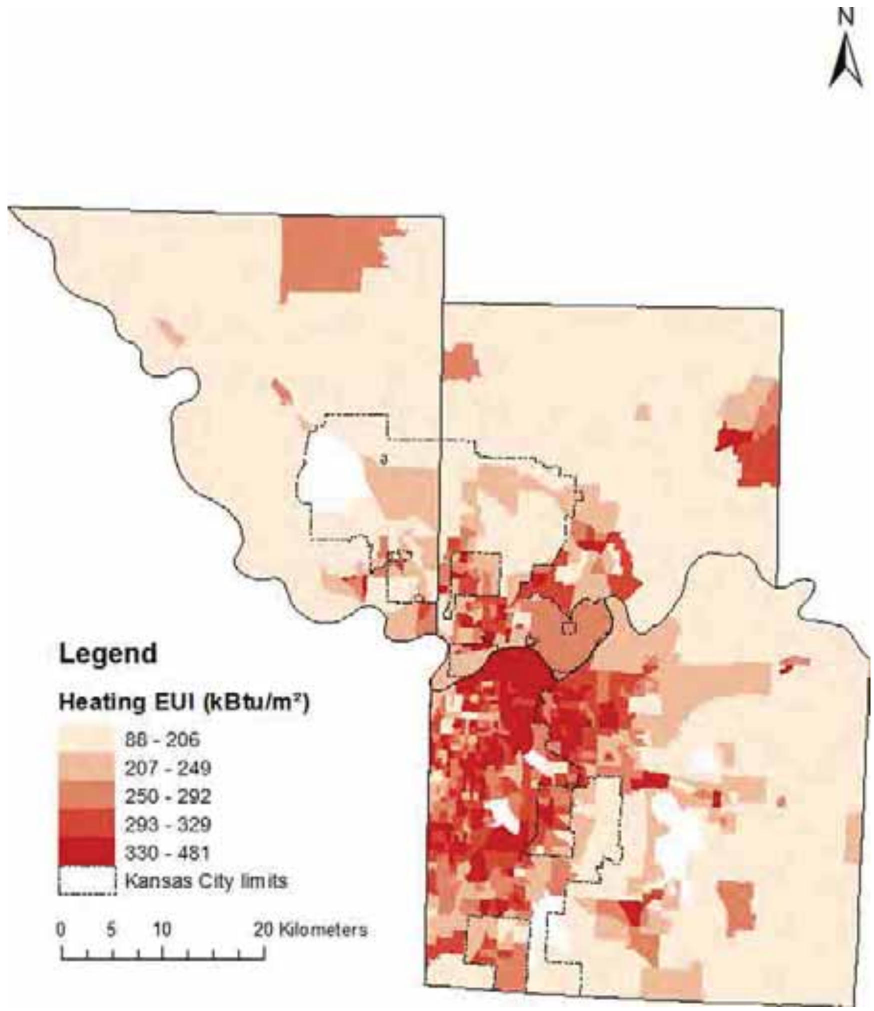

Fig. 2. Predicted block group mean annual heating EUI (kBtus/m^2).

(Wooldridge, 2009). Multicollinearity can also be a major problem for statistical models of residential energy use, and can result in poor predictions of certain end uses (Swan and Ugursal, 2009). Multicollinearity commonly arises with variables that tend to be correlated, such as household income and housing unit size. However, correlations between any two variables in the final model did not exceed 0.45, and the variance inflation factor is 1.32. Thus, the model did not indicate a noticeable presence of multicollinearity.

Fig. 2 illustrates the spatial distribution, in quintiles, of the predicted mean annual heating EUI for each block group, darker shading represents higher predicted heating EUI. The six uninhabited block groups were left uncolored. It is important to note that predicted values reflect the mean heating EUI of all housing units in the block group rather than any specific house (Min et al., 2010). Among the 757 block groups there was significant difference in values of heating EUI, ranging from 88 to 481 kBtus/m^2. The metropolitan mean heating EUI, 269.6 kBtu/m^2 (SD=66.7 k/Btus/m^2), was higher than the state mean heating EUI, 218.9 kBtus/m^2. The heating EUI variation, nearly 400 kBtus/m^2, is quite large. This means that within the same metropolitan region, homes in some areas were far less efficient than others. While block groups with higher heating EUIs are scattered throughout the three counties, the majority of block groups with the highest EUIs were concentrated within the Kansas City limits and its urban core. Of the 151 block groups with the highest (fifth quintile) predicted heating EUI, 119 (78.8%) were located within the city limits.

Table 2
Pearson's correlation between race/ethnicity, socioeconomics and predicted heating energy use intensity (EUI).

Category	Description	Pearson's correlation
Economic status	Median household income	-0.62
	Percent households below poverty level	0.47
Education	Percent population with less than high school diploma	0.51
Age	Percent households with householder aged 65+	0.12
Race/Ethnicity	Percent white householders	-0.37
	Percent black householders	0.32
	Percent Hispanic householders	0.31
Tenure	Percent renters	0.40

All coefficients significant at $p < 0.001$

Pearson correlations, shown in Table 2, revealed statistically significant relationships between socioeconomics, race/ethnicity and predicted heating EUI ($p < 0.001$). Heating EUI is positively correlated with block groups with a higher number of adults without a diploma (0.51), higher number of households in poverty (0.47), more renters (0.40), more Black householders (0.32), more Hispanic householders (0.31), and more senior householders (0.12). Furthermore, heating EUI was negatively correlated with median household income (-0.62) and percentage of White

Table 3
Relationship between estimated heating EUI and block group race/ethnicity, segregation and socioeconomic characteristics.

	Model 1		Model 2		Model 3		Model 4	
	b	S.E.	b	S.E.	b	S.E.	b	S.E.
Percent black householders	0.75^{***}	0.07	0.19^{*}	0.09				
Percent Hispanic householders	2.58^{***}	0.29	0.71^{*}	0.32				
Percent households below poverty level			1.24^{***}	0.20				
Percent population with less than high school diploma			1.47^{***}	0.28				
Percent households with householder aged 65+			0.75^{***}	0.17				
Black residential segregation					90.93^{***}	7.19	37.09^{***}	9.19
Hispanic residential segregation					238.68^{***}	22.03	94.27^{**}	29.92
Proportion households below poverty level							98.37^{***}	22.87
Proportion population with less than high school diploma							146.14^{***}	29.97
Proportion households with householder aged 65+							64.32^{***}	16.89
Intercept	240.13^{***}	3.29	210.56^{***}	4.75	232.34^{***}	3.39	210.09^{***}	4.82
N		757		757	757			757
R^2		0.21		0.33	0.23			0.33

* Significance $p < 0.05$.
** Significance $p < 0.01$.
*** Significance $p < 0.001$.

householders (-0.37). Thus, census block groups with lower socioeconomics, lower median household incomes, and higher percentages of Black or Hispanic households are more likely to have higher heating EUIs. Additionally, Kruskal-Wallis tests were conducted to determine if heating EUI was different among block groups divided into quintiles by the socioeconomic and race/ethnicity variables of interest. Individual Kruskal-Wallis tests showed there were statistically significant differences in heating EUI between the quintiles of median household income ($\chi^2=330.9$), percent poverty ($\chi^2=171.1$), percent less high school education ($\chi^2=195.2$), percent senior headed households ($\chi^2=20.2$), percent renters ($\chi^2=168.2$), percent White householders ($\chi^2=78.1$), percent Black householders($\chi^2=97.2$), and percent Hispanic householders ($\chi^2=94.7$), (DF=4, $p<0.001$).

Regression models examining how race/ethnicity are related to heating EUI are shown in Table 3. Model 1 in Table 3 shows this relationship when socioeconomic characteristics of the block group are not taken into account. This model reveals a strong relationship between race/ethnicity and heating EUI. The model shows that as the percentage of Black households and Hispanic households in a block group increase, heating EUI increases by 0.75 and 2.58 kBtu/m^2, respectively.

The second model in Table 3 (Model 2) shows how race/ethnicity are related to heating EUI when the effects of socioeconomic characteristics of the block group (percent poverty, percent less than high school diploma and percent senior householders) are held constant. In this model, while the positive relationship between race/ethnicity and heating EUI remain, as in Model 1, the effects are moderated by the socioeconomic characteristics of the block group with percent of households below poverty, percent of population with less than a high school diploma, and percent senior headed households having a larger effect on heating EUI, 1.24 ($t=6.3$), 1.47 ($t=5.4$), and 0.75 ($t=4.5$) kBtu/m^2, respectively. After controlling for socioeconomics, the effect of a percent increase in Black or Hispanic households increasing a block group's heating EUI drops to 0.19 ($t=2.2$) and 0.71 ($t=2.2$) kBtu/m^2, respectively.

The final two models reported in Table 3 (Models 3 and 4) exchange the percentage of Black and Hispanic households in the block group with a measure of the block group's level of Black and Hispanic racial residential segregation (RRS). The RRS, a measure of the geographic isolation of race/ethnicity from other racial groups (Massey and Denton, 1993, Reardon and O'Sullivan, 2004, Anthopolos et al., 2011). RRS has received increased attention as a major social determinant in poor outcomes (i.e. health effects) and may be a proxy for concentrated neighborhood disadvantage, including exposure to socio-physical environmental stressors in the built environment (Anthopolos et al., 2011). Model 3 shows that RRS has a strong positive relationship with heating EUI. Each unit increase in Black isolation increases heating EUI by roughly 91 kBtu/m^2. Hispanic isolation has an even greater effect on heating EUI. Every unit increase in Hispanic isolation increases heating EUI 239 kBtu/m^2. In Model 4 the relationship between segregation and heating EUI remains strong even after controlling for the socioeconomic characteristics of the block group. Given that the isolation index is a value between 0 and 1, the socioeconomic block group characteristics in Model 4 are in proportions rather than percentages. The Black and Hispanic isolation indexes maintain a strong positive relationship with heating EUI but are slightly moderated by block group socioeconomic characteristics. Once socioeconomic characteristics- poverty ($t=4.3$), less high school ($t=4.9$), senior households ($t=3.8$)- are taken into account, the effect that a unit increase in Black and Hispanic isolation increases heating EUI drops to 37 ($t=4.0$) and 94 ($t=3.2$) kBtu/m^2, respectively.

Fig. 3 illustrates the spatial distribution of high-risk block groups, which would be prime candidates for energy efficiency interventions. High-risk block groups are defined as those where predicted heating EUI was greater than study area mean (269.6 kBtu/m^2), median year home built was less than the study area mean (1966.5), and median household income was less than the study area mean ($51411.50). There were 263 block groups meeting these criteria (34.7% of block groups). More than a quarter of the area's population (26.6%) resided in high-risk block groups. The racial composition included 49.7% of the Black population, 46.9% of the Hispanic population, and 18.7% of the White population. Black and Hispanic households within the high-risk block groups are highly overrepresented compared to their representation within the entire study area (29.6% Black, and 8.6% Hispanic), while White households are underrepresented (62.4%). If there were no disparities in heating EUI this would not be the case.

To understand the odds that the racial/ethnic and socioeconomic characteristics of a block group contribute to that block group's likelihood of being high-risk, logistic regression results are presented in Table 4. Table 4 suggests that a 10% difference in percent households in poverty increased the odds by 2.7% ($p<0.01$) that the block group is high-risk. Racial/ethnic characteristics (percentages of Black and Hispanic households) are significant predictors of high-risk block groups ($p<0.001$). For instance, a 10% increase in Hispanic households increased the high-risk odds by a factor of 10.8. Logistic regression results showed that high-risk block groups are poorer, have less educational attainment, have more households headed by seniors, and

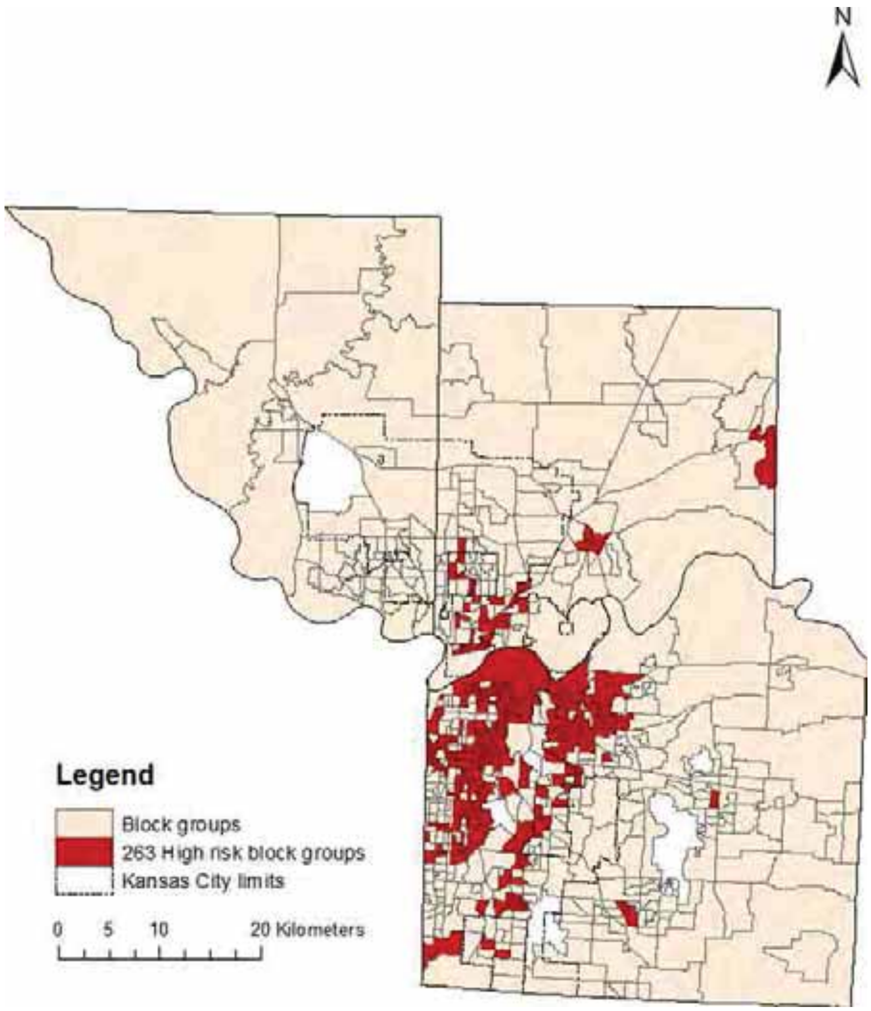

Fig. 3. High-risk block groups. High-risk block groups are defined as those where heating EUI, median age of home, and median household income were worse than the study area average. There are 263 high-risk block groups identified.

Table 4
Logistic regression – high-risk block groups.

	Odds ratio	S.E.
Percent black householders	1.014***	0.004
Percent Hispanic householders	1.079***	0.023
Percent households below poverty level	1.027**	0.010
Percent population with less than high school diploma	1.050***	0.013
Percent households with householder aged 65+	1.021**	0.008
Intercept	0.060***	
Pseudo R^2	0.24	
N	757	

*Significance $p < 0.05$
** Significance $p < 0.01$.
*** Significance $p < 0.001$.

have greater percentages of Black and Hispanic households.

4. Conclusion and policy implications

This study estimated the mean heating EUI for 757 census block groups in Kansas City, Missouri (Jackson, Clay, and Platte counties). The findings demonstrate that disparities exist in the relationships between the spatial, racial/ethnic, and socioeconomic characteristics of census block groups and the estimated mean block group heating EUI (kBtu/m^2), a proxy for energy efficiency where a higher EUI signals relatively less efficiency when compared to similar sized homes. Predictions reveal that block groups with lower median incomes, a greater percentage of households below poverty, a greater percentage of racial/ethnic minority headed households, and a larger percentage of the population with less than a high school education experienced higher mean heating EUIs. Essentially, homes in block groups exhibiting these demographic and socioeconomic characteristics are more likely to be less energy efficient when compared to other block groups in the region.

This analysis also reveals an association between the enduring effects of residential racial and income segregation and the distribution of residential energy disparities. The figures above illustrate that past institutionalized residential segregation continues to influence urban housing consumption and translates directly to energy-related disparities. Urban sociologists often associate residential segregation with concentrated social and economic disadvantage (Sharkey, 2013; Sampson, 2012; Klinenberg, 2002). The results of this study follow decade-old reports by two major African American organizations about the relationship between Blacks, energy and climate change. Both the Congressional Black Congress Foundation and the American Association of Blacks in Energy released reports in 2004 assessing the disproportionate effects of energy inequities on Blacks. Since these reports, there has been little research conducted on this issue and virtually no policy advances. Recognizing that the uneven development patterns and high levels of residential segregation evident in Kansas City occur in other US urban areas, such as St. Louis and Detroit, this study should be replicated to explore if similar energy disparity patterns exist and determine the need for a national urban energy justice policy.

Space heating remains the largest, single end use, accounting for 41% of residential energy consumption (EIA, 2013c). Modeling the efficiency of residential space heating (and cooling) is important because of its responsiveness to weather. Prioritizing heating energy efficiency and targeting building envelope retrofits, before appliance and lighting efficiency, may have greater potential as the lifespan of a housing unit most likely outlasts the current occupant and appliances. Additionally, in dominant discussions on climate change, global warming specifically, winter weather and cold conditions receive far less attention. Nevertheless, recent studies have found that the effects of global warming (i.e. the loss of Arctic sea ice) can be linked to extreme and prolonged cold weather patterns in mid-latitudes, such as the cold spells experienced by northeastern and Midwestern states during the polar vortex of winter 2014 (Peings and Magnusdottir, 2014, Tang, 2013, Francis and Vavrus, 2012). Subsequently, as climate change adaptation discourse becomes more prevalent, it is necessary to understand the material experience of changing environmental conditions, the effect on everyday life, and the potential ways in which communities are threatened (Schlosberg, 2013).

Furthermore, energy related disparities increase the sensitivity of low-income and other vulnerable households to extreme temperature exposure resulting in detrimental health implications (Noe, Jin and Wolkin, 2012; Centers for Disease Control [CDC], 2006; Taylor et al., 2001). The Centers for Disease Control (CDC) found that between 2006 and 2010, 63% of weather-related deaths were attributed to extreme cold exposure, compared to 31% attributed to heat-related causes (Berko et al., 2014). Weather-related death rates varied by age, race/ethnicity, sex, location, and income (Berko et al., 2014). For vulnerable populations like the elderly, extremely cold temperatures can be deadly, even indoors. Elderly patients admitted to the intensive care unit for hypothermia are more severely affected and die more frequently when found indoors compared to those found outside with equivalent body temperatures (Mégarbane et al., 2000). In another study, almost half of hypothermia-related deaths occurred indoors, with death rates particularly high among Blacks aged 80 years or older (Taylor et al., 2001). Despite these findings, there is a lack of recognition of the magnitude of problems associated with dangerous indoor temperatures when homes are not adequately heated. Instead, public health agencies often issue broad cold-weather injury risk reduction precautions primarily focused on outdoor protection, like layering clothes and keeping emergency kits and blankets in the car (CDC, 2006). Mapping heating energy efficiency can be combined with hypothermia health data for additional analysis on the connection between efficiency and winter-related injuries and death.

To the disadvantage of the millions of Americas who struggle to access and maintain affordable heating energy services, the consequence of not identifying distinct forms of social inequality in residential energy efficiency means more broad-based energy policies that fail to serve those with the greatest need. For instance, the passage of the 2009 economic stimulus bill created various residential energy efficiency programs across the country. Most programs, however, were market-based interventions in the form of low-interest loans and tax rebates which limited participation by low-income households who often lack adequate credit worthiness to qualify for loans and rarely earn enough annual income to file for tax rebates. Although $5 billon was committed to the Department of Energy's Weatherization Assistance Program, the rollout was slow and inconsistent (Grunwald, 2012). In part, the lack of comprehensive accounting of local energy consumption and efficiency disparities, forced weatherization agencies to rely on prevailing practices of first-come, first-served self-referral operating procedures (Fuller et al., 2010; Madrid and James, 2012). A growing body of research demonstrates that the spatial concentration of fuel poverty risk factors, justifies taking proactive, targeted, area- or community-based approaches for implementing energy assistance programs to overcome participation barriers, including those that are social and cultural, and to more efficiently and effectively deliver services in vulnerable communities (Reames, 2016; Walker et al., 2013; Hallinan et al., 2012).

Moreover, modeling energy use intensity rather than total energy consumption provides more meaningful information for analyzing disparities and targeting the most appropriate intervention to the appropriate location. The residential sector has made energy efficiency progress, continuing a three-decade decline in average consumption per home even as the number and average size of housing units increase. This trend is primarily a result of efficiency improvements for newer homes. While aggregate residential sector statistics and analyses are useful for policy and program development, they often mask the heterogeneity of energy users, resulting in a lack of equity considerations. The use of bottom-up statistical models and mapping, extrapolated to smaller-scale spatial areas allows a more nuanced analysis of energy consumption. While several energy-mapping projects are in various stages of development and implementation across the nation (e.g., Twin Cities Energy Mapping Tool in Minnesota), a barrier to more of these projects remains the proprietary nature of individual energy data, as utilities express concerns about customer privacy, or have little incentive to participate in projects that have the potential reduce revenue. In the meantime, using readily available public data and the methodological procedures presented in this study, offer an alternative for community energy mapping when local utility energy data are unavailable.

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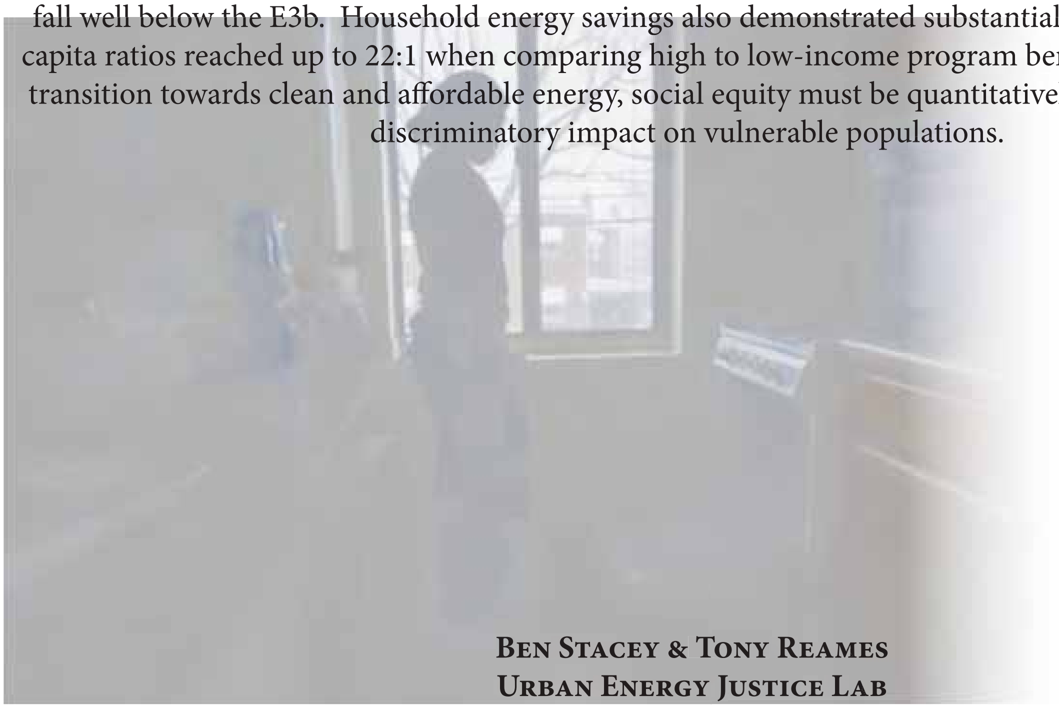
Social Equity in State Energy Policy: Indicators for Michigan's Energy Efficiency Programs

Summary

State policies providing residential energy efficiency programs have emerged over the past decade with the goal of producing widespread economic and environmental benefits. While these policies have largely achieved and surpassed legislated objectives, the degree to which program benefits are distributed amongst population subgroups, particularly low-income residents, remains unclear. On average in the United States, low-income households are less energy efficient contributing towards 1 in 3 of these homes struggle to afford energy, and 1 in 5 facing decisions between energy use and other necessities such as food or medicine. Energy efficiency programs however, may offer a critical avenue in alleviating energy poverty. This study focuses on measuring the social equity achieved through Michigan's "Energy Waste Reduction" programs for the state's two major investor-owned utilities (IOUs). The study establishes a novel, quantitatively sensitive measure, called the Energy Efficiency Equitable baseline (E3b). This measure is used to identify disparities that occur in policy decision-making and outcomes. Particularly, the study quantifies disparities in program investments and household energy savings on a per capita basis between low and high-income residential groups. E3b reveals trends in policy outcomes from a social perspective, illustrating high variability in social equity between energy type and providers. Broad patterns showed that gas program investments approached equitable levels, however, electric Low-Income program investments fall well below the E3b. Household energy savings also demonstrated substantial disparities, where per capita ratios reached up to 22:1 when comparing high to low-income program benefits. As states aim to transition towards clean and affordable energy, social equity must be quantitatively evaluated to prevent discriminatory impact on vulnerable populations.



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KEY FINDINGS

- 35% of Michigan residents qualify for Low-Income Energy Waste Reduction (EWR) programs; this ranges widely (30-40%), depending upon utility territory.
- One key policy consideration for MI low-income consumers: In approving utility EWR Plans, the Michigan Public Service Commission, must consider, "the extent to which the plan provides programs that are *available*, *affordable*, and *useful* to all customers." -P.A. 342
- There is a $73.4 million gap in utility investment levels between equitable (E3B) and actual low-income program investments. This gap is only $1.0 million *gas* LI programs (2010-2016).
- On average, utilities invested 3 times less on Low-Income (electric) programs per capita, and near equitable levels for Low-Income gas programs .
- Low-income consumers overall recieved 10 times less home energy savings (electric) and 3.4 times less home energy savings (gas) when compared to high-income consumers. The greatest difference found, by utility, was 22 times higher.

I. BACKGROUND

Energy Poverty

The relationship between residents and energy use varies between sociodemographic groups and the homes in which they live. This study focuses on income, as distinguished by state policy, however, the social perspective applied in this study can also be applied to groups by race, age, ability, and tenure.

Low-income consumers, defined as households earning below 200% of the federal poverty level (FPL), oftentimes occupy older homes which are energy inefficient. This contributes to a high energy-use-intensity (EUI), a proxy for energy waste, when compared to higher-income households. Nearly one-third of US homes struggle to afford adequat energy, and one in five homes trade-off energy use with other necessies such as food or medicine.[1] When a household's energy burden, or the percentage of income allocated towards energy bills, surpasses10%, the home is considered to suffer energy poverty.[2] Above 6%, the burden is considered unaffordable. In Michigan studies show that in 2016, 999,442 households experienced an energy burden greater than 10% while earning less than 150% of the FPL.[3] For low-income households, the average home energy affordability gap (HEAG) is $1,250 per year, totalling $1.7 billion in 2016 for Michigan.[4] Energy poverty has been shown to lead to negative mental and physical health impacts, recurring debt, and homelessness.[5] In severe cases, as described in the NAACP report, Lights Out in the Cold (2017), the struggle to afford heating bills in Michigan winters, has resulted in hypothermia and death.[6] Similarly, populations unable to afford cooling their homes, are vulnerable to the health impacts of urban heat islands.[7]

Policy & Social Problems of Energy

State and federal policies to address the social concerns surrounding energy affordability include energy shut-off protections, bill-payment assistance programs, home weatherization and energy efficiency programs.[8] Major federal policies include Low Income Home Energy Assistance Program (LIHEAP), and the Weatherization Assistance Program (WAP). While many states such as Michigan have legislated bill-payment assistance programs, policy targeting the reduction of energy waste at the household level presents an alternative approach that empowers households facing energy poverty and reduces the home energy affordability gap. For many low-income energy advocates, these state energy efficiency programs offer hope for a sustainable path towards eliminating energy poverty. Yet, while reports claim widespread social and economic benefits, concerns have been raised in regards to utility investment levels in programs targeting low-income residents and the impact on achieving an equitable energy future.

Source: Amanda Voisard, Washington Post (2016)

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MI Energy Efficiency Policy: Goals & Accomplishments

The social, economic and environmental benefits of energy efficiency have driven policy changes in efficiency standards in residential building, appliance and vehicles over the past several decades. These policies have led to substantial social benefits including reductions in atmospheric emissions, consumer economic gains, and national security through reduced dependency on foreign energy. However, to understand the relative impact of energy efficiency policies from a social perspective, the distribution of costs and benefits between population subgroups must be clearly understood to avoid unintended social consequenses.

Energy efficiency legislation was first signed into Michigan law in 2008 as the Clean, Renewable and Efficient Energy Act, and amended in 2016 as the Clean and Renewable Energy and Energy Waste Reduction Act. This establishes standards for utility companies to achieve energy savings equivalent to 0.75% and 1% of retail sale volumes from the previous year for natural gas and electricity respectively. Regulatory agency reports show that the energy savings resultant of this policy (Subpart C. Energy Waste Reduction), has saved billions of dollars in energy costs to commercial, industrial, and residential consumers through these state regulated, utility managed, energy efficiency programs. As in many other state energy efficiency policies, energy providers are required to achieve these annual energy savings targets through EWR Plans, which outline the utility's portfolio composed of various Residential and Commercial & Industrial (C&I) programs.

Policy Goals:

"Help customers reduce energy waste" &
"To reduce the future costs of provider service to customers" -P.A. 342

Utility companies accomplish this through their range of programs targeting various consumer markets and employing a variety of energy savings interventions. For residential energy consumers, these programs are tailored towards two socioeconomic groups: low-income and non-low-income (higher-income).

In 2016, the Michigan Licensing and Regulatory Affairs (LARA) reported that EWR programs across the state resulted in consumer electricity savings of 1.1 million MWh and natural gas savings of 4.58 million Mcf. Utility companies spent $262 million of rate-payer funds on these programs, and captured a life cycle savings of $1.1 billion for consumers, demonstrating an aggregate return of $4.35 for every $1 invested across the state as a whole.

To incentivize energy savings beyond legislated standards, utilities exceeding these goals are granted financial incentives up to the lesser amount of:

Utility Financial Incentives:

20% of the annual EWR program expenditures OR
30% of the net-present-value of life-cycle cost reductions -P.A. 342

Program Revenue & Spending

To fund these programs, energy providers, whose rates are regulated by the state, are allowed to recover program costs from two distinct customer classes: Residential (including low-income residents), and Commercial and Industrial (C&I). Base revenue, is generated through an on-bill surcharge to consumers. The residential consumer class is charged volumetrically, dependent upon energy use (kWh, ccf), while C&I consumers are charged on a per-meter basis. The allocation of base revenue funds are restricted on a customer class basis. In other words, funds generated in the residential class were not allocated towards C&I programs. Both customer classes contribute to low-income programs. Similarly, utilities recover performance-based financial incentives through an on-bill surcharge.

Policy: Low-Income Consumer Outcomes

The Residential customer class in Michigan is composed of 9.7 million residents, 3.4 million (35%) of which qualify as low-income, face gaps in unaffordability and are likely to experience energy poverty. While not officially recognized within state legislation, regulatory agencies, energy providers, and low-income advocacy groups frequently cite the benefits of energy efficiency policy in reducing the impacts of energy poverty. However, the broad impact on energy poverty remains unclear.

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MI EWR Act requires that utility companies offer programs for low-income residents, calling for "an established spending level" on Low-Income programs. While this study was unable to identify a standardized spending level, this requirement appears to be met through the EWR plan filing process, which requires Michigan Public Service Commission (MPSC) approval. EWR stipulates that in order to approve an EWR plan:

Michigan Public Service Commission must consider: "The extent to which the energy waste reduction plan provides programs that are *available*, *affordable*, and *useful* to all customers" (PA 342)

Metrics for *availability, affordability* and *usefulness* were unable to be identified in this study, and are addressed in the Policy Recommendation section. Once approved, Low-Income program investment levels are subject to change. Commission Order U-15806 allows energy providers to reallocate up to 30% of any program's designated funds elsewhere.

Because residential programs employ tailored approaches for incentivizing participation, funding low-income specific programs is crucial to reach these households. While Low-Income programs are often free, non-low-income progams provide subsidized rates for incentives to participate. Commonly, identical or similar programs are offered separately as Low-Income or "Residential" (referred to henceforth as "High-Income" programs).

Policy also requires that collectively, program spending must prove to be cost-effective. However, this excludes Low-Income programs. The cost-benefit is measured as the Utility-Resource-Cost-Test (URCT), however, this cost-benefit metric does not account for the non-energy impacts (NEI's), and reduced demand for bill payment assistance that result from Low-Income programs.

In this study, the social disparities in distribution (between Low and High-Income programs) of rate-payer revenue (utility investments) and program benefits (household energy savings) are quantified. The results show wide variation in equity achieved by energy type (electric/gas) and provider (Utility A/Utility B), raising social and economic concerns for policy efficacy for providing household energy savings benefits to one-third of the state's population. This study demonstrates the necessity for developing metrics for EWR plan approval on the basis of *acessibility, affordability and usefulness*, and suggests the need for a Low Income oriented cost-benefit analysis tool.

From an energy justice perspective, energy efficiency policies have the significant potential to reduce energy poverty and the home energy affordability gap, but is shown here, that these policies are susceptible to furthering social inequities. As energy efficiency forms an integral role in planning for state energy demands, it is essential that policy makers, regulatory agencies and utility companies examine the impact from a social perspective in order to reach a more just energy future.

II. STUDY SCOPE & METHODS

This study establishes a metric tool, the Equitable Energy Efficiency baseline (E3b), to quantify the gap between equitable and actual levels in utility program investments and houehold energy savings. Trends from Michigan's two main investor-owned utility (IOU) providers, refered to as Utility A and Utility B, are compared spanning the policy implementation period from 2010-2016.

Data on utility investments and energy savings were extracted from annual regulatory reports detailing electric and gas EWR programs for each utility. 2009 data was excluded as a partial (first) year with incompatible data reports for the purposes of this study. Slight variation between utility reporting required minor data revisions, specifically the removal of Utility B pilot program data which did not differentiate Residential and C&I pilot programs comparably to Utility A).

Each utility territory, or coverage area, is unique in terms of population characteristics (figures 1 and 2). To assess equitable distribution program spending and energy savings between utility providers, these variables were normalized by the proporton of low-income residents in each utility territory. Spatial data describing energy provider coverage area at the subtownship level was provided by the Michigan Agency for Energy and paired with US Census Bureau 5-year ACS data (2015) to accurately differentiate variation in low-income population levels. Populations in subtownships which had multiple, or overlapping energy providers, were attributed to both utility populations as consumer choices were indiscernible in these areas. Actual data for utilities' customer population socioeconomic composition were unavailable. To quantify disparities in utility investments in Low-Income programs, the E3b was established for each utility by energy type (Utility A electric, Utility A gas, Utility B electric, Utility B gas). This was done for each provider, by multiplying the annual sum of residential program investments (Low and High-Income) with the proportion of low-income residents in the respective territory. Investment deficit/surplus was calculated as the difference between actual spending and the E3b.

To compare disparities in per capita investments and energy savings by energy provider, utility reported data were compared to the territory population. Given the imprecision in determining actual utility customer populations, these values should be used for relative comparison only.

The focus of this study is limited to quantifying disparities in investments and energy savings between programs targeting low- and high-income residents. While it is plausible that "Residential (non-low-income programs) may spill-over to low-income consumers, this study distinguishes these programs with the assumption that this impact is minimal. Further studies are necessary to better assess the accessibility and impact of non-low-income residential programs on low-income customers. As previously noted, several non-low-income residential programs, have similar or identical counterparts offered as Low Income programs. Hence this study distinguishes the two as High Income and Low Income programs based upon their targeted markets.

III.RESULTS

Variation in Low-Income Population by Utility Territory

There are 3,390,700 Michigan residents who qualify for Low-Income EWR programs, however, they are not evenly distributed across geographic space (eg. utility coverage area). Spatial variation in income levels are illustrated in Figures 1 and 2 for electric provider territories. Depending on the service and provider, the percentage of low-income

Table 1. Percent population low-income by utility territory. (*Source*: Michigan Agency for Energy, US Census ACS 5-year 2015)

Population	State of Michigan	Utility A Electric	Utility B Electric	Utility A Gas	Utility B Gas
Total Population	9,677,170	4,348,955	4,675,213	4,785,515	3,577,48
Low-Income Population	3,390,700 **(35.04%)**	1,584,048 **(36.42%)**	1,549,477 **(33.14%)**	1,435,612 **(30.00%)**	1,428,0 **(39.92%**
Minority Population	2,076,696 (20.98%)	651,989 (14.5%)	1,361,406 (28.73%)	825,571 (17.13%)	1,087,96 (29.71%

consumers ranges between 30.0-39.9% and 14.5-29.7% for minority populations (table 1).

Low-income populations for electric coverage area varies between 36.4% (Utility A) and 33.1% (Utility B) and racial composition varies by minority populations composing 14.5% (Utility A) and 28.7% (Utility B). Utility B territory encompasses 1.4 million non-white Michigan residents, including the largest black population in the state located in Detroit.

Population socioeconomc characteristics vary more greatly for gas service providers. Utility A Gas territory includes 4.8 million residents of which, 30.0% qualify for Low-Income programs, while Utility B gas, with 3.6 million residents, encompasses 39.9% low-income. Utility B gas also has 12.6% higher proportion of minority residents.

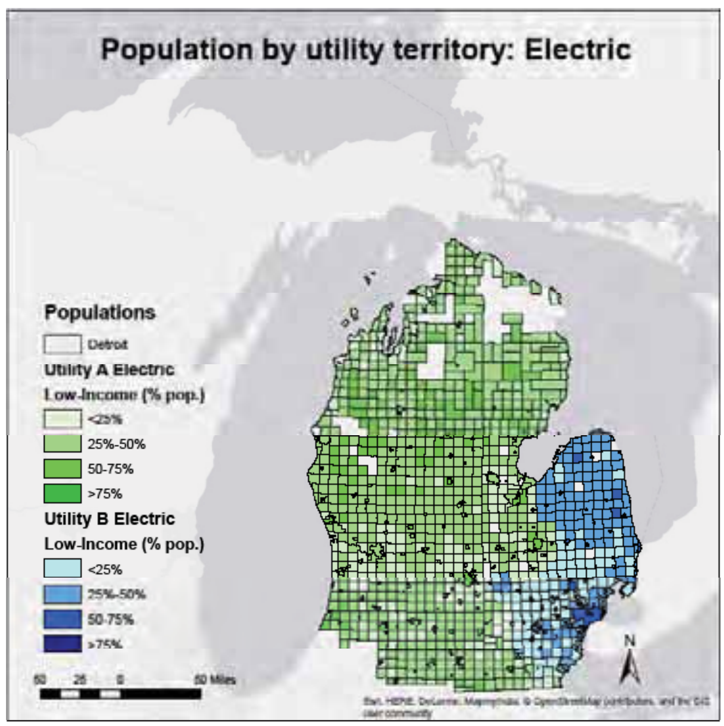

Figure 1. Low-income population distribution for Utility A and Utility B territories. (*Source*: US Census, Michigan Agency for Energy)

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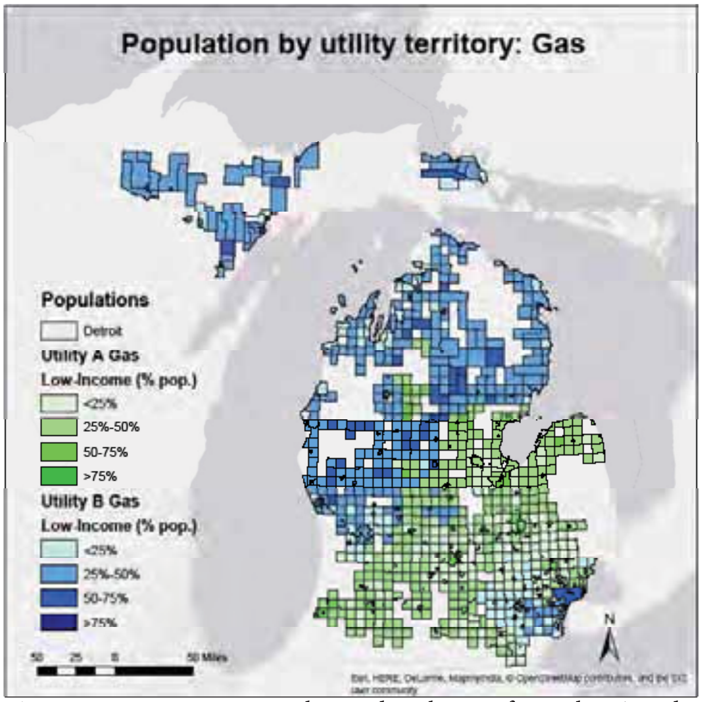

Figure 2. Low-income population distribution for Utility A and Utility B Gas territories. (*Source*: US Census, Michigan Agency for Energy)

Disparities in Equitable Utility Investments and Consumer Benefits

Summatively, Utility A and Utility B spent $596 million on EWR Residential programs between 2010-2016. For electric programs, Utility A invested $160 million total, ($18.7 million Low-Income). Utility B invested $237 million total ($40 million Low-Income). For gas programs, Utility A invested $187 million, ($62 million Low-Income) and Utility B $112 million total ($38 million Low-Income). Comparing the actual investment levels in Low-Income programs to the territory tailored E3b, a deficit for Low-Income program investments of $74.3 million (electric) and $1.0 million (gas) was identified (Table 2). Figure 7 demonstrates that there is a high degree of variability in proximity to E3b investments by energy type and provider. On average, gas programs were funded closer to E3b (1% below) than electric programs (56% below).

Investments in Energy Efficiency Electric Programs

Investment trends for both the Utility A and Utility B electric programs demonstrate a substantial deficit between actual and E3b levels from 2010-2016. Yearly, deficits ranged from $1.5 million to $7.4 million (Utility A) or 40%-82% under the E3b, and for Utility B: $3.5 to $6.9 million, or 39%-61% under the E3b (figures 3-7). Recently (2016), the equitable investment deficit for electric programs totalled $13.6 million for Utility A ($6.7 million or 64% under E3b) and Utility B ($6.9 million or 51% under E3b). The total spending deficit for electric Low-Income programs from 2010-2016 was $73.4 million, approximately 55.5% under the equitable baseline (table 2).

Investments in Energy Efficiency

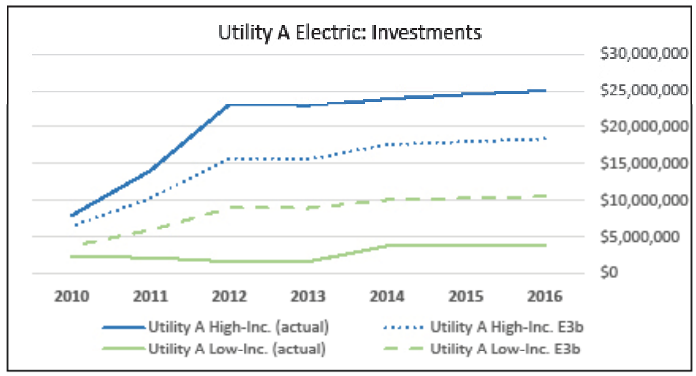

Figure 3. Actual vs. Equitable (E3b) spending for Utility A electric EWR programs between 2010-2016. *Source*: EWR Annual Reconciliation Reports (Utility A, 2010-2016), US Census Bureau 5-year ACS 2015, Michigan Agency for Energy.

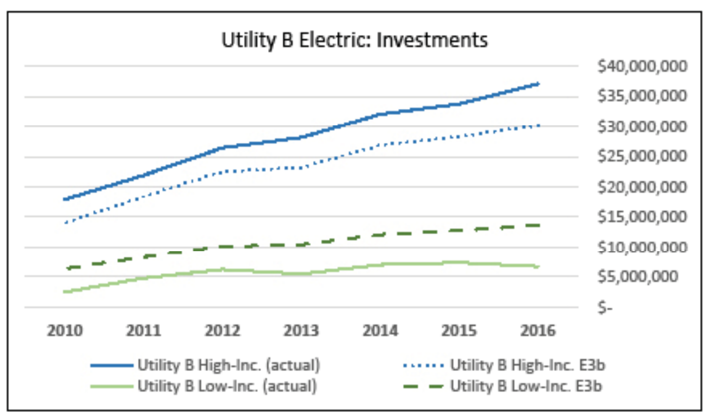

Figure 4. Actual vs. Equitable (E3b) spending for Utility B electric EWR programs between 2010-2016. *Source*: EWR Annual Reconciliation Reports (Utility B, 2010-2016), US Census Bureau 5-year ACS 2015, Michigan Agency for Energy.

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Gas Programs

Investment trends for gas programs show a much different pattern than electric programs, with actual investment levels near or surpassing the E3b. The cumulative spending deficit for EWR gas Low-Income programs from 2010-2016 is $1.0 million, reflecting an under investment of only 1%. This was composed of Utility A surpassing the E3b by $5.9 million and Utility B investing $6.9 million under the baseline, relatively 10.5% over and 15.4% under respectively (Table 2). Low-Income program spending ranged yearly, from $1.7 million under to $4.7 million over the E3b. In 2016, Low-Income investments by Utility A gas was $0.4 million, or 5% above, and $1.2 million or 18% below for Utility B (Figure 5-7).

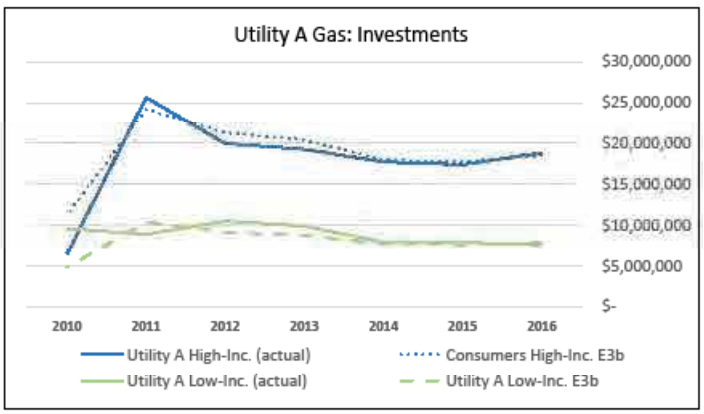

Figure 7. Actual vs. Equitable (E3b) spending for Utility A gas EWR programs between 2010-2016. *Source*: EWR Annual Reconciliation Reports (Utility A Energy, 2010-2016), US Census Bureau 5-year ACS 2015, Michigan Agency for Energy.

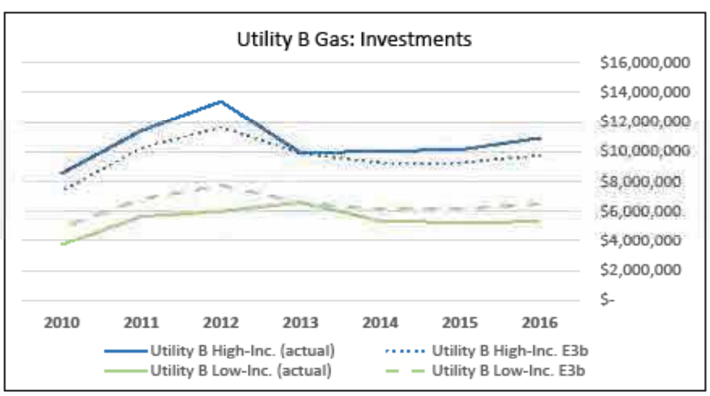

Figure 6. Actual vs. Equitable (E3b) spending for Utility B gas EWR programs between 2010-2016. *Source*: EWR Annual Reconciliation Reports (Utility B Energy, 2010-2016), US Census Bureau 5-year ACS 2015, Michigan Agency for Energy.

Table 2. Summary of EWR program investments, Actual vs. Equitable (E3b), 2010-2016.

Low-Income Program	Actual Investment	Equitable Investment	Investment Deficit	Proportion Deficit
Utility-A Electric	$18,670,697	$58,268,333	-$39,597,636	-68.0%
Utility-B Electric	$40,070,000	$73,828,290	-$33,758,290	-45.7%
Total Electric	$58,740,697	$132,096,623	-$73,355,926	-55.5%
Utility-A Gas	$62,151,372	$56,223,498	+$5,927,874	+10.5%
Utility-B Gas	$37,811,000	$44,711,541	-$6,900,541	-15.4%
Total Gas	$99,962,372	$100,935,039	-$972,667	-1.0%
Total	$158,703,069	$233,031,662	-$74,328,593	-31.9%

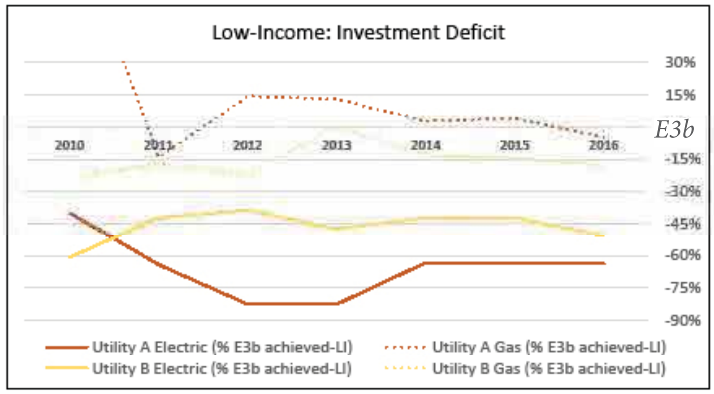

Figure 7. Summary comparison of EWR program investments (Actual vs. Equitable) between 2010-2016. *Source*: EWR Annual Reconciliation Reports (Utility A & Utility B, 2010-2016), US Census Bureau 5-year ACS 2015, Michigan Agency for Energy

MPSC Approved Plan vs. Actual

The difference between MPSC approved EWR Plan investment and actual investments varied between energy type and provider. In electric programs, the greatest yearly decreases were found in Utility B Low-Income programs, where reductions in three of seven years ranged from 25-31% (figures 8 & 9). No other program exceeded a 10% increase or decrease any year. Utility A electric Low and High-Income programs showed an average spending change of less than 1%. Utility B electric programs showed an average increase of 1% in High-Income and an average decrease of 14% in Low-Income programs. Variance in gas program spending included increases in Low-Income programs for Utility A (2010) and Utility B (2013), with a decrease in High-Income programs Utility B (2013). Average variance for Low-Income gas programs was 2% (Utility A and

Utility B), while High-Income programs increased by 1% and decreased by 4% respectively.

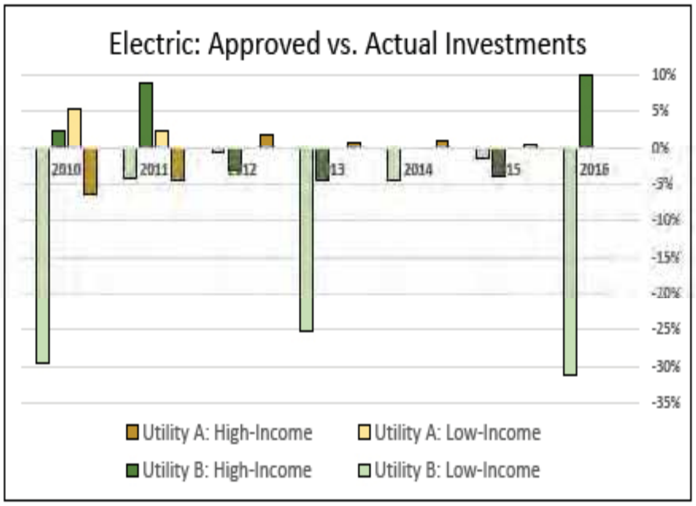

Figure 8. Variance in Electric Program spending (%) between EWR Plan approved and Actual spending for Utility A and Utility B (2010-2016).

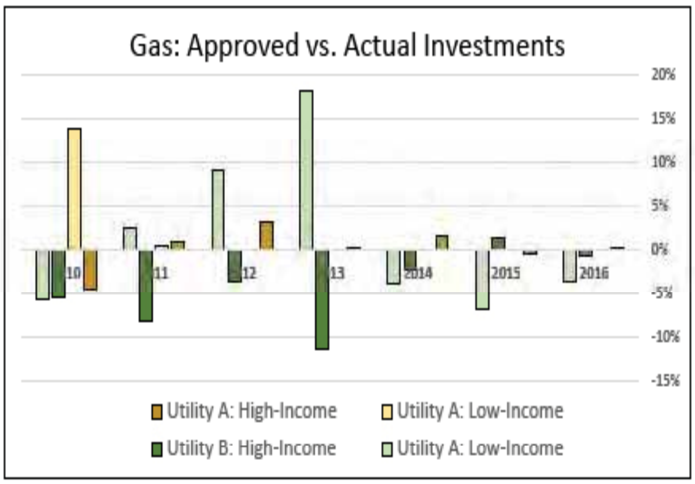

Figure 9. Variance in Gas Program spending (%) between EWR Plan approved and Actual spending for Utility A and Utility B (2010-2016).

Table 3. Summary of variance between Actual energy savings and Equitable (E3b) energy savings achieved (2010-2016).

EWR Program	Actual Energy Savings	Equitable Energy Savings	Energy Savings Deficit	Proportiona Deficit
Utility-A Electric (Mwh)	26,352	374,615	-348,263	-93.0%
Utility-B Electric (Mwh)	130,851	618,160	-487,309	-78.8%
Total Electric (Mwh)	157,203	992,775	-835,572	-84.2%
Utility-A Gas (Mcf)	670,513	2,023,135	-1,352,622	-66.9%
Utility-B Gas (Mcf)	842,927	1,858,773	-1,015,846	-54.7%
Total Gas (Mcf)	973,778	2,476,933	-1,503,155	-60.7%

Policy Benefits: Household Energy Savings benefits:

While the allocation of energy savings are not as direct as utility investment allocations in the decision-making process, the energy savings outcomes for both electric and gas EWR programs show severe disparities when comparing Low- and High-Income program results. Total energy savings deficits, representing disparities in outcomes, show outcomes 84.2% (total electric), and 60.7% (total gas) below E3b (Table 3). Again, patterns vary substantially by energy type and utility (figure 10). On an annual basis, electric programs ranged from 88-97% (Utility A) and 71-89% (Utility B) under E3b for Low-Income programs, with weighted averages at 93% (Utility A) and 79% (Utility B). For gas programs, annual disparities in energy savings ranged from 39-81% (Utility A) and 45-62% (Utility B), with weighted averages of 67% and 55% respectively.

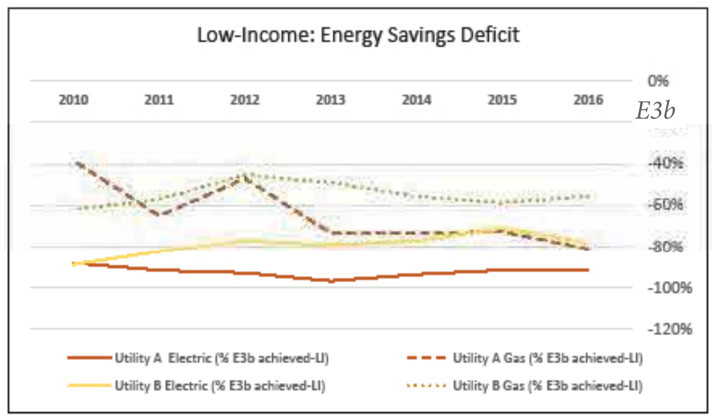

Figure 10. Summary comparison of EWR program energy savings (Actual vs. Equitable) between 2010-2016. *Source*: EWR Annual Reconciliation Reports (Utility A & Utility B, 2010-2016), US Census Bureau 5-year ACS 2015, Michigan Agency for Energy.

Per Capita Comparison: Utility Investments & Consumer Benefits

Results show that for EWR Residential *electricity* programs overall, utilities are investing 3.1 times as much per capita on High-Income programs. This varied between energy providers, where Utility A invested 4.3 and Utility B invested 2.4 times greater in High-Income programs (Table 4). For EWR Residential gas programs overall, utilities invested

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Table 4. Summary comparison of per capita investments and energy savings between Low- (LI) and High- (HI) income populations.

	LI Investment ($ per capita)	HI Investment ($ per capita)	Investment ratio (LI:HI)	LI Energy Saved (per capita)	HI Energy Saved (per capita)
Utility A Electric	$11.79	$51.14	4.34	16.6	362.7
Utility B Electric	$25.86	$63.13	2.44	84.4	594.0
Total Electric	$18.75	$57.50	3.07	50.1	485.5
Utility A Gas	$43.29	$37.39	0.86	467.1	1,813.0
Utility B Gas	$26.48	$34.54	1.30	590.3	1,775.2
Total Gas	$34.91	$36.28	1.04	528.5	1,798.2

only 1.04 times greater in High-Income programs. This also varied between gas providers, with Utility A and Utility B investing 0.86 and 1.30 times as much in High-Income programs.

In terms of per capita energy savings, high-income electric consumers received on average, 9.7 times greater household savings than low-income consumers. For natural gas, high-income received 3.4 times greater savings. Particularly high, was Utility A's ratio of 22:1 (High/Low-Income) electric savings while Utility B programs produced electric savings at a 7:1 ratio. For gas programs, Utility A produced a savings ratio of 4:1, while Utility B performed at a 3:1 ratio.

IV. DISCUSSION

Impacts Across Residential Socioeconomic Groups

The results of this study demonstrate the occurance of severe disparities in Michigan's state energy efficiency policy between 2010-2016. The degree of social equity highly depended upon energy type and the utility provider. The disparities in program outcomes can partially be attributed to sustantialy lower investments in Low Income programs and repeated reallocation of Low-Income funds from MPSC plan approved spending levels. However, one utility's investments in EWR Low Income gas programs exceeded equitable investment levels. Yet, low-income consumer savings produced were four times less per capita. This demonstrates that while equitable investments are important, it will not lead to equitable policy outcomes.

While some states have addressed social concerns through the establishment Low-Income program investment standards, whether as a percentage of total program spending (ie. MA) or dependent upon utility size (ie. IL), this study demonstrates the need for further alignment in policy, regulatory processes and the underlying mechanisms for measuring costs and capturing bnefits in order to achieve socially equitable outcomes. Further studies on alternative policy measures are necessary to guide policy makers, regulatory agencies and utility decision-makers towards a more just energy future.

V. RECOMENDATIONS

To achieve greater social equity in energy efficiency and consumption in the household across socio-economic groups, this study concludes with the following policy and regulatory recommendations:

- Establish investment standards for Low-Income programs that reflect the E3b tailored spatial and socioeconomic approach for each utility.
- Set a ceiling for inequiable policy outcomes (e.g. a max ratio of household energy savings benefits per capita, resulting from High and Low-Income programs.
- Develop further metrics for current state policy requiring the Commission to approve or reject proposed EWR plans based upon: availability, affordability, usefulness.
- Create Low-Income specific cost-benefit measures that capture the full social benefits of reducing severe home energy burdens. This includes non-energy imacpts (NEIs) such as health, employment, education, safety.

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Data Sources

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2. US Cencus Bureau American Communities Survey data (2010-2015)
3. Michigan Agency for Energy
4. DTE Annual EWR Reconciliation Reports (2010-2016)
5. Consumers Energy Annual EWR Reconciliation Reports (2010-2016)

About the Authors

Ben Stacey is a graduate student at the School for Environment and Sustainability, as well as Taubman College for Urban and Regional Planning at the University of Michigan. He has been a member of the Urban Energy Justice Lab since 2016.

Tony Reames is the Director of the Urban Energy Justice Lab and an Assistant Professor who instructs the "Energy Justice" course at the School for Environment and Sustainability at the University of Michigan.

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a force for growth & prosperity

2017 Corporate Citizenship Report
Global Reporting Initiative

DTE Energy

DTE Energy

2017 Global Reporting Initiative

DTE Energy's Corporate Citizenship Report 2017 describes our commitment to:

People

Improving lives and creating community

Places

Partnering with communities for growth

Planet

Leadership toward cleaner energy and environmental stewardship

Progress

Powering a brighter tomorrow

Philanthropy

Impacting Michigan's future

This document is designed to provide information in accordance with the Global Reporting Initiative's Sustainability Reporting Standards (GRI Standards), core option.

See also DTE Energy's 10-K filing with the U.S. Securities and Exchange Commission, as well as our 2018 Environmental, Social, Governance, and Sustainability Report, which is based on the Edison Electric Institute industry sector template.

Visit www.DTEImpact.com to learn more about DTE Energy as a force for growth and prosperity in the communities where we live and serve.

TABLE OF CONTENTS

GRI 102: GENERAL DISCLOSURES

102-1: NAME OF THE ORGANIZATION

DTE Energy Company

102-2: ACTIVITIES, BRANDS, PRODUCTS, AND SERVICES

DTE Energy Company is a publicly traded (NYSE: *DTE*) diversified energy company involved in the development and management of energy-related businesses and services nationwide. Our largest operating subsidiaries are DTE Electric and DTE Gas. More than three million residential, business and industrial customers throughout Michigan are customers of DTE Electric, DTE Gas, or both of these regulated utility companies.

DTE Energy's other businesses are involved in natural gas pipelines, gathering, and storage; power and industrial projects; and energy marketing and trading operations.

Our electric and gas utility businesses have each been in operation for over a century. We have leveraged that wealth of experience and assets to develop a number of non-utility subsidiaries which provide energy-related services to business and industry nationwide.

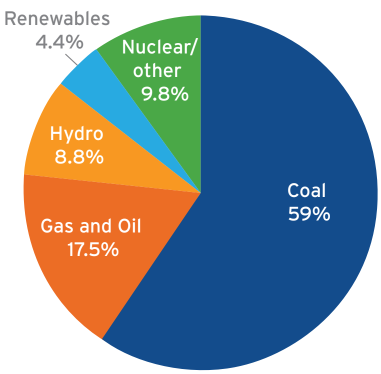
At DTE Energy, our aspiration is to be the best-operated energy company in North America and a force for growth and prosperity in the communities where we live and serve. Our aspiration grew from our employees' desire to build a better future for Michigan and for every community in which DTE operates.

DTE Energy

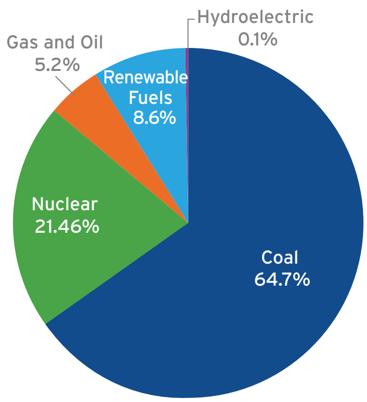
2017 operating revenue: $12.6 billion

DTE Electric

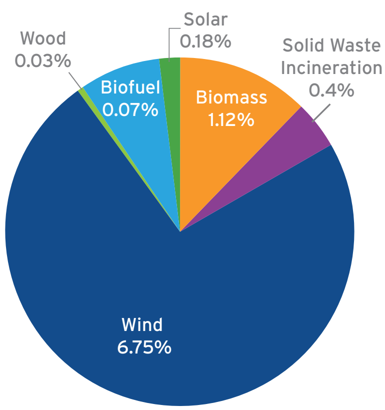
2.2 million customers
7,600 square mile service territory



2017 Electric Generation Capacity



2017 Fuel Mix
Used to Generate Electricity



Renewables Fuels Breakdown

DTE Gas

1.3 million customers
20,300 square mile service territory
Natural gas storage, transport and distribution

Non-Utility Businesses

Gas Storage and pipelines consist of natural gas pipeline, gathering, transportation, and storage businesses.

More than 60 power and industrial projects in 22 states. These are primarily projects delivering energy and utility-type products and services to industrial, commercial, and institutional customers, produce reduced emissions fuel, and sell electricity from renewable energy projects.

Energy Trading focusing on physical and financial power and gas marketing and trading, structured transactions, enhancement of returns from DTE's asset portfolio and optimization of contracted natural gas pipeline transportation, and storage positions. Energy Trading also provides natural gas, power, and related services which may include the management of associated storage and transportation contracts on the customers' behalf and the supply or purchase of renewable energy credits to various customers.[1]

102-3: LOCATION OF HEADQUARTERS

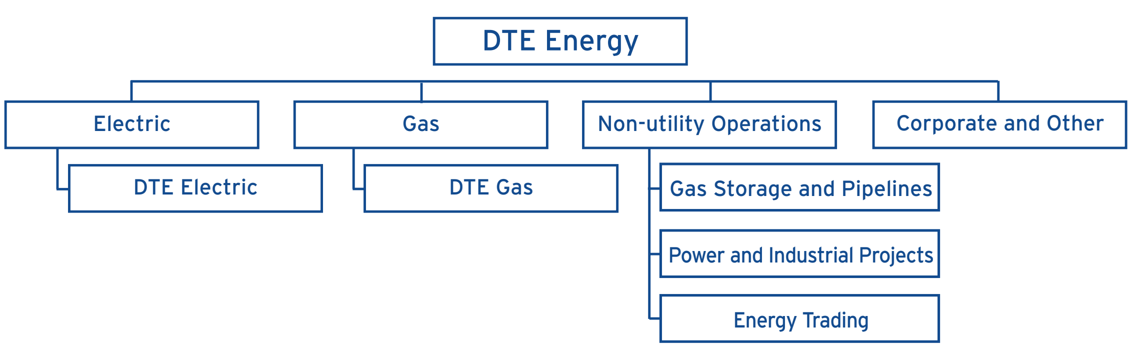
Detroit, Michigan, United States

102-4: LOCATION OF OPERATIONS

United States and Ontario, Canada

102-5: OWNERSHIP AND LEGAL FORM

Incorporated in the State of Michigan in 1995, DTE Energy is a publicly traded (NYSE: DTE), Detroit-based diversified energy company involved in the development and management of energy-related businesses and services nationwide. DTE Energy's utility operations consist primarily of DTE Electric and DTE Gas. DTE Energy also has three other segments engaged in other energy-related businesses.



1 *Edited from 10-K for year ending December 31, 2017, page 18*

DTE Electric is a Michigan corporation organized in 1903 and is a wholly-owned subsidiary of DTE Energy. DTE Electric is a public utility engaged in the generation, purchase, distribution, and sale of electricity to approximately 2.2 million customers in southeastern Michigan.

DTE Gas is a Michigan corporation organized in 1898 and is a wholly-owned subsidiary of DTE Energy. DTE Gas is a public utility engaged in the purchase, storage, transportation, distribution, and sale of natural gas to approximately 1.3 million customers throughout Michigan and the sale of storage and transportation capacity.

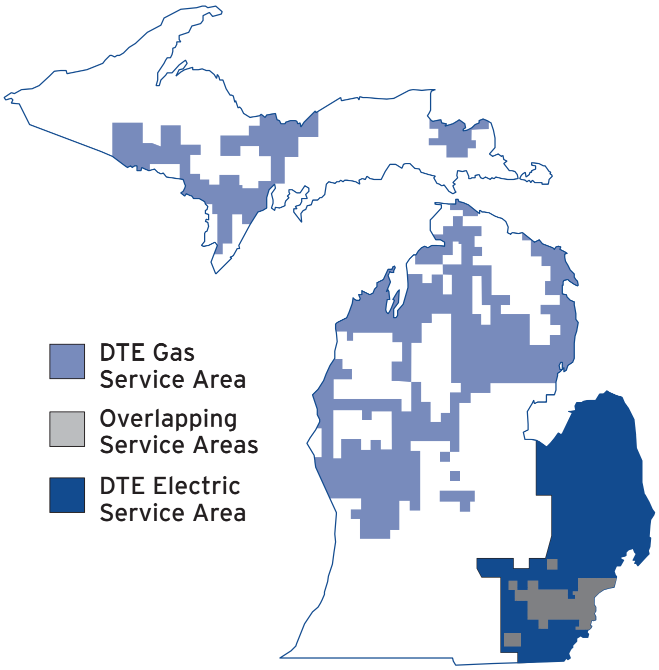
DTE Energy's other businesses are involved in natural gas pipelines, gathering, and storage; power and industrial projects; and energy marketing and trading operations.

DTE Electric and DTE Gas are regulated by the Michigan Public Service Commission. Certain activities of DTE Electric and DTE Gas, as well as various other aspects of businesses under DTE Energy are regulated by the Federal Energy Regulatory Commission. DTE Electric and DTE Gas are regulated by other federal and state agencies including the Nuclear Regulatory Commission, the Environmental Protection Agency, the Michigan Department of Environmental Quality and, for DTE Energy, the U.S. Commodity Futures Trading Commission. A section of the Vector Natural Gas Pipeline, a DTE joint venture, is located in Ontario, Canada, and is regulated by provincial and Canadian federal authorities.

102-6: MARKETS SERVED

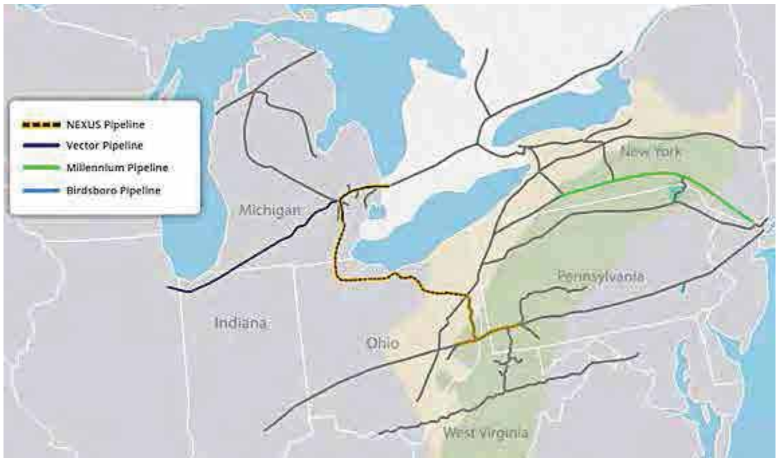
DTE Electric serves 2.2 million residential, business, commercial, and industrial customers in a service territory encompassing 7,429 square miles in southeastern Michigan. DTE Gas serves 1.3 million residential, business, commercial, and industrial customers in a distribution territory of 20,315.2 square miles in Michigan.

Service Map



DTE Gas Pipelines

DTE's natural gas pipeline transmission network connects markets in the Midwest, Northeast and eastern Canada. These pipelines connect producing regions to market areas to meet rising demand for clean, reliable natural gas. These pipelines also access underground storage fields in Michigan and Dawn, Ontario to provide critical supply particularly during the coldest winter months.



In addition to utility operations in Michigan, the DTE Energy portfolio includes non-utility energy businesses focused on power and industrial projects, natural gas pipelines, gathering and storage, and energy marketing and trading in 22 states:

State	DTE Energy Presence
Alabama	DTE Biomass Energy
	DTE Power & Industrial
Arizona	DTE Biomass Energy
California	DTE Biomass Energy
	DTE Power & Industrial
Florida	DTE Biomass Energy
Georgia	DTE Energy Trading
Illinois	DTE Biomass Energy
	DTE Power & Industrial
	DTE Gas Storage & Pipeline
Indiana	DTE Power & Industrial
	DTE Gas Storage & Pipeline
Kansas	DTE Biomass Energy
Maryland	DTE Power & Industrial
Michigan	Citizens Gas Fuel
	DTE Biomass Energy
	DTE Power & Industrial
	DTE Energy Trading
	DTE Gas Storage & Pipeline
	NEXUS Pipeline

State	DTE Energy Presence
Mississippi	DTE Power & Industrial
Nevada	DTE Power & Industrial
New York	DTE Biomass Energy
	DTE Power & Industrial
	DTE Gas Storage & Pipeline
North Carolina	DTE Biomass Energy
Ohio	DTE Biomass Energy
	DTE Power & Industrial
	NEXUS Pipeline
Oklahoma	DTE Biomass Energy
Pennsylvania	DTE Power & Industrial
	DTE Gas Storage & Pipeline
South Carolina	DTE Power & Industrial
Texas	DTE Biomass Energy
	DTE Energy Trading
Utah	DTE Biomass Energy
Virginia	DTE Biomass Energy
Wisconsin	DTE Power & Industrial
	Midwest Energy Resources

In addition to these states, a section of DTE's Vector Pipeline is located in Ontario, Canada. The pipeline transports natural gas from Illinois, to Indiana, Michigan and into Ontario, Canada, linking storage fields in Michigan and Ontario to markets across the Midwest, eastern Canada and the Northeast.

102-7: SCALE OF THE ORGANIZATION

Employees

In 2017 DTE Energy and its subsidiaries had more than 10,000 employees of which approximately 5,000 were represented by unions.

Operations

Electric

DTE Energy's Electric segment consists principally of DTE Electric, an electric utility engaged in the generation, purchase, distribution, and sale of electricity to approximately 2.2 million customers in southeastern Michigan. DTE Electric is regulated by numerous federal and state governmental agencies. Electricity is generated from fossil-fuel plants, a hydroelectric pumped storage plant, a nuclear plant, wind and other renewable assets and is supplemented with purchased power. The electricity is sold, or distributed through the retail access program, to three major classes of customers: residential, commercial, and industrial, throughout southeastern Michigan.

Operating Revenues by Electric Service *(in millions)*:

	2017
Residential	$ 2,310
Commercial	1,758
Industrial	667
Other[(a)]	313
Subtotal	5,048
Interconnection sales[(b)]	54
Electric segment operating revenues	$ 5,102

(a) Includes revenue associated with the under or over recoveries of tracking mechanisms.

(b) Represents power that is not distributed by DTE Electric.

DTE Electric generating facilities owned and in service as of December 31, 2017:

Facility	Location by Michigan County	Year in Service	Net Generation Capacity [a] (MW)
Fossil-Fueled Steam-Electric			
Belle River[b]	St. Clair	1984 and 1985	1,034
Greenwood	St. Clair	1979	785
Monroe[c]	Monroe	1971, 1973, and 1974	3,066
River Rouge	Wayne	1958	272
St. Clair	St. Clair	1953, 1954, 1961 and 1969	1,216
Trenton Channel	Wayne	1968	520
			6,893
Natural Gas and Oil-Fueled Peaking Units	Various	1966-1971, 1981, 1999, 2002, and 2003	2,033
Nuclear-Fueled Steam-Electric			
Fermi 2	Monroe	1988	1,141
Hydroelectric Pumped Storage			
Ludington[d]	Mason	1973	1,019
Renewables[e]			
WIND			
Brookfield Wind Park	Huron	2014	75
Echo Wind Park	Huron	2014	112
Gratiot Wind Park	Gratiot	2011 and 2012	102
Pinnebog Wind Park	Huron	2016	51
Thumb Wind Project	Huron and Sanilac	2012	110
			450
SOLAR			
Utility-Owned SolarCurrents	Various	2010-2016	16
Utility Scale Solar	Various	2017	50
			66
			11,602

(a) Represents summer net rating for all units with the exception of renewable facilities. The summer net rating is based on operating experience, the physical condition of units, environmental control limitations, and customer requirements for steam, which would otherwise be used for electric generation. Wind and solar facilities reflect name plate capacity.
(b) The Belle River capability represents DTE Electric's entitlement to 81% of the capacity and energy of the plant.
(c) The Monroe generating plant provided 40% of DTE Electric's total 2017 power plant generation.
(d) Represents DTE Electric's 49% interest in Ludington with a total capability of 2,080 MW.
(e) In addition to the owned renewable facilities described above, DTE Electric has long-term contracts for 489 MW of renewable power generated from wind, solar, and biomass facilities.

DTE Electric owns and operates 692 distribution substations with a capacity of approximately 36,357,000 kilovolt-amperes (kVA) and approximately 440,500 line transformers with a capacity of approximately 31,777,000 kVA. Circuit miles of electric distribution lines owned and in service as of December 31, 2017:

		Circuit Miles
Operating Voltage-Kilovolts (kV)	**Overhead**	**Underground**
4.8 kV to 13.2 kV	28,479	15,122
24 kV	182	689
40 kV	2,301	378
120 kV	61	8
	31,023	16,197

Circuit miles of electric distribution lines owned and in service as of December 31, 2017 are shown in the following table:

		Circuit Miles
Operating Voltage-Kilovolts (kV)	**Overhead**	**Underground**
4.8 kV to 13.2 kV	28,479	15,122
24 kV	182	689
40 kV	2,301	378
120 kV	61	8
	31,023	16,197

There are numerous interconnections that allow the interchange of electricity between DTE Electric and electricity providers external to the DTE Electric service area. These interconnections are generally owned and operated by ITC Transmission, an unrelated company, and connect to neighboring energy companies.

Gas

DTE Energy's Gas segment consists principally of DTE Gas, a natural gas utility engaged in the purchase, storage, transportation, distribution, and sale of natural gas to approximately 1.3 million residential, commercial, and industrial customers throughout Michigan, and the sale of storage and transportation capacity.

Operating Revenues by Gas Service *(in millions)*

	2017
Gas sales	$ 1,002
End-user transportation	206
Intermediate transportation	49
Other	131
Gas segment Operating Revenues	$ 1,388

- *Gas sales — The sale and delivery of natural gas primarily to residential and small-volume commercial and industrial customers.*
- *End-user transportation — Gas delivery service provided primarily to large-volume commercial and industrial customers.*
- *Intermediate transportation — Gas delivery service provided to producers, brokers, and other gas companies that own the natural gas, but are not the ultimate consumers.*
- *Other — Includes revenue from natural gas storage, appliance maintenance, facility development, and other energy-related services.*

DTE's gas distribution system has a planned maximum daily send-out capacity of 2.4 Bcf, with approximately 65 percent of the volume coming from underground storage for 2017. The distribution system includes approximately 19,500 miles of distribution mains, approximately 1,216,000 service pipelines, and approximately 1,262,000 active meters, and DTE Gas owns approximately 2,000 miles of transmission pipelines that deliver natural gas to the distribution districts and interconnect DTE Gas storage fields with the sources of supply and the market areas. DTE Gas owns storage properties relating to four underground natural gas storage fields with an aggregate working gas storage capacity of approximately 139 Bcf. DTE Gas also sells storage services to third parties. Most of DTE Gas' distribution and transportation property is located on property owned by others and used by DTE Gas through easements, permits, or licenses.

DTE Gas Storage and Pipelines

DTE Gas Storage and Pipelines owns natural gas storage fields, lateral and gathering pipeline systems, compression and surface facilities, and has ownership interests in interstate pipelines serving the Midwest, Ontario, and Northeast markets. DTE Gas Storage and Pipelines holds the following properties:

Property Classification	% Owned	Description	Location
Pipelines			
Appalachia Gathering System	100%	114-mile pipeline delivering Marcellus Shale gas to Texas Eastern Pipeline and Stonewall Gas Gathering system	PA and WV
Stonewall Gas Gathering	55%	68-mile pipeline connecting Appalachia Gathering System to Columbia Pipeline	WV
Bluestone Pipeline	100%	59-mile pipeline delivering Marcellus Shale gas to Millennium Pipeline and Tennessee Pipeline	PA and NY
Susquehanna gathering system	100%	Gathering system delivering Southwestern Energy's Marcellus Shale gas production to Bluestone Pipeline	PA
Vector Pipeline	40%	348-mile pipeline connecting Chicago, Michigan, and Ontario market centers	IL, IN, MI, and Ontario
Millennium Pipeline	26%	251-mile pipeline serving markets in the Northeast	NY
Michigan gathering systems	100%	Gathers production gas in northern Michigan	MI
Storage			
Washington 10	100%	75 Bcf of storage capacity	MI
Washington 28	50%	16 Bcf of storage capacity	MI

In addition, DTE Energy owns a 50 percent interest in the NEXUS Pipeline, a 255-mile pipeline to transport Utica and Marcellus shale gas to Ohio, Michigan, and Ontario market centers. A FERC application was filed in the fourth quarter of 2015 and was approved in August 2017. Construction has commenced with an anticipated third quarter 2018 in-service date. In May 2017, DTE Energy filed a FERC application for approval of the Birdsboro Pipeline, a 14-mile lateral to serve a new power plant in Pennsylvania. DTE Energy is targeting a 2018 in-service date.

Power and Industrial Projects (P&I) is comprised primarily of projects that deliver energy and utility-type products and services to industrial, commercial, and institutional customers, produce reduced emissions fuel, and sell electricity from renewable energy projects. This business segment provides services using project assets usually located on or near the customers' premises in the steel, automotive, pulp and paper, airport, chemical, and other industries as follows:

Industrial Energy Services

- **Steel and Petroleum Coke** — Produces metallurgical coke from a coke battery with a capacity of 1.0 million tons per year and has an investment in a second coke battery with a capacity of 1.2 million tons per year. Power and Industrial Projects also provides pulverized coal and petroleum coke to the steel, pulp and paper, and other industries.

- **On-Site Energy** — Provides power generation, steam production, chilled water production, wastewater treatment and compressed air supply to industrial customers. Power and Industrial Projects also provides utility-type services using project assets usually located on or near the customers' premises in the automotive, airport, chemical, and other industries.

Renewable Energy

- **Wholesale Power and Renewables** — P&I has ownership interests in and operates five renewable generating plants with a capacity of 217 MW. The electric output is sold under long-term power purchase agreements.

- **Landfill Gas Recovery** — P&I has ownership interests in and operates 22 landfill gas recovery sites in eight different states. The sites recover methane from landfills and converts the gas to generate electricity, replace fossil fuels in industrial and manufacturing operations, or refine to pipeline-quality gas, which can then be used as vehicle fuel.

Reduced Emissions Fuel (REF)

- P&I has constructed and placed in service REF facilities at 11 sites including facilities located at eight third-party owned coal-fired power plants. DTE Energy has sold membership interest in four of the facilities and entered into lease arrangements in three of the facilities. In addition, DTE Energy has entered into an agreement to operate an REF facility owned by an outside party located at a third-party owned coal-fired power plant. The facilities blend a proprietary additive with coal used in coal-fired power plants, resulting in reduced emissions of nitrogen oxide and mercury. Qualifying facilities are eligible to generate tax credits for ten years upon achieving certain criteria.

Significant properties operated by DTE's Power and Industrial Projects:

Business Areas	Location	Service Type
Industrial Energy Services		
Steel and Petroleum Coke		
Pulverized Coal Operations	MI	Pulverized Coal
Coke Production	MI	Metallurgical Coke Supply
Other Investment in Coke Production and Petroleum Coke	IN and MS	Metallurgical Coke Supply and Pulverized Petroleum Coke
On-Site Energy		
Automotive	IN, MI, NY, and OH	Electric Distribution, Chilled Water, Waste Water, Steam, Cooling Tower Water, Reverse Osmosis Water, Compressed Air, Mist, and Dust Collectors
Airports	MI and PA	Electricity and Hot and Chilled Water
Chemical Manufacturing	KY and OH	Electricity, Steam, Natural Gas, Compressed Air, and Wastewater
Consumer Manufacturing	OH	Electricity, Steam, Wastewater, and Sewer
Business Park	PA	Electricity
Hospital and University	CA and IL	Electricity, Steam, and Chilled Water
Renewable Energy		
Pulp and Paper	AL	Electric Generation and Steam
Renewables	CA and MN	Electric Generation
Landfill Gas Recovery	AZ, CA, MI, NC, NY, OH, TX, and UT	Electric Generation and Renewable Natural Gas
Reduced Emissions Fuel	MI, OH, OK, IL, PA, TX, and WI	REF Supply

	2017
Production Tax Credits Generated (Allocated to DTE Energy) *(in millions)*	
REF	$ 144
Renewables	6
Landfill Gas Recovery	3
	$ 153

Energy Trading

Energy Trading focuses on physical and financial power and gas marketing and trading, structured transactions, enhancement of returns from its asset portfolio and optimization of contracted natural gas pipeline transportation, and storage positions. Energy Trading also provides natural gas, power, and related services which may include the management of associated storage and transportation contracts on the customers' behalf and the supply or purchase of renewable energy credits to various customers. Energy Trading's customer base is predominantly utilities, local distribution companies, pipelines, producers and generators, and other marketing and trading companies. Energy Trading enters into derivative financial instruments as part of its marketing and hedging activities.

Corporate and Other

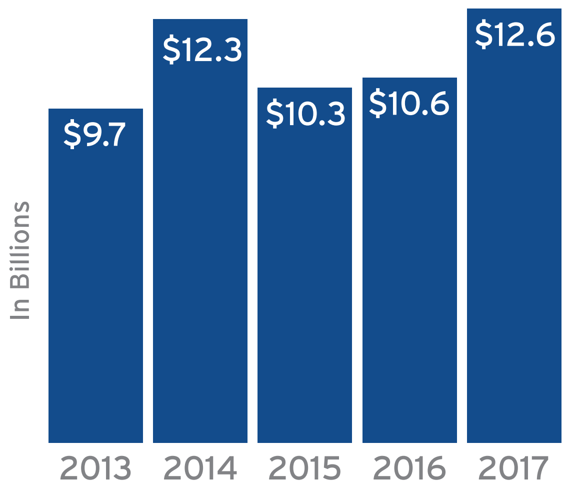
Includes various holding company activities, holds certain non-utility debt, and holds energy-related investments.

Net Revenues and Total Capitalization

The following Consolidated Statement of Operations if for the year ending December 31, 2017. Numbers are in millions except for per-share amounts. For additional financial detail, please see DTE Energy's 10-K for the fiscal year ending December 31, 2017.

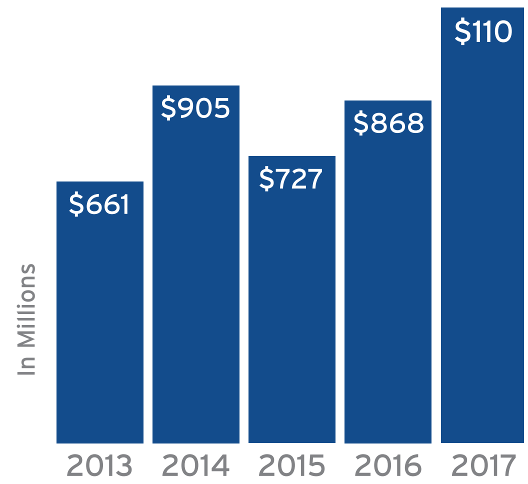
Operating Revenues *(in millions)*	**2017**
Utility operations	$ 6,434
Non-utility operations	6,173
Net Revenue	$ 12,607

Operating Revenue

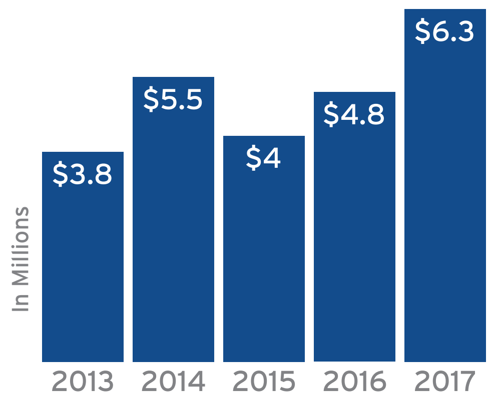


Operating Expenses *(in millions)*	
Fuel, purchased power, and gas — utility	1,881
Fuel, purchased power, and gas — non-utility	5,283
Operation and maintenance	2,335
Depreciation and amortization	1,030
Taxes other than income	391
Asset (gains) losses and impairments, net	41
	10,961
Operating Income	1,646
Other (Income) and Deductions	
Interest expense	536
Interest income	(12)
Other income	(268)
Other expenses	103
	359
Income Before Income Taxes	1,287
Income Tax Expense	175
Net Income	1,112
Less: Net Loss Attributable to Non-Controlling Interests	(22)
Net Income Attributable to DTE Energy Company	$1,134
Basic Earnings per Common Share	
Net Income Attributable to DTE Energy Company	$6.32
Diluted Earnings per Common Share	
Net Income Attributable to DTE Energy Company	$6.32
Weighted Average Common Shares Outstanding	
Basic	179
Diluted	179
Dividends Declared per Common Share	$3.36

Earnings *(in millions)*



Diluted Earnings *(in millions)*



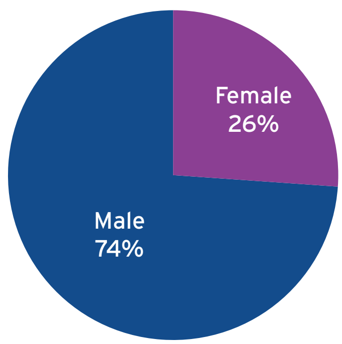
102-8: INFORMATION ON EMPLOYEES AND OTHER WORKERS

DTE's workforce in 2017 totaled approximately 10,400 employees with unions representing 49 percent of the company's permanent, full time employees. All DTE employees work in the United States, primarily in Michigan.

Permanent and Temporary Employees by Gender[2]

Employee Type	Female	Male
Regular	2,661	7,440
Temporary	130	185

Employees by Gender



Fulltime and Part-Time Employees by Gender[3]

Employee Type	Female	Male
Full Time Regular	2,749	7,608
Part-Time Regular	42	17

Contractors

Contractor Type	DTE Enterprise Wide	Utility Only
Badged Contractor Headcount	545	490
Full Time Equivalent Headcount *(excludes temporary)*	10,107	9,074
Full Time Equivalent and Contractor Headcount Combined	10,652	9,564
Percent of Contractors among Workforce	5.11%	5.12%

2 Six employees did not select a gender
3 Six employees did not select a gender

102-9: SUPPLY CHAIN

DTE views its suppliers as strategic partners in company success. DTE expects those with whom the company does business to share the same values and principles that enable DTE to enjoy an excellent reputation within the communities it serves.

In 2017, DTE managed supplier relationships and expectations through more than 116 supplier performance scorecards and periodic executive reviews to measure performance and develop corrective actions.

In 2017, DTE Energy conducted 104 executive forums and reviews with top suppliers and senior leadership. Focusing on safety priorities, DTE Gas scheduled monthly contractor partnership meetings to discuss safety and quality audit results.

In 2017, DTE contracted with suppliers providing products and services in nearly 30 categories:

1. Construction
2. Electrical
3. Engineering
4. Environmental
5. Facilities
6. Fleet Materials
7. Fleet Services
8. Gasoline
9. Heating-Ventilation-Air Conditioning
10. Home Protection Program
11. Information Technology
12. Instrumentation
13. Maintenance
14. Maintenance Materials
15. Metering Services
16. Meters
17. Miscellaneous-Other
18. Maintenance, Repair, Operations
19. Natural Gas and Chemicals used in Fossil Fuel Plants
20. Oil Filled Equipment
21. Personnel
22. Pipes, Valves, Fittings
23. Power Generation Production Materials
24. Professional Services
25. Pumps, Motors and Generators
26. Safety
27. Transportation Services
28. Vehicles and Equipment
29. Wire and Cable

Last year, 4,676 suppliers were in DTE's companywide supply chain. The following includes the supplier count associated with DTE's lines of business. Some DTE suppliers contract with multiple lines of DTE business:

Distribution Operations	662
Gas	845
Energy Optimization	150
Fossil Generation	1,396
Gas Storage and Pipelines	221
Corporate Services	752
Major Enterprise Projects	649
Nuclear Generation	703
Power and Industrial	1,807

DTE's 4,676 suppliers in 2017 were located in every state except Alaska, Hawaii, Montana, and South Dakota. The estimated monetary value of payments made to suppliers by DTE in 2017 is more than $2.8 billion.

DTE is a nationwide leader in supplier diversity, emphasizing the importance of contracting with women, veteran and minority-owned firms, which has diversified the company's supplier base. Last year, DTE spent $441 million with diverse vendors and captured six industry-wide awards for its commitment to supplier diversity. We encourage our suppliers to have the same commitment in their use of materials and services from their own base of diverse suppliers and contractors.

Fuel Supply and Purchased Power

DTE Electric's power is generated from a variety of fuels and supplemented with purchased power. DTE Electric's generating capability is heavily dependent on coal, which is purchased from various sources in different geographic areas under agreements that vary in pricing and terms. DTE Electric has long-term and short-term contracts and pricing schedules for the purchase of approximately 26.7 million tons of low-sulfur western coal and approximately 1 million tons of Appalachian coal to be delivered from 2018 to 2021. DTE Electric has approximately 94 percent of the expected coal requirements for 2018 under contract. To transport the coal from suppliers to its power plants, DTE leases a fleet of railroad cars and has contracts with Great Lakes bulk-cargo shipping firms.

Natural Gas Supply

DTE purchases natural gas supplies in the open market by contracting with producers and marketers, and maintains a diversified portfolio of natural gas supply contracts. Supplier, producing region, quantity, and available transportation diversify DTE's natural gas supply base. Natural gas supply is obtained from various sources in different geographic areas (Gulf Coast, Mid-Continent, Canada, and Michigan) under agreements varying in pricing and terms. DTE Gas is directly connected to interstate pipelines, providing access to most of the major natural gas supply producing regions in the Gulf Coast, Mid-Continent, and Canadian regions. The primary long-term transportation supply contracts at December 31, 2017 are listed below.

	Availability (MDth/d)	Contract Expiration
Great Lakes Gas Transmission L.P.	30	2022
Viking Gas Transmission Company	21	2022
Vector Pipeline L.P.	20	2022
ANR Pipeline Company	204	2028
Panhandle Eastern Pipeline Company	125	2029

Nuclear Fuel

In 2017, DTE utilized three suppliers for fuel at its Fermi II Nuclear Power Plant including Cameco, Urenco, and Global Nuclear Fuel (General Electric).

Michigan Supplier and Diversity

Amid the deepening recession several years ago, DTE refocused its purchasing practices to target Michigan based businesses. Since 2010, we've invested more than $7.5 billion with local suppliers of goods and services, creating 16,000 jobs statewide. In 2017, DTE spent nearly $1.7 billion with 3,500 Michigan businesses, creating or sustaining 5,100 jobs statewide. More than 70 percent of DTE's purchasing dollars now go Michigan businesses, achieved without compromising cost or quality.

102-10: SIGNIFICANT CHANGES TO THE ORGANIZATION AND ITS SUPPLY CHAIN

There were no significant changes to DTE's organization structure in 2017. There were no significant changes related to DTE's supply chain. There were no major DTE plant openings, closings or expansions.

DTE Energy owns a 50 percent interest in the Nexus Pipeline, a 255-mile pipeline to move 1.5 billion cubic feet of domestically produced Utica and Marcellus shale gas to Ohio, Michigan, Pennsylvania and Ontario market centers. Construction has commenced with an anticipated third quarter 2018 in-service date. In May 2017, DTE Energy filed a FERC application for approval of the Birdsboro Pipeline, a 14-mile lateral gas pipeline to serve a new power plant in Pennsylvania. DTE Energy is targeting a 2018 in-service date.

102-11: PRECAUTIONARY PRINCIPLE OR APPROACH

See the DTE Energy Company 10-K for the Year Ending 12-31-17, Item 1A., Risk Factors, pages 20-25. For additional information on risks associated with DTE's sustainability and climate change plans, see DTE's 2018 Environmental, Social, Governance and Sustainability Report, Sustainability Strategy, pages 3-6.

102-12: EXTERNAL INITIATIVES

DTE Energy follows or subscribes to numerous voluntary environmental, social and governance charters, guidelines and standards including:

ISO 14001 Environmental Management

Environmental Protection Agency Global Methane Initiative

Edison Electric Institute ESG Template

National Wildlife Federation Wildlife Habitat Certification

Environmental Protection Agency WasteWise

Michigan Department of Environmental Quality Clean Corporate Citizen

Michigan Business Pollution Prevention Partnership (MBP3)

Electric Utility Industry Sustainable Supply Chain Alliance

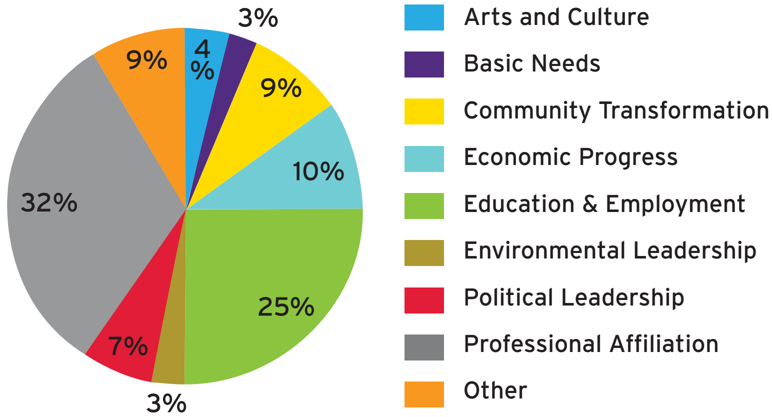
Michigan Economic Development Corporation Pure Michigan Business Connect

102-13: MEMBERSHIP OF ASSOCIATIONS

DTE Energy has representation on various associations, councils and organizations involving and representing stakeholders of industry and professional importance. The following list of organizations to which DTE belongs represents affiliations with leading utility-relevant industry and professional groups. DTE representatives are board members on some and those relationships are used to communicate DTE operational plans, benchmark best practices for organizational management, as well as understand and influence legislative and policy agendas.

Organization	Stakeholder Group
American Gas Association	Industry Association
American Iron and Steel Institute	Industry Association
Ann Arbor SPARK	Business Partner
Biomass Power Association	Industry Association
Business Leaders for Michigan	Business Partner
Center on Executive Compensation	Business Partner
Coalition to Keep Michigan Warm	Nonprofit
Construction Association of Michigan	Business Partner
Detroit Regional Chamber of Commerce	Chamber of Commerce
Edison Electric Institute	Industry Association
Electric Reliability Coordinating Council	Industry Association
Human Resources Policy Association	Business Partner
Interstate Natural Gas Association of America	Industry Association
Local Chambers of Commerce (more than 65 throughout Michigan)	Chambers of Commerce
Marcellus Shale Coalition	Industry Association
Metropolitan Affairs Coalition	Industry Association
Michigan Association of Counties	Government
Michigan Association of Planning	Government
Michigan Chamber of Commerce	Chamber of Commerce
Michigan Economic Development Corporation	Economic Development
Michigan Electric and Gas Association	Industry Association
Michigan Manufacturers Association	Business Partner
Michigan Municipal League	Government
Michigan Retailers Association	Business Partner
Michigan Townships Association	Government
National Association of Manufacturers	Business Partner
National Energy and Utility Affordability Coalition	Nonprofit
Northern Chamber Alliance	Chamber of Commerce
Nuclear Energy Institute	Industry Association
Nuclear Waste Strategy Coalition	Industry Association
Public Affairs Council	Business Partner
Regional CEO Group	Economic Development
Small Business Association of Michigan	Business Partner
The Right Place	Nonprofit
U.S. Chamber of Commerce	Chamber of Commerce
West Michigan Policy Forum	Business Partner

DTE executives serve as board members for more than 100 nonprofits, professional groups, trade associations and other organizations. To identify and track this aspect of the company's community engagement, in 2017 DTE implemented a process to capture, analyze and update board service roles among its executive leadership. Data quality was thus improved, a board service succession plan was created, and a DTE executive board service governance committee was established.



DTE's executive team service in 2017 with nonprofits and other organizations:

Organization	Stakeholder Group
Arab Community Center for Economic and Social Services	Education and Employment
Accounting Advisory Council	Industry Boards
Advancing Macomb	Community Transformation
Associated Food and Petroleum Dealers Foundation • Board of Trustees	Other
American Association of Blacks in Energy • Michigan Chapter	Industry Boards
American Gas Association • Environmental Matters Committee • Leadership Council Committee • Legal Committee and Executive Committee • Operations Section Managing Committee • Safety Committee • Tax Committee • Sustainable Growth Committee	Industry Boards
American Hazard Control Group • Corporate Affiliate	Industry Boards
American Heart Association • Go Red Campaign	Other
American Iron and Steel Institute	Industry Boards
American Red Cross of Southeast Michigan	Basic Needs
American Society of Employers • Board of Directors	Education and Employment
Ann Arbor SPARK	Economic Progress
Association of Edison Illuminating Companies • Power Generation Committee	Industry Boards
Autism Alliance of Michigan	Education and Employment
Business Leaders for Michigan • Executive Committee	Political Leadership

DTE's executive team service in 2017 with nonprofits and other organizations *(cont.)*:

Organization	Stakeholder Group
Citizens Research Council of Michigan	Other
Communities in Schools of Michigan	Education and Employment
Community Foundation for Southeast Michigan	Community Transformation
Conference Board - Chief Environmental Health and Safety Officers • Officers Council	Industry Boards
Conservation Resource Alliance	Environmental Leadership
Council of Great Lakes	Industry Boards
Cranbrook Schools • Board of Trustees	Education and Employment
Cranbrook Institute of Science	Education and Employment
Crime Stoppers Alliance for a Safer Greater Detroit • Communications Committee	Community Transformation
Detroit Area Pre-College Engineering Program	Education and Employment
Detroit Crime Commission	Other
Detroit Economic Club	Economic Progress
Detroit Economic Growth Corporation	Economic Progress
Detroit Institute of Arts	Arts and Culture
Detroit Opera House	Arts and Culture
Detroit Public Television	Other
Detroit Regional Chamber • Economic Development Advisory Board • Mackinac Conference Planning Committee • Public Policy Committee	Economic Progress
Detroit Regional Chamber	Political Leadership
Detroit Regional Chamber of Commerce Foundation	Community Transformation
Detroit Symphony Orchestra	Arts and Culture
Detroit Workforce Development Board	Education and Employment
Detroit Zoological Society	Arts and Culture
Downtown Detroit Partnership • Executive Committee	Community Transformation
Edison Electric Institute • Accounting Leadership • Chief Accounting Officers Group • CIO Security and Technology Policy • Clean Air Strategy Group • Environmental Executive Advisory Committee • Executive Advisory Committee • Executive Committee • Human Resources Executive Advisory Committee • Global Climate Change • Legal Committee • Plugin Electric Vehicle Committee • Retail Energy Services • Treasurers Group	Industry Boards

DTE's executive team service in 2017 with nonprofits and other organizations *(cont.)*:

Organization	Stakeholder Group
Edison Electric Institute, Retail Energy Services • Executive Advisory Committee	Industry Boards
Electric Power Research Institute • Resource Allocation Committee	Industry Boards
Electric Utility Industry Sustainable Supply Chain Alliance	Economic Progress
Endeavor Detroit	Economic Progress
Engineering Society of Detroit	Education and Employment
Ferris State University • Playmaker Committee	Education and Employment
FIRST in Michigan • FIRST Robotics	Education and Employment
Fish and Loaves Community Food Pantry • Advisory Board	Other
Focus: HOPE	Education and Employment
Forgotten Harvest	Other
Friends of Dearborn Animal Shelter	Other
Girl Scouts of Southeast Michigan	Education and Employment
Gleaners Community Food Bank of Southeast Michigan	Basic Needs
Goodwill Industries of Greater Detroit	Education and Employment
Green Light Detroit	Education and Employment
Haven Foundation – Oakland County	Other
Human Resources Policy Association • Employments Rights Committee	Industry Boards
Hudson Webber Foundation	Community Transformation
Inforum Michigan	Education and Employment
Invest Detroit	Economic Progress
Junior Achievement	Education and Employment
Livingston County Catholic Charities	Community Transformation
Local Initiatives Support Corporation	Economic Progress
Mayor's Workforce Development Board	Political Leadership
M-1 Rail	Economic Progress
McGregor Fund	Community Transformation
Metropolitan Affairs Coalition	Political Leadership
Michigan Chamber of Commerce	Political Leadership
Michigan Colleges Alliance	Education and Employment
Michigan Economic Development Corporation	Economic Progress
Michigan Economic Development Foundation	Community Transformation
Michigan Hidden Talent Workshop	Education and Employment
Michigan Hispanic Chamber of Commerce	Economic Progress
Michigan Humane Society	Community Transformation
Michigan Manufacturers Association	Political Leadership

DTE's executive team service in 2017 with nonprofits and other organizations *(cont.)*:

Organization	Stakeholder Group
Michigan Minority Supplier Development Council	Economic Progress
Michigan Municipal Electric Association	Industry Boards
Michigan Roundtable for Diversity and Inclusion	Community Transformation
Michigan Saves	Environmental Leadership
Michigan Science Center	Education and Employment
MidTown Detroit, Inc. • Audit/Finance Committee	Economic Progress
Midwest Utility Group • Labor Relations Advisory Group	Industry Boards
National Association of Manufacturers	Political Leadership
New Education Highway	Education and Employment
NextEnergy	Economic Progress
Oakland University • Engineering Advisory Committee	Education and Employment
Reading Works	Education and Employment
Ready Nation	Education and Employment
Regional CEO Group	Political Leadership
ReliabiltyFirst Corporation	Industry Boards
Retail Energy Services • Executive Advisory	Industry Boards
Southwest Solutions • Board of Advisors	Education and Employment
St. Joseph Mercy Health System	Other
Solid Waste Association of North America	Industry Boards
Talent 2025	Education and Employment
TechTown Detroit	Economic Progress
The Heat and Warmth Fund (THAW)	Basic Needs
The Conference Board Council of US Diversity and Inclusion Executives	Industry Boards
The First Tee of Greater Michigan	Other
The Henry Ford	Arts and Culture
The Nature Conservancy • Michigan Chapter	Environmental Leadership
The Parade Company	Arts and Culture
The Right Place	Economic Progress
The Skillman Foundation	Community Transformation
University of Michigan – Dearborn • College of Business Board of Advisors • Executive Leaders Advocacy Group	Education and Employment
University of Michigan School of Education (Dean's Advisory Council)	Education and Employment

DTE's executive team service in 2017 with nonprofits and other organizations *(cont.)*:

Organization	Stakeholder Group
United Way for Southeastern Michigan	Community Transformation
University Musical Society	Education and Employment
Utility Procurement Mangers Group	Economic Progress
Vista Maria	Education and Employment
Wayne State University College of Fine, Performing and Communications Arts • Board of Volunteers	Education and Employment
Wayne State University Industrial and Systems Engineering • Board of Advisors	Education and Employment
Wayne State University Mike Illitch School of Business Administration • Board of Advisors	Education and Employment
Wayne State University Foundation • Investment Committee	Education and Employment
West Michigan Policy Forum	Economic Progress
Wildlife Habitat Council	Environmental Leadership

102-14: STATEMENT FROM SENIOR DECISION MAKER

Video from Gerry Anderson, Chairman and CEO, DTE Energy
https://youtu.be/Ew7ZwjMdp7k

102-15: KEY IMPACTS, RISKS, AND OPPORTUNITIES

See DTE Energy Company 10-K for Year Ending 12-31-17. For risk-specific information, see: Item 1A., Risk Factors, pages 20-25. Also see DTE's 2018 Environmental, Social, Governance, and Sustainability Report, which is based on the Edison Electric Institute template. A description of DTE's material sustainability issues is included in this GRI Report, under Standard 102-47.

102-16: VALUES, PRINCIPLES, STANDARDS, AND NORMS OF BEHAVIOR

Aspiration

DTE is striving to become the best-operated energy company in North America and a force for growth and prosperity in the communities where its employees live and serve. Building upon a 150-year history, DTE is progressing toward this aspiration by continually emphasizing collaboration among employees, urging all to stay connected to the company's purpose, by focusing on DTE's seven company priorities, and by expecting every employee to integrate company values in their daily work.

Purpose

"We serve with our energy, the lifeblood of communities and the engine of progress." This sense of purpose – remembering why DTE Energy exists – give work at DTE a unique meaning for every employee. It is a source of inspiration and strength.

Values

Intended to guide how DTE employees think about the company, the way they work, and how they interact with one another, these "rules of the road" are meant to guide all decisions and actions; to be intentionally embraced and acted upon with conviction.

- We put the health and safety of people first... and know this responsibility rests with each of us.
- We act with integrity and show respect... and understand this defines our company's character.
- We see our work through the eyes of those we serve... and know that our work is a powerful means to serve others.
- We bring our best energy and focus to our work... and are fully engaged and accountable for results.
- We believe that improvement is our daily responsibility... and know those we serve have the right to expect that from us.
- We play to win as a team... and put the needs of our enterprise first.
- We are passionate about the success of our company... and know that its health and growth generate prosperity.

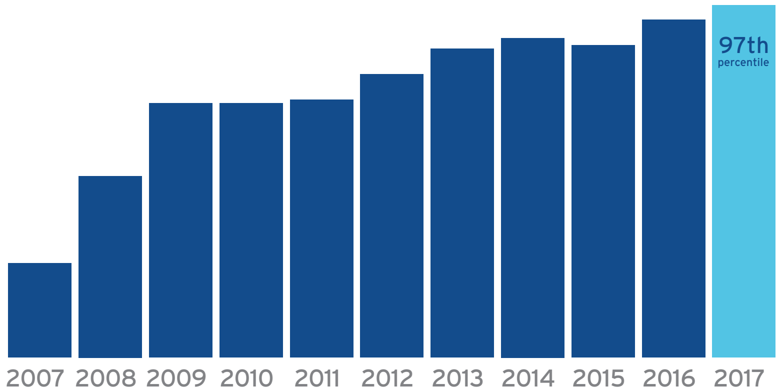
Priorities

Used to drive toward achieving DTE's aspiration, these seven connected company priorities interact and influence one another as a reinforcing system. This illustration summarizes DTE Energy's corporate priorities as strategic drivers and how they connect to propel the company toward a strong, sustainable future. Success depends in large part upon growth and prosperity among the customers and communities served by DTE.

Code of Conduct

The DTE Energy Way, the code of conduct on which all employees are trained beginning the first day on the job, is the highest level of policy for all employees. It guides how employees behave on the job to ensure their activities are consistent with DTE values. The DTE Energy Way is detailed in an extensive section on the DTE internal website, Quest, which covers dozens of issues from defining DTE values, asking questions, seeking help and reporting concerns of harassment, conflicts of interest, and insider trading. DTE Energy also has a supplier code of conduct to ensure its business partners adhere to the same standards.

Gallup Ranking of DTE Employee Engagement



DTE uses the Gallup Survey to measure the success of its engagement efforts. Gallup is a global research and polling firm that assists organizations through measurement tools, strategic advice and education.

102-17: MECHANISMS FOR ADVICE AND CONCERNS ABOUT ETHICS

DTE Energy promotes an ethical culture among employees properly grounded on company values. This emphasis on ethics and values starts with DTE's board of directors and extends throughout the company. The DTE Energy Code of Ethics is published on DTE's public website, along with the Board of Directors Mission and Guidelines, Board Codes and Policies, and Categorical Standards for Director Independence.

DTE's Ethics and Compliance Office promotes a culture of integrity, respect, and compliance with laws and regulations. To encourage supporting behaviors, ethics ambassadors are embedded within business groups companywide. These ambassadors are an in-department resource for employees seeking guidance as well as related training and communication. A list of ethics ambassadors by name, title, and with email addresses is published on the DTE internal website, *Quest*.

Beyond these peer experts assigned in every DTE business unit, DTE employees can learn about and seek information on ethical concerns through extensive web-based resources on *Quest*. The resources include a downloadable DTE Ethics in Action pamphlet, which details ways to learn about ethical concerns at DTE, pinpoints examples of questionable behavior, and provides reporting options. Provided to all new DTE employees on intake as well as at business unit training sessions, this pamphlet and additional content populate an Ethics and Compliance section on *Quest*.

Resources include a 20-question and answer FAQ resource addressing issues including:

- *I'm not sure if what I've seen or heard is a violation of company policy. Where can I find more information?*
- *I know of some questionable legal or ethical behavior. What should I do?*
- *What happens after I file a report?*
- *I'm concerned about backlash. What assurances can you provide that my name will remain anonymous?*

Several articles on ethics are also published on *Quest* for context and reference.

DTE's Ethics in Action Program, administered by the Ethics and Compliance Office, promotes a "speak-up" culture by providing mechanisms for employees, retirees, vendors, customers, shareholders, and the public to report suspected non-compliance or work practices inconsistent with DTE standards and values. This independent system for questionable, unethical, and illegal behavior has five reporting pathways including though *Quest*, DTE's public website, via phone (24/7), by mail and directly informing the business unit leader, Human Resources, or the DTE Ethics and Compliance Office

An independent third party operates DTE's Ethics in Action Helpline through which individuals can make confidential and, if desired, anonymous reports. This third-party vendor, NAVEX Global, operates EthicsPoint® web and telephone reporting channels. These hotlines are open to the public. Anyone can report any issue of concern ranging from violation of policy and inappropriate use of DTE equipment to concerns about purchasing practices and harassment. Every contact is acted upon and investigated.

102-18: GOVERNANCE STRUCTURE

The DTE governance structure consists of a board of directors and committees of the board of directors. The DTE Energy Bylaws describe how the company will operate with regard to shareholders, the Board of Directors and Board Committees, Officers, stock, and other matters.

As of December 31, 2017, the DTE Energy board consisted of 12 independent directors elected annually by shareholders, plus DTE's chairman and CEO, the sole non-independent management director. The DTE Energy board meets regularly to lead the company in fulfilling its mission and achieving its goals. With respect to economic, environmental, and social issues, the DTE board:

- Is responsible for creating long-term value for shareholders while ensuring that the company operates in an environmentally sensitive and socially responsible manner
- Oversees company management and assesses the effectiveness of management policies and decisions, including management's development and execution of the company's strategies
- Approves all major environmental initiatives

Information on DTE's board members, committees, bylaws and other governance resources is on the Governance page of DTE's public website.

All six DTE board committees are comprised exclusively of independent directors with a lead independent director elected by the independent members of the board of directors. Each committee of the board has adopted a written charter, approved by the full board of directors, setting forth the purpose and duty of each committee:

1. Audit Committee
2. Corporate Governance Committee
3. Finance Committee
4. Nuclear Review Committee
5. Organization and Compensation Committee
6. Public Policy and Responsibility Committee

While ultimately determined by the full board, decision-making recommendations on economic, environmental, and social topics rest with DTE's Public Policy & Responsibility Committee (PPRC), the purpose of which is to review DTE Energy Company's performance as a responsible corporate citizen and suggest policies to the Board of Directors to enable the Company to respond appropriately to its social responsibilities and its shareholder' interests. Consisting of four independent directors from the Board, the PPRC reviews and advises the Board on emerging social, economic, political, reputational, and environmental issues that could significantly affect the Company's business and performance in relation to the community, shareholders, customers and employees. In this role, the PPRC:

- Advises the Board of Directors on emerging Environmental, Social, and Governance (ESG) issues, including climate change
- Receives and reviews reports from management relating to ESG risks and opportunities
- Meets regularly, including in executive sessions without management present
- Retains independent outside professional advisers, as needed

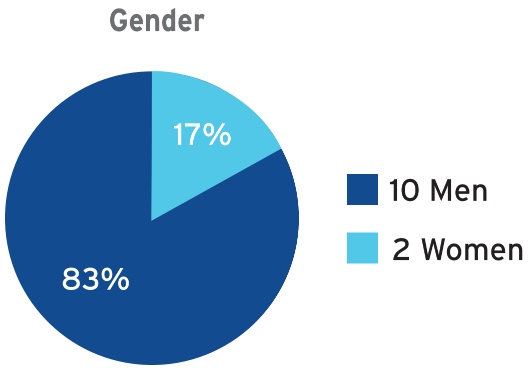
The Board of Directors reviews and approves recommendations from the Public Policy & Responsibility Committee.

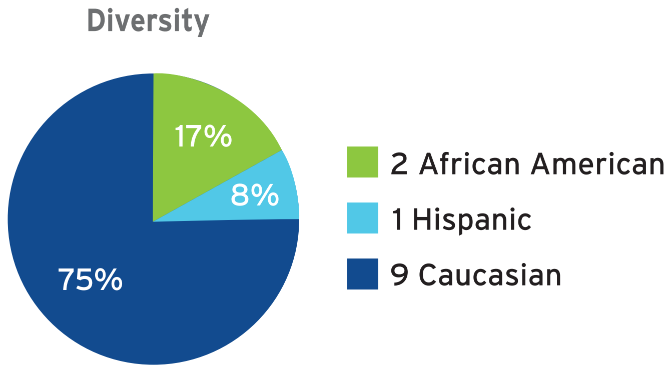
DTE's Chairman and CEO, together with other senior leaders of the company, exercise leadership in the company's sustainability initiatives. Through the Government, Regulatory and Community Committee, Force for Growth Committee, and other management leadership committees, DTE's senior management:

- Executes the company's ESG strategy in consultation with the Board of Directors
- Manages environmental compliance processes and carbon reduction aspirations
- Mobilizes employees, resources and partner organizations to strengthen and promote prosperity in communities served by DTE
- Reports to the DTE board on outcomes of ESG initiatives
- Manages risks associated with environmental and sustainability opportunities

102-22: BOARD COMPOSITION

As the highest governance body of DTE Energy, as of June 2017 the DTE board of directors consisted of 12 directors, 11 of which are independent, and DTE's chairman and CEO, who is the sole non-independent management director and the only non-independent company executive serving on the board. DTE's board members as of June 30, 2017 included 10 men and two women of whom nine were white, two African American, and one Hispanic.



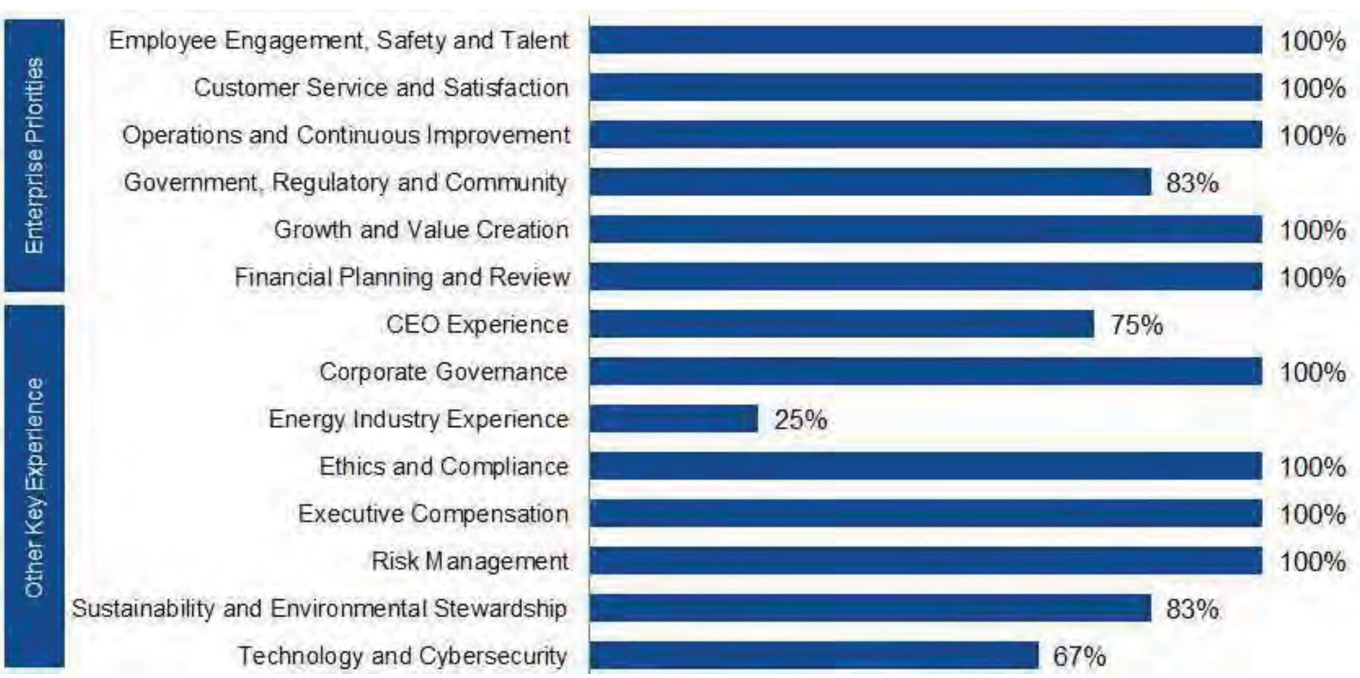


Board Diversity

DTE's board members for the balance of 2017 follow. For information on other significant positions held by DTE board members and their competencies relating to economic, environmental, and social topics, visit the DTE website

DTE Board Member	Board Tenure	Committees
Gerard M. Anderson	DTE Energy chairman and CEO as of December 30, 2013; Director since 2009	None
David A. Brandon	Director since 2010	Organization and Compensation
W. Frank Fountain, Jr.	Director since 2007	Public Policy and Responsibility
Charles G. "Chip" McClure, Jr.	Director since 2012	Nuclear Review
Gail J. McGovern	Director since 2003	Organization and Compensation
Mark A. Murray	Director since 2009	Public Policy and Responsibility
James B. Nicholson	Director since 2012	Organization and Compensation Public Policy and Responsibility
Charles W. Pryor, Jr.	Director since 1999	Nuclear Review
Josue Robles, Jr.	Director since 2003	Corporate Governance
Ruth G. Shaw	Director since 2008	Nuclear Review Organization and Compensation
David A. Thomas	Director since 2013	Public Policy and Responsibility
James H. Vandenberghe	Director since 2006	Corporate Governance Finance

The following illustrates the collective skills and experience of DTE board members:



102-40: LIST OF STAKEHOLDER GROUPS

See Stakeholder Table in Appendix

102-41: COLLECTIVE BARGAINING AGREEMENTS

49 percent of DTE's full-time employees are covered by collective bargaining agreements.

102-42: IDENTIFYING AND SELECTING STAKEHOLDERS

DTE Energy's stakeholder engagement process involves outreach to people and organizations that affect or can be affected by company decisions. The stakeholders with whom DTE interacts may support or oppose company decisions, but regardless of their stance, DTE believes everyone benefits from the exchange of factual information and open dialogue. DTE's ongoing membership and participation in energy policy organizations, state and national trade associations, industry and customer advocacy coalitions and other groups helps the company identify stakeholders, particularly as new issues emerge in the industry.

Our largest stakeholder group, customers, are identified through the gas and electric bills they pay.

DTE Energy maintains a Community Advisory Council, which involves a rotating group of community members. The council enables DTE to identify stakeholders, better understand local perceptions of DTE Energy and improve community relationships.

DTE operates a Community Outreach team which is linked with hundreds of neighborhood groups, nonprofits, multicultural organizations, and faith institutions throughout the company's service area. Through this network last year, DTE organized more than 30 neighborhood Customer Assistance Days, identifying 17,000 households that needed and qualified for Low Income Heating and Assistance Program funds.

We identify elected and appointed government officials at the local, state, and federal levels as well as business leaders through our Government Affairs team which is charged with identifying those government, political, and business leaders critical to our business, services, and customers. DTE's Regulatory Affairs team identifies regulatory stakeholders.

DTE executive leaders identify potential stakeholders through their service as board members of approximately 100 nonprofit and other organizations located in DTE's service territory.

DTE's Supplier Diversity Advisory Council helps identify suppliers with which DTE might do business.

For Faith-Based stakeholders, DTE's Community Outreach unit identifies partners by applying selection criteria including whether the potential partner has had a previous relationship with a DTE business unit; an assessment of the potential partner's community and political influence; whether the entity has engaged in significant community outreach; and the size of the institution.

DTE also engages with environmental non-governmental organizations (NGOs) to foster working relationships to enhance the environment and wellbeing of the communities where we live and serve. Working together to develop mutual solutions to environmental issues is in everyone's best interest. We engage and serve on the boards of environmental NGOs such as the Nature Conservancy and Southwest Detroit Environmental Vision to bring DTE's environmental perspective and technical expertise to help address environmental issues.

102-43: APPROACH TO STAKEHOLDER ENGAGEMENT

DTE annually engages more than 400 nonprofit, academic, environmental and faith-based community partners across Michigan through a combination of formal community advisory councils and community partner meetings. Five times per year, facilitated discussions with DTE's chief executive officer and the company's executive team provide the company with feedback from community partners to identify areas of needs and opportunities for program development through which stakeholders are also identified and engaged.

DTE Energy maintains a Community Advisory Council, which involves a rotating group of community members. The council enables DTE to better understand local perceptions of DTE Energy and improve community relationships. The council also works on developing programs to better serve the needs of our customers.

DTE's Regional Relations team proactively manages relationships with elected and appointed government officials. In partnership with the DTE Public Affairs unit, Regional Relations works with key community stakeholder organizations and nonprofits including more than 65 local chambers of commerce across Michigan.

DTE executive leaders identify potential stakeholders through their service as board members of approximately 100 nonprofit, industry, and other organizations. DTE conducted 104 executive forums and executive reviews in 2017 with the company's top suppliers and senior leadership.

Involvement in energy policy organizations provides DTE with a strong understanding of energy issues and potential stakeholders in the areas of safety, reliability and affordability.

DTE belongs to state and national trade associations to align company positions and participate in advocacy to policymakers.

We participate in a series of industry and customer advocacy coalitions that support our goal of strong customer access to information.

We investigate and respond to all complaints filed with the Michigan Public Service Commission (MPSC) by customers of DTE Gas and DTE Electric. In 2017, there were 1,827 complaints, compared to 1,967 the previous year. Gas complaints in 2017 equalled 118; in 2016, 131.

DTE's Supplier Diversity Advisory Council provides DTE with advice and assistance from external resources on stakeholder outreach and to ensure its diversity goals are aligned with and supported by the communities served by the company.

For additional information on our approach to stakeholder engagement please see the Stakeholder Engagement Table in Appendix.

102-44: KEY TOPICS AND CONCERNS RAISED

DTE Energy communicates on key topics and concerns with stakeholder groups through several channels including Empowering Michigan blog posts, the DTE Energy website, the DTE newsroom, and through DTE's social media presence on Facebook, LinkedIn, Twitter, and YouTube. DTE employee communication is primarily through Quest, the company's internal website, and email. For key topics and concerns, please see the Stakeholder Engagement Summary Table on page 71 of this report.

102-45: ENTITIES INCLUDED IN CONSOLIDATED FINANCIAL STATEMENTS

See DTE Energy Company 10-K for Year Ending 12-31-17, Consolidated Statements, pages 59-73. All entities in DTE's consolidated financial statements or equivalent documents are covered in this GRI report and DTE's 10-K.

102-46: DEFINING REPORT CONTENT AND TOPIC BOUNDARIES

This Corporate Citizenship Report is built around DTE Energy's material aspects or topics that have a direct or indirect impact on the company's ability to create, preserve or erode economic, environmental and social value for DTE, our stakeholders and society at large.

In preparation for last year's report (covering 2016 performance), DTE updated its materiality assessment to evaluate and prioritize key sustainability issues for its business and stakeholders. This included a benchmarking of five peer companies, interviews with external stakeholders from a variety of organizations and a survey completed by stakeholders within DTE as well as outside the company.

In determining the content for this year's Corporate Citizenship Report, DTE applied the principles laid out in the Global Reporting Initiative (GRI) Standards. Issued by the Global Sustainability Standards Board in late 2016, the GRI Standards are a voluntary[4] global framework, intended for use by organizations to report about their impacts on the economy, the environment and society.

4 Use of the GRI Standards is voluntary in the U.S., although some countries and stock exchanges outside of North America require companies to prepare GRI reports.

The GRI Standards lay out four principles for determining report content. We have addressed each of these principles as follows:

- **Stakeholder Inclusiveness** – DTE reached out to a broad and diverse group of stakeholders as part of the materiality assessment process and the planning process for this specific report. Through direct interviews, questionnaires and online surveys, we obtained input on the expectations and interests of employees, customers, community partners, senior management, government representatives, investors, non-governmental organizations and suppliers.
- **Sustainability Context** – This report considers the sustainability context relevant for our industry sector and geographic region. Our discussion of the broader energy transformation that is underway across the United States is a key example of this reporting principle.
- **Materiality** – We have conducted extensive analysis to identify topics covering our economic, environmental and social impacts, as well as topics that interest and influence our stakeholders. DTE has conducted benchmarking against other companies' reports, both inside and outside the energy sector; participated extensively with industry organizations; and engaged third-party consulting expertise in GRI reporting to ensure that we obtain a thorough understanding of our material issues.
- **Completeness** – This report presents data for 2017, for those metrics we publicly report. These publicly-reported metrics, supplemented with narrative descriptions of programs and case studies, provide a complete view of DTE's sustainability/citizenship performance as determined through our internal analysis and our discussions with stakeholders.

102-47: LIST OF MATERIAL TOPICS

See Materiality in 2017 Corporate Citizenship Report

102-48: RESTATEMENTS OF INFORMATION

There are no restatements of information in DTE's report covering 2017.

102-49: CHANGES IN REPORTING

There are no changes in reporting in material topics or reporting boundaries compared to last year's report.

102-50: REPORTING PERIOD

Calendar year 2017

102-51: DATE OF PREVIOUS REPORT

Published in summer 2017, DTE's previous report covered the 2016 calendar year.

102-52: REPORTING CYCLE

Annual

102-53: CONTACT POINT FOR QUESTIONS REGARDING THE REPORT

Learn more by emailing: impact@dteenergy.com

102-54: CLAIMS OF REPORTING IN ACCORDANCE WITH GRI STANDARDS

This report has been prepared in accordance with the GRI Standards: Core option.

102-55: GRI CONTENT INDEX

This report lists every GRI Standard disclosure, in numerical order, and includes references to other documents where appropriate. See the Table of Contents at the front of this report to navigate to specific sections and pages.

102-56: EXTERNAL ASSURANCE

DTE Energy applied the GRI Standards as the basis for this Corporate Citizenship Report, in accordance with the Core option. This report was reviewed by internal subject matter experts in each GRI disclosure area and assessed for completeness by ERM, a third party, independent, private sector firm providing environmental, health, safety, risk, and social consulting services.

GRI 103: MANAGEMENT APPROACH

DTE manages its material issues in a thoughtful and responsible way. For each of our material topics, we have internal policies, goals and targets that drive improvement. We monitor progress through management dashboards to track metrics. Our code of business conduct and ethics – the DTE Energy Way – is publicly available in the Corporate Governance section of our website. Many other policies – including health and safety, cybersecurity and diversity and inclusion – are distributed internally. We have a robust training program that covers in detail the policies relevant to each employee's duties.

Our commitment to Continuous Improvement (CI) provides us with a framework for evaluating the effectiveness of our management approach. We conduct regular reviews of our activities and incorporate lessons learned in a "plan, do, check and act" CI cycle that benefits future projects.

For more information on DTE's policies and programs addressing key impacts and material issues, see our 10-K filing with the U.S. Securities and Exchange Commission; our 2018 Environmental, Social, Governance, and Sustainability Report, which is based on the Edison Electric Institute industry sector template; and www.DTEImpact.com

GRI 201: ECONOMIC PERFORMANCE

201-1: DIRECT ECONOMIC VALUE GENERATED AND DISTRIBUTED

Operating Revenue	$ 12.6 billion
Operating Expenses	$ 11 billion

Total Payroll and Benefits

Regular Labor Costs	$400 million
Benefit Costs	$ 310 million
Overtime Labor Costs	$ 210 million
Incentive Compensation	$ 180 million
Total Compensation and Benefit Costs	$ 1.1 billion

Dividends to Shareholders	$642 million

DTE paid approximately $435 million in state and federal income taxes, use taxes, property taxes, and payroll taxes in 2017. Approximately $330 million of this total was taxes paid in Michigan.

201-2: FINANCIAL IMPLICATIONS AND OTHER RISKS AND OPPORTUNITIES DUE TO CLIMATE CHANGE

Background

DTE Energy is strongly committed to safely reducing carbon emissions while maintaining customer reliability and affordability. DTE has invested substantial time and resources in building a strategy to address climate change, which Gerry Anderson, DTE chairman and CEO, has described as the defining policy issue of our era. Well before the August 2015 announcement of the U.S. Clean Power Plan and the December 2015 adoption of the Paris Agreement, DTE had started its transition toward a lower carbon profile for its generation fleet. Since 2005, DTE has reduced its carbon dioxide emissions by approximately 24 percent.

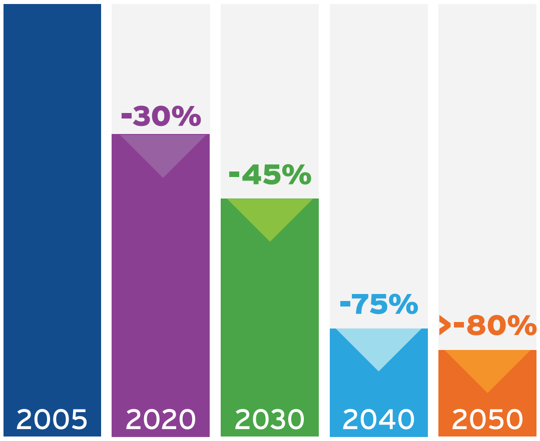
Carbon Reduction Plan

DTE's commitment to provide affordable and sustainable energy resulted in an industry-leading May 2017 announcement launching a broad sustainability initiative to dramatically reduce the company's carbon emissions. This comprehensive plan includes:

1. Steady retirement of DTE's remaining coal generation units
2. Construction of additional solar and wind generation
3. Construction of new natural gas generation capacity
4. Heavy investment in energy waste reduction and reducing peak demand, together with extensive investment in modernization of the electric grid and gas infrastructure

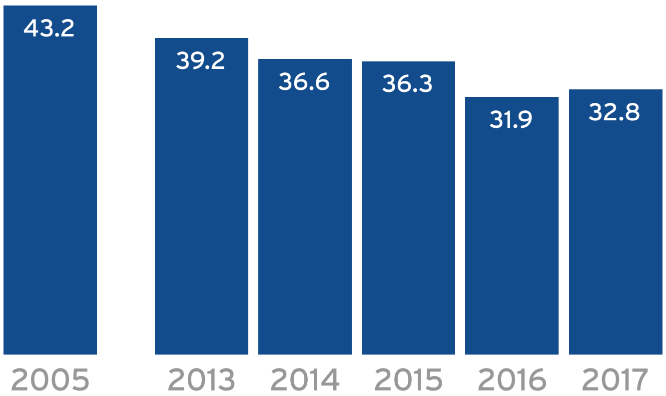
This plan will achieve a 30 percent reduction in CO_2 emissions from 2005 levels by the early 2020s, a 45 percent reduction by 2030, a 75 percent reduction by 2040 and an 80 percent or higher reduction by 2050. Applying customer best interest, DTE will continue to review technology development, electricity demand and economics to make additional low and zero emission modifications to the plan.

Carbon Reduction Goals



DTE is on a trajectory to meet its carbon reduction goal of 30 percent below 2005 by the early 2020s. The company's 2017 total emissions of CO_2 from electric generation were 24 percent below 2005 levels.

DTE Electric CO_2 Emissions *(million tons)*



Regulatory Risks

Uncertainty around future environmental regulations creates difficulties in planning long-term capital projects in DTE's generation fleet and gas distribution businesses. These laws and regulations require DTE to seek a variety of environmental licenses, permits, inspections and other regulatory approvals. The company could be required to install expensive pollution control measures or limit or cease activities, including the retirement of certain generating plants, based on these regulations. Financial implications that could be expected under future but uncertain air regulations to reduce emissions of air pollutants and greenhouse gases could involve the costs to emit under an emission trading program, such as under a carbon tax or carbon cap and trade system. Potential financial impacts include expenditures for capital equipment beyond what is currently planned, financing costs related to additional capital expenditures, and the retirement of facilities where control equipment is not economical. DTE manages these risks through its board committee structure described in the company response to GRI disclosure 102-18 and through DTE's established long-term planning processes. DTE is actively involved in shaping and influencing proposed state and federal regulations through its involvement with industry groups. DTE advocates for environmental policies that proceed in a manner affordable to our customers and do not negatively affect Michigan's economy.

DTE is subject to Michigan and potential future federal legislation and regulation requiring the company to secure sources of renewable energy. Federal legislation regarding renewable power mandates are less likely than state legislation. Future mandates for renewable generation at the state or federal level would likely require significant investment in renewable energy generation sources by DTE. The company is engaged in developing renewable energy projects and identifying third party projects in which it can invest.

Physical Risks

Decreases in Great Lakes water levels due to changes in precipitation and evaporation patterns could have a negative impact on the ability to utilize water for electric generation cooling purposes or in transporting fuel and other raw materials to our plants via water vessels. Financial implications of Great Lakes water level changes could include capital costs to change cooling water intake structures and equipment, and costs to modify existing vessel unloading facilities. A longer shipping season on the Great Lakes due to warmer lake temperatures could have beneficial financial impacts due to a longer season for shipping coal and other commodities transported by ship. DTE does not expect physical risks from climate change to impact the company in a way that would impact its normal long-range planning process. The company is not actively planning to manage or adapt to changes in Great Lakes water levels or temperatures.

Warmer average summer and winter temperatures could potentially impact seasonal demand for electricity and natural gas. Year to year deviations from normal hot and cold weather conditions affect our earnings and cash flow. Higher than normal summer temperatures increase electricity demand for residential and commercial air conditioning, and potentially increase peak demand days for DTE Electric. Warmer than normal winters reduce the need for natural gas for heating, resulting in lower gas sales to retail customers. DTE cannot predict whether long-term trends in average temperatures due to climate change will have more of an impact on the demand for electricity or natural gas than year to year variations from normal temperatures.

Increased frequency of severe storm events would have an impact on the electrical transmission and distribution system infrastructure such as poles and wires. Ice storms, wind storms, severe thunderstorms and tornadoes can damage the electric distribution system infrastructure and require us to perform emergency repairs and incur material unplanned expenses. The expenses of storm restoration efforts may not be fully recoverable through the regulatory process. The most significant financial implications associated with the identified risks are the severe weather events for which DTE Electric Co. already has an existing budgeting and planning process in place to manage. DTE Electric maintains a storm emergency and readiness center that is put into action when severe weather causes sudden increases in customer outages. The unpredictability of severe weather events makes it difficult to quantify the potential incremental cost of this risk that would be attributed to climate change. DTE does not expect physical risks from climate change to impact the company's storm emergency planning process in a way that would impact its normal long-range planning process. DTE cannot predict whether long term changes in frequency of severe weather events due to climate change will have more of an impact on the electric distribution infrastructure than normal year to year variations in severe weather events.

Reputational Risks

Incorrect or negative perceptions of DTE's approach to addressing climate change may lead to shareholder resolutions requesting additional action from the company. The estimated financial implications would vary depending on the scope of a proposed shareholder resolution that passed by a majority vote of shareholders. In 2017 a shareholder proposal requested that DTE Energy, with board oversight, publish an assessment of the long-term impacts on the company's portfolio, of public policies and technological advances that are consistent with limiting global warming to no more than two degrees Celsius over pre-industrial levels. The proposal was defeated by a vote of shareholders. The company communicates with its shareholders about a broad range of topics. DTE's shareholder engagement efforts have generated valuable feedback related to renewable energy and sustainability and the company will continue to seek input from our shareholders around these issues. DTE publishes an annual corporate citizenship report indexed to GRI standards. The company responds to environmental, social and governance (ESG) organization requests for information such as the Carbon Disclosure Project (CDP) Carbon and CDP Water questionnaires. In addition, in 2017 DTE Energy announced a long-term goal to reduce carbon emissions from 2005 levels by more than 80 percent by 2050, with interim milestones for the 2020s, 2030, and 2040 and which provides a timeline to DTE Energy's approach to addressing climate change.

Opportunities Related to Climate Change

Michigan energy legislation mandating a renewable portfolio standard and energy waste reduction requirements creates opportunities for DTE to meet these requirements. Financial implications associated with the opportunities from Michigan Public Act 342 of 2016 include the costs to build renewable energy capacity to meet renewable energy requirements. DTE has invested approximately $1 billion in renewable energy since 2008 and has spurred an additional $1 billion in third party renewable energy investment. DTE recently submitted its 2018 Renewable Energy Plan to the Michigan Public Service Commission proposing to add another 675 MW of wind capacity and approximately 15 MW of solar capacity over the next three years. DTE Electric recovers costs through regulatory proceedings in general rate case filings and renewable energy plan filings for capital expenditures consistent with prior ratemaking treatment.

In addition to renewable energy, DTE has been working since 2009 on energy efficiency programs designed to help reduce customer energy usage. More than 2.9 million electric customers and 2.1 million gas customers have directly participated in DTE's energy efficiency programs. As a result, DTE customers have saved approximately 5,100 gigawatt hours (GWh) and over 11 billion cubic feet (Bcf) of natural gas since the program started. The savings achieved so far will continue for years into the future. The electric savings are equivalent to the energy required to power all the homes for more than eleven years in cities similar in size to Lansing or Ann Arbor, Michigan. The gas savings are equivalent to the energy required to heat the same number of homes in cities similar in size to Lansing or Ann Arbor, Michigan, for almost two years. DTE's energy optimization program has been ranked highly with respect to cost effectiveness and savings when compared with other utility companies, in a recent internal benchmarking study. For every $1 spent on energy efficiency programs, DTE Energy customers save nearly $5 in avoided energy costs.

Opportunities to participate in carbon trading programs were written into the EPA's Clean Power Plan rule finalized in 2015. The Clean Power Plan (CPP) never went into effect and DTE does not expect the CPP to survive given the proposed repeal of the rule by the EPA. However, a CPP replacement rule is likely and DTE expects that opportunities for states to participate in carbon trading programs will continue to emerge. In addition, there are opportunities to purchase and/or sell emissions offsets under existing regional cap and trade programs, or under a potential future regional or nationwide cap and trade program. Economic analyses of participation in carbon trading programs that addressed the CPP indicated that participation in multi-state trading programs lowers overall costs to comply with emission reduction targets. The amount of savings depends on the number of states participating in the trading program. In addition, opportunities include the creation, purchase or sale of greenhouse gas (GHG) emission offsets from landfill gas-to-energy projects operated by DTE Biomass under existing cap and trade programs, such as the California Cap and Trade Program. DTE Energy Trading manages opportunities for trading emission allowances and offsets. In addition, DTE Biomass provides carbon credit and offset services for the voluntary capture and destruction of landfill methane.

As increased utilization of plug-in electric vehicles occurs, opportunities to sell additional electricity to displace petroleum consumption in the transportation sector will increase, especially during traditional off-peak electric consumption periods (i.e. overnight). In 2009, DTE Energy joined the Edison Electric Institute (EEI) in an industry-wide plug-in vehicle market readiness pledge that includes five areas of focus: Infrastructure, Customer Support, Customer and Stakeholder Education, Vehicle and Infrastructure Incentives, and Utility Fleets. DTE Electric has also begun to offer competitive rates for plug-in electric vehicles including incentives for off-peak charging.

Retail customers are showing increased interest in voluntary renewable programs to meet their energy needs. DTE Energy has responded with programs to help customers voluntarily increase their renewable energy consumption up to 100 percent. MIGreenPower is DTE's voluntary renewable electric energy program. Customers enrolling in MIGreenPower support the generation of electricity from Michigan-based, renewable energy sources. In addition, BioGreenGas is a voluntary residential program for DTE Gas customers supporting the local development of renewable natural gas by using methane arising from landfills. The MIGreen Power and BioGreenGas programs are managed through established marketing and billing programs.

GRI 203: INDIRECT ECONOMIC IMPACTS

203-2: SIGNIFICANT INDIRECT ECONOMIC IMPACTS

DTE Energy's aspiration to be a Force for Growth (FFG) is incorporated into the company's values, priorities, capabilities, and purpose. To operationalize this commitment, in 2017, DTE launched a five-year plan and established Force for Growth as a corporate priority. Aligned with DTE's business operations, FFG is structurally integrated to ensure a sustained presence in day-to-day work at the company. Approximately half of DTE's 10,000-person workforce is personally engaged in fulfilling FFG objectives. FFG is comprised of five pillars, three of which address or influence economic impacts: Economic Progress, Education and Employment, and Community Transformation.

Economic Progress

In 2017 the Economic Development Team partnered with 42 economic development agencies and worked on nearly 70 projects in manufacturing, automotive, food processing, residential, warehouse/distribution, information technology and business services. In these projects, DTE provides energy rate design and analysis, coordinates with local and state economic development partners, and in some cases assists with site identification. In 2017, more than 2,200 jobs in Michigan were sustained or created through these projects.

Education and Employment

DTE Energy supports a range of education and employment initiatives, with an emphasis on revitalizing Michigan's skilled trades and technical education pipeline.

More than half of Detroit's youth and adult populations are unemployed. Meanwhile, 3,100 jobs open every year in area construction and manufacturing. DTE is nourishing individual talent and work ethic with training in skilled trades connected to immediate, well-paying jobs. The DTE Foundation has invested over $2.5 million in a talent-to-trades pipeline, the front end of which is Detroit's Randolph Career Technical Center, offering a construction trades and technical education program for high school students. In 2017, $500,000 in DTE Foundation support leveraged $10 million from community partners to refurbish the school. Enrollment at Randolph has tripled from 100 in 2016-17 to over 300 this year. Randolph's courses give students fundamental skills and daily, hands-on experience in six construction trades including carpentry, computer-aided design, electrical, HVAC, masonry and plumbing-pipefitting. Students learn how to use hand tools and power equipment, industry-standard safety practices, blueprint reading and other skills, supported by integrated reading and math resources. DTE infused Randolph with 1,800 hours of in-kind support, including company employees serving as volunteer teachers. DTE is also supporting other training programs and with its suppliers has committed to hire 1,000 adults as well as 1,000 youth with multiple barriers to employment into the area workforce by 2022.

At Henry Ford College (HFC) in nearby Dearborn, the DTE Foundation provided $600,000 to launch a Power and Trades Pathways program emphasizing foundational and technical skills in the energy, construction, and electrical trades. Two DTE retirees serve as instructors, now helping teach the first cohort of 21 at-risk young adults enrolled through DTE's at-risk Summer Youth Skilled Trade Internship. In 2017 DTE also fueled an additional trades career path for the disadvantaged by addressing growing demand for tradespeople in green services like urban agriculture and forestry. The DTE Foundation invested $650,000 to support a workforce development program at Greening of Detroit in which 160 under-employed Detroiters are now learning green services trades.

Helping young people and adults learn job skills in the classroom and in the real world, the DTE Energy Foundation helped to create 650 summer positions in 2017 for young people statewide. The summer jobs included a six-week work experience through United Way of the Lakeshore for 133 youth in six west Michigan counties. Foundation support also enabled Grow Detroit's Young Talent to place hundreds of youth between 14 and 24 years of age in summer jobs. Another Foundation grant provided summer jobs in urban forestry for 20 Detroit high school students through Greening of Detroit.

Community Transformation

In 2017, DTE opened Beacon Park, located adjacent to the company's headquarters campus in downtown Detroit. Planned, built, programmed and paid for by DTE and the DTE Energy Foundation, nearly 50,000 people visited Beacon Park during its July 2017 opening weekend to celebrate Detroit's newest public space. In less than a year, Beacon Park has attracted more than 240,000 visitors to free events organized with community partners including live music, movie screenings, food truck rallies, and other activities. The development of the 1.5-acre park spurred an announced $120 million redevelopment of an adjacent historic hotel, where 339 affordable and market-rate apartments with a 650-space parking deck will attract more residents and visitors to the neighborhood. This neighborhood recreational centerpiece has accelerated redevelopment in Detroit's west downtown area with Beacon Park now surrounded by residential and office building rehabilitations, restaurant openings and parking improvements. To ensure continued momentum, a DTE-funded neighborhood master plan will be finalized this year with the involvement of business, residential, and nonprofit stakeholders. The revival of DTE's Detroit neighborhood into a thriving urban environment is benefitting the city and region by catalyzing investment in business, infrastructure, and economic development.

DTE Energy Foundation

The DTE Energy Foundation promotes economic progress to improve the lives of people in communities throughout Michigan. The Foundation partners with organizations focused on creating a culture of innovation through entrepreneurship, accelerating economic growth, as well as attracting, strengthening and developing businesses in Michigan. In 2017 the Foundation supported 165 festivals and events throughout Michigan, including celebrations that brought people together and sparked local economic activity. These festivals and events were among 270 grants the DTE Energy Foundation awarded to promote community services and activities throughout the state in 2017. The Foundation also provided grants to economic development organizations including The Right Place, which supports business growth in West Michigan; Ann Arbor SPARK, focused on attracting high-tech and innovative business development; and the Detroit Economic Growth Association, working to create jobs and commercial and industrial growth.

Supplier Spending

DTE Energy spent nearly $1.7 billion with Michigan businesses in 2017, and created or sustained 5,100 jobs across the state. In the past eight years, DTE has spent more than $7.5 billion with local suppliers of goods and services, creating 16,000 jobs. This is detailed in disclosure 204-1.

Low-Income Assistance

About 200,000 of DTE's residential customers are identified as low-income, many needing help to keep their homes warm. In 2017, DTE organized more than 30 neighborhood Customer Assistance Days, providing 17,000 households with $3 million for bill payments using federal Low Income Heating and Assistance Program funds. In 2017, DTE spent $12 million in energy optimization efforts targeting low-income customers and through its Low-Income Self Sufficiency Plan payment program, DTE helped keep year-round power flowing to nearly 52,000 Michigan households. These efforts are detailed in disclosure 413-1.

Public Policy

From helping equip youth and adults with skills and experience to land well-paying jobs to working on public policy to enhance Michigan's workforce, DTE is continually engaged in removing barriers to employment leading to favorable economic impacts. In 2017, DTE added its voice to a statewide, bipartisan coalition that successfully advocated for eliminating Driver Responsibility Fees (DRFs). A series of additional charges tacked onto traffic tickets for thousands of drivers, DRFs led to widespread license suspensions and even more fees. In a state with limited public transportation options, people were unable to legally drive to work, transport children, or do grocery shopping. Michigan's DRF program will officially end October 1, 2018.

GRI 204: PROCUREMENT PRACTICES

204-1: PROPORTION OF SPENDING ON LOCAL SUPPLIERS

DTE Energy spent nearly $1.7 billion with Michigan businesses in 2017, and created or sustained 5,100 jobs across the state. In the past eight years, DTE has spent more than $7.5 billion with local suppliers of goods and services, creating 16,000 jobs. Highlights of DTE's partnership with Michigan-based vendors in 2017:

- **In Southeast Michigan and Metro Detroit:** DTE invested more than $1 billion with 1,312 companies, impacting 3,879 jobs
- **In West Michigan:** DTE spent nearly $59 million with 225 companies, impacting 190 jobs
- **Northeast and Northwest Michigan:** DTE invested more than $33 million with 165 companies, impacting 108 jobs
- **South Michigan:** DTE partnered with 557 companies, spending nearly $169 million, impacting 547 jobs
- **Central Michigan:** DTE invested nearly $19 million with 480 companies, impacting 60 jobs
- **Thumb Region:** DTE spent more than $87 million with 802 companies, impacting 282 jobs
- **Upper Peninsula:** DTE spent nearly $11 million with 53 companies, impacting 35 jobs

More than 70 percent of the funds that DTE spends with suppliers now go to Michigan businesses. The company also invested $510 million with Detroit-based businesses last year. Also in 2017, DTE spent $441 million with diverse vendors and captured six industry-wide awards for its supplier diversity commitment. DTE also encourages suppliers to buy and hire locally, and provides networking opportunities so vendors can develop business relationships with other Michigan companies.

GRI 302: ENERGY

302-5: REDUCTIONS IN ENERGY REQUIREMENTS OF PRODUCTS AND SERVICES

Please see DTE's 2016 Energy Optimization Annual Report. DTE will report its 2017 energy optimization data to the Michigan Public Service Commission in May 2018 and will publish its 2017 Energy Optimization Annual Report on the DTE website in July 2018.

GRI 303: WATER

303-1: WATER WITHDRAWAL BY SOURCE

We use water from lakes and rivers to cool our thermal electric power plants. Our power plants withdraw and return water to Michigan's surface waters under the authority of permits issued by the State of Michigan. In addition, our Taggart gas facility in Six Lakes, Michigan withdraws water for cooling of the gas compressors at the site.

2017 Total Surface Water Withdrawals:

Power Generation	1,079 billion gallons
Gas Operations	3.4 billion gallons
Total	**1,082 billion gallons**

The above data is for Michigan utility operations only.

Ground Water Withdrawal:

Ground water withdraw in Michigan operations (Sibley Quarry) totals

	534 million gallons

Rainwater collection contributes negligible amounts to our total water requirements and DTE does not account for volume from rainwater.

Wastewater from another Organization:

DTE does not use wastewater from outside organizations.

Municipal Water Supplies or other Public or Private Water Utilities:

DTE is beginning to track municipal water more closely at select facilities but a system for measuring aggregated water use data has not yet been established.

Standards, Methodologies, and Assumptions:

DTE reports total water withdrawal in accordance with National Pollutant Discharge Elimination System (NPDES) permit requirements.

303-3: WATER RECYCLED AND REUSED

The Fermi 2 Power Plant and the Greenwood Energy Center have closed-cycle cooling systems, which reduce the amount of water withdrawal required. In 2017, these plants recycled approximately 439 billion gallons of water, or about 40 percent of total water withdrawals.

Fermi II Nuclear Power Plant	420 billion gallons
Greenwood Oil and Gas Energy Center	18.6 billion gallons

GRI 304: BIODIVERSITY

304-3: HABITATS PROTECTED OR RESTORED

At DTE Energy, we work to take care of the land, water and living creatures on our properties and beyond. Among the largest landowners in Michigan, DTE voluntarily maintains 8,000 acres of land in its natural state, thereby providing habitat for hundreds of species of birds, mammals, fish and insects. We also reclaim previously disturbed land to create and manage habitat featuring native Michigan plants, such as gardens that benefit the monarch butterfly and other pollinators. We also manage about 140 acres to support biodiversity required for mitigation.

Wildlife Habitat Council Certified Sites

DTE Energy properties are home to hundreds of species of wildlife. Some are endangered or threatened. DTE facilities are often located on properties with abundant opportunities for wildlife and DTE is helping to attract and increase wildlife populations at these sites. To this end, DTE Energy has 34 sites certified under the Wildlife Habitat Council (WHC), a nonprofit organization that helps companies manage their property for the benefit of wildlife

Wildlife Habitat Council Sites	Location	Initial Certification	Certified Through	Certification Status
Allen Road Service Center Complex	Melvindale	2008	2019	Gold
Alpena Service Center	Alpena	2009	2019	Certified
Ashley Mews	Ann Arbor	2007	2019	Gold
Belle River Mills Compressor Station	East China Twp.	2008	2019	Gold
Belle River Power Plant	East China Twp.	1996	2019	Silver
Big Rapids Service Station	Big Rapids	2010	2019	Gold
Cadillac Service Center	Cadillac	2010	2019	Silver
Citizen's Gas	Adrian	2016	2018	Silver
Detroit Headquarters Campus	Detroit	2000	2018	TBD
Escanaba Service Center	Escanaba	2015	2019	Silver
Fermi 2 Nuclear Power Plant	Newport	2000	2019	Gold
Gaylord Transmission & Storage Operations Service Station	Gaylord	2012	2019	Silver
Grayling Service Center	Grayling	2008	2018	Silver
Greenwood Energy Center	Kenockee	2004	2018	TBD
Kalkaska Transmission and Storage Operations	Kalkaska	2009	2018	Silver
Kingsford Service Center	Kingsford	2015	2020	Gold
Ludington Service Center	Ludington	2009	2019	Silver
Michigan Avenue Service Center	Ypsilanti	2008	2020	Gold
Milford Compressor Station	Milford	2009	2019	Silver
Monroe Power Plant	Monroe	1999	2018	TBD
Mt. Pleasant Service Center	Mt. Pleasant	2008	2019	Silver

Wildlife Habitat Council Sites	Location	Initial Certification	Certified Through	Certification Status
Muskegon Service Center	Muskegon	2009	2019	Gold
Newport Service Center	Monroe	2016	2018	Silver
Petoskey Service Center	Petoskey	2015	2019	Certified
River Rouge Power Plant	River Rouge	2004	2018	TBD
Sault Ste. Marie Service Center	Sault Ste. Marie	2015	2019	Certified
St. Clair Power Plant	East China Twp.	2001	2019	Silver
Tawas Service Center	Tawas	2009	2019	Silver
Traverse City Gas Operations	Traverse City	2009	2019	Silver
W.C. Taggart Compressor Station	Six Lakes	2003	2020	Gold
Washington-10 Compressor Station	Romeo	2008	2019	Gold
Wealthy Street Station	Grand Rapids	2012	2018	Certified

GRI 305: EMISSIONS

305-1: ENERGY DIRECT (SCOPE 1) GHG EMISSIONS

DTE Energy's 2017 direct (Scope 1) emissions were 31.9 million metric tons from the following DTE Energy business units:

- DTE Electric (94.3%)
- DTE Gas (2.2%)
- Power and Industrial Projects (2.2%)
- Gas Storage & Pipelines (1.3%)

DTE Energy uses the U.S. EPA Mandatory Greenhouse Gas Reporting rule to calculate and report carbon dioxide equivalent (CO_2e) emissions. The EPA GHG rule includes calculation of direct emissions of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) and emission factors and global warming potentials used for calculating GHG emissions. Biogenic emissions were 1.5 million metric tons from facilities in Power & Industrial Projects.

Our base year for Scope 1 emissions is 2005 and our base year emissions were 37.7 million metric tons, as reported to CDP (formerly the Carbon Disclosure Project). We use an equity share approach in reporting greenhouse gas emissions to CDP.

For a breakdown of DTE Electric's direct GHG emissions (which make up more than 90 percent of DTE Energy's direct emissions), see the 2018 Environmental, Social, Governance and Sustainability Report, Quantitative Information, page 12.

305-2: ENERGY INDIRECT (SCOPE 2) GHG EMISSIONS

DTE Energy's indirect (Scope 2) emissions are for transmission and distribution line losses and internal use of power on the DTE Electric system. This excludes Scope 2 emissions from interconnection sales, e.g. power that is not distributed by DTE Electric. We use the appropriate regional emission factor from EPA's eGRID database to calculate these emissions, which includes calculations for CO_2, CH_4 and N_2O. Our 2017 Scope 2 location-based emissions were 1.7 million metric tons CO_2 equivalent.

Our base year for Scope 2 emissions is 2006 and our base year emissions were 3.6 million metric tons, as reported to CDP. We use an equity share approach in reporting greenhouse gas emissions to CDP.

DTE uses these standards, methodologies, assumptions and tools to calculate greenhouse gas emissions:

- The U.S. EPA Mandatory Greenhouse Gas Reporting Rule
- The World Resource Institute Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (Revised Edition)

305-5: REDUCTION OF GHG EMISSIONS

Since 2005, DTE Electric has reduced its direct (Scope 1) emissions of carbon dioxide (CO_2) from its fossil fuel power plant by 10.4 million tons (9.4 million metric tons). This represents a 24 percent reduction from the 2005 baseline year. These CO_2 emissions are measured directly by continuous emission monitoring (CEM) systems installed to measure stack gas concentrations for regulatory reporting to the EPA under 40 CFR Part 75 and 40 CFR Part 98.

305-7: NITROGEN OXIDES (NO_X), SULFUR OXIDES (SO_2), AND OTHER SIGNIFICANT AIR EMISSIONS

2017 emissions from DTE Electric and DTE Gas:

NO_x	22,477 tons
SO_2	48,682 tons
Particulate matter (PM):	523 tons

Other standard categories of air emissions:

Mercury	174.5 pounds

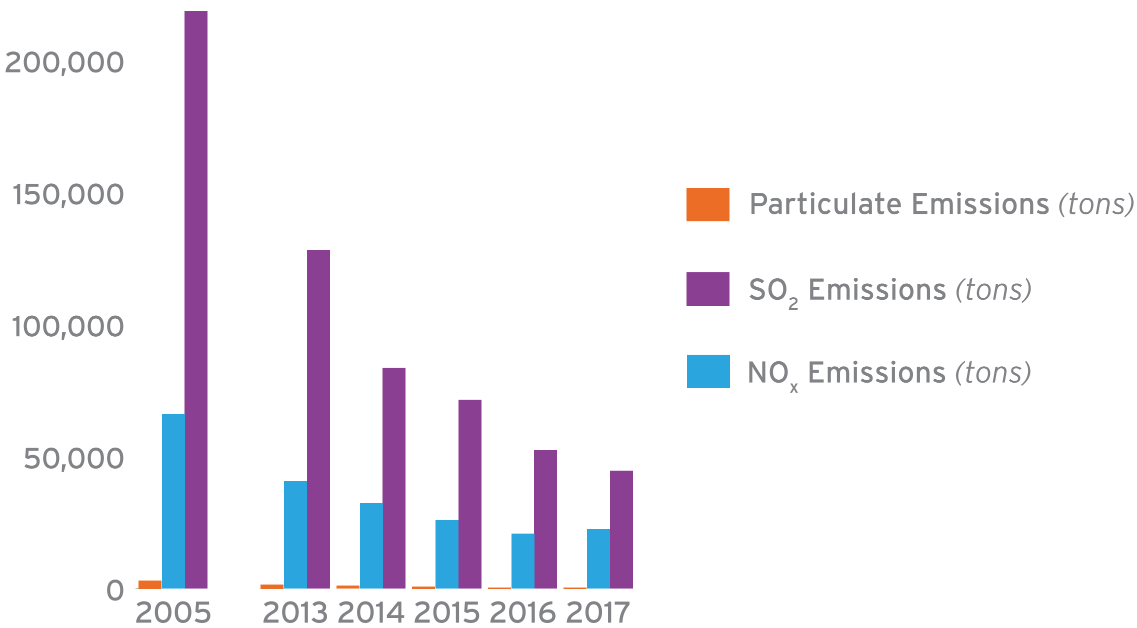
Source of the emission factors used:

- Standards methodologies, assumptions, and calculation tools: Power plant data is from Continuous Emissions Monitoring Systems (CEMS) and includes DTE's Renaissance Natural Gas Power Plant in Carson City. Combustion turbine generator (CTG) data is from Predictive Emissions Measurement Systems (PEMS).

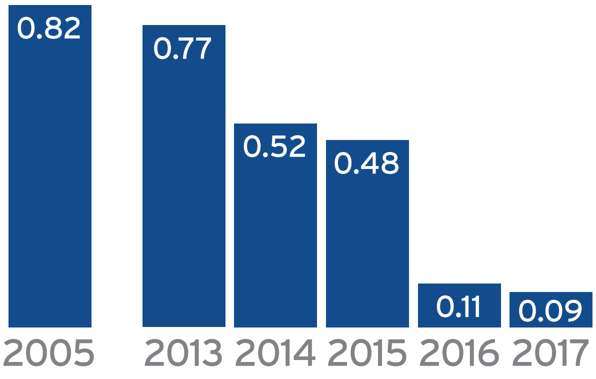
Particulate Matter (PM) emissions are calculated based on continuous opacity monitors, excluding the DTE Monroe Power Plant, where PM emissions are calculated using continuous emission monitoring systems

- Mercury emissions data is derived from sorbent trap monitoring systems included in DTE's Toxic Release Inventory (TRI). DTE Gas data is calculated from fuel use and run hours as reported to the Michigan Air Emissions Reporting System (MAERS).

NO_x SO_2 Emissions from DTE Electric Generation Sources



Mercury Emissions *(tons)* from DTE Electric



GRI 306: EFFLUENTS AND WASTE

306-2: WASTE BY TYPE AND DISPOSAL METHOD

Hazardous Waste	Tons
Recycling	0.09
Recovery	21
Fuel Blending	8.8
Incineration	0.92
Landfill	24
TOTAL	55
Other Waste	**Tons**
Polychlorinated Biphenyl (PCB)[5]	531
Asbestos	140
Universal Waste	72

Total weight of non-hazardous waste, with a breakdown by the following disposal methods where applicable:

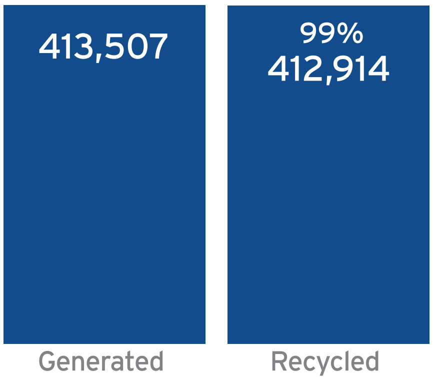
Fly ash and bottom ash are byproducts of the coal burned in our power plants. Synthetic gypsum is a byproduct of the flue gas desulfurization (FGD) units that reduce sulfur dioxide emissions from coal-fired plants. These coal combustion residual (CCR) materials – ash and synthetic gypsum – are recycled to the greatest extent possible. The portion of the CCR not recyclable is disposed in state and federally regulated landfills and impoundments. Our ash recycling rates dropped starting in 2016 as we brought sorbent injection and activated carbon emission controls on line to meet the Mercury and Air Toxic Standards (MATS) rule. The presence of sorbents and activated carbon in coal ash reduces its acceptability for beneficial reuse.

Gypsum is used as a component in drywall manufacturing and as a beneficial additive in agriculture. In 2017, we recycled 99 percent of the gypsum produced at DTE Energy power plants.

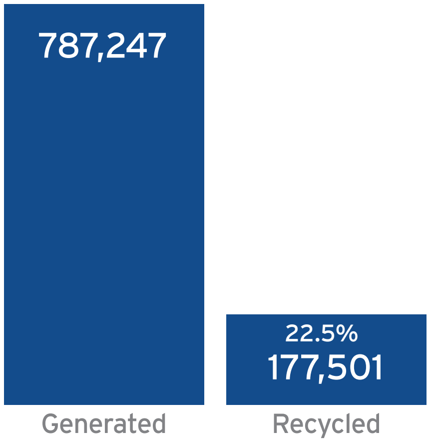
DTE Energy operates three licensed landfills to dispose of unrecycled fly ash and CCR. Each coal plant has on-site facilities for managing CCR before it is recycled or disposed. These landfills operate in compliance with applicable state and federal laws and are routinely inspected by state and local regulatory agencies. We assess the condition of our facilities and equipment on a regular basis and conduct maintenance and repairs as necessary to maintain structural integrity and operational performance.

5 *In 2017, DTE Energy disposed of PCB materials including solids, liquids, and transformers. PCBs were disposed of using a variety of management methods consisting of recycling, decontamination, landfill, and incineration. In August 2017, DTE experienced a PCB related incident following a fire at a substation in Plymouth, Michigan. Much of the PCB waste for 2017 was due to PCB-contaminated material associated with clean-up after the fire.*

2017 Gypsum Generated and Recycled *(tons)*



2017 Ash Generated and Recycled *(tons)*



DTE Energy's pollution prevention programs help to minimize impacts and conserve resources by reducing the volume of waste that would otherwise go to landfills for disposal. The table below summarizes the materials that DTE Energy recycled in Michigan during 2017:

Material	Weight
Copper	587 tons
Lead	418 tons
Aluminum	398 tons
Steel / Ferrous – Electric Operations	3,140 tons
Steel / Ferrous – Gas Operations	635 tons
Non-Ferrous / Wire Bundles	224 tons
Non-Ferrous / *(e.g. transformers)*	1,304 tons
Miscellaneous Metals	927 tons
Meters – Electric	126 tons
Meters – Gas	300 tons
Outage Material *(e.g. poles, wires, equipment from storms)*	1,531 tons
Plastic (HDPE)	60 tons
Scrap Electronics	59 tons
Transformer Oil	400 tons (107,831 gallons)
Cardboard	87 tons
Wood *(e.g. poles, pallets)*	489 tons
Paper	262 tons
Total *(not including ash and gypsum)*	**11,047 tons**

DTE Energy also recovers used oil for energy across our gas and electric utilities. Total recovered used oil is shown below.

Recovery

Used Oil	183,511 gallons

In addition, DTE Energy captured the following food and paper wastes at its Detroit headquarters campus, diverting these waste streams from landfills:

Composting	31.5 tons
Waste to energy (incineration)	322 tons

GRI:307: ENVIRONMENTAL COMPLIANCE

307-1: NONCOMPLIANCE WITH ENVIRONMENTAL LAWS AND REGULATIONS

Total monetary value of significant fines in 2017

DTE (Utility)	$56,000
DTE (Power and Industrial)	$2,572,994
Total	**$2,628,994**

Total number of non-monetary sanctions in 2017

DTE (Utility)	22 violation notices
DTE (Power and Industrial)	25 violation notices
Total	**47 violation notices**

Woodland Biomass Power, a California Limited Partnership, has agreed to the terms of a Yolo County Judgment and will pay $4.22 million for penalties, costs and remediation related to the improper handling of hazardous wood ash waste. Woodland Biomass has cooperated fully with Yolo County's investigation into the mischaracterization and subsequent mishandling of wood ash waste.

It was never the intent of Woodland Biomass to mishandle hazardous wood ash waste. The company has always taken pride in its adherence to environmental regulations. While one employee's decision to falsify some test records was utterly irresponsible, costing him his job, Woodland responded by setting new procedures in place to prevent this from ever happening again. Woodland accepts full responsibility for what happened and accepts the ruling of the Yolo County Superior Court.

The terms of the agreement include, payment for penalties (included in figure above), court costs and remediation of a site where the wood ash was disposed.

GRI 401: EMPLOYMENT

401-1: NEW EMPLOYEE HIRES AND EMPLOYEE TURNOVER

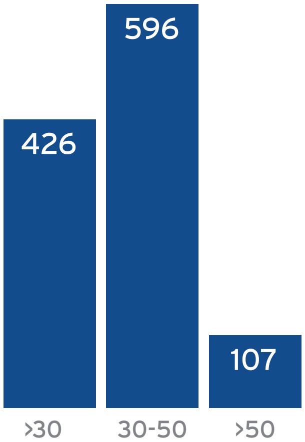
Age of New Hires Excluding Temps and Students	Number	Percent of Total
Under 30	426	38%
30-50	596	53%
Over 50	107	9%
Totals	1,129	100%

Gender of New Hires	Number	Percent of Total
Female	346	31%
Male	783	69%
Totals	1,129	100%

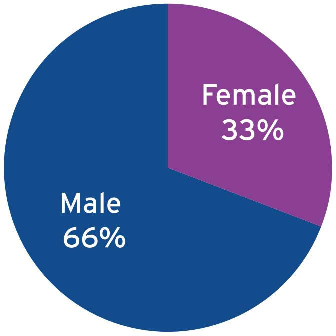
Employee Turnover Age	Number of Departures	Percent of Beginning of 2017 Headcount
Under 30	61	8.1%
30-50	194	4.3%
Over 50	624	13.3%

Employee Turnover Gender	Number of Departures	Percent Of Beginning of 2017 Headcount
Female	256	9.8%
Male	623	8.5%
Totals	879	

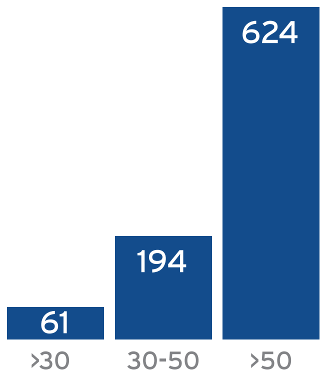
New Hires by Age



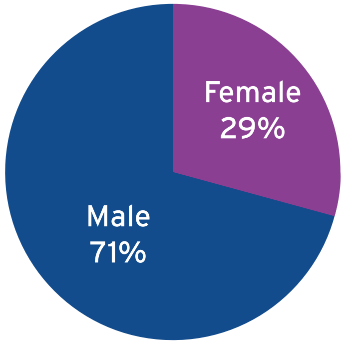
New Hires by Gender



Turnover by Age



Turnover by Gender

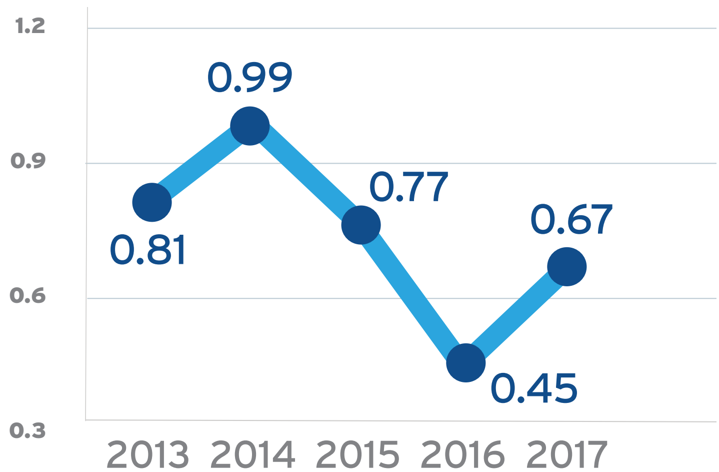


GRI 403: OCCUPATIONAL HEALTH AND SAFETY

403-2: TYPES AND RATES OF INJURY, OCCUPATIONAL DISEASES, LOST DAYS, AND NUMBER OF WORK-RELATED FATALITIES

DTE's Federal Occupational Safety and Health Administration (OSHA) recordable incident rate for all employees in 2017 was 0.67, which is based on an industry-standard calculation (the number of injuries or illnesses incurred in the workplace multiplied by 200,000 then divided by the number of employee labor hours worked)

Occupational Safety and Health Administration (OSHA) Recordable Rate



DTE achieved a 0.37 rate in 2017 for Days Away, Restrictions and Transfers (DART). The company does not break down work hour data by region or gender for OSHA-recordable incidents and DART rates.

DTE recorded an all-injury rate of 2.45 in 2017, which includes all first aid and recordable injuries, derived from the aforementioned industry-standard calculation for OSHA recordable incident rates. DTE's injury rate for 2017 is based on the following incident data:

Injury Type [6]	Incidents
Animal Bite	8
Arc Flash	1
Burns	10
Caught in, under, or between	16
Contact with electric current	1
Contact with radiation, caustics, toxic	4
Cumulative trauma/repetitive motion	1
Cut by object	32
Electrical equipment failure	1
Equipment accident	2
Eye injury	5
Fall from elevation	2
Insect bite	15
No accident	6
Overexertion	50
Poison Ivy	1
Rubbed or abraded	3
Slip, trip, fall	56
Struck by/against	41
Vehicle accidents	14

DTE follows Michigan Occupational Safety and Health Administration (MIOSHA) Part 11 recording and reporting of occupational injuries and illnesses.

DTE's Lost Day Rate (LDR) is 9.55 and is calculated from the day the employee was put off work and includes work days.

DTE's absentee rates are derived by calculating the number of hours absent divided by total number of hours. DTE's absences fall into two categories, managed and non-managed, the latter generally protected by federal law such as under the Family and Medical Leave Act.

6 *Includes all first aid and recordable injuries*

DTE's Absentee Rates for 2017:

All Company	Non-Managed	Managed	Total
Hours Worked	27,336,653.80	27,336,653.80	27,336,653.80
Absent Hours	230,678.79	434,574.65	665,253.44
Absence Rate	0.84%	1.59%	2.43%

Female	Non-Managed	Managed	Total
Hours Worked	5,388,867.99	5,388,867.99	5,388,867.99
Absent Hours	92,135.47	129,008.65	221,144.12
Absence Rate	1.71%	2.39%	4.10%

Male	Non-Managed	Managed	Total
Hours Worked	21,947,785.81	21,947,785.81	21,947,785.81
Absent Hours	138,543.32	305,566.00	444,109.32
Absence Rate	0.63%	1.39%	2.02%

DTE had no fatalities in 2017.

Regarding workplace safety, DTE achieved a company-wide 98th percentile performance as measured through the 2017 Safety Barometer Survey conducted by the National Safety Council. In addition, for the second consecutive year, DTE earned the American Gas Association's (AGA) Safety Achievement Award for excellence in employee safety. Based on safety results in 2016, the award recognizes companies with the fewest employee injuries and illnesses as measured by the OSHA. DTE also achieved impressive safety results at its two Monroe County power plants last year. One of Michigan's safest workplaces is in Newport, where Unit 2 of DTE's Fermi nuclear power earned a Michigan Voluntary Protection Program Star Award from the Michigan Occupational Safety and Health Administration (MIOSHA). Eight miles away, personnel at DTE's coal-fired Monroe Power Plant completed more than two million hours worked without an OSHA-reportable injury, an accomplishment never previously achieved.

GRI 404: TRAINING AND EDUCATION

404-3: PERCENTAGE OF EMPLOYEES RECEIVING REGULAR PERFORMANCE AND CAREER DEVELOPMENT REVIEWS

100 percent of non-represented, regular employees have the opportunity to participate in goal-setting at the beginning of the year, a mid-year evaluation to review progress on performance and development goals, and year-end review on performance and development. Depending on when an employee hires into the company, the full, annual review process may be pushed to the next review period. The "regular" employees do not include temporary personnel, contractors, interns, students, or seasonal staff.

GRI 405: DIVERSITY AND EQUAL OPPORTUNITY

405-1: DIVERSITY OF GOVERNANCE BODIES AND EMPLOYEES

	Male	Female	Under 30 Years of Age	30-50 Years of Age	Over 50 Years of Age	Minority Percentage
DTE Board	83%	17%	0%	0%	100%	25%
Executives and Senior Leaders	80%	20%	0%	29%	71%	13%
Executives, Senior Leaders, and Directors	76%	24%	0%	47%	53%	15%
Managers and Supervisors	78%	22%	1%	54%	45%	22%
Individual Contributors/ Workers	73%	27%	12%	48%	40%	29%

GRI 413: LOCAL COMMUNITIES

413-1: OPERATIONS WITH LOCAL COMMUNITY ENGAGEMENT, IMPACT ASSESSMENTS, AND DEVELOPMENT PROGRAMS

DTE's community engagement and development efforts in 2017 were highlighted by the opening of Beacon Park in downtown Detroit, summer work experiences for youth and young adults, ongoing investments in regional talent-to-trades pipelines, customer assistance and community partnership efforts.

The revival of the neighborhood surrounding DTE's downtown Detroit headquarters into a thriving urban environment is benefitting the city and region by catalyzing investment in business, infrastructure, and economic development. DTE is helping transform the 148-acre neighborhood surrounding its downtown Detroit campus into a welcoming, safe place to live, work, and play. The neighborhood's new recreational centerpiece is Beacon Park, opened last year by DTE on a 1.5-acre lot, previously the location of a dilapidated industrial building. Planned, built, programmed and paid for by DTE and the DTE Energy Foundation, more than 240,000 people visited Beacon Park in its first six months. The park – Detroit's newest – spurred an announced $120 million redevelopment of an adjacent historic hotel and the area is now surrounded by other residential, office, and mixed-use building rehabilitations. To ensure public safety in the area, DTE widened its campus security presence to cover the entire neighborhood. A DTE-led Crime Deterrence Initiative (CDI) has improved street lighting and video monitoring, reducing vehicle break-ins, bike thefts, and other crimes by 80 percent.

Aligned with the City of Detroit's prioritization of youth employment, DTE provided financial support for summer work experience programs in the city last year while directly employing 55 city youth in summer internships in professional and skilled trades. The DTE Energy Foundation supported 650 summer positions for young people statewide. The summer jobs included a six-week work experience through United Way of the Lakeshore for 133 youth in six West Michigan counties. Foundation funding also enabled Grow Detroit's Young Talent to place about 400 youth between 14 and 24 years of age in summer jobs. Another Foundation grant provided summer jobs in urban forestry for 20 Detroit high school students through Greening of Detroit. The beneficial community impact of these efforts included a public safety element – keeping youth and young adults off the streets and engaged in meaningful activities; providing additional financial resources for participants and their families; and offering meaningful work experiences and career exposure to inspire continued education among participants.

Working with community partners, DTE is addressing the city's long-term, structural employment deficits. More than half of Detroit's youth and adult populations are unemployed, outside the workforce and/or not in school. Meanwhile, 3,100 jobs open every year in area construction and manufacturing. DTE is helping to nourish individual talent and work ethic with training in skilled trades connected to immediate, well-paying jobs. Last year the DTE Energy Foundation invested hundreds of thousands of dollars in a talent-to-trades pipeline, including at Detroit's Randolph Career Technical Center. After three years of direct involvement by DTE's chief administrative officer to keep the doors open at Randolph, $500,000 in DTE Foundation seed funding last year leveraged $10 million from community partners to refurbish the school. Enrollment at Randolph tripled from 100 students in 2016-17 to more than 300 this year. DTE additionally infused Randolph with 1,800 hours of in-kind support, including company employees serving as volunteer teachers. DTE has also supported other training programs and with its suppliers has committed to hire 1,000 adults as well as 1,000 youth with multiple barriers to employment by 2022.

About 200,000 of DTE's residential customers were identified in 2017 with incomes below the poverty line, many needing help to keep their homes warm. To reach these and other customers, DTE's Community Outreach team connected with hundreds of neighborhood groups, nonprofits, multicultural organizations, and faith institutions. Through these relationships, in 2017 DTE organized more than 30 neighborhood Customer Assistance Days, providing 17,000 households with $3 million for bill payments using federal Low Income Heating and Assistance Program funds. Last year DTE also provided $12 million in energy optimization assistance to households below the poverty line including through 3,967 home energy consultations and by distributing free energy efficiency kits.

More broadly and with a focus on transforming communities, DTE last year engaged more than 400 community partners across Michigan through a combination of formal community advisory councils and community partner meetings. Five facilitated discussions with DTE's CEO and executives last year provided the company with direct feedback from community partners to identify areas of needs, opportunities for program development and refinement in its Force for Growth initiatives. DTE also conducted two community partners briefings – one in Detroit and then other in West Michigan to advise the community leaders on DTE initiatives, obtain feedback, and to spur involvement. Community partners were encouraged to apply to the DTE Energy Foundation for grants to build upon the inventory of DTE community programs to collectively drive impact.

Becoming the top-ranked regional utility for customer satisfaction reflects companywide intent, sound operational decisions, and research. Achieving top decile customer satisfaction is one of seven corporate priorities at DTE Energy, indicating the preeminence of customer engagement in company culture as well as the emphasis regulators and investors place on customer perceptions. An executive committee at DTE oversees the collection and analysis of quantitative and qualitative data to inform operational decisions which in turn refine how DTE communicates to its customers, regulators, and investors. Customer satisfaction study findings published by J.D. Power and Associates, along with customer inquiry analysis, proprietary customer research, and other measures inform operational decisions. While J.D. Power scores provide an objective, external measurement against peer companies, DTE's internally-designed and executed surveys measure and track customer perceptions of the company on a more frequent basis. Cross-functional teams pinpoint customer service gaps, improvement actions, and opportunities to influence operations. In 2015, this systemic attention to customer service resulted in J.D. Power ranking DTE first in the Midwest for Business and Residential Gas and, by the end of 2017, DTE reached the #1 rank in the Midwest for Business Gas and Electric Customer Satisfaction and #2 rank in the Midwest for Residential Gas and Electric Customer Satisfaction.

To learn more, please see DTE's stakeholder engagement table on page 71.

GRI 415: PUBLIC POLICY

415-1: POLITICAL CONTRIBUTIONS

Formed in 1977, the DTE Energy Company Political Action Committee (PAC) is a voluntary, non-partisan committee promoting and supporting responsible government through contributions to candidates for election to federal, state and local offices. The DTE Energy PAC enables employees to support candidates and key policymakers who support DTE's mission, business goals, and, most importantly, the best interests of DTE customers and employees. It provides DTE Energy employees with an effective, convenient way to participate in the democratic process and have their voices heard on key issues. The DTE Energy PAC is guided by a steering committee comprised of company employees elected every two years by members of the PAC.

Information about DTE Energy PAC contributions can be obtained via the Federal Election Commission website and the Michigan Secretary of State's Bureau of Elections website.

ELECTRIC UTILITIES SECTOR SUPPLEMENT

Specific Organizational Profile Disclosures

EU1: INSTALLED CAPACITY

Installed capacity, broken down by primary energy source and by regulatory regime

Facility	Location by Michigan County	Year in Service	Net Generation Capacity [a] (MW)
Fossil-fueled Steam-Electric			
Belle River	St. Clair	1984 and 1985	1,034
Greenwood	St. Clair	1979	785
Monroe	Monroe	1971, 1973, and 1974	3,066
River Rouge	Wayne	1958	272
St. Clair	St. Clair	1953, 1954, 1961, and 1969	1,216
Trenton Channel	Wayne	1968	520
			6,893
Natural gas and Oil-fueled Peaking Units	Various	1966-1971, 1981, 1999, 2002, and 2003	2,033
Nuclear-fueled Steam-Electric Fermi 2	Monroe	1988	1,141
Hydroelectric Pumped Storage Ludington	Mason	1973	1,019
Renewables			
Wind			
Brookfield Wind Park	Huron	2014	75
Echo Wind Park	Huron	2014	112
Gratiot Wind Park	Gratiot	2011 and 2012	102
Pinnebog Wind Park	Huron	2016	51
Thumb Wind Project	Huron and Sanilac	2012	110
			450
Solar			
Utility-Owned SolarCurrents	Various	2010-2016	16
Utility Scale Solar	Various	2017	50
			66
			11,602

EU2: NET ENERGY OUTPUT BROKEN DOWN BY PRIMARY ENERGY SOURCE AND BY REGULATORY REGIME

Net energy output broken down by primary energy source and by regulatory regime

Net Generation from 2017 expressed in MWh	
Coal	26,559,727
Natural Gas	2,230,042
Nuclear	9,565,994
Petroleum	80,188
Total Renewable	3,677,031
Biomass/Biogas	529,414
Geothermal	0
Hydroelectric	56,841
Solar	82,204
Wind	3,008,572

EU3: NUMBER OF RESIDENTIAL, INDUSTRIAL, INSTITUTIONAL AND COMMERCIAL CUSTOMER ACCOUNTS

Number of residential, industrial, institutional and commercial customer accounts

Electric Customers:	
Residential	2,003,490
Commercial and Industrial	208,339

Gas Customers:	
Residential	1,178,537
Large Industrial	907
Commercial	86,900

EU4: LENGTH OF ABOVE AND UNDERGROUND TRANSMISSION AND DISTRIBUTION LINES

Length of above and underground transmission and distribution lines by regulatory regime

Miles of underground electric lines	16,000
Miles of overhead wire	31,000
Total miles of underground, overhead	47,000

EU5: ALLOCATION OF CO_2E EMISSIONS ALLOWANCES

Allocation of CO_2e emissions allowances or equivalent, broken down by carbon trading framework

DTE Electric operates entirely within the state of Michigan and is not covered by a CO_2e emissions trading program.

EU12: DISTRIBUTION LINE LOSSES

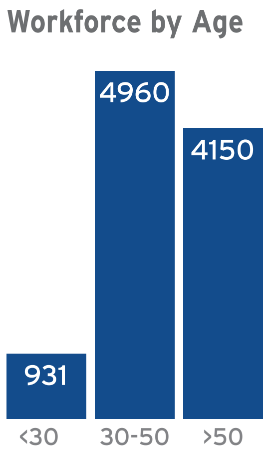
2017	3,203 GWh – 6.36% of net system output

EU15: PERCENTAGE OF EMPLOYEES ELIGIBLE TO RETIRE

Percentage of employees eligible to retire in the next 5 and 10 years broken down by job category and by region

The percentage of DTE employees eligible for retirement in the next five years will depend on the definition of retirement eligibility:

1. Through the company retirement plan: 15 percent of the current population will be eligible
2. 7 percent of the current population will be 67 years old or older in the next 5 years (full eligibility for social security benefits eligible)
3. 23% of the current population will be 62 years old or older in the next 5 years (partial eligibility for social security benefits)



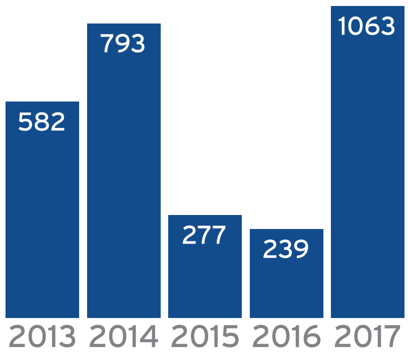
EU28: POWER OUTAGE FREQUENCY

All-weather SAIFI	1.39
Excluding major event day	0.99

EU29: AVERAGE POWER OUTAGE DURATION

Excluding the March 8, 2017 windstorm	231 minutes
Including the March 8, 2017 windstorm	1063 minutes

Reliability Duration Index



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APPENDIX

APPROACH TO STAKEHOLDER ENGAGEMENT

We engage our stakeholders through a variety of mechanisms that provide meaningful dialogue around topics of mutual interest. The table below highlights some of the most significant ways in which we communicate with stakeholders. The last column in the table describes the material issues that each group is most interested in, based on our interactions and what we hear from our stakeholders. Click on each topic to go to the report section that discusses DTE Energy's programs and performance in that area.

Stakeholder Engagement Table

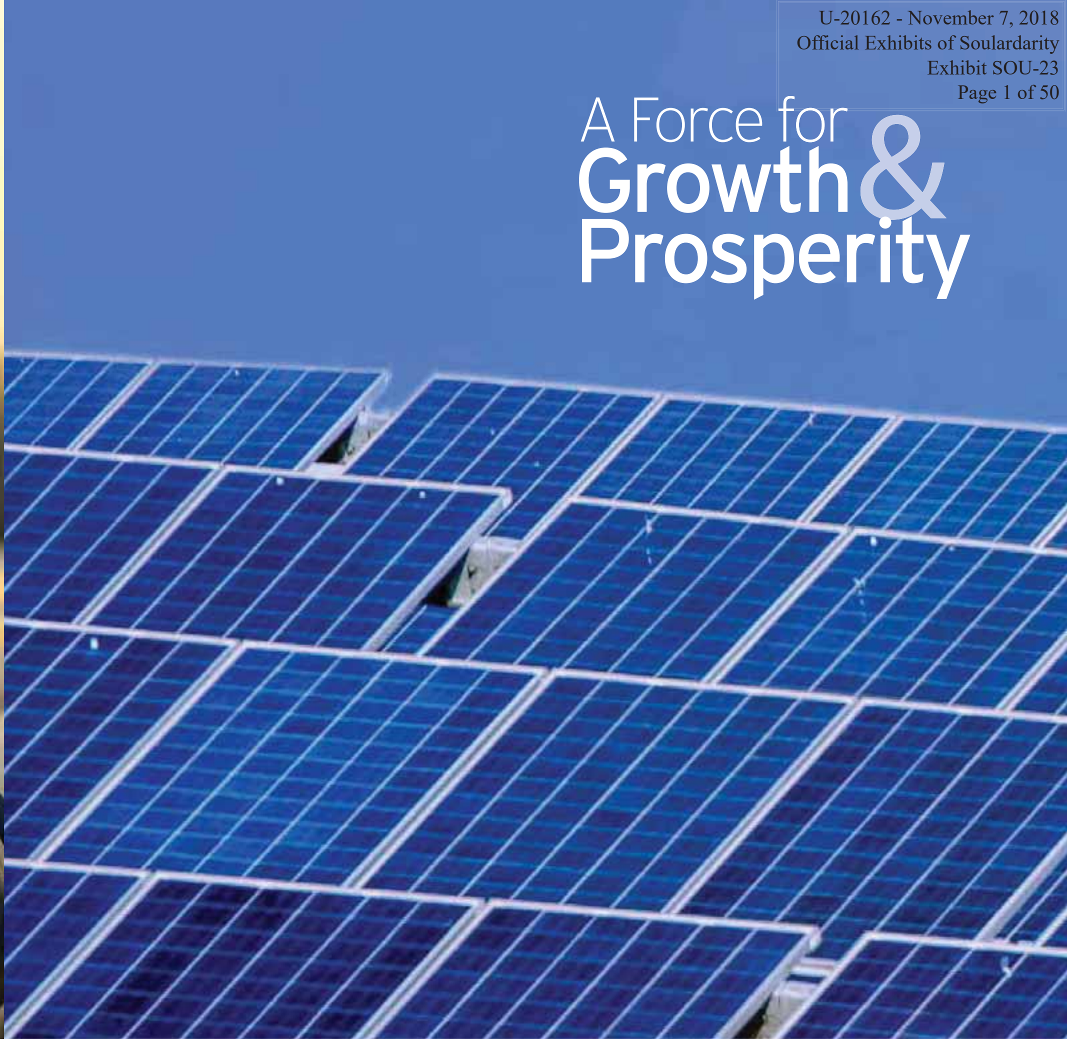
Stakeholder Group	Type of Engagement	Frequency	Topics Raised
Communities	Community Advisory Council meetings	Tri-annual (March, July, November)	• Customer Service & Assistance Programs • Community Outreach (organizations, events, partnerships) • Jobs & Employment (training, access, hiring process) • Political Involvement (lobbying, advocacy) • Diversity and Inclusion • Economic Development (entrepreneurship, small business support) • Energy Efficiency • Reliability and Infrastructure • Public Safety • Neighborhood development
	Community Partners meeting External Organization	Annual meetings in South East Michigan and Greater Michigan	
	Partnerships (Non-profits, Chambers, Associations, Clubs attending/supporting events & programs)	Regularly throughout the year	
	Volunteering (Board service, events, long-term programs)	Regularly throughout the year	
	Neighborhood Stakeholder meetings	Quarterly	
Customers	DTE website	Updated regularly	• Customer satisfaction • Cybersecurity • Economic development • Energy affordability • Energy efficiency • Greenhouse gases • Reliability and infrastructure • Renewables • Safety
	Billing statements and messaging	Monthly	
	Press releases and local media	Regularly throughout the year	
	Customer feedback via online comments and phone hotline	Continuous dialogue	
	Account management for large commercial & industrial customers	Continuous dialogue	
	J.D. Power survey	Twice annually	

Stakeholder Group	Type of Engagement	Frequency	Topics Raised
Employees	Company intranet (Quest)	Updated regularly	• Community assistance • Cybersecurity • Diversity and inclusion • Employee engagement • Safety • Environment
	Training events	Ongoing throughout the year	
	Town Hall meetings	Regularly throughout the year	
	Employee feedback via online comments	Continuous dialogue	
	Gallup engagement survey	Annual	
	Volunteerism	Ongoing throughout the year	
	Month of Caring	Annual	
	Employee Energy Groups	Monthly	
	Performance reviews	Annual	
Facility neighbors	Press releases and local media	Regularly throughout the year	• Air emissions • Community assistance • Economic development • Habitat and biodiversity • Reliability and infrastructure • Renewables • Safety • Waste management • Public Safety • Education • Jobs and Employment • Transportation • Beautification
	Community meetings associated with specific facility projects or events	Periodically as needed	
	Program partner newsletters and communications	Periodically as needed	
	Community meetings associated with ongoing neighborhood work and programming	Regularly throughout the year	
Government (local, state, federal)	Attendance at state agency meetings and legislative hearings	Continuous dialogue	• Community assistance • Customer satisfaction • Cybersecurity • Economic development • Energy affordability • Energy efficiency • Greenhouse gas emissions • Reliability and infrastructure • Renewables • Safety • Environment
	Attendance at meetings and hearings with federal regulators and policymakers	Continuous dialogue	
	Volunteer events	Regularly throughout the year	
	Press releases and local media	Regularly throughout the year	
	Facility tours for legislators	Regularly throughout the year	
Industry associations	Attendance at regular meetings and conferences. For example: • Edison Electric Institute • Nuclear Energy Institute • American Gas Association • Interstate Natural Gas Association of America • Michigan Manufacturers Association • Michigan Chamber of Commerce • Detroit Regional Chamber	Regularly throughout the year (monthly, quarterly and annual)	• Air emissions • Cybersecurity • Energy efficiency • Greenhouse gases • Habitat and biodiversity • Reliability and infrastructure • Renewables • Safety • Waste management
	Ongoing discussions around specific topics of concern to DTE Energy	Continuous dialogue on a project or case by case basis	

Stakeholder Group	Type of Engagement	Frequency	Topics Raised
Environmental groups	Attendance at regular meetings and conference, including: • The Nature Conservancy • Wildlife Habitat Council • Detroiters Working for Environmental Justice • Southwest Detroit Environmental Vision	Regularly throughout the year	• Air emissions • Energy efficiency • Greenhouse gases • Habitat and biodiversity • Renewables • Waste management
	Ongoing discussions around specific topics of concern to environmental groups related to DTE Energy activities	Continuous dialogue on a project or case by case basis	
Shareholders	Investor calls	Quarterly	• GHG emissions • Reliability and infrastructure • Renewables • Safety • Financial performance
	Press releases	Periodically throughout the year	
	DTE Investor Relations website	Updated regularly	
	Investor Relations Day	2-5 years	
Suppliers	Supplier Meetings, Symposiums, Executive Reviews	Weekly, Monthly, Quarterly and/or Annually	• Cybersecurity • Diversity and inclusion • Economic development • Energy efficiency • Energy affordability • Reliability and infrastructure • Renewables • Safety • Waste management
	Supplier scorecards	Weekly, Monthly, Quarterly and/or Annually	

PERFORMANCE DATA SUMMARY 2017

Performance Metric	2012	2013	2014	2015	2016	2017
Employees						
Employee Engagement Gallup Grand Mean score	4.08	4.18	4.28	4.27	4.33	4.38
Occupational Safety and Health Administration (OSHA) Recordable Rate	1.24	0.81	0.99	0.77	0.45	0.67
Customers						
Reliability Duration Index *(minutes)*	472	582	793	277	239	1063
Enrollment in Low-Income Self-Sufficiency Plan	N/A	28,947	22,000	34,000	35,000	40,000
Community						
Spending in Michigan *(million dollars)*	$ 825	$ 800	$ 922	$ 945	$ 1,300	$17,000
Total number of volunteers	N/A	1,450	2,000	2,335	2,300	3,500
Total number of volunteer hours	N/A	N/A	N/A	12,000	21,750	57,681
Total amount of skills-based volunteer hours	N/A	N/A	N/A	N/A	N/A	18,500
Climate Change						
Net gas energy savings - customer programs *(million cubic feet)*	1,474 MMcf saved	1,436 MMcf saved	1,413 MMcf saved	1,480 MMcf saved	1,620 MMcf saved	1,735 MMcf saved
Required gas savings *(million cubic feet)*	1,186 MMcf	1,240 MMcf	1,209 MMcf	1,178 MMcf	1,301 MMcf	1,305 MMcf
Net electricity energy savings - customer programs *(gigawatt-hours)*	611 GWh saved	614 GWh saved	682 GWh saved	621 GWh saved	631 GWh saved	762 GWh saved
Required electricity savings (gigawatt-hours)	455 GWh	471 GWh	478 GWh	485 GWh	481 GWh	485 GWH
CO_2 emissions *(million tons)*	38.1	39.2	36.6	36.3	31.9	32.8
Environment						
NO_x emissions *(tons)*	37,272	40,494	32,185	25,804	20,648	22,477
SO_2 emissions *(tons)*	133,456	128,178	83,447	71,465	52,245	48,682
Particulate emissions *(tons)*	1,291	1,645	1,105	767	536	523
Mercury emissions *(tons)*	0.747	0.773	0.522	0.479	0.112	0.087
Water withdrawal *(billion gallons)*	1,330	1,307	1,242	1,222	1,080	1,082
Water consumption *(billion gallons)*	20.5	20.4	18.8	20	19.1	19.45
Coal ash generation *(million tons)*	1.05	1.06	0.92	0.93	0.74	0.78
Recycling rates for ash *(percent)*	39%	42%	42%	42%	25%	23%
Gypsum generation *(million tons)*	0.16	0.2	0.28	0.36	0.36	0.41
Recycling rates for gypsum *(percent)*	100%	97%	100%	97%	100%	99%
Recycling rates *(combined ash and gypsum)*	47%	51%	55%	53%	48%	49%
Our Company						
Operating Earnings Per Share (EPS)	$3.94	$ 4.09	$4.60	$4.82	$ 5.28	$ 5.59
Annual Growth Rate in Operating EPS	5.07%	3.81%	12.47%	4.78%	9.54%	8.9%
Annual Shareholder Return *(percent)*	14.90%	14.89%	34.61%	-3.77%	26.33%	
Funds from operations (“FFO”)/debt ratio	Debt/ Capital: 49% FFO/Debt: 22%	Debt/ Capital: 50% FFO/Debt: 23%	Debt/ Capital: 51% FFO/Debt: 25%	Debt/ Capital: 52% FFO/Debt: 21%	Debt/ Capital: 51% FFO/Debt: 21%	Debt/ Capital: 51% FFO/Debt: 20%
Diluted earnings per common share *(dollars)*	$3.55	$ 3.76	$ 5.10	$4.05	$ 4.83	$ 6.32
Net income *(million dollars)*	$ 610	$ 661	$905	$ 727	$ 868	$ 1,112
Operating revenue *(billion dollars)*	$ 8.8	$ 9.7	$ 12.3	$ 10.3	$ 10.6	$ 12.6



A Force for Growth & Prosperity

2016-2017 Corporate Citizenship **Report**

A Force for Growth & Prosperity Across Michigan 2016-2017

This report, and our Corporate Citizenship Report Highlights document, are available for download at **dtecitizenship.com**.

CEO Message

Not long ago, I spent two weeks in Peru with my oldest son hiking and experiencing local culture. A highlight of our trip came near its end, when we hiked out of Colca Canyon, the second deepest in the world. Before beginning the climb, I worried about my ability to ascend the steep, rocky climb out. I soon realized that the prior two weeks of vigorous physical activity at high elevation had made me stronger than I realized, and I enjoyed a hike that had seemed daunting a few hours earlier.

The story is much the same at DTE Energy. We are doing things at our company today that would have been incredibly hard or maybe even impossible just a few years ago. By challenging ourselves to continuously improve – and building our strength in the process – we have found that we are now capable of more than we understood.

DTE Energy is embracing its role as a transformational force, both in Michigan and in the other states in which we operate. The economic engine resides in the private sector and we need to harness that engine to the task of revitalizing our neighborhoods, strengthening our economy and rebuilding and broadening the middle class. We are fully committed to our aspiration to be a force for growth and prosperity in the communities where we live and serve.

Our commitment to be a force for growth also extends to environmental sustainability. For many years, the industry has viewed sustainability as a choice between affordability for customers and environmental outcomes. We reject that premise. Our work in environmental sustainability establishes DTE Energy as a leader without ever losing sight of our mission to provide safe, affordable and reliable energy to our customers.

We accept the challenges before us with confidence because our success is grounded in the capabilities and determination of 10,000 DTE Energy employees who bring their best energy and focus to their work every day. As our company continues to grow stronger, we will apply that strength to becoming the best energy company in the world – and the best energy company for the world.

Gerry Anderson

Gerry Anderson
DTE Energy Chairman and CEO

2016-2017 DTE Energy Corporate Citizenship **Report**

Our Aspiration: To be the best-operated energy company in North America and a force for growth and prosperity in the communities where we live and serve.

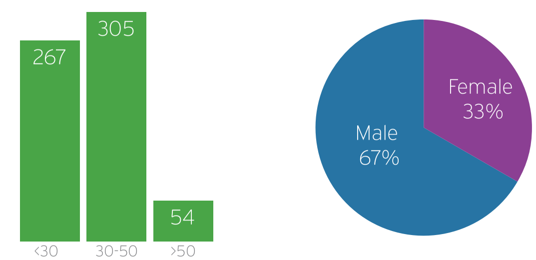
Table of Contents

Engaged Employees Creating a Force for Growth

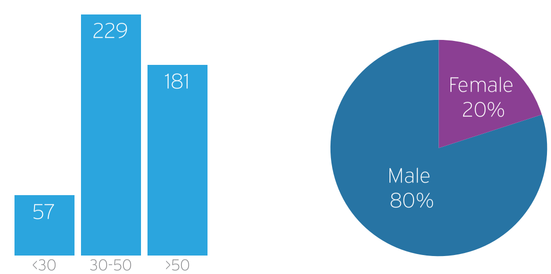
To realize our aspiration of being the best-operated energy company in North America, we rely on the capabilities of our nearly 10,000 DTE employees. As the energy industry undergoes significant change, DTE is building a workforce that will lead us into the future. Each and every accomplishment is due to the hard work and tenacity of dedicated DTE employees.

Employees

2016 Employee New Hires (by age)



2016 Employee Turnover (by age)



Our commitment to respect each other and create an engaged, inclusive environment goes beyond race and gender. We believe that a diverse workforce with a healthy mix of educational experiences, backgrounds, ages, cultures, religions, sexual orientation, abilities and personal interests expands our base of knowledge, skills and cross-cultural understanding.

As of year-end 2016, DTE Energy employed nearly 10,000 people across all its businesses, plus an additional 750 contractors (7 percent of our workforce). Approximately 48 percent of DTE's workforce is represented by unions under collective bargaining agreements. We respect our employees' right to be represented by a labor union. We work together to promote productive relationships with our unions that consider the interests of our employees, customers and business. Non-represented employees are considered "at will" and the terms of their employment are guided by United States labor laws. There are several bargaining units for DTE Energy's represented employees. The majority of our represented employees are under contracts that expire in 2017 and 2020.

Employees

Safety

In 2016, DTE Energy achieved its best safety performance in the company's history. This accomplishment is a tribute to our corporate safety culture in which each employee is 200 percent accountable for safety 100 percent for themselves – and 100 percent for their team members. DTE leaders believe the measure of a company lies in its commitment to keeping employees safe. Knowing many of our employees face dangerous situations at work, we will continue to promote our strong safety culture and provide the tools and training necessary to ensure our employees return to their families safely each day.

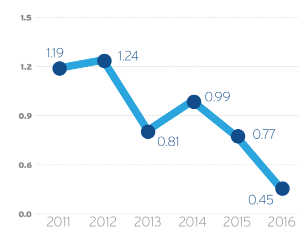
Our excellent safety performance is particularly noteworthy in light of two significant events at DTE facilities during 2016:

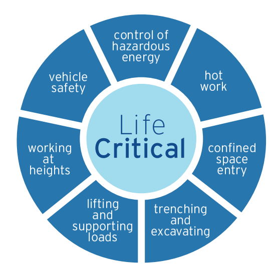
- In July, a vehicle collision at the DTE Gas Allen Road Service Center in Melvindale, Mich., caused a natural gas line to rupture and explode. Four DTE employees and a security contractor were safely evacuated. As a precaution, about 1,500 nearby residents were evacuated for a short time. Through a combination of safety systems, emergency planning and quick employee response, there were no injuries and damage was minimal.
- The DTE Electric St. Clair Power Plant in East China Township, Mich., experienced a major fire in August. The facility was quickly evacuated and no one was injured. The facility underwent repairs and began generating electricity again in September 2016.

DTE set an ambitious target to reach top decile safety performance by 2016. Compared to the peer utility companies, we reached the target by reducing our rate of injuries by nearly 40 percent – achieving the best safety record in our company's 168-year history.

In 2016, DTE Gas earned the Safety Achievement Award from the American Gas Association for the second consecutive year.

Occupational Safety and Health Administration (OSHA) Recordable Rate





Safety Awards and Recognition
In 2016, DTE Energy gained admission into the National Safety Council's Campbell Institute – a partnership of companies across a variety of industries that share best practices in environmental, health and safety performance. Companies are selected for their demonstrated commitment to employee safety and business excellence.

DTE Gas also earned the Safety Achievement Award from the American Gas Association for 2016, the second consecutive year we have achieved this recognition.

Life Critical Standards
Our Life Critical Standards program provides a comprehensive toolkit to help employees carefully perform work and manage risk associated with some of our more dangerous tasks. These include controlling hazardous energy and high voltage, lifting and supporting heavy loads and vehicle safety. The standards also address working at heights or within trenches and enclosed spaces. Toolkits include stop cards, which are checklists that aid employees in determining critical phases of work.

Employees

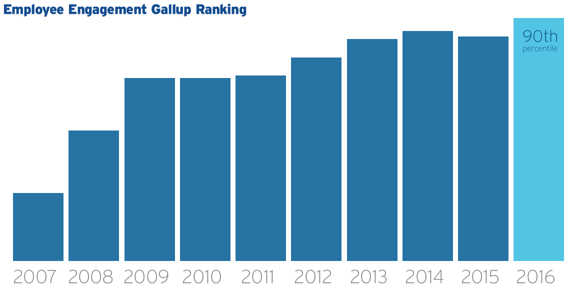
Employee Engagement

In April 2017, DTE was named a Gallup Great Workplace for the fourth consecutive year.

At DTE Energy, our employees are the foundation of our company and the energy behind our operations. Throughout our company, we strive to maintain a positive, collaborative workplace environment where everyone feels valued. Employee engagement is a key enabler and driver to achieving our goal of being the best-operated energy company and a force for growth and prosperity in our communities.

In 2016, our score on the Gallup employee engagement survey ranked in the 90th percentile among thousands of workplaces around the world. This is the highest employee engagement ranking we have ever received and a significant increase from the 86th percentile in 2015. DTE has received the Gallup Great Workplace Award for the fourth year in a row. This award recognized us as an organization making engagement a fundamental core value of our business. We remain the only energy company to ever win this award.

Employee Engagement Gallup Ranking



We use the Gallup survey to measure the success of our engagement efforts over time. Gallup is a global research and polling company helping organizations boost organic growth through measurement tools, strategic advice and education.

Career Development

In the next five years, more than one-fourth of DTE Energy employees will be eligible for retirement. The future of the company will depend on our ability to transfer knowledge to a younger generation through training programs and skills development.

DTE Energy is preparing for these changes by ensuring our current workforce is ready for this transition. We have invested heavily in developing our people by establishing our Foundational Capabilities Curriculum, which defines the training, skills and development employees need for success within the company. Training is provided through Aspire, DTE's learning platform. It includes a combination of web-based and classroom courses. The Foundational Capabilities Curriculum covers topics within the following categories: safety fundamentals, engagement skills, customer focus, continuous improvement, project management, supplier performance management, asset maintenance, strong leadership and business acumen.

When our employees continue their education and become more skilled in their trade or profession, all our stakeholders benefit. For these reasons, DTE supports employees in their professional development by providing financial assistance through our education tuition reimbursement program.

2016 Foundational Capability Training

Training hours completed	Number of course completions	Number of individuals who completed courses	
50,772 hours	14,169 completions	3,124 employees	1,142 leaders, managers and directors

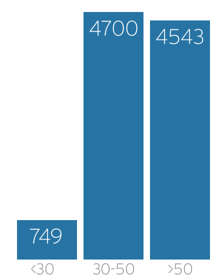
FUEL Event Engages New Employees

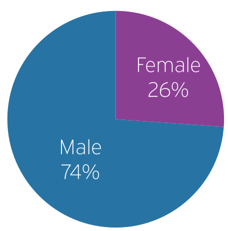
Our FUEL event series is an exciting element of our new "power up" onboarding process for recent DTE Energy recruits. It is designed as a creative way to welcome and engage new hires. In 2016, we held the first-ever FUEL event to provide new employees a unique opportunity to learn about our company's culture directly from senior leadership. At this dynamic event, senior leaders shared anecdotes about their own careers, provided insights into the future direction of our industry and business, and discussed the importance of continuous improvement. The inaugural event highlighted the enthusiastic participation of several DTE Energy executives. DTE will host FUEL events quarterly so new employees can gain better insight into company values and feel connected to our team.

Employees

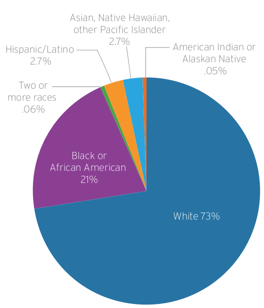
Diversity and Inclusion

DTE Workforce Demographics (by age)





Race/ethnicity



DTE Energy has a rich history of working to create a diverse and inclusive workplace. We know unique backgrounds and experiences lead to more engaged employees. It is the responsibility of each DTE employee to keep diversity and inclusion at the forefront of what we do. This means embracing the differences in our life experiences, cultures, personal interests, ways of thinking and individual strengths. When we embrace diversity, we deepen our understanding of one another and improve our ability to serve our customers in our communities.

Fostering an inclusive environment – actively seeking opportunities for collaboration, inviting healthy discussion of new ideas and seeking to understand others by being curious and interested – catalyzes our priority for continuous improvement and contributes to our company's employee engagement.

DTE's recruiting and outreach efforts focus on ensuring our workforce is skilled, talented and reflective of our customer base. We actively support programs to encourage young students from a wide range of geographical, cultural and socioeconomic backgrounds to pursue academic programs related to science,

technology, engineering and math (STEM). We strive to raise awareness and promote education around technical and skilled trade careers in the energy sector.

In 2016, DTE Energy sponsored a Coalition of Minority Professional Engineering Societies (COMPES) career development conference and job fair designed to help bring women and underrepresented groups into STEM-related jobs. We believe that building partnerships with organizations like COMPES will help us develop robust talent pipelines and recruit talented individuals.

DTE Energy was ranked third among utility companies in the 2016 rankings published by DiversityInc. The ranking recognized our strong efforts to hire, retain and promote women, minorities, people with disabilities, lesbian, gay, bisexual, transgender and queer individuals.

Veterans

The Michigan Veterans Affairs Agency has named DTE Energy a Gold-Level Veteran-Friendly employer. This distinction is reserved for employers who commit to military veteran recruitment, training and retention. To make it easier for veterans to identify career opportunities at DTE, our company careers website contains military occupational codes and translates the codes into open positions at DTE. In 2016, 11 percent of our external hires were veterans.

Supporting Individuals with Disabilities

DTE believes we all have a role to play in breaking down employment barriers that individuals with disabilities face when pursuing a career. Each October, we participate in the National Disability Employment Awareness Month to highlight disability employment issues and celebrate the many contributions of American workers with disabilities.

In 2016, we continued our efforts to create a more accessible work environment for people with disabilities by complying with Americans with Disabilities Act (ADA) regulations. We have improved elevator access and added ADA-designated seating in the cafeteria. We facilitated the use of new accessibility features in our recently upgraded software to make it easier for visually impaired individuals to obtain information from websites. We distributed braille business cards to visually impaired individuals at career fairs, increased ADA parking for visitors and employees and included ADA contact information in communications to new hires and job candidates.

In 2017, we are re-launching our employee resource group that is focused on raising awareness for, and supporting, workers with disabilities.

Energy Groups at DTE

AMEA - Asian and Middle Eastern American

DAWG - Disabilities Awareness Working Group

POP - Power of Pride

REACH - Respecting Ethnic and Cultural Heritage

Somos - Energy Group for Hispanic/Latino employees

Surge - DTE Young Professionals

VETS - Veteran Empowerment, Transition and Support

Women at DTE

Veteran Empowerment, Transition and Support Program

At DTE Energy, affinity and resource groups have been a long-standing part of our culture, serving as forums for individuals to share experiences, network and develop their careers. We continue to promote our eight resource groups who meet routinely to exchange knowledge and ideas to enhance their work experience, encourage personal and professional growth and support our business goals. In 2016, we re-launched our resource groups as "energy groups" with additional support to drive deeper engagement.

One such energy group, Veteran Empowerment Transition and Support (VETS), is designed to support employees and members of the veteran community. VETS aims to foster a strong community network of leaders within DTE Energy who can advocate for the recruitment, development and retention of veterans.

Employees

Health and Wellness

DTE Energy promotes a healthy work environment and helps our employees pursue healthy lifestyles.

Across our organization, DTE Energy promotes a healthy work environment and helps our employees pursue healthy lifestyles. Our company-wide wellness program, Energize Your Life (EYL), offers many avenues of support for employees seeking to maintain or improve their health. We encourage our employees, retirees and family members to get appropriate health screenings and to follow guidelines for avoiding chronic diseases. Through EYL, we offer a variety of innovative and informative programs and services to make healthy living easier, including:

- Opportunities to learn more about their health through annual physicals and a health assessment
- Health and wellness programs to help them manage stress, lose weight, get active, eat better, manage chronic conditions and more
- Rewards for completing healthy activities

To support a healthy and active culture, we have fitness campaigns and challenges offering incentives throughout the year to promote movement, good nutrition and healthy lifestyle choices. Our cafeterias offer healthy food and nutritional information. Many of our facilities include exercise rooms.

In January 2016, we opened a state-of-the-art health and wellness center at our Detroit headquarters complex. We partnered with two of the most highly respected and recognized performance and health teams in the country – EXOS and the Henry Ford Health System – to provide our employees with industry-leading approaches to overall physical health and the best medical care.

- The Fitness Zone offers one-on-one coaching with fitness experts and personal counseling with a nutrition specialist or dietitian. The workout facilities include a recovery area with healthy pre and post-workout food options. Group exercise classes are provided, including spin and yoga, as well as recreational sports such as basketball and volleyball.
- The Health Zone, our onsite medical center, offers basic primary care, occupational health services, first aid and on-site physical therapy. We also offer flu shots and discounted over-the-counter medications.

This investment in physical and mental well-being is grounded in our belief that healthy employees are more productive, engaged and energetic at work and at home.

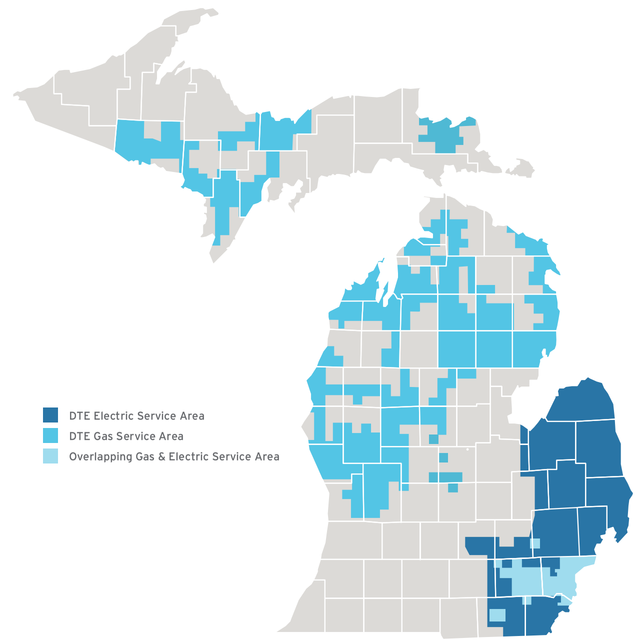
Focusing on Customer Satisfaction

Serving our customers is the number one priority at DTE Energy. We work tirelessly to provide our customers with safe, reliable and affordable energy. Our customer base is extensive and diverse. DTE Electric and DTE Gas serve millions of households, businesses and organizations throughout Michigan, while our non-utility businesses provide energy supplies and related services to industrial customers around the United States. Every interaction is an opportunity to exceed our customers' expectations.

Customers

DTE's utility businesses supply energy to our customers through 47,000 miles of electric distribution lines and 21,000 miles of gas pipelines.

Our Utility Operations in Michigan



Measuring Customer Satisfaction

DTE Energy's ongoing efforts to continuously improve our products, programs and processes, with a stellar customer experience, have resulted in significant improvements in customer satisfaction since 2007. DTE measures customer satisfaction with our utility businesses through J.D. Power – a global marketing information company that represents the voice of the customer – and their extensive consumer studies in the utility industry.

We rank second in J.D. Power customer satisfaction scores for both gas and electric residential customers in the Midwest. Our goal is to be number one and maintain that position. We recognize the most significant factor in achieving that ranking from our electric customers is through improving reliability. We have made significant investments and they are paying off. In 2016, we had our best reliability performance in the past decade. We continue to communicate with our customers to raise awareness of the full range of services and community benefits that DTE Energy provides.

Reliability and Infrastructure

In March 2017, DTE experienced the worst weather-related outage in the company's history. Near hurricane-force winds pounded the state for nearly 12 hours, leaving 800,000 customers without power.

Along with a full contingent of our own crews, DTE brought in crews from seven states to restore power as quickly as possible. Customers affected by this storm were restored at an unprecedented rate of recovery considering the magnitude of the storm.

Both DTE and its community partners rallied to support those without power, providing supplies to warming centers and going door-to-door in many neighborhoods to ensure the safety of residents.

DTE Electric

We understand how much our customers depend on the electricity we provide. We're always working to improve the 7,600 square miles of our electrical service area to deliver energy customers can count on.

In 2016, we replaced utility poles, installed smart grid sensors and continued to proactively trim trees near power lines. The result was an improved reliability for our customers as we keep the lights on at homes and businesses. Compared to 2014, reliability for our customers improved 70 percent and rates remained below the national average.

In 2016, DTE Energy:

- Began construction on four new state-of-the-art substations and upgraded equipment in many other substations to prepare for increased customer demand in fast-growing areas.
- Upgraded equipment on over 200 customer-serving circuits and replaced approximately 3,000 utility poles to strengthen reliability. We're using new designs and materials that can better withstand Michigan's severe weather, ultimately reducing power outages.
- Installed more than 3,500 new smart grid sensors and other smart grid devices. Smart grid upgrades will help us pinpoint the locations and extent of outages quickly. New technologies identify and diagnose equipment issues early so we can service them proactively, preventing many outages before they occur.
- Trimmed 650,000 trees. Toppled trees and branches are responsible for two-thirds of the time DTE customers spend without power. Recently trimmed areas have seen reliability improve significantly.
- Substantially finished a multi-year installation of more than 2.4 million electric smart meters. Smart meters allow customers to monitor energy use through the DTE Insight App. In conjunction with the DTE Energy Bridge, our customers can monitor electricity use in real time and find ways to conserve energy.

Customers

We made great progress in 2016, but our work is not done. We're committed to implementing additional infrastructure upgrades that will result in stronger reliability and peace of mind for our customers. By taking actions to modernize our grid, we are creating a smarter, more reliable system to prepare for Michigan's energy needs today and in the future.

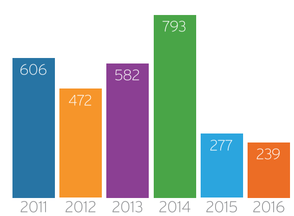
Like most energy companies, DTE Energy tracks service reliability using the Reliability Duration Index, also known as the System Average Interruption Duration Index (SAIDI). SAIDI measures the average length of time in minutes that a customer is without power over the course of a year. DTE is working to reduce the average length of power outages by building a stronger, smarter electrical grid. As we provide more reliable service for our customers, the score on the reliability index will grow smaller. In 2016, we reduced our SAIDI index to 239 minutes – the lowest level in 10 years.

Tree Trimming

DTE recognizes the value of trees in our communities, both for habitat conservation and aesthetics. As part of our continuing journey toward becoming the best-operated energy company in North America, DTE Energy is renewing its emphasis on tree trimming near our power lines.

Trees are a source of tremendous pride, but they are one of the main causes of power outages. Trees that come into contact with power lines also pose potential safety concerns. In 2016, DTE Energy trimmed trees along 3,348 miles of circuits. Areas trimmed under the enhanced program in 2016 experienced a 78 percent reduction in tree-related outage minutes. Customer complaints filed with the Michigan Public Service Commission went down by 83 percent.

Reliability Duration Index (minutes)



Over the next five years, we plan on investing $1.6 billion in our natural gas infrastructure. This will help fund the ongoing modernization of our main pipelines and installation of new service lines to homes and businesses.

DTE Gas

Maintaining a safe and reliable natural gas system is a commitment we take very seriously. The energy we provide is used to heat schools, hospitals, police and fire departments, homes and businesses.

DTE Gas continuously strives to meet or exceed all federal, state and local guidelines for safety, inspections and operations of our pipeline system in Michigan. We have completed all required inspections of our transmission pipelines and voluntarily expanded our program to inspect three times more transmission pipeline miles than required by regulation.

Public safety is extremely important to us. We maintain the safety and reliability of our natural gas pipeline system through a comprehensive program of inspections, maintenance and upgrades.

Over the next 25 years, DTE Gas is upgrading gas mains and service lines to advanced plastic materials, to maintain safe and reliable service for our customers. DTE upgraded 100 miles of main in 2016 and 290 miles of service lines. We plan to modernize another 140 miles of main and 320 miles of service lines annually now through 2021. Along the way, we are also moving indoor gas meters to an outside location so we can provide customers with safer, less intrusive service. By installing new advanced metering technology, we can increase remote data sensing, reduce operating costs and maintain affordable customer rates.

We conduct more than 300,000 gas meter safety inspections every year to ensure safe and reliable operation. In addition, we survey nearly 10,000 miles of pipeline annually, verifying there are no natural gas leaks in the system that serves our customers.

In our gas storage operations, DTE Energy maintains storage wells in adherence with strict state standards and specifications to protect public health and safety. We use remote data monitoring and on-site inspections to continuously monitor the performance of each well. We also perform regular corrosion assessments and pressure testing as well as annual groundwater monitoring to detect and address any methane leakage.

Serving Our Customers

We know our customers' expectations are changing and we must too. All DTE employees take pride and ownership in delivering highly satisfied customer experiences.

In 2016, our customer outreach teams worked with community partner organizations throughout Michigan to plan and implement 18 Customer Assistance Days, which provided on-site, in-person customer service. These events provided an opportunity for low and limited income residents to apply for energy assistance, obtain energy efficiency information and learn about related human services.

DTE's Customer Experience Initiative focuses on our customers' needs to ensure they have consistent, positive experiences with DTE, no matter how they do business with us. Customers are able to choose from a variety of self-service options available for accessing their account information and interacting with DTE, including the DTE Energy Mobile App. This app provides a convenient way for customers to manage their accounts. In just a few clicks, customers can pay bills, compare their monthly energy usage or report/track an outage. It is compatible with iOS and Android smart phones and can be used on iPads and Android tablets.

Learn more about our customer energy efficiency programs and Low Income Self-Sufficiency Plan.

In 2016, our customer outreach teams worked with community partner organizations throughout Michigan to organize and implement 18 Customer Assistance Days, which provided on-site, in-person customer service. These events provided an opportunity for low and limited income residents to apply for energy assistance, obtain energy efficiency information and learn about related human services.

A Grassroots Approach to Customer Service

The "I Can Help!" program makes it possible for any DTE employee to assist customers whose concerns have not been resolved through our normal customer service processes. When a customer comes to any DTE employee with an unresolved question or concern about their service, that employee can immediately respond by referring the customer's issue to the "I Can Help!" program. DTE employees can use their smartphones, tablets or home computers to submit an "I Can Help!" escalation request. From there, our Executive Customer Assistance Center follows up with customers to resolve their issue.

Energy Efficiency Services for Business Customers

Our Energy Partnership group provides support to DTE's largest customers for energy efficiency projects, both for electricity and gas usage. DTE Energy engineers develop and manage global energy monitoring programs for Michigan-headquartered companies, using the same software we employ at DTE Energy's own facilities around the country. For the small to medium-sized customer, our Energy Partnership group conducts facility assessments and provides recommendations of best practices for both gas and electric services.

In 2016, our customers across the United States achieved $15 million in energy savings through the work of our Energy Partnership teams. We further identified over $100 million in energy savings projects for future implementation.

DTE Energy's MIGreenPower Program

DTE Energy is continuously working to help customers to use clean energy. In 2017, the company launched MIGreenPower™ to address our customer's demand for a more flexible and affordable alternative to installing renewable equipment at their homes or businesses. MIGreenPower™ provides customers a convenient way to reduce their carbon footprint by supporting power from wind and solar farms – two of the most affordable renewable energy sources available.

Energy for the program is sourced from the Pinnebog Wind Park, located in Huron County, and three solar arrays located in Detroit and Lapeer. By subscribing to MIGreenPower™, customers pay a modest premium to support development of additional renewable generation resources in Michigan. Participation in this voluntary program is open to all DTE Energy business and residential electric customers.

Technology and Innovation

DTE Insight App
The DTE Insight App is a mobile app providing customers with real-time home energy usage data by connecting their home's advanced meter to their smartphone. Our customers can use this data to make decisions about home energy usage – from heating and cooling, to the use of appliances and even home weatherization. The app can help customers save energy and reduce their bills.

Since the DTE Insight App became available to iPhone and Android users in summer 2014, more than 115,000 households have downloaded it onto 245,000 devices. The number of residential customers using it in 2016 doubled from the previous year.

The DTE Insight App encourages and enables customers to save energy by changing their behavior, utilizing the following sophisticated tools:

- **Historical tracking** allows customers to see how much energy they use each day, week and month. Over time they can analyze energy trends and progress.
- **Target setting** helps customers set energy usage goals and track their consumption as they approach their energy target.
- **Dashboard view** gives customers continuous insight into their home's energy efficiency and performance.
- **Tips and challenges** provides customers with helpful ideas and challenges to inspire energy reduction and savings.

Customers can also obtain a free DTE Energy Bridge that provides real-time monitoring of home energy usage. Our analysis shows that, on average, residential customers using the DTE Insight App reduce their electricity usage by an estimated 2 percent. By using the DTE Energy Bridge, the energy reduction improves an average of five percent, with some users achieving up to 10 percent.

Customers who use the DTE Insight App together with the DTE Energy Bridge are achieving reductions in their energy use by up to 10 percent.

Smart Metering

Electric

Installed in 2016	321,426
Total Completed	2,517,959
% Completed	98%

Gas

Installed in 2016	92,733
Total Completed	933,522
% Completed	90%

Smart Meters
Smart meter technology is a system upgrade that uses secure, low-frequency radio transmissions to send electricity and gas usage data without the need for a manual meter reading. Over the last several years, DTE Energy has been installing smart meters across Michigan to ensure our customers have a safe, secure technology that connects directly to their DTE Energy online profiles. This technology allows our customers to better manage their energy usage and lower their bills. Our goal is to convert all DTE Electric meters by the end of 2017 and all DTE Gas meters by the end of 2022. We are on track to meet these goals. Currently we stand at 98 percent completion for DTE Electric and 90 percent for DTE Gas.

Smart meters support technology that brings a wide range of benefits and services to customers. The new technology allows DTE Energy to:

- Improve reliability by quickly identifying and addressing power outages and other service problems.
- Virtually eliminate estimated bills through automated meter reading.
- Remotely connect and disconnect residential electric service which means faster, less intrusive service.
- Reduce operating costs and thereby limit future rate increases.

Customers

Cybersecurity

In 2016, we received no complaints concerning breaches of customer data privacy.

Protecting the integrity of our computing networks and information has become increasingly important with the rise of concerns about potential malware and data breaches. We take these threats very seriously. DTE Energy has invested in developing a robust Information Protection & Security (IPS) group to ensure that we are fully addressing cybersecurity issues. IPS works to continually maintain and enhance appropriate safeguards to protect critical corporate assets. Protecting information assets from unauthorized access, disclosure, modification or destruction helps ensure that DTE does not suffer loss of customer confidence, market share or competitive advantage. By using a defensive, multi-level approach, we are able to secure our customer's data and other critical digital infrastructure.

In recent years, technology advancements have allowed us to improve our customer service by introducing online platforms and electronic databases to streamline our information management systems. To protect our customer's personal information, we take a proactive stance on the cybersecurity risks associated with new technologies. We participate in numerous state and industry-specific cybersecurity initiatives and adhere to the Michigan Public Service Commission privacy rules and our own information security policy. We perform security assessments of our suppliers and take measures to ensure the safety and security of our smart meter network.

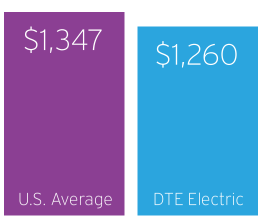
Our best line of defense for information protection and security is our employees. Internal message boards and other employee communications periodically remind the entire workforce about the importance of defensive measures such as strong passwords and proper email security. We provide mandatory, annual security awareness training to deliver a consistent message. Employees must be aware of potential cyber risks in their daily lives and know how to counteract those risks.

Infrastructure Protection

We also ensure that DTE operations maintain full compliance with federal rules for safeguarding critical infrastructure, which includes our system of electricity generation and distribution. We have strong policies and programs in place to ensure the complex network of controls delivering electricity across our system is not compromised.

Energy Affordability

Average Yearly Residential Electric Bills



DTE Energy offers BudgetWise Billing and Flexible Due Date options for customers to more easily manage their bills and make affordable payments.

DTE Energy is committed to keeping energy affordable for our customers. Reasonable electric rates, for businesses as well as residential customers, contribute to the strength and competitiveness of Michigan's economy. We will continue investing in new, cleaner generation to meet our environmental targets and customer expectations, while maintaining and enhancing reliability. We are aggressively pursuing continuous improvement in productivity and efficiency to ensure continued energy affordability for our customers.

The Michigan Public Service Commission approved an electric rate increase in 2016 that will support our efforts to repair and modernize our aging infrastructure. This rate increase is necessary to enable delivery of reliable, safe energy to our customers.

For our residential customers, annual bills tend to be a better measure of affordability than rates alone. DTE Electric residential customers' electric bills are 6 percent below the national average. For our industrial customers that compete on a global or regional scale and have energy-intensive manufacturing processes, competitive electric rates are especially important. From 2013 through July 2016, DTE Electric industrial rates declined 19 percent and are now below the national average.

For residential and business customers of DTE Gas, we have lowered prices steadily since 2008. This reflects the substantial increase in natural gas supply in the United States. In addition, Michigan's unique geology allows us to buy large quantities of natural gas when prices are low and store it underground until it is needed during cold winter months. This gives DTE customers price stability. The average bill for gas customers is 24 percent lower today than it was 10 years ago.

We encourage our customers to take advantage of our residential energy efficiency programs. In 2015, we reached more than 560,000 electric and almost 300,000 gas customers to help lower their natural gas and electric bills.

Low Income Self-Sufficiency Plan

While unemployment rates have improved in Michigan, there are still many people struggling to pay their bills. Roughly 16 percent of Michigan residents live below the poverty line. However, government funding for low-income customer assistance has been declining. Approximately 117,500 DTE customers received some kind of energy assistance in 2016.

DTE Energy pioneered an innovative program called the Low Income Self-Sufficiency Plan (LSP) to help economically stressed customers bridge the gap between extreme-weather energy bills and reduced government aid. This proactive, year-round assistance program helps customers budget for their energy payments, avoid service interruptions during hard times and puts them on a path to self-sufficiency.

Under DTE's LSP, customers who enroll are required to pay a fixed amount every month based on income and energy use. Their unpaid bill totals are frozen and reduced quarterly with successful payment compliance. Customers on the plan receive home energy assessment services to assist in weatherizing and improving energy efficiency.

During 2015-2016, 35,000 customers enrolled in the LSP and 84 percent successfully stayed on the plan. Only one percent of our LSP customers experienced a service disconnect during the program year. We expect to grow the enrollment to about 50,000 customers in 2017.

Partnering with The Heat and Warmth Fund and United Way

DTE Energy understands the importance of energy in our customers' daily lives. That's why we work with government agencies and community organizations to bring energy and payment assistance to low-income residents. We believe it is our responsibility to protect our customers from the dangers and financial impact associated with extreme temperatures that occur in Michigan.

By partnering with agencies like United Way and The Heat and Warmth Fund (THAW), we're able to provide ongoing relief to our most vulnerable customers and help them reduce energy-related expenses throughout the year.

DTE helped bridge the gap to help its most vulnerable customers – the elderly, unemployed, underemployed and disabled customers across Michigan – who struggle to pay their utility bills. With $11 million in donations in 2016 from the DTE Energy Foundation and DTE Energy to THAW and United Way, we were able to keep the lights and heat on for these customers.

Serving our Communities as a Leading Corporate Citizen

DTE Energy builds strong relationships with people in the communities where we live and serve. This connection extends beyond our business operations. We believe it is our responsibility to help protect and shape a prosperous future for our communities. Our employees live this belief by dedicating their time, skills and energy to organizations throughout Michigan.

Community

Community Support

A few examples of the great work supported by the DTE Energy Foundation in 2016:

Partnership with Conservation Resource Alliance in Traverse City for its River Care Program. Over the next three years, this grant will help build trail bridges, remove barriers, improve aquatic habitat and enhance recreational access to northwest Michigan waterways.

ArtPrize in Grand Rapids. We provided sponsorship support for this three-week art competition that celebrates artists from around the world and draws nearly 400,000 visitors to Grand Rapids and the surrounding region.

DTE Energy Foundation
The DTE Energy Foundation awarded nearly $15 million during 2016 to 360 nonprofit organizations to positively impact communities throughout the state.

We believe it is our responsibility to sustain and protect Michigan's legacy – from its cultural institutions to its beautiful natural environment – and help build its future. Our support allows people and communities to flourish – making the homes where we live and the neighborhoods where our children play much safer. We provide educational opportunities and create jobs to ensure a strong quality of life for all Michigan residents.

Basic Needs and Education
We are focused on making sure basic needs are met so people and communities can thrive through our partnerships with human service organizations like United Way and American Red Cross. We want to ensure people have affordable housing through Habitat for Humanity of Michigan and provide access to food through Kids' Food Basket. We help preserve and protect Michigan's natural resources with The Nature Conservancy. When basic needs are met, children, students and young adults can focus on education and work opportunities. The DTE Energy Foundation provides hands-on learning opportunities through FIRST in Michigan – a nonprofit organization establishing robotics teams and competitions throughout high schools in Michigan. We also support summer work experiences for youth through United Way Lakeshore and Grow Detroit's Young Talent.

Community and Business Development
From our neighborhoods to our businesses, we are helping to ensure people take pride in where they live, work and play. We support organizations focused on innovation through entrepreneurship, increasing economic growth and strengthening and developing businesses throughout Michigan. The foundation supports the Downtown Detroit Partnership, Endeavor Detroit, Ann Arbor SPARK and the Michigan Hispanic Fund for their continued efforts in our communities.

Arts, Culture and Diversity
The DTE Energy Foundation recognizes the role arts, culture and diversity play in enriching lives and communities. We support events like ArtPrize in Grand Rapids, the National Cherry Festival in

Traverse City, the Detroit Tree Lighting, the GRandJazzFest in Grand Rapids and Detroit Jazz Festival. Our support also extends to the Sphinx Organization and the Detroit Symphony Orchestra in order to enhance and promote diversity within the arts.

We also provide support for Autism Alliance, Michigan Women's Foundation and the Arab-American Chaldean Chamber.

Corporate Giving
DTE Energy provides support to organizations across the state. With our $2.5 million donation to The Heat and Warmth Fund (THAW), the company is committed to being a force for growth and prosperity in the communities where we live and serve.

United Way
In 2016, DTE Energy employees, retirees and the DTE Energy Foundation collectively pledged nearly $2.35 million to improve lives and support communities through United Way. Through charitable giving, our company supports more than 40 United Ways across Michigan.

Volunteerism
Volunteerism is integrated into DTE Energy's workplace culture, representing a direct employee connection to our corporate citizenship efforts. Volunteering provides opportunities for employees to develop leadership skills, connect with colleagues who have similar interests across the enterprise, build relationships and use their unique skills to help others. We are harnessing the energy and expertise of our 10,000 employees for volunteer efforts that have a real impact across Michigan.

In 2016, we rolled out a skills-based volunteer initiative to complement our DTE Care Force volunteer program. Through DTE Care Force, our employees leveraged their knowledge and professional abilities to support volunteer projects that positively impacted nonprofits and community programs.

DTE Care Force seeks to connect employee volunteers to communities in a sustainable and meaningful way. During 2016, more than 2,300 employees participated in company-sponsored volunteer events including DTE's flagship programs – Holiday Meals on Wheels, Arbor Day and our first annual Month of Caring in August. DTE employees volunteered over 21,000 hours to more than 300 organizations in 2016.

Community

Jobs and Education

DTE Energy supports a wide range of education and employment initiatives, with a particular focus on revitalizing the skilled trades and technical education pipeline in Michigan. We are implementing programs that support summer work and high school internships, introducing young people to professional and skilled trade careers. Over time, these initiatives will be integrated into broader professional development and mentorship programs that connect students to specific training, apprenticeships and employment opportunities.

We work with public schools, community colleges and the State of Michigan to prepare students, veterans and experienced workers for careers in the energy sector. We develop programming – in partnership with universities and community colleges throughout Michigan – that includes specialized energy courses and apprenticeship training programs. These initiatives are critical for our long-term business success. They also provide tremendous economic and social benefits for our communities.

Summer Jobs Program
In 2016, the DTE Energy Foundation provided nearly $900,000 in grants to fund nearly 600 summer work opportunities with more than 50 nonprofits in and around Detroit and Greater Michigan. We provided funding for these employment programs through the following partnerships:

- **Grow Detroit's Young Talent** supported jobs for nearly 400 people between the ages of 14 and 24 who are working in Detroit.
- **City Connect Detroit** supported 75 summer jobs for youth in Pontiac, Inkster, Ypsilanti and Highland Park.
- **United Way Lakeshore** paid wages for 100 youth enrolled in the summer program on the west side of the state, in Muskegon, Newaygo, Oceana, Kent, Mecosta and Lake Counties.

Since 2003, the DTE Energy Foundation has donated more than $4.5 million to support summer employment initiatives, impacting more than 2,000 young people.

FIRST in Michigan
Students throughout Michigan are seeing firsthand how dedicated DTE employees are to the youth in our communities and the future of the energy industry. Many employees share their passion, expertise and time by volunteering with the Michigan chapter of For Inspiration and Recognition of Science and Technology (FIRST). FIRST in Michigan is a group of programs including FIRST Robotics, FIRST Tech Challenge and FIRST Lego League. These programs help prepare young people for their careers.

DTE Energy has been involved with FIRST for more than 10 years and provides support for more than 50 Michigan teams in the FIRST Tech Challenge and nine Michigan teams for the FIRST Robotics Challenge. As part of our continuing efforts to be a force for growth and prosperity in the communities where we live and serve, we are increasing our presence with existing teams and supporting the development of new teams focused on girls and at-risk youth. Volunteers guide and mentor students through the process and provide support at competition events.

Community

Neighborhoods

In recent years, DTE has been actively revitalizing the neighborhood surrounding our downtown Detroit headquarters. The landscape is changing and the streets are more alive as pedestrians and bikers travel to downtown businesses, restaurants, renovated buildings and residences. Other initiatives we have supported to benefit our hometown community, our employees and our local customers are highlighted below.

LED Street Lights for a Brighter City
DTE's leading project management organization facilitated the City of Detroit's Public Lighting Authority (PLA) project to install 65,000 new energy efficient light-emitting diode (LED) street lights. The dream of relighting the city began in 2012, when less than 50 percent of the city's street lights were functioning and Detroit residents needed a greater sense of security. DTE worked with state and local governments to help draft legislation to create the PLA – a separate entity with the mission of improving, modernizing and maintaining Detroit's street lighting infrastructure with brighter, more reliable and energy-efficient lights. When the project was completed in December 2016, Detroit became the largest city in the United States to have 100 percent public LED lighting.

Detroit Solar Park
In 2016, we partnered with the City of Detroit to break ground on one of the largest urban solar power arrays in the country. The Detroit solar park is housed on surplus city-owned property and is expected to generate more than $1 million in tax revenue for the city over the life of the 20-year lease. It will also produce enough clean energy to power approximately 450 homes. The facility is scheduled to come on line during the summer of 2017.

DTE's New Public Park
As part of our ongoing efforts to invest in the local community, DTE Energy is developing a 1.5 acre park along the western edge of downtown Detroit. The new park, opening in 2017, will help spur economic development in the area and provide a place for the enjoyment for those who live, work and play in Detroit. Part of the park development includes a year-round restaurant featuring a sustainable green roof designed to conserve and collect runoff water and a large roof-deck offering panoramic views of the city.

Open Streets Detroit
The DTE Energy Foundation teamed up with the Downtown Detroit Partnership in 2016 to host Open Streets Detroit — a unique opportunity for individuals and families to experience the streets of Detroit by engaging in healthy, recreational and cultural activities. As part of the event, a four-mile route was closed to vehicles to allow for a variety of free community activities including: dance workshops, cycling events, exercise classes, sporting events, dog training classes and children's activities.

Supporting Project Green Light
DTE Energy is providing incentives for businesses participating in the City of Detroit's Project Green Light, a public safety partnership. Detroit-based businesses can receive special rebates and no-interest financing when they install qualifying energy-efficient lighting systems. Project Green Light participating businesses saw a 50 percent reduction in violent crime during 2016. DTE's support of this program helps improve neighborhood safety and promote local economic growth.

Community

Public Safety

Emergency Preparedness
DTE responds with urgency to all electrical interruptions. Restoration efforts begin with the earliest forecast of severe weather. Crews and support staff prepare to work around-the-clock. When storms cause catastrophic damage, restoration crews from other energy companies in the region as well as local contractors assist DTE as needed. Likewise, when storms cause major outages in areas outside of Michigan, DTE reciprocates by sending crews to help local utilities in restoration efforts.

During storm conditions, whenever the number of reported hazards exceeds the number of restoration crews available for dispatch, we activate Public Protection teams — DTE Energy employees trained in procedures to help protect the public from potentially hazardous wires. If there is a high risk of public contact from a downed wire, a Wire Guard team is the first to arrive to tape and secure the site, which may then be guarded by a Public Protection team until restoration crews arrive. During 2016, we dispatched a total of 1,289 Wire Guard teams to prevent potentially dangerous conditions. Public Protection is a vital service our employees provide to customers and communities during storms. It is a key way we live our core value of safety as a company.

In addition to our utilities' public safety focus, we need to be prepared for any emergency that could severely impact our operations, our employees and the delivery of energy to our customers. Our business planning practices address all types of contingencies — from weather-related reliability challenges to extremely low probability events like criminal attacks or catastrophic failures. DTE Energy has a strategy for maintaining communications and restoring services in response to any emergency. We strive to identify potential risks and prevent emergencies from happening or at least minimize their impact.

Our emergency plans address issues such as electrical and natural gas safety, protection from cyberattacks and maintaining the safety and integrity of our nuclear facilities and coal ash management structures.

Planning and Preparation Pay off in DTE Gas Incident

In July, a vehicle driven by a Michigan resident crashed through protective barriers at our Allen Road Service Center in Melvindale, Mich. The crash ruptured a natural gas line and caused an explosion and fire. The only injury was to the driver of the car. Four DTE Gas employees and a security contractor were safely evacuated from the service center. The incident, which occurred around 3 a.m., also caused the evacuation of about 1,500 nearby residents as a precaution. There were no major outages for DTE's natural gas and electric customers.

Our pipeline technology worked as designed and quickly closed a valve to the ruptured gas line that shut off the source of the fire. In addition, DTE Gas personnel and first responders from the Dearborn Fire Department had participated in an emergency training exercise two weeks prior, using a hypothetical accident scenario very similar to the actual event. Our engaged employees responded quickly to the incident. Their preparation and safety-minded focus kept this incident from being worse.

Nuclear Safety

At our Fermi 2 Power Plant, we continue to implement corrective and preventive maintenance strategies to ensure the highest standards of nuclear safety. In 2016, we invested in a series of industrial safety improvements including new safety gear for employees and upgrades to plant lighting.

In 2016, Fermi 2 Power Plant received its license renewal from the Nuclear Regulatory Commission (NRC). The renewal permits the power plant to continue generating electricity until 2045. The NRC approved the license renewal request after more than two years of extensive technical and environmental reviews.

To ensure continued safety and to comply with NRC regulations, Fermi 2 Power Plant's emergency plans are tested regularly. In 2016, nearly 300 participants — including DTE Energy personnel and representatives of nearly 30 federal, state and local agency partners — were involved in an exercise of the plant's emergency response plan. The NRC found that the emergency plan and response by plant personnel demonstrated protection of public health and safety. The NRC noted the exercise was challenging, well-managed and that plant personnel executed their roles well.

Community

Driving Economic Progress

Our goal is to attract and expand business activity by bringing new investments and base jobs to Michigan.

DTE Energy is one of the region's largest employers. We partner with more than 38 economic development agencies, including the Michigan Economic Development Corporation (MEDC), Ann Arbor SPARK, The Right Place Program, Lake Shore Advantage and Detroit Economic Growth Corporation. Our partner organizations stretch from the Upper Peninsula, to Grand Rapids, to the City of Detroit. Through these partnerships, we provide financial support and leadership on committees and boards of organizations. The most critical component of our economic development partnerships is supporting projects that bring new business to the communities we serve. This work includes helping to answer utility-related questions and solving problems for potential customers.

Our goal is to attract and expand business activity, bringing new investment and base jobs to Michigan. Base jobs are critical to our region's success. They are created by firms that export their products outside of the community where they operate. Examples include automotive manufacturers and suppliers. These jobs in turn create non-base jobs that serve the local market, like restaurants and retailers.

As we continue to grow our non-utility businesses, our economic impact outside the state also is expanding.

DTE Attracts Amazon and New Jobs

DTE Energy was part of the team bringing Amazon to Livonia, Mich. The online retail giant plans to open a large-volume product fulfillment center and invest nearly $90 million. When the facility opens in October 2017, Amazon's move to Michigan will create 1,000 jobs. The project has been awarded a $7.5 million performance-based grant from the Michigan Business Development Program to help offset recruiting costs. Amazon selected Michigan over competing sites in Indiana and Ohio.

DTE was a key team member with Michigan Economic Development Corporation, Wayne County and the City of Livonia in landing this project. We worked closely with the site owner, Ashley Capital, to meet Amazon's aggressive cost and timing needs. DTE Energy will be building an industrial substation for Ashley Capital to meet the project's requirements.

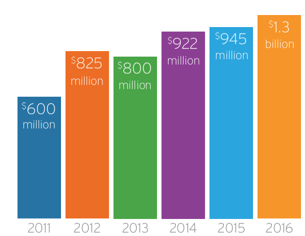
Pure Michigan Business Connect

DTE Energy is one of seven original leaders in Pure Michigan Business Connect, an $8 billion public-private initiative established in 2011 to increase business with Michigan suppliers throughout the state. In May 2013, we pledged to spend $1 billion with Michigan-based businesses by 2015. We met this goal and surpassed it a full year ahead of schedule. Building on the success of this initiative, in June 2015 we announced our commitment to spend another $5 billion with Michigan-based companies over the next five years, a significant expansion of the initial pledge.

The company supported a number of Michigan-based businesses in 2016, spending $1.3 billion throughout the year. To date, DTE, in partnership with Pure Michigan Business Connect, has spent $2.6 billion cumulatively with Michigan businesses, creating 13,000 new jobs. Highlights of DTE's partnership with Michigan-based vendors in 2016 include:

- In Southeast Michigan and Metro Detroit, DTE exceeded $1 billion in spending with 700 companies, which created and supported nearly 5,400 jobs.
- In Western and Northern Michigan, DTE spent $68 million with 165 companies, which created and supported nearly 350 jobs.
- In the Greater Lansing Area, DTE spent $17 million, doing business with 30 companies, which created more than 85 jobs.
- In Eastern Michigan, DTE spent nearly $67 million with 190 companies, which created and supported more than 330 jobs.

Michigan Based Supplier Spend



Building Job Opportunities in Michigan

Ideal Contracting, a Michigan-based supplier, has added 75 new employees in recent years to support work the company performs at DTE's Monroe, Trenton and St. Clair Power Plants. DTE spent $25 million with the company in 2016. As a result of the increased work, Ideal Contracting now employs more than 100 full-time staff and an average of 250 skilled trade laborers.

Community

In 2016, DTE spent more than $410 million with certified diverse suppliers, representing nearly 20 percent of the company's overall spend.

Supply Chain Management and Diversity

We value the business relationships we have with our suppliers and view them as strategic partners to our company's success. We expect those with whom we do business to share the same values and principles that allow our company to enjoy an excellent reputation within the communities we serve.

DTE Energy expects its suppliers to provide a safe and healthy work environment for our employees, subcontractors, customers and all visitors to the premises. Suppliers must also conduct their business operations in a way that protects and sustains the environment and is in full regulatory compliance.

We manage these supplier relationships and expectations through supplier performance scorecards and periodic executive reviews. In 2016, DTE Energy conducted 75 executive forums and reviews with top suppliers and senior leadership. Focusing on safety priorities, DTE Gas scheduled monthly contractor partnership meetings to discuss safety and quality audit results. We have more than 105 supplier scorecards in place to measure performance and develop corrective actions when necessary.

DTE Energy is committed to using a diverse supplier base, including businesses principally owned and operated by women and minorities. We require our suppliers have the same commitment in their use of materials and services from their own base of diverse suppliers and contractors.

In 2016, DTE spent more than $410 million with certified diverse suppliers, representing nearly 20 percent of the company's overall spend. This included $184 million in spending with minority-owned businesses and $226 million with women-owned businesses. We also hosted and attended 37 business networking events focused on supplier diversity.

Business Customers

Through the services we provide to our business customers, DTE supports the economic development of our region. We recognize energy costs can be a significant proportion of operating costs. We work with commercial and industrial customers ranging from small businesses to large manufacturing facilities to help them improve their energy efficiency. By helping our customers thrive, we are supporting a stronger economy across Michigan, which will expand our customer base in the future.

We want our business customers to think of us as partners in energy savings. DTE Energy employs an Energy Optimization team to help business customers learn how to use energy more efficiently through practical steps geared toward specific needs. In 2016, the energy optimization team partnered with Fluidline Components – a leading distributor of pneumatic and hydraulic equipment – to install foam insulation around electric water heater pipes, upgrade to a light-emitting diode exit sign and replace existing T12 fluorescent lights with new, high-efficiency T8 lamps. DTE Energy incentives covered nearly half the project's costs. Within 10 months, energy savings paid for the remaining investment.

Energy Policy Leadership

As a force for growth in Michigan, we support constructive, balanced policies that benefit the state's families and businesses.

Michigan's Energy Future

Our goal is to promote long-term energy policy that achieves affordability and reliability for our customers and is adaptable to the changing energy landscape. As a force for growth in Michigan, we believe it is our responsibility to support constructive, balanced policies that benefit the state's families and businesses.

Michigan, and the entire United States, has entered a period of the most profound transformation of the power generation sector since World War II. Many factors will affect Michigan's energy portfolio moving forward, such as:

- The aging of our coal fleet
- The emergence of cost-competitive natural gas-fired and wind-powered energy generation
- State and federal clean energy policies

This transformation is underway. Retirement of older and less-efficient coal plants has already begun. We need to determine the type of new energy generation to replace coal-fired capacity. We take many factors into account including projected costs of different technologies and fuel sources, their operating characteristics and environmental impact. Michigan needs a flexible process to integrate cost-effective technologies to ensure affordable rates for customers. Today, and for the foreseeable future, natural gas and wind are the most economical sources of energy for Michigan.

In December 2016, the Michigan Legislature and Governor Rick Snyder enacted a comprehensive new energy policy, which became effective in April 2017. We support this constructive policy as it protects reliability and affordability for our customers and promotes cleaner sources of energy. Among its provisions, the law increases the renewable energy portfolio from the previous goal of 10 percent of sales to a new goal of 15 percent by 2021.

As the state transitions to supplying cleaner forms of energy, the policy also creates a framework for fair and competitive electric supply planning processes that support Michigan's reliability and economy.

Involvement in Energy Policy Organizations

DTE Energy believes a constructive, balanced policy is underpinned by a strong understanding of energy issues that affect safety, reliability and affordability. We participate in the following industry associations to collaborate and jointly advocate for issues benefiting our industry:

American Gas Association

- Biomass Power Association
- Edison Electric Institute
- Interstate Natural Gas Association of America
- Iron and Steel Institute
- Nuclear Energy Institute

We are also members of state and national trade associations where the company holds positions on their boards, participates on projects or serves on committees. We actively engage in discussions with the following groups to help align our positions and participate in their advocacy to policymakers to the extent possible:

- Business Leaders for Michigan
- Detroit Regional Chamber of Commerce
- Michigan Chamber of Commerce
- Michigan Manufacturers Association
- National Association of Manufacturers
- U.S. Chamber of Commerce

We participate in a series of industry and customer advocacy coalitions that support our goal of strong customer access to information:

- Coalition to Keep Michigan Warm
- Marcellus Shale Coalition
- National Energy & Utility Affordability Coalition
- Nuclear Waste Strategy Coalition

DTE Energy is also a member of the Human Resources Policy Association and the Center on Executive Compensation.

Political Contributions

We believe participation in the political and public policy arenas, when conducted in a legal and transparent manner, is an important and appropriate role for companies in open societies. In the United States, there are important federal and state laws that govern this participation.

The DTE Energy Political Action Committee (PAC) was formed in 1977 as a voluntary, non-partisan committee to promote and support responsible government through contributions to candidates for election to federal, state and local offices. It is designed to provide DTE Energy employees with an effective, convenient way to make financial contributions to candidates and to participate in the democratic process. The PAC is guided by a steering committee made up of employees from around the company. Information about DTE Energy's PAC contributions can be obtained via the websites of the Federal Election Commission and the Michigan Secretary of State's Bureau of Elections.

Climate Change: Taking Action for the Future

The energy industry across the United States is undergoing a major transformation by seeking lower-carbon energy sources while meeting growing demand. At DTE Energy, we recognize our role in this industry-wide transformation and our responsibility to provide affordable, reliable and cleaner energy for our customers. Today, we are pursuing a deliberate course of action to meet the challenges of the future.

Climate Change

Greenhouse Gas Emissions

Emission Reduction Goals:

Reduce carbon dioxide emissions from electric generation by **75 percent below 2005 levels by 2040**

and

Reduce carbon dioxide emissions from electric generation by **80 percent below 2005 levels by 2050**

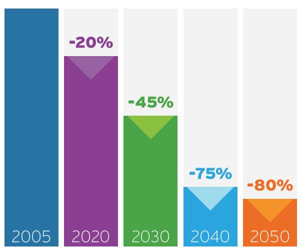
DTE Energy recognizes climate change as a key long-term policy issue we must address. Taking into account the long-term needs of our business, our customers and the environment, we have committed to reduce greenhouse gas emissions from electric generation by 75 percent below 2005 levels by 2040 and 80 percent by 2050. These long-term commitments include milestone reductions of 20 percent below 2005 levels by 2020 and 45 percent by 2030.

These goals will be met by retiring existing coal plants, building new natural gas-fired generation, developing more wind and solar projects and continuing to operate our Fermi 2 Power Plant. In addition to our investments in new energy generation, we are taking action across the company to reduce and offset greenhouse gas emissions:

- We are helping our customers reduce energy usage and lower their bills by becoming more energy efficient.
- We are national leaders in developing landfill gas capture systems and in converting small coal-fired power plants to run on biomass fuels.
- In 2016, we received an operating license renewal for our Fermi 2 Power Plant to extend operation from 2025 to 2045. We already hold a license to construct and operate a new nuclear unit at the Fermi site. We have not committed to building new nuclear capacity, but nuclear power is the only proven carbon-free power source that can operate around the clock.
- As a founding partner in the United States Environmental Protection Agency's Natural Gas STAR Methane Challenge Program, DTE has committed to use best management practices to reduce methane emissions from our gas operations over the next five years.

Climate Change

Emission Reduction Goals



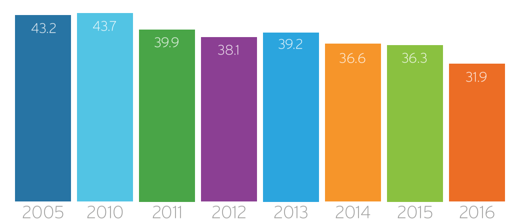
DTE Energy is committed to a long-term strategy to reduce greenhouse gas emissions that will guide our investment in new clean energy generation while minimizing financial impacts on customers.

Beginning in 2016, we moved our baseline for evaluating emission reductions from 2010 levels back to 2005 levels to be consistent with how we report other air emissions. This year's report shows performance against both the 2005 and 2010 baselines. For more information, see our discussion in the Air Quality section.

Controls to reduce carbon dioxide (CO_2) emissions have not been commercially demonstrated. Additional reductions in CO_2 must be achieved through reduced use of fossil fuels to produce electricity, improved efficiency at power plants, switching to less carbon-intensive fuels and other technological alternatives that cut CO_2 emissions for every megawatt-hour (MWh) of generation. We are already on a trajectory to reduce our CO_2 emissions from electric generation by 30 percent below 2005 levels in the early 2020s. Our 2016 total emissions of CO_2 from electric generation were 26 percent below 2005 levels. Some decrease in emissions is due to the extended shutdown of our St. Clair Power Plant following a fire in August 2016. For more information, see our Safety Section.

DTE actively participates with the following organizations to shape carbon performance standards: the United States Environmental Protection Agency (EPA), Michigan's Agency for Energy, Michigan's Department of Environmental Quality, the Edison Electric Institute and other business and community stakeholder groups to shape carbon performance standards, including the Clean Power Plan issued by the EPA in 2015. Regardless of possible changes in policy, DTE CO_2 emission reductions will continue, driven by our customers' economic and environmental interests. Our greenhouse gas reduction goals meet or exceed the reduction requirements of the Clean Power Plan – a policy designed to lower CO_2 emissions by power generators.

Greenhouse Gas Emissions in millions of tons of carbon dioxide equivalent (CO_2e)

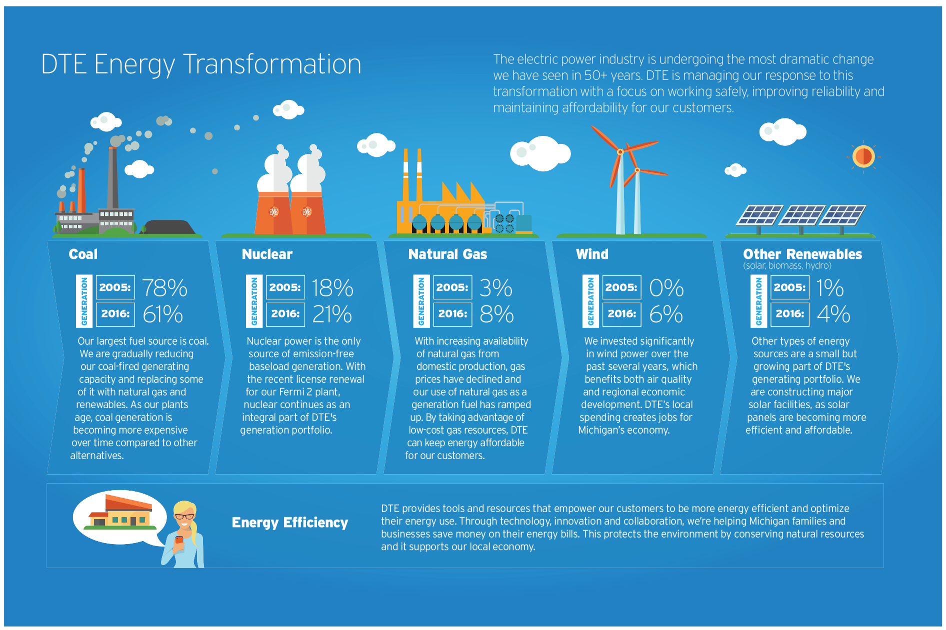


We believe regulations can be established to achieve national environmental and economic goals, plus coordinate with energy policy development in Michigan. Our goals align with Michigan Governor Rick Snyder's focus on adaptable energy and environmental policy. Every decision is based on excellent reliability, affordable prices and protecting/sustaining the environment. In 2016, Michigan passed significant energy legislation to enhance the state's commitment to reliable, clean energy. DTE's approach to managing our energy generation fleet will continue to be coordinated with federal and state policies.

Alternative Fuel Vehicles

Out of our company-wide fleet of vehicles across Michigan, about 500 are either fueled by compressed natural gas or are electric or hybrid vehicles. This represents nearly 13 percent of DTE Energy vehicles. Our alternative fuel vehicles create less greenhouse gas emissions and other air pollution compared to conventional service trucks and cars.

Transformation of Electric Generation



Our power is generated or purchased from a variety of sources including nuclear, coal, natural gas, oil and renewable energy. The overall mix of generation assets – especially the proportion of coal-fired capacity – is already changing and will continue to evolve. The shift in our generation portfolio is expected to cost between $7 billion and $8 billion. It is a dramatic transformation we are preparing for and will manage, while being mindful of our customers' needs for affordability and reliability.

Compared to newer energy generating alternatives, our coal fleet is aging and becoming more expensive to operate. Our generation mix is shifting over time from a portfolio of heavily-weighted coal toward a more balanced mix of coal, natural gas, renewable energy and nuclear energy. DTE recently closed the Marysville and Harbor Beach plants. In 2016, we announced plans to retire eight additional coal-fired energy-generating units at three sites in Michigan within the next seven years. The energy-generating units slated for retirement include units at our River Rouge Power Plant, St. Clair Power Plant and Trenton Channel Power Plant. Combined, these three power plants generated about 25 percent of the electricity produced by DTE in 2015 – enough energy to power 900,000 homes. The retirements are part of the fundamental transformation in the way electricity is being supplied across Michigan and throughout the United States.

Managing the Impacts of Coal Plant Closures

DTE Energy, in partnership with the United States Economic Development Administration (EDA), is providing grants to help St. Clair County and the City of Harbor Beach redevelop property following retirements of DTE Energy coal-fired power plants in an effort to help mitigate economic and social impacts of plant retirements in these two cities. DTE Energy's Harbor Beach Power Plant was retired in 2013 and the St. Clair Power Plant is expected to retire by 2023.

We recognize these plants have served communities for decades, providing jobs and significant revenue for municipal and community services. These grants will help St. Clair and Harbor Beach identify potential solutions to reinvest in the community and generate a new tax base. Specifically, the grant money will be used to commission a comprehensive economic impact study for the St. Clair plant closure that will assess the economic value of the plant and recommend strategies for economic diversification and reinvestment. We are also helping Harbor Beach develop a comprehensive feasibility study for a local multipurpose space that could serve as a business start-up hub.

DTE employees at those plants being closed are offered transfers to other positions within the company. We have not laid off any workers as a result of coal plant retirements within our generating fleet.

Pinnebog Wind Park

In December 2016, our Pinnebog Wind Park in Huron County began generating electricity. An expansion of our existing Echo Wind Park, the Pinnebog facility consists of 30 wind turbines with the ability to produce a combined 50 megawatts of clean, renewable energy – enough to power more than 22,000 homes. Pinnebog brings the number of DTE owned or operated wind parks to 13 across Michigan.

Approximately 150 people were employed to work on various aspects of the project during construction. DTE now has a total of 30 full-time employees working at its Huron County Renewable Energy Center. In addition to the creation of construction and operations jobs and local economic development, DTE wind projects in Huron County will generate tax revenue of more than $20 million by 2020.

We are actively working to replace retiring coal-fired capacity with other generating assets to maintain adequate reserves. DTE is evaluating options for new capacity to ensure safe, clean and reliable energy for our customers. One alternative under consideration is construction of a new, state-of-the-art natural gas-fired power plant. We have also brought in a substantial amount of new renewable energy capacity to our system. Building new generating assets in Michigan has the added benefit of creating jobs for Michigan residents.

To address immediate capacity needs, in 2015 we purchased two natural gas-fired simple cycle plants that, combined, can provide more than 1,000 megawatts of power during peak demand periods. Our major investments in natural gas transmission and storage infrastructure, including the NEXUS interstate pipeline and our new Link lateral and gathering pipeline system, also support the overall energy industry transformation.

Nuclear power generation provides a significant amount of carbon-free, base-load electricity, which is crucial for helping the state of Michigan and the entire United States meet the challenges of reducing greenhouse gases. In fact, 87 percent of Michigan's carbon-free electricity output is generated by the state's three nuclear energy facilities. In 2016, DTE received a 20-year license renewal from the United States Nuclear Regulatory Commission (NRC) for the Fermi 2 Power Plant, enabling the plant to continue operating through 2045. In addition, we hold an NRC license – obtained in 2015 – to construct and operate a new nuclear energy facility on the site of the existing plant, although we have no immediate plans to build a new nuclear plant. With these NRC approvals in hand, DTE Energy now possesses a diverse, comprehensive slate of options to plan for Michigan's energy future.

Climate Change

Renewable Energy

In 2016, we generated or contracted for more than 3.4 million megawatt hours of electricity from renewable energy sources – enough to power nearly 450,000 households.

Electricity from renewable resources – wind, sunlight and biomass – plays an important role in meeting our customers' energy needs while reducing our environmental impact. DTE is Michigan's largest investor in and producer of renewable energy. In 2016, our capital spending was $83 million for solar projects and $49 million for wind projects. The company has driven over $2 billion in investments in renewable energy since 2008.

In 2016, we generated or contracted for more than 3.4 million megawatt hours (MWh) of electricity from renewable energy sources – enough to power nearly 450,000 households.

In compliance with state-mandated targets, DTE Energy met the 10 percent renewable energy standard for 2016 based on retail sales. This was accomplished by retiring approximately 4.2 million certified Renewable Energy Credits (RECs) and other eligible credits that equated to 10 percent of our total 2014 retail sales of 42.4 million MWh, weather-normalized. Each of the RECs represents one MWh of renewable energy generated by DTE or purchased from third-party renewable sources.

Under the new Michigan energy legislation, electricity suppliers must meet a 12.5 percent renewable energy target by 2019 and 15 percent by 2021. DTE is well positioned to meet these future goals with the addition of wind and solar resources.

Climate Change

Wind Energy

Wind power is increasingly cost-competitive with traditional power generation technologies and we anticipate this trend to continue. Over the past six years, the average price of United States wind power has declined by 66 percent. For our region of the country, it is also the most efficient and cost-effective form of renewable energy.

Michigan is among the top 15 states in the nation for wind production. The cost to produce wind energy is now on par with natural gas generation.

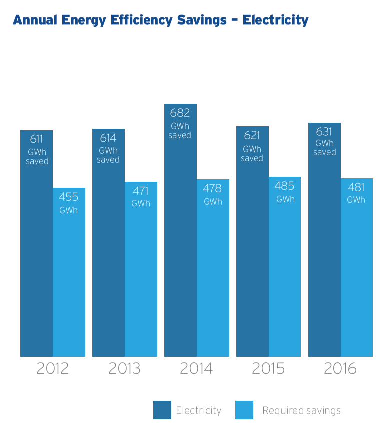
DTE Energy values its relationships with landowners and local communities at our wind power sites. We work diligently to maintain strong community support as we pursue new wind projects. Wind energy continues to be valuable to DTE Energy as part of a well-balanced generation portfolio.

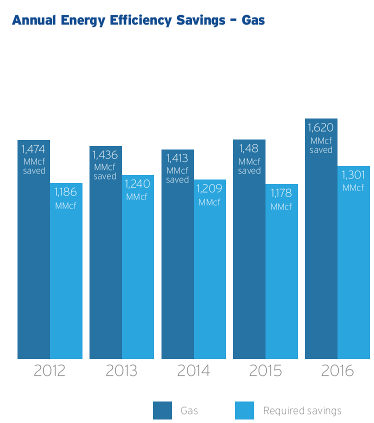
Leading Michigan in Solar Power

With 28 solar projects in its portfolio, DTE Energy continues to be Michigan's largest producer of solar energy. The company has additional solar projects in various stages of development. In 2016, DTE broke ground on three new solar projects in Michigan, two in the city of Lapeer and one in Detroit. The two Lapeer projects combined represent the largest utility-owned solar installation in Michigan and rank among the top five in the Eastern United States. Comprised of nearly 200,000 solar panels, the arrays (pictured at left) will produce enough clean, emission-free energy to power 9,000 homes when they begin generating electricity in 2017. The O'Shea Park array on the west side of Detroit — also scheduled for operation in 2017 — will be one of the largest urban solar arrays in the country.

Climate Change

Energy Efficiency





Customers
We provide incentives, information and techniques to help residential and business customers use energy more efficiently. This helps our customers reduce their costs, strengthening Michigan's economy. Energy efficiency also provides environmental benefits by conserving resources and reducing pollution.

DTE's energy efficiency programs help reduce customers' energy use by increasing awareness of energy saving possibilities and provide products and services. Rebates, tips, comparison tools, strategies and energy efficiency education help customers make informed energy saving decisions. Programs are designed to capture both electric and natural gas savings for all customers. For those DTE customers with only electric or only natural gas service, we make efforts to coordinate with other utility companies so that these customers can easily take advantage of energy efficiency program offerings to reduce both electricity and gas usage.

Michigan enacted legislation in 2008 that set energy optimization targets for utility companies and provided a funding mechanism to pay for program costs. As the charts to the left demonstrate, we have consistently exceeded the legislated targets. During 2016, utility customers saved energy by implementing measures such as installing more efficient appliances and lights, adding insulation, weatherizing homes and conducting boiler tune-ups. The efficiency programs are managed by DTE Energy and serviced by expert contractors. Our Energy Optimization Annual Report provides more detail about the specific programs in place.

Efficiency at DTE Energy Facilities
Across the organization, we are re-designing our workspaces to be more energy efficient, particularly our lighting systems, which are significant users of electricity. We completed light-emitting diode (LED) retrofits in office spaces and warehouses and developed a corporate standard for controlled temperatures. We have switched to all LED lighting with automated controls in our Detroit headquarters building. Company-wide, these facility improvements will save an estimated 2.8 million kilowatt hours annually, representing about 2,000 tons of greenhouse gases avoided.

Visit the DTE website to find our Energy Optimization Annual Report and other DTE newsletters, magazines and reports for residential and business customers.

Metro Detroit Freeways Light Up with New Energy Efficient LEDs

At DTE Energy, we create energy efficiency programs designed to save customers money, reduce energy waste and safeguard the environment. In 2016, DTE Energy partnered with the Michigan Department of Transportation to install energy efficient LED lighting on a number of major Metro Detroit freeways as part of DTE's Energy Efficiency Business Program. In total, nearly 13,000 high-pressure sodium, metal halide and mercury vapor fixtures were replaced by new, efficient LED fixtures. This lighting upgrade successfully reduced energy use by 65 percent and is expected to save Michigan residents an estimated $2 million in energy costs in 2017.

Environmental Leadership

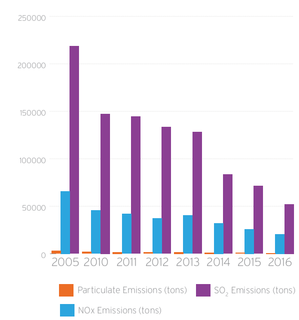
Clean land, water and air are essential to human life and health. DTE Energy is committed to environmental stewardship and protecting the natural resources upon which we all depend.

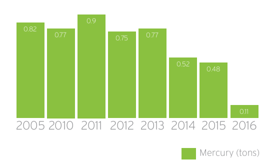
Environment

Air Quality

Our environmental expenditures in 2016 totaled $57 million.

Air Emissions





We have been a leader in adopting new technologies and practices to reduce emissions since the 1920s, when our Trenton Channel Power Plant was among the first to install electrostatic precipitators to remove fly ash from the exhaust stacks.

DTE Electric has reduced emissions of particulate matter (PM), sulfur dioxide (SO_2) and nitrogen oxides (NO_x) by more than 85 percent since the mid-1970s. During this same period, total annual generation increased 12 percent. More recently, since 2005 we have reduced emissions 83 percent for PM, 76 percent for SO_2, 69 percent for NO_x and 86 percent for mercury.

We continue to invest in emission reductions to meet increasingly stringent air quality requirements, spending $2.4 billion through 2016 to comply with federal regulations. DTE has completed installation of state-of-the-art emission controls at the Monroe Power Plant, our largest generating plant and the fourth largest coal-fired plant in the country. The emission controls consist of flue gas desulfurization (FGD) and selective catalytic reduction (SCR) units to control emissions of SO_2, NO_x, mercury and other hazardous pollutants. These controls allow the plant to meet stringent federal regulations including the United States Environmental Protection Agency's Mercury and Air Toxics Standards (MATS).

Our remaining coal-fired power plants reduce mercury and other toxic air pollutant emissions with a combination of dry sorbent injection and activated carbon injection emission control systems. As shown in the air emissions chart to the left, mercury emissions from DTE Electric power plants have decreased dramatically as a result of these measures.

Environment

Habitat and Biodiversity

2016 Wildlife Habitat Council Awards

River Rouge Power Plant Regional Corporate Habitat of the Year

Muskegon Service Center Bats Project Award, recognizing the team's efforts to create habitat for native bat species

At DTE Energy, we work to take care of the land, water and living creatures both within our service territories and beyond. DTE is one of the largest landowners in Michigan. We maintain thousands of acres of land in its natural state and provide habitat for hundreds of species of birds, mammals, fish and insects. We also reclaim previously disturbed land to actively create and manage habitat featuring native Michigan plants, such as gardens that benefit the monarch butterfly and other pollinators.

Our utility operations implement an avian protection plan to minimize the impacts of our electric lines on bird populations. An electronic reporting system helps to identify key equipment that may need to be modified to enhance avian protection. With the increasing number of wind turbines in our generation portfolio, the plan has been appropriately broadened to address the impact of bats also. Plan implementation involves establishing procedures for observing birds and bats near electric lines and wind turbines, for removing nests from transmission poles before birds can become settled and for documenting and communicating these management measures. We train our field employees to be aware of the requirements under federal wildlife protection rules.

Wildlife Habitat Council Certified Sites
DTE Energy facilities are home to hundreds of species of wildlife. Some are endangered or threatened and we are helping their populations increase and stabilize through our efforts to provide habitat in an environment that frequently makes little room for wildlife. To this end, DTE Energy has 36 sites certified under the Wildlife Habitat Council, a nonprofit organization that helps companies manage their property for the benefit of wildlife. In 2016, two of our locations received new certificationss – Citizen's Gas in Adrian, Mich., and DTE Electric's Newport Service Center in Monroe. We continue to increase the amount of habitat our operations support. Ten existing sites were also re-certified during the year.

WHC certified sites

1996	**Belle River Power Plant:** East China Township
1999	**Monroe Power Plant:** Monroe
2000	**Fermi 2 Power Plant:** Newport
	Downtown Headquarters: Detroit
2001	**St. Clair Power Plant:** East China Township
2002	**Trenton Channel Power Plant/Sibley Quarry:** Trenton
2003	**Taggart Compressor Station:** Six Lakes
2004	**Greenwood Energy Center:** Kenockee
	River Rouge Power Plant: River Rouge
2005	**Western Wayne Service Center:** Belleville
2007	**Ashley Mews:** Ann Arbor
2008	**Allen Road Facility:** Melvindale
	Belle River Compressor Station: East China Township
	Grayling Service Center: Grayling
	Michigan Avenue Service Center: Ypsilanti
	Mt. Pleasant Service Center: Mt. Pleasant
	Washington-10 Compressor Station: Washington
2009	**Alpena Service Center:** Alpena
	Kalkaska T&SO: Kalkaska
	Ludington Service: Center Ludington
	Milford Compressor Station: Milford
	Muskegon Service Center: Muskegon
	Tawas Service Center: Tawas City
	Traverse City Operations: Traverse City
	Conner's Creek Power Plant: Detroit
2010	**Big Rapids:** Big Rapids
	Cadillac: Cadillac
2012	**Gaylord T&SO Station:** Gaylord
	Wealthy Street Station: Grand Rapids
2015	**Escanaba Service Center:** Escanaba
	Kingsford Service Center: Kingsford
	Lynch Road Service Center: Detroit
	Petoskey Service Center: Petoskey
	Sault Ste. Marie Service Center: Sault Ste. Marie
2016	**Citizen's Gas:** Adrian
	Newport Service Center: Monroe

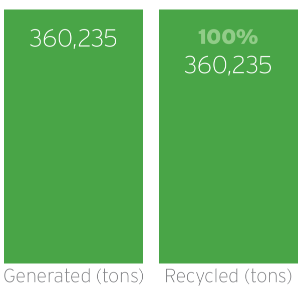
DTE - Gas DTE - Electric Other

Reforestation in Lower Michigan

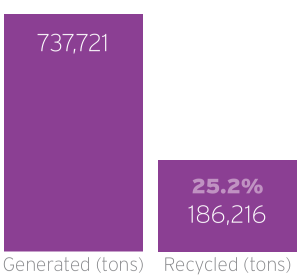
DTE Energy has a long history of preserving, protecting and sustaining our environment. In 2016, the DTE Energy Foundation partnered with ReLeaf Michigan to plant 115 trees in seven communities from Wayne and Macomb counties to the Thumb to Northern Lower Michigan. The DTE Energy Foundation also worked closely with the Michigan Department of Natural Resources to plant trees, marking the 20th anniversary of a partnership that has resulted in more than 40,000 trees and seedlings being planted in 490 Michigan communities.

Waste and Recycling

Gypsum



Ash



Coal Combustion Residuals

Fly ash and bottom ash are byproducts of the coal burned in our power plants. Synthetic gypsum is a byproduct of the flue gas desulfurization (FGD) units that reduce sulfur dioxide emissions from coal-fired plants. These coal combustion residual (CCR) materials – ash and synthetic gypsum – are recycled to the greatest extent possible. The portion of the CCR not recyclable is disposed in state and federally regulated landfills and impoundments. Our ash recycling rates dropped in 2016 as we brought sorbent injection and activated carbon emission controls on line to meet the Mercury and Air Toxic Standards (MATS) rule. The presence of sorbents and activated carbon in coal ash reduces its acceptability for beneficial reuse.

Gypsum is used as a component in drywall manufacturing and as a beneficial additive in agriculture. In 2016, we recycled 100 percent of the gypsum produced at DTE Energy power plants, 360,235 tons.

DTE Energy operates three licensed landfills for disposal of fly ash not recycled and each coal plant has on-site facilities for managing CCR before it is recycled or disposed. These landfills operate in compliance with applicable state and federal laws and are routinely inspected by state and local regulatory agencies. We assess the condition of our facilities and equipment on a regular basis and conduct maintenance and repairs as necessary to maintain structural integrity and operational performance.

In response to high-profile incidents around the country involving coal ash spills in 2014, DTE Energy began re-evaluating all of our ash handling facilities and determined that we have no issues of concern. In April 2015, the Environmental Protection Agency (EPA) finalized a rule to regulate CCR. The rule maintains the status of CCR as non-hazardous waste and lays out various design and performance standards that companies must meet. DTE Energy continues to implement a compliance program managing our CCR landfills and impoundments in accordance with state regulations and EPA's rule.

Recycling

DTE Energy's pollution prevention programs help to minimize impacts and conserve resources by reducing the volume of waste that would otherwise go to landfills for disposal.

As part of our customer energy efficiency programs, we accept old appliances for recycling when customers purchase new, more efficient models. In 2016, DTE customers recycled more than 37,000 appliances, saving nearly 38,000 megawatt hours of electricity due to improved energy efficiency. To administer the program, we partner with Solutions for Energy Efficient Logistics to manage the appliance pick-ups and Goodwill's Green Works safely dismantles and recycles the scrapped appliances.

The table below summarizes all the materials that DTE Energy recycled in Michigan during 2016:

Material Recycled	Weight (lbs.)
Lamps	22,188
Batteries	70,112
Paper	390,202
Cardboard	728,065
Electronics	249,240
Mercury/Mercury Containing Equipment	3,782
Metal Non-Ferrous	134,206,531
Metal Ferrous	9,302,874
Miscellaneous	100,050
Plastic	78,500
Wood	795,875

Nuclear Waste

Our Fermi 2 Power Plant has on-site facilities for the management, processing and temporary storage of radioactive waste materials.

Used nuclear fuel consists of solid, ceramic-like pellets secured in zirconium alloy tubes. After the fuel has expended its useful energy, it is removed from the reactor and stored in a steel-lined, concrete vault filled with water. Water provides a natural radiation barrier and cooling for the used fuel. After seven years in the used fuel pool, it can be moved into large concrete and steel storage containers. Fermi 2 began on-site dry storage of used fuel in 2014. All on-site nuclear waste storage is subject to strict regulations requiring multiple layers of safety and security systems.

Low-level radioactive solid waste sent from Fermi 2 for off-site disposal includes material generated during water treatment, trash with radioactive contamination and irradiated components. Fermi 2 complies with extensive federal regulations governing radioactive waste shipments to licensed burial sites or intermediate processing facilities. Any low-level waste sent for processing is then shipped directly to a licensed burial site.

Land Restoration and Remediation

Before natural gas became widely available in the 1940s and '50s, "manufactured gas" produced from coal and oil was used for lighting, cooking and heating in homes and businesses. As natural gas – which is extracted from underground geological formations – replaced manufactured gas, manufactured gas plants (MGPs) were shut down. Years later, industry, state and federal environmental agencies began studying these sites and recognized that plant operations and the way in which MGPs were abandoned had resulted in residual contamination at the sites. The U.S. Environmental Protection Agency estimates that 3,000 to 5,000 former MGP sites are located in towns and cities across the country.

As DTE Gas, founded in 1849, grew into the statewide utility it is today, it acquired numerous local gas companies that had operated MGPs. Today, DTE Gas is responsible for a total of 16 MGPs throughout the state. A preliminary response and investigation has been completed at each site and work has been completed at several sites. In addition to these DTE Gas properties, DTE Electric is responsible for three MGPs and our subsidiary Citizens Gas is responsible for one site.

Full remediation and closure has been achieved at nine sites, allowing the properties to be developed for a variety of uses. Two other MGPs have undergone partial site closure.

During 2016, closure was completed at the following sites:

- DTE Gas's former manufactured gas plant (MGP) site in Greenville, Mich., property currently operates as a landscaping business.
- Citizens Gas's former MGP site in Adrian, Mich., received closure for the remainder of the property and the River Raisin. The property currently operates as the Citizens Gas Fuel Service Center.

Additionally in 2016, DTE Gas made significant progress on MGP site cleanup at its Wealthy Service Center in Grand Rapids and the former Station A site located within the City of Detroit's Riverside Park.

Reef Project for Sturgeon in Detroit River

DTE Energy is doing its part to support restoration efforts to spur the recovery of native fish in the Great Lakes region. Loss of rocky habitat in the Detroit and St. Clair River systems, which has occurred since the 1800s due to industrialization, has contributed to a decline in the lake sturgeon population – a state and provincially threatened species that can grow to up to 6.5 feet in length and live up to 40 years. DTE Energy is proud to support restoration efforts in these rivers to rebuild native fish communities throughout the Great Lakes region and in turn benefit communities and the residents who live there.

DTE Energy biologists who monitor water intake pipes and conduct ecological assessments for the company have contributed their time and unique expertise to support reef construction projects designed to facilitate fish spawning. Other project partners include the University of Michigan Water Center, Michigan Sea Grant, U.S. Geological Survey, U.S. Fish and Wildlife Service and Michigan Department of Natural Resources.

The restoration team built their first pilot spawning reef near the head of Belle Isle in the Detroit River in 2004. DTE provided coal cinders, a by-product of a nearby power plant, to help reduce the cost of the pilot project and demonstrate that a constructed reef was possible in the Detroit River. Most recently, in 2016, DTE Energy provided a staging area at our retired Connors Creek Power Plant for 15,000 tons of limestone to support the construction and expansion of additional spawning reefs in the St. Clair River and the Detroit River.

The results of the team's efforts are already becoming visible. Lake sturgeon eggs were found on four different constructed spawning reefs in the Detroit and St. Clair Rivers. This means sturgeon found the new habitat structures and deemed them suitable for spawning. Equally important, sturgeon eggs appear to be incubating and hatching successfully on the reefs, producing viable larvae that are showing up in nets downstream of the constructed reefs.

Water

We use water from lakes and rivers to cool our thermal electric power plants. Our power plants withdraw and return water to Michigan's surface waters under the authority of permits issued by the State of Michigan.

In 2016, DTE Energy facilities in Michigan withdrew approximately 1.08 trillion gallons of surface water. Most of that volume, 1.07 trillion gallons, was cooling water for generating facilities — about 27,300 gallons per megawatt-hour generated. Water consumption — water not returned directly to the water system and largely lost through evaporation — is calculated to be 1.8 percent of withdrawal.

The majority of our power plants utilize once-through cooling, so most of the water withdrawn is then returned to the same water body with a slightly elevated temperature. These thermal discharges have not been found to adversely affect aquatic ecosystems. The Fermi 2 Power Plant and the Greenwood Energy Center have closed-cycle cooling systems, which reduce the amount of water withdrawal required. In 2016, these plants recycled approximately 462 billion gallons of water.

One of our generating facilities is located in an area where water resources are constrained — the 44 megawatt Mt. Poso biomass plant near Bakersfield, Calif., representing less than 0.01 percent of our total generating capacity. Located in the arid Central Valley region of California near Bakersfield, the Mt. Poso facility reuses water recovered from the oil production activities of an adjacent oil field instead of directly withdrawing surface water. Surplus water is provided to local ranchers for their cattle operations.

Environmental Protection Agency Clean Water Act Regulations

The United States Environmental Protection Agency (EPA) finalized regulations in 2015 that set limits on the levels of toxic metals in power plant wastewater discharges and required the elimination of discharges from ash transport systems. To meet compliance deadlines starting in November 2018, DTE is evaluating alternatives and will likely implement new wastewater treatment measures, as well as changes to ash handling and storage at several power plants.

DTE is also evaluating alternatives for reducing the environmental impacts of intake structures at several facilities in response to cooling water withdrawal regulations issued by the EPA in May 2014. We are coordinating our work with the State of Michigan to determine whether any significant aquatic impacts are associated with our existing intake structures and whether there are cost-effective alternatives. Under the regulations, impact studies need to be completed over the next several years. State regulators will then make the final determination of what type of technology will be needed to reduce impacts to fish and other aquatic life.

Compliance

Compliance

The United States Environmental Protection Agency (EPA) and an environmental activist group have brought litigation against DTE Electric for alleged violations of the Clean Air Act. DTE Energy has maintained throughout these legal proceedings that we have operated our plants in compliance with all applicable state and federal laws and regulations. Initial court rulings agreed and found DTE to be in compliance. However, in January 2017, a divided appeals court reversed the decision of the lower court and ruled against DTE. DTE Energy filed a petition for rehearing in front of the appeals court in February 2017 and is awaiting a response from the court.

Depending upon the outcome of the litigation and further discussions with the EPA, DTE Electric could be required to install additional pollution control equipment at some or all of the power plants in question, implement early retirement of facilities where control equipment is not economical, engage in supplemental environmental programs and/or pay fines.

In 2016, DTE Electric and DTE Gas facilities — four separate sites — received a total of nine letters of violation (LOVs). None of these have resulted in any fines or penalties. In 2016, 23 LOVs were received by facilities in DTE's Power and Industrial Projects business unit. Six of these LOVs resulted in fines totaling just over $400,000. The remaining LOVs have not resulted in any fines or penalties and some were resolved with no violations identified. After receiving these LOVs, we conducted thorough reviews of the findings for actionable tasks, identified root causes and implemented improvement tools to prevent recurrence of the violations.

As a result of a multimedia inspection by the United States Environmental Protection Agency (EPA), EES Coke — the Michigan coke battery facility, a wholly-owned subsidiary of DTE Energy — received two Findings of Violation (FOVs) related to: failing to repeat benzene sampling of waste streams due to a process change and use of calibration gas inconsistent with the applicable regulation; and alleged deficiencies in its oil pollution prevention measures and spill prevention, control and countermeasures plan. EES Coke is currently working with the EPA to address the alleged violations. At this time, DTE Energy cannot predict the impact of the final settlement.

We addressed two compliance related issues during 2016 at DTE facilities outside of Michigan:

- After closure of the Shenango coke battery plant, the Allegheny County Health Department in Pittsburgh, Pa., issued a demand for $482,000 to resolve alleged Clean Air Act violations. Shenango filed an appeal of such demand on Aug. 19, 2016. In November 2016, the parties reached a settlement and Shenango agreed to pay $231,000.
- At Woodland Biomass Power in California, a renewable wood-fired power generation facility, the plant's ash management practices are under investigation — specifically whether some of the ash generated at the facility should have been characterized and handled as hazardous waste under California regulations. Woodland is cooperating with the investigation and has committed to remove or remediate any ash improperly characterized.

Our Company

At DTE Energy, our aspiration is to be the best-operated energy company in North America and a force for growth and prosperity in the communities where we live and serve. Our aspiration grew out of our employees' genuine desire to help build a better future for Michigan and for every community in which we operate.

Our Company

Company Profile

Our businesses include DTE Electric and DTE Gas – energy utilities regulated by the Michigan Public Service Commission – and non-utility energy operations located throughout the country. In 2016, DTE Energy's operating revenue totaled $10.6 billion.

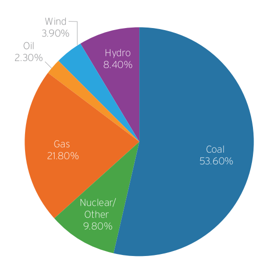
DTE Electric

In 2016, we delivered electricity to our customers from coal, natural gas, oil, nuclear and renewable energy sources. Our customers include residential, institutional, commercial and industrial accounts. DTE Electric owns and operates fossil fuel and nuclear plants totaling 10.2 gigawatts (GW) of installed capacity in Michigan, 958 megawatts (MW) of pumped storage hydroelectric and 493 MW of renewable energy capacity – wind and solar. In 2016, our total electric sales amounted to 48,600 gigawatt-hours (GWh). Purchased electricity accounted for 21 percent of the electricity supplied by DTE Electric during this period.

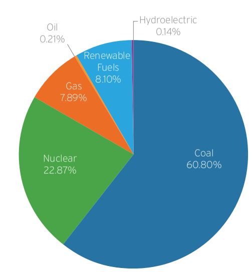
More information on renewable energy is included in the Climate Change section of this report.

DTE Electric owns and operates approximately 31,000 miles of overhead distribution lines and 16,000 miles of underground distribution lines. Our service territory encompasses 7,600 square miles and includes about 2.2 million residential, commercial and industrial customers.

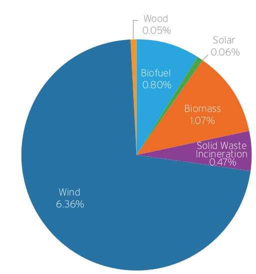
2016 Electric Generation Capacity



2016 Fuel Mix Used to Generate Electricity



Renewable Fuels Breakdown



New Link Lateral & Gathering

In October 2016, DTE Energy closed on the purchase of natural gas pipeline assets in Pennsylvania and West Virginia, complementing and expanding our existing midstream operations. These facilities, called Link Lateral & Gathering, will connect with the NEXUS pipeline and facilitate our ability to serve market demand. This was a significant acquisition that reflects the continuing growth and importance of our non-utility gas business.

DTE Gas

Our natural gas utility business serves approximately 1.3 million residential, commercial and industrial customers throughout Michigan. Our service territory covers 14,700 square miles. Founded in 1849, DTE Gas is one of the nation's largest natural gas utilities. We own distribution, storage and transportation facilities, approximately 2,000 miles of large gas transmission pipelines and 19,000 miles of smaller distribution mains.

We own storage properties relating to four underground natural gas storage fields with an aggregate working gas storage capacity of 139 billion cubic feet. These facilities are important in providing reliable and cost-effective service to our customers. We also sell storage services to third parties. There is more natural gas storage capacity in Michigan than in any other state.

DTE Gas is directly connected to interstate pipelines, providing access to most of the major natural gas supply producing regions in the Gulf Coast, Mid-Continent and Canadian regions. We are planning significant investments over the next two years to expand our capacity and increase the amount of natural gas our system can bring into Michigan and deliver to the state's gas customers. This is important to maintain reliable and affordable supply for residential and business customers, especially as natural gas is increasingly used as a fuel for generating electricity, replacing more carbon-intensive coal-fired capacity.

Gas Storage and Pipelines

DTE Energy controls two natural gas storage fields in Michigan, gathering pipeline systems in Michigan and Pennsylvania and ownership interests in two interstate pipelines. The two storage facilities in Michigan — combined working storage capacity of 91 billion cubic feet — operate separately from our regulated gas utility assets, but are well integrated. DTE Gas provides physical operations, maintenance and technical support for the storage facilities and in-state gathering systems.

Gas Storage and Pipelines has more than doubled in net income over the past five years, reflecting tremendous growth in natural gas production and use. Continuing this trend, we are partnering with Houston-based Spectra Energy to develop the NEXUS Pipeline, a 255-mile gas pipeline through Ohio and Michigan that will serve the next generation of natural gas-fueled power plants. The pipeline, pending approval by the Federal Energy Regulatory Commission, is expected to be operational by the end of 2017. During 2016, DTE acquired additional, significant pipeline projects that expand our capacity for gathering and marketing natural gas from Pennsylvania and West Virginia.

Power and Industrial Projects

Our Power and Industrial business provides energy-related products and services nationwide to energy-intensive industrial, commercial and institutional customers. Its product lines are concentrated in the industrial energy services, renewable energy and environmental controls markets. Industrial energy services include the production of blast furnace coke and pulverized coal for sale to integrated steel producers and the provision of on-site energy services such as waste water treatment, process steam, co-generated power, chilled and hot water, and compressed air to automotive, chemical and consumer products companies and institutions such as hospitals, universities and governmental authorities. In the renewable energy market, the company produces renewable energy from waste-wood and landfill gas for sale to regional electric utility companies and industrial customers. The environmental services business uses a proprietary process to treat coal resulting in reduced environmental emissions when combusted.

Power and Industrial encompasses more than 60 projects in 17 states, employing approximately 700 people. For more information, visit the DTE Power & Industrial web page.

Energy Trading

DTE Energy Trading conducts energy marketing and trading operations, serving primarily utilities, local distribution companies and other marketers. In 2016, the value of our trading volume totaled about $2.6 billion.

DTE Energy Corporate Citizenship Report 2016-2017

Corporate Values and Priorities

Our values shape the way we think about our company and the way that we work on a daily basis. They highlight the "rules of the road" and guide all of our decisions and actions.

Our values have real power because we routinely live them, act on them – and do so with conviction.

We put the health and safety of people first… and know this responsibility rests with each of us.

We act with integrity and show respect… and understand this defines our company's character.

We see our work through the eyes of those we serve… and know that our work is a powerful means to serve others.

We bring our best energy and focus to our work… and are fully engaged and accountable for results.

We believe that improvement is our daily responsibility… and know those we serve have the right to expect that from us.

We play to win as a team… and put the needs of our enterprise first.

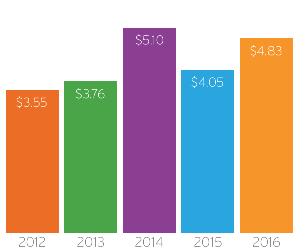
We are passionate about the success of our company… and know that its health and growth generate prosperity.

This illustration summarizes DTE Energy's seven corporate priorities – the strategic drivers that propel our business toward a strong future. In 2016, we added Force for Growth in Communities as a pillar of our corporate strategy. Our success depends upon the growth and prosperity of the customers and communities we serve.

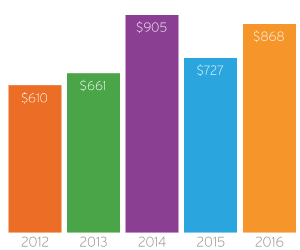
Our Company

Financial Performance

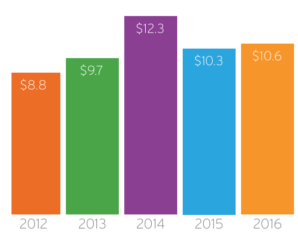
Diluted Earnings Per Common Share (dollars)



Net Income (million dollars)



Operating Revenue (billion dollars)



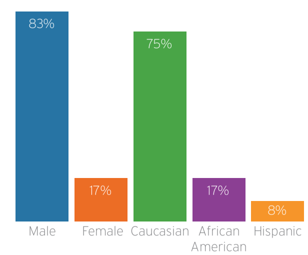
DTE Energy has delivered total shareholder return above the energy company average for the past three-year, five-year and 10-year periods.

Detailed information about our financial performance is available in our Form 10-K filing with the U.S. Securities and Exchange Commission. Visit our Investor Relations website for more information or download the Form 10-K.

Our Company

Governance

Diversity of Board Members



Visit our Governance web page for more information about our board's oversight and committee structure.

We believe a successful business is built on strong leadership and well-managed operations. At DTE Energy, our board of directors is committed to creating long-term value for its shareholders while operating as a responsible corporate citizen. Working toward that goal, the board performs a number of functions for the company following sound governance practices, including:

- Selecting company leaders
- Setting direction and approving strategy for the company
- Oversight of company management
- Regular oversight of the effectiveness of management policies and decisions, including management's development and execution of the company's strategies

We value an independent perspective of the management of our company. Our board is comprised of 11 independent directors, plus our chairman and CEO, the only management director. We hold annual director elections where a majority vote is required for uncontested appointments. All of the board committees are composed exclusively of independent directors and we have a lead independent director elected by the independent members of the board of directors.

To maintain the highest level of integrity, the board of directors and its committees hold annual self-assessments. Executive officers and directors are subject to robust stock ownership requirements. We uphold policies applicable to all company directors, officers and employees to ensure their economic interests are aligned with those of the shareholders. Our board membership reflects a diversity of experience, gender, race, ethnicity and age. Directors also possess the highest personal and professional ethics, integrity and values.

Ethics

At DTE Energy we encourage an ethical culture and our employees are kept grounded by our values. Our emphasis on ethics and values starts with our board of directors and extends throughout the entire company. The DTE Ethics and Compliance Program is designed to promote a culture of integrity, respect and compliance with the law. The DTE Energy Way, our code of conduct, is the highest level of policy for all of our employees. It guides how we behave on the job to ensure our activities are consistent with our values. All employees are trained on our code of conduct. In addition, DTE Energy has a supplier code of conduct to ensure our business partners adhere to the same standards and align with DTE Energy's values.

To promote a culture of ethics and integrity and to help drive supporting behaviors, ethics ambassadors are embedded within business groups across the company. These ambassadors serve as a resource for employees seeking guidance regarding ethical concerns and to assist with ethics-related training and communication.

Our Ethics in Action Program promotes a "speak-up" culture by providing mechanisms for employees, retirees, vendors, customers, shareholders and the general public to report suspected non-compliance or work practices that are inconsistent with our values and standards. In addition to reporting suspected concerns, the system allows you to ask questions or seek guidance. Individuals can make a confidential and, if desired, anonymous report through an independent third party by contacting the on-line Ethics in Action Helpline.

Stakeholders

Our Stakeholder Engagement Summary Table describes some of the ways DTE Energy communicates with our different stakeholder groups.

Maintaining an open and transparent relationship with our stakeholders is important to our success as a business and a responsible corporate citizen. DTE Energy's stakeholder engagement process involves outreach to people and organizations that may be affected by the decisions we make. The stakeholders with whom we interact may support or oppose our decisions, but regardless of their stance, we believe everyone benefits from the exchange of factual information and open dialogue.

DTE Energy maintains a Community Advisory Council, which involves a rotating group of community members. The Community Advisory Council is a partnership that allows us to gain insight into local perceptions of DTE Energy and provides us an opportunity to improve our relationship with the community. The council also works toward developing programs to better serve the needs of our customers.

DTE's Regional Relations team proactively manages relationships with elected and appointed officials. In partnership with Public Affairs, the team also works with key community stakeholder organizations and nonprofits. They represent DTE through membership and interaction with 45 Chambers of Commerce across Michigan. In addition, DTE executive leaders contribute their expertise and time to the community by serving in 70 board positions for nonprofit organizations throughout our service territory.

Please refer to the Policy Leadership section of this report for a list of advocacy groups with whom DTE engages.

We investigate and respond to all complaints filed with the Michigan Public Service Commission (MPSC) by customers of DTE Gas and DTE Electric. In 2016, there were 1,827 complaints, compared to 1,967 the previous year. Our approach to all complaints is to resolve the issue and restore our relationship with the customer. The details of complaints received and resolved are shared with the business units so we can learn and continuously improve. Our goal is to have stellar customer interactions each and every time.

Key Stakeholders:

Communities
Customers
Employees
Facility Neighbors
Government
Industry Associations
Non-Governmental Organizations
Shareholders
Suppliers

Stakeholder Engagement Summary

STAKEHOLDER GROUP	TYPE OF ENGAGEMENT	FREQUENCY	TOPICS RAISED	DTE RESPONSE
Communities	Community Advisory Council meetings Community Partners meeting External Organization Partnerships (Nonprofits, Chambers, Associations, Clubs attending/supporting events & programs) Volunteering (Board service, events, long-term programs) Neighborhood stakeholder meetings	Tri-annual (March, July, November) Annual meetings in Southeast Michigan and Greater Michigan Periodically throughout the year Regularly throughout the year Regularly throughout the year Quarterly	Customer service & assistance programs Community outreach (organizations, events, partnerships) Jobs & employment (training, access, hiring process) Political involvement (lobbying, advocacy) Diversity and inclusion Economic development (entrepreneurship, small business support) Energy efficiency Reliability and infrastructure Public safety Neighborhood development	See discussion in the following report sections: • Diversity and Inclusion • Community Support • Jobs and Education • Neighborhoods • Public Safety • Driving Economic Progress
Customers	DTE website Billing statements and messaging Press releases and local media Customer feedback via online comments and phone hotline Account management for large commercial & industrial customers J.D. Power survey	Updated regularly Monthly Regularly throughout the year Continuous dialogue Continuous dialogue Twice annually	Customer satisfaction Cybersecurity Economic development Energy affordability Energy efficiency Greenhouse gases Reliability and infrastructure Renewable Energy Safety	See discussion in the following report sections: • Measuring Utility Customer Satisfaction • Reliability and Infrastructure • Serving Our Customers • Technology and Innovation • Cybersecurity • Energy Affordability • Driving Economic Progress • Green House Gas Emissions • Transformation of Electric Generation • Renewable Energy • Energy Efficiency
Employees	Company intranet (Quest) Training events Town Hall meetings Employee feedback via online comments Gallup engagement survey Volunteerism Month of Caring Employee Energy Groups Performance reviews	Updated regularly Ongoing throughout the year Regularly throughout the year Continuous dialogue Annual Ongoing throughout the year Annual Monthly Annual	Community assistance Cybersecurity Diversity and inclusion Employee engagement Safety Environment	See discussion in the following report sections: • Safety • Employee Engagement • Diversity and Inclusion • Health and Wellness • Cybersecurity • Community Support • Transformation of Electric Generation • Environmental Leadership (all subsections)
Facility neighbors	Press releases and local media Community meetings associated with specific facility projects or events	Regularly throughout the year Periodically as needed	Air emissions Community assistance Economic development Habitat and biodiversity Reliability and infrastructure Renewable Energy Safety Waste management	See discussion in the following report sections: • Safety • Reliability and Infrastructure • Community Support • Public Safety • Driving Economic Progress • Transformation of Electric Generation • Renewable Energy • Environmental Leadership (all subsections)

STAKEHOLDER GROUP	TYPE OF ENGAGEMENT	FREQUENCY	TOPICS RAISED	DTE RESPONSE
Government (local, state, federal)	Attendance at state agency meetings and hearings Attendance at meetings and hearings with federal regulators and policymakers Volunteer events Press releases and local media Facility tours for legislators	Continuous dialogue Continuous dialogue Regularly throughout the year Regularly throughout the year Regularly throughout the year	Community assistance Customer satisfaction Cybersecurity Economic development Energy affordability Energy efficiency Greenhouse gas emissions Reliability and infrastructure Renewable Energy Safety Environment	See discussion in the following report sections: • Safety • Measuring Utility Customer Satisfaction • Reliability and Infrastructure • Technology and Innovation • Cybersecurity • Energy Affordability • Public Safety • Driving Economic Progress • Energy Policy Leadership • Climate Change (all subsections) • Environmental Leadership (all subsections)
Industry associations	Attendance at regular meetings and conferences. For example: • Edison Electric Institute • Nuclear Energy Institute • American Gas Association • Interstate Natural Gas Association of America • Michigan Manufacturers Association • Michigan Chamber of Commerce • Detroit Regional Chamber	Regularly throughout the year (monthly, quarterly and annually)	Air emissions Cybersecurity Energy efficiency Greenhouse gases Habitat and biodiversity Reliability and infrastructure Renewable Energy Safety Waste management	See discussion in the following report sections: • Reliability and Infrastructure • Cybersecurity • Technology and Innovation • Climate Change (all subsections) • Environmental Leadership (all subsections)
Environmental groups	Attendance at regular meetings and conference, including: • The Nature Conservancy • Wildlife Habitat Council • Detroiters Working for Environmental Justice • Southwest Detroit Environmental Vision Ongoing discussions around specific topics of concern to environmental groups related to DTE Energy activities	Regularly throughout the year Continuous dialogue on a project or case-by-case basis	Air emissions Energy efficiency Greenhouse gases Habitat and biodiversity Renewable Energy Waste management	See discussion in the following report sections: • Reliability and Infrastructure • Cybersecurity • Technology and Innovation • Climate Change (all subsections) • Environmental Leadership (all subsections)
Shareholders	Investor calls Press releases DTE Investor Relations website Investor Relations Day	Quarterly Periodically throughout the year Updated regularly Annual	Greenhouse Gas emissions Reliability and infrastructure Renewable Energy Safety Financial performance	See discussion in the following report sections: • Safety • Reliability and Infrastructure • Climate Change (all subsections) • Our Company (all subsections)
Suppliers	Supplier Meetings, Symposiums, Executive Reviews Supplier scorecards	Weekly, monthly, quarterly and/or annually Weekly, monthly, quarterly and/or annually	Greenhouse Gas emissions Reliability and infrastructure Renewable Energy Safety Financial performance	See discussion in the following report sections: • Safety • Reliability and Infrastructure • Driving Economic Progress • Transformation of Electric Generation • Renewable Energy • Waste and Recycling

About Our Report

This Corporate Citizenship Report is built around our company's material aspects or topics that have a direct or indirect impact on our ability to create, preserve or erode economic, environmental and social value for ourselves, our stakeholders and society at large. We review our material topics annually to identify and confirm issues that matter most to DTE Energy and prioritize the content of our report accordingly.

About Our Report

Materiality

In 2013, we conducted an in-depth materiality assessment in preparation for our first Corporate Citizenship Report. Our cross-functional corporate sustainability team conducted a benchmark of 15 utilities, analyzed the Electric Power Research Institute's (EPRI) Energy Sustainability Interest Group materiality study and participated in a comprehensive Global Reporting Initiative (GRI) training workshop. This initial phase helped us generate a list of 40 sustainability topics we considered in later phases of our materiality assessment process.

To prioritize the 40 initial aspects, the team evaluated each topic for low, medium or high alignment with DTE Energy's six corporate priorities. We also assessed the level of interest in each topic expressed by internal, external and government stakeholders, based on existing engagement channels. We sent a survey with the highest scoring aspects to all members of the team as well as the Steering Committee – our broader management oversight group – to establish the final ranking.

This year, in preparation for the 2016 report, DTE conducted a robust materiality refresh to reevaluate and prioritize key sustainability issues for our business and stakeholders. This included a benchmarking of five peer companies, interviews with external stakeholders from a variety of organizations and a survey completed by stakeholders within DTE as well as outside the company. Based on feedback from this materiality refresh, the following changes were made:

- Cybersecurity, Diversity and Inclusion, Habitat and Biodiversity and Waste Management were added as new material topics.
- Corporate Viability and Government Policy were removed from the list of material topics.
- Asset Management and Emergency Preparedness were wrapped into Reliability and Infrastructure. Compliance and Ethics were combined into a single topic. Employee Engagement and Employee Retention were combined.

About Our Report

MATERIAL ASPECT	DESCRIPTION	IS TOPIC PRIMARILY INSIDE OR OUTSIDE OUR OPERATIONS?	FINANCIAL PERFORMANCE	VALUE CREATION STRATEGY	POLITICAL & REGULATORY	CUSTOMER SATISFACTION	EMPLOYEE ENGAGEMENT	CONTINUOUS IMPROVEMENT	FORCE FOR GROWTH
1. Air Emissions	Efforts to reduce non-greenhouse gas emissions	Inside		X	X			X	
2. Community Assistance	Corporate and foundation giving, community and customer outreach	Outside				X	X		X
3. Compliance and Ethics	Compliance with environmental and business regulations and fostering a culture of strong corporate ethics	Inside		X	X		X	X	
4. Customer Satisfaction	Delivering excellent customer satisfaction	Outside	X	X		X	X	X	X
5. Cybersecurity	Protecting the electrical grid from external, unauthorized manipulation or damage; maintaining customer data privacy and internal systems control	Inside			X	X		X	
6. Diversity and Inclusion	A workforce that reflects our diverse customer base and workplaces where every employee is valued	Inside			X		X		X
7. Economic Development	Developing businesses and jobs in our region (e.g., Pure Michigan, Energize Detroit)	Outside	X	X					X
8. Employee Engagement	Ensuring that DTE has an extremely engaged, high-quality workforce; employee retention and development	Inside	X			X	X		X
9. Energy Affordability	Effectively manage customer affordability and rate competitiveness for both gas and electric utilities	Inside & Outside	X	X	X	X		X	X
10. Energy Efficiency	Making efficient use of energy resources in our own operations and on the customers' side	Inside & Outside	X	X		X		X	X
11. Greenhouse Gases	Efforts to reduce emissions of greenhouse gases	Inside		X	X			X	X
12. Habitat and Biodiversity	Conserving and enhancing wildlife habitat and areas of high biodiversity	Inside					X	X	X
13. Reliability and Infrastructure	Providing reliable gas and electric service to our customers and maintaining infrastructure to support energy delivery	Inside	X	X	X	X			X
14. Renewable Energy	Encouraging development of renewable energy sources	Inside		X	X				X
15. Safety	Employee safety and public safety	Inside & Outside			X	X	X	X	
16. Waste Management	Efforts to manage waste responsibly, maximize reuse and recycling and ensure nuclear waste safety	Inside			X			X	

Reporting Principles

In determining the content for this year's Corporate Citizenship Report, DTE applied the principles laid out in the Global Reporting Initiative (GRI) Standards. Issued by the Global Sustainability Standards Board in late 2016, the GRI Standards are a voluntary [1] global framework, intended for use by organizations to report about their impacts on the economy, the environment and society. The GRI Standards lay out four principles for determining report content. We have addressed each of these principles as follows:

- **Stakeholder Inclusiveness** – DTE reached out to a broad and diverse group of stakeholders as part of the materiality assessment process and the planning process for this specific report. Through direct interviews, questionnaires and online surveys, we obtained input on the expectations and interests of employees, customers, community partners, senior management, government representatives, investors, non-governmental organizations and suppliers.
- **Sustainability Context** – This report considers the sustainability context relevant for our industry sector and geographic region. Our discussion of the broader energy transformation that is underway across the United States is a key example of this reporting principle.
- **Materiality** – We have conducted extensive analysis to identify topics covering our economic, environmental and social impacts, as well as topics that interest and influence our stakeholders. DTE has conducted benchmarking against other companies' reports, both inside and outside the energy sector; participated extensively with industry organizations; and engaged third-party consulting expertise in GRI reporting to ensure that we obtain a thorough understanding of our material issues.
- **Completeness** – This report presents data for 2016, for those metrics we publicly report. These publicly-reported metrics, supplemented with narrative descriptions of programs and case studies, provide a complete view of DTE's sustainability/citizenship performance as determined through our internal analysis and our discussions with stakeholders.

1 Use of the GRI Standards is voluntary in the U.S., although some countries and stock exchanges outside of North America require companies to prepare GRI reports.

Management Approach

DTE manages all of its material issues in a thoughtful and responsible way. This section of our Corporate Citizenship Report provides basic information about our management approach, governance structure and strategy.

The DTE Energy Board of Directors has overall management responsibility at the highest level for our sustainability strategy, which we call our Force for Growth strategy. The following board committees are responsible for supervising various aspects of our material issues

- The Public Policy and Responsibility Committee (PPRC) is responsible for reviewing and advising the board on emerging social, economic, political, reputational and environmental issues that could significantly affect the company's business and performance in relation to the community, shareholders, customers and employees. The PPRC's charter is available on our Corporate Governance web page and spells out the committee membership, responsibilities and duties. The committee is responsible for evaluating its performance annually and reporting results to the board.
- The purpose of the audit committee is to assist the board in its oversight of the company's compliance with legal and regulatory requirements and the integrity of the company's financial statements.
- The Nuclear Review Committee provides oversight and review of the company's nuclear power generation program, including safety, regulatory compliance and operational performance.

For each of our material topics, we have internal policies, goals and targets that drive improvement. We monitor progress through the use of management dashboards to track metrics. Our code of business conduct and ethics – the DTE Energy Way – is publicly available in the Corporate Governance section of our website. Many other policies – including health and safety, cybersecurity and diversity and inclusion – are distributed internally. We have a robust training program that covers in detail the policies relevant to each employee's duties.

Our commitment to Continuous Improvement (CI) provides us with a framework for evaluating the effectiveness of our management approach. We conduct regular reviews of our activities and incorporate lessons learned in a "plan, do, check and act" CI cycle that benefits future projects.

About Our Report

Environmental Management Systems

Our internal environmental audit programs help keep us accountable and drive improvement. Our International Organization for Standardization (ISO) 14001 certified facilities undergo annual environmental management system conformance audits. DTE Gas, DTE Electric and DTE non-utility operating facilities also undergo periodic environmental compliance audits and we perform periodic environmental risk audits for all waste vendors we utilize. The results of these audits are reported through top-level management reviews within business units and an annual summary of audit program effectiveness is provided to the board. We track corrective actions and use problem solving tools to identify and address root causes.

Educated and engaged employees play an important role in managing our environmental aspects. Annual, web-based training encourages DTE Electric and DTE Gas employees to understand the relationship between their work and the environment. This mandatory environmental training module covers significant environmental aspects that can have an impact on the environment such as controlling emissions, handling waste, reducing vehicle idling, managing storm water and protecting wildlife habitat.

DTE Electric and DTE Gas facilities are currently third-party certified under the ISO 14001:2004 Environmental Management Systems Standard including the Fossil Generation facilities, Fermi 2 Power Plant, substations, renewable operations and all DTE Gas facilities.

An ISO 14001 standard revision was issued in September 2015. DTE Energy is currently transitioning to the ISO 14001:2015 standard and we will be updating our management systems throughout 2017. Our goal is to complete all third-party certifications under the new standard for DTE Electric and DTE Gas facilities by the end of 2018.

Clean Corporate Citizens

Michigan's Clean Corporate Citizen (C3) program is designed to honor and recognize businesses that have demonstrated strong environmental stewardship throughout their operations. To be designated a C3, facilities must have a comprehensive and facility-specific environmental management system that sets targets and objectives for continual environmental improvement; pollution prevention programs focusing on reduce, reuse, recycle; and a history of compliance with environmental regulations.

Clean Corporate Citizens who voluntarily participate in this program receive public recognition and are entitled to certain regulatory benefits, including expedited permits. Seven DTE Electric power plants and 26 DTE Gas facilities have earned C3 recognition:

DTE Electric Power Plants:

- Belle River Power Plant
- Fermi 2 Power Plant
- Greenwood Energy Center
- Harbor Beach Power Plant
- Monroe Power Plant
- River Rouge Power Plant
- St. Clair Power Plant

DTE Gas Facilities:

- Allen Road Service Center
- Alpena Service Center
- Belle River Mills Compressor Station
- Big Rapids Service Center
- Cadillac Service Center
- Citizens Gas and Fuel
- Columbus Station
- Coolidge Service Center
- Escanaba Service Center
- Gaylord T&SO Office
- Grayling Station
- Kalkaska Station
- Kingsford Service Center
- Ludington Service Center
- Lynch Road Service Center
- Michigan Avenue Service Center

Performance Data

PERFORMANCE METRIC	2012	2013	2014	2015	2016
Employees					
Employee Engagement Gallup Grand Mean score	4.08	4.18	4.28	4.27	4.33
Occupational Safety and Health Administration (OSHA) Recordable Rate	1.24	0.81	0.99	0.77	0.45
Customers					
Advanced meters installed, cumulative - Electric	–	1,143,088	1,767,682	2,196,460	2,517,959
Advanced meters installed, cumulative - Gas	–	211,887	586,316	788,487	933,522
Reliability Duration Index (minutes)*	472	582	793	277	239
Enrollment in Low Income Self-Sufficiency Plan	–	28,947	22,000	34,000	35,000
Community					
Spending in Michigan (million dollars)	$825	$800	$922	$945	$1,300
Total number of volunteers	–	1,450	2,000	2,335	2,300
Total number of volunteer hours	–	N/A	N/A	12,000	21,750
Total amount of DTE Foundation grants (million dollars)	–	$10	$11	$15	$15
Climate Change					
Net gas energy savings - customer programs (million cubic feet)	1,474 MMcf saved	1,436 MMcf saved	1,413 MMcf saved	1,480 MMcf saved	1,620 MMcf saved
Required gas savings (million cubic feet)	1,186 MMcf	1,240 MMcf	1,209 MMcf	1,178 MMcf	1,301 MMcf
Net electricity energy savings - customer programs (gigawatt-hours)	611 GWh saved	614 GWh saved	682 GWh saved	621 GWh saved	631 GWh saved
Required electricity savings (gigawatt-hours)	455 GWh	471 GWh	478 GWh	485 GWh	481 GWh
CO_2 emissions (million tons)	38.1	39.2	36.6	36.3	31.9

* Reliability Duration Index is calculated as the length of customer interruptions divided by the number of customers also called the System Average Interruption Duration Index or SAIDI.

PERFORMANCE METRIC	2012	2013	2014	2015	2016
Environment					
NO_x emissions (tons)	37,272	40,494	32,185	25,804	20,648
SO_2 emissions (tons)	133,456	128,178	83,447	71,465	52,245
Particulate emissions (tons)	1,291	1,645	1,105	767	536
Mercury emissions (tons)	0.747	0.773	0.522	0.479	0.112
Water withdrawal (billion gallons)	1,330	1,307	1,242	1,222	1,080
Water consumption (billion gallons)	20.5	20.4	18.8	20	19.1
Coal ash generation (million tons)	1.05	1.06	0.92	0.93	0.74
Recycling rates for ash (percent)	39%	42%	42%	42%	25%
Gypsum generation (million tons)	0.16	0.2	0.28	0.36	0.36
Recycling rates for gypsum (percent)	100%	97%	100%	97%	100%
Recycling rates (combined ash and gypsum)	47%	51%	55%	53%	48%
Our Company					
Operating earnings per share (EPS)	$3.94	$4.09	$4.60	$4.82	$5.28
Annual growth rate in operating EPS	5.07%	3.81%	12.47%	4.78%	9.54%
Annual shareholder return (percent)	14.90%	14.89%	34.61%	-3.77%	26.93%
Funds from operations (FFO)/debt ratio	Debt/Capital: 49% FFO/Debt: 22%	Debt/Capital: 50% FFO/Debt: 23%	Debt/Capital: 51% FFO/Debt: 25%	Debt/Capital: 52% FFO/Debt: 21%	Debt/Capital: 51% FFO/Debt: 21%
Diluted earnings per common share (dollars)	$3.55	$3.76	$5.10	$4.05	$4.83
Net income (million dollars)	$610	$661	$905	$727	$868
Operating revenue (billion dollars)	$8.8	$9.7	$12.3	$10.3	$10.6

GRI Index

This is the fourth Global Reporting Initiative (GRI)-compliant report for DTE Energy, covering calendar year 2016. GRI is a voluntary, international framework that provides guidance to organizations on non-financial reporting. In 2016, GRI published its GRI Standards, the next generation framework for sustainability reporting. DTE Energy applied the GRI Standards as the basis for this Corporate Citizenship Report, in accordance with the Core option.

We intend to publish our Corporate Citizenship Report on an annual basis. As we are still developing and formalizing our data collection process, we have not pursued third-party data assurance for this year. Report data represents aggregated data across our entire operation unless otherwise stated.

The index below lists the GRI indicators addressed in this report and either includes the information directly or provides a reference to the relevant page(s) within this Corporate Citizenship Report.

GRI INDICATOR		SECTION
General Disclosures		
102-1	Name of organization	DTE Energy Company
102-2	Primary products and services	Company Profile
102-3	Location of headquarters	Detroit, Michigan, United States
102-4	Number of countries	United States only
102-5	Nature of ownership and legal form	Governance See also Form 10-K*
102-6	Markets served	Company Profile
102-7	Scale of the organization	Our Company; Employees See also Form 10-K*
102-8	Total workforce	Number of employees of each type, based on DTE employment records as of December 31, 2016: (see table below) All employees work within the United States; the temporary employees represent primarily summer interns, which is the main type of seasonal employment we use. See also Employees report section.
102-9	Supply chain	Supply Chain Management and Diversity
102-10	Significant changes since last report	Company Profile
102-11	Precautionary approach	See Form 10-K
102-12	External initiatives	Energy Policy Leadership; Waste and Recycling; Habitat and Biodiversity; Environmental Management Systems; Community
102-13	Membership in associations	Stakeholders; Energy Policy Leadership
102-14	CEO statement	CEO Message
102-15	Key impacts, risks and opportunities	CEO Message
102-16	Values, standards, codes	Corporate Values and Priorities; Ethics
102-17	Mechanisms for reporting ethical concerns	Ethics
102-18	Governance structure	Governance
102-22	Board composition	Governance
102-40	Stakeholder groups	Stakeholders
102-41	Collective bargaining agreements	Employees

	Male	Female
Regular	7,369	2,623
Temporary	175	93
Full-time	7,368	2,603
Part-time	1	20

*Form 10-K annual financial report for DTE Energy is available in the Investor Relations section of our corporate website.

GRI INDICATOR		SECTION
102-42	Selection of stakeholders	Stakeholders
102-43	Approach to engagement	Stakeholders
102-44	Topics raised through engagement	Stakeholders; Materiality
102-45	Operational structure	Company Profile
102-46	Defining report content	Materiality
102-47	Material aspects	Materiality
102-48	Restatements	This report contains no material restatements of previously reported information.
102-49	Significant changes in scope and boundaries	Not applicable
102-50	Reporting period	Calendar year 2016
102-51	Date of previous report	Summer 2016 (covering calendar year 2015)
102-52	Reporting cycle	Annual
102-53	Contact point	CEO Message
102-54	Claims of GRI reporting	This report has been prepared in accordance with the GRI Standards: Core option.
102-55	GRI content index	GRI Index
102-56	External assurance	GRI Index
Economic		
201-1	Direct economic value	Driving Economic Progress; Performance Data Summary; See also Form 10-K
201-2	Risks and opportunities related to climate change	Climate Change
203-2	Indirect economic impacts	Community Support; Driving Economic Progress; Land Management and Remediation; Performance Data Summary
204-1	Local suppliers	Driving Economic Progress; Performance Data Summary
Environment		
302-5	Energy efficiency and renewable energy initiatives	Renewable Energy; Energy Efficiency
303-1	Total water withdrawal by source	Water; Performance Data Summary
304-1	Biodiversity	Habitat and Biodiversity
305-2	Greenhouse gas emissions	Climate Change; Air Quality; Performance Data Summary DTE uses the following standards, methodologies, assumptions and/or calculation tools to calculate Greenhouse gas emissions: The U.S. Environmental Protection Agency Mandatory Greenhouse Gas Reporting Rule and The World Resource Institute Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (Revised Edition)
305-5	Initiatives to reduce Greenhouse gas emissions	Climate Change

GRI INDICATOR		SECTION
305-7	NO_X, SO_2 and other air emissions	Air Quality; Performance Data Summary DTE uses the following standards, methodologies, assumptions and/or calculation tools to calculate air emissions: NO_x and SO_2 emissions are calculated using continuous emission monitoring systems. Particulate matter (PM) emissions are calculated based on opacity for all plants, excluding the DTE Monroe Power Plant. The Monroe Power Plant PM emissions are calculated using continuous emission monitoring systems.
306-2	Waste by type and disposal	Waste and Recycling; Performance Data Summary
307-1	Environmental fines and sanctions	Compliance
Social		
401-1	Hire rates and turnover rates	Employees
403-2	Rates of injury	2016 Days Away, Restrictions and Transfers (DART) rate = 0.24 Absentee rates for 2016: Male = 2.22%, Female = 3.46% Gender breakdown is not available for Occupational Safety and Health Administration recordable incidents and DART rates. See also Safety and Performance Data Summary.
404-3	Skills management	In addition to the Foundational Capabilities training described in the report, DTE employees completed technical, regulatory and compliance training during 2016: • Training hours completed – 282,227 hours • Number of course completions – 172,081 • Number of employees and leaders with course completions – 13,283 • Gender breakdown of training data is not available. See also Employee Engagement section.
405-1	Employee diversity	Diversity and Inclusion
413-1	Community engagement	Stakeholders; Community
415-1	Political contributions	Political Contributions
Disclosures From Electric Utilities Sector-Specific Guidance		
EU1	Installed capacity	Company Profile
EU2	Net energy output	Company Profile
EU3	Customer accounts	Company Profile
EU4	Transmission and distribution mileage	Company Profile
EU5	CO_2e emissions allowances	Not applicable
EU12	Distribution line losses	3,394 gigawatt hours (6.53% of net system output)
EU15	Percent of employees near retirement age	Employees
EU28	Power outage frequency	System Average Interruption Frequency Index = 0.988
EU29	Average power outage duration	Reliability; Performance Data Summary