OLSON, BZDOK & HOWARD

January 12, 2018

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

Via E-filing

RE: MPSC Case No. U-18419

Dear Ms. Kale:

The following is attached for paperless electronic filing:

Direct Testimony of Chris Neme on behalf of the Michigan Environmental Council, the Natural Resources Defense Council and Sierra Club

Exhibits MEC-17 and MEC-39

Proof of Service

Sincerely,

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STATE OF MICHIGAN

MICHIGAN PUBLIC SERVICE COMMISSION

In the matter on the Application of DTE ELECTRIC COMPANY for Approval of Certificates of Necessity Pursuant to MCL 460.6s, as amended, in connection with the addition of a natural gas combined cycle generating facility to its generation fleet and for related accounting and ratemaking authorizations	Case No. U-18419 ALJ Suzanne D. Sonneborn

DIRECT TESTIMONY OF CHRIS NEME

ON BEHALF OF
MICHIGAN ENVIRONMENTAL COUNCIL,
NATURAL RESOURCES DEFENSE COUNCIL, AND
THE SIERRA CLUB

January 12, 2018

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I. Introductions and Qualifications

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

A: My name is Chris Neme. I am a co-founder and Principal of Energy Futures Group, a consulting firm that provides specialized expertise on energy efficiency and renewable energy markets, programs and policies. My business address is P.O. Box 587, Hinesburg, VT 05461.

Q: Please describe your educational background.

A: I received a Master of Public Policy degree from the University of Michigan (Ann Arbor) in 1986. That is a two-year, multi-disciplinary degree focused on applied economics, statistics and policy development. I also received a Bachelor's degree in Political Science from the University of Michigan (Ann Arbor) in 1985. My first year of graduate school counted towards both my Masters' and Bachelor's degrees.

Q: Please summarize your business and professional experience.

A: As a Principal of Energy Futures Group, I play lead roles in a variety of energy efficiency consulting projects. Recent examples include:

- Representing NRDC in consultations with utilities and other parties in Michigan, Illinois and Ohio on efficiency program and portfolio design, cost-effectiveness screening, evaluation, shareholder incentive structures and other related topics;
- Helping the National Association of Regulatory Utility Commissioners and the Michigan Public Service Commission staff assess the relative merits of alternative approaches to

defining savings goals for utility efficiency programs (focusing on lifetime rather than just first year savings);

- Serving as an appointed expert representative on the Ontario Energy Board's Evaluation and Audit Committee for natural gas demand-side management;

- Serving on the Management Committee and leading strategic planning and program design for a team of firms, led by Applied Energy Group, that was hired by the New Jersey Board of Public Utilities to deliver the electric and gas utility-funded New Jersey Clean Energy Programs;

- Serving on a five-person national drafting committee for development of a new National Standard Practice Manual for cost-effectiveness screening of energy efficiency measures, programs and portfolios, which was published in May 2017;

- Leading a project for the Northeast Energy Efficiency Partnerships (NEEP) to document lessons learned from utility and other efforts across the United States over the past 25 years to use geographically targeted efficiency programs (sometimes in concert with other distributed resources) to cost-effectively defer capital investment in transmission and/or distribution system infrastructure; and

- Drafting policy reports for the Regulatory Assistance Project on a variety of energy efficiency and related regulatory policy issues, such as whether 30% electric savings is achievable in ten years, the history of efforts across the United States to use geographically targeted efficiency programs to cost-effectively defer transmission and distribution system investments, and the history of bidding of efficiency resources into the PJM and New England capacity markets.

Prior to co-founding Energy Futures Group in 2010, I worked for 17 years for the Vermont Energy Investment Corporation ("VEIC"), the last 10 as Director of its Consulting Division managing a group of 30 professionals with offices in three states. Most of our consulting work involved critically reviewing, developing and/or supporting the implementation of electric, gas, and multi-fuel energy efficiency programs for clients across North America and beyond.

During my more than 25 years in the in the energy efficiency industry, I have worked in numerous jurisdictions to develop or review energy efficiency potential studies; develop or review Technical Reference Manuals ("TRM") of deemed savings assumptions (including the Michigan, Ohio and Illinois TRMs); support utility-stakeholder "collaboratives" (including those in Michigan, Illinois and most recently Ohio); negotiate or support development of efficiency program performance incentive mechanisms (including the current Michigan and Ontario mechanisms, as well as the mechanism included in recently passed Illinois legislation); review or develop efficiency programs; and/or review or develop utility load forecasts. All told, I have worked on these and/or other policy and program issues for clients in more than 30 states, half a dozen Canadian provinces, and several European countries. I have also led courses on efficiency program design, published widely on a range of efficiency topics and served on numerous national and regional efficiency committees, working groups and forums. A copy of my curriculum vitae is attached as Exhibit MEC-17.

Q: Have you previously filed expert witness testimony in other proceedings before the Commission?

A: Yes. I filed testimony in the following Michigan Public Service Commission Dockets:

- U-18268, regarding DTE's proposed 2018-2019 gas energy efficiency programs (Energy Waste Reduction) plan;
- U-18262, regarding DTE's proposed 2018-2019 electric energy efficiency programs (Energy Waste Reduction) plan;
- U-18261, regarding Consumers Energy Company's proposed 2018-2021 energy efficiency programs (Energy Waste Reduction) plan;
- U-17771, regarding Consumers Energy Company's proposed amendment to its 2017 energy efficiency programs (Energy Waste Reduction) plan;
- U-17762, regarding DTE's proposed amendment to its 2017 energy efficiency programs (Energy Waste Reduction) plan;
- U-17429, regarding Consumers Energy's estimates of energy efficiency potential in its assessment of alternatives to its proposal to construct a new 700 MW gas-fired power plant (Thetford);
- U-17138, regarding Consumers Energy's proposed modifications to its 2013-2015 Energy Optimization plans;
- U-17049, regarding DTE's proposed modifications to its 2013-2015 Energy Optimization plan;
- U-16670, regarding Consumers Energy's biennial review and Amended Energy Optimization plan; and
- U-16671, regarding DTE's biennial review and Amended Energy Optimization plan.

Q: Have you been an expert witness on energy efficiency matters before other regulatory commissions?

A: Yes, I have filed expert witness testimony on more than 35 occasions before similar regulatory bodies in nine other states and provinces, including the neighboring jurisdictions of Ohio, Illinois and Ontario.

Q: Are you sponsoring any exhibits?

A: Yes.

- MEC-17 Christopher Neme CV
- MEC-18 MECNRDCSCDE-1.5
- MEC-19 MECNRDCSCDE 1.6
- MEC-20 MECNRDCSCDE 1.7 + Excel Attachment
- MEC-21 MECNRDCSCDE 1.28
- MEC-22 MECNRDCSCDE 4.5e
- MEC-23 MECNRDCSCDE 4.9
- MEC-24 MECNRDCSCDE 7.4
- MEC-25 MECNRDCSCDE 4.8
- MEC-26 MECNRDCSCDE 1.1civ + Attachment
- MEC-27 MECNRDCSCDE-4.10
- MEC-28 MECNRDCSCDE-7.5
- MEC-29 MECNRDCDE-1.30a + Attachment
- MEC-30 ISO New England System Planning, "*Forecast Modeling Procedure for 2017 CELT: ISO New England Long-Run Energy and Seasonal Peak Forecasts*", May 4, 2017

- MEC-31 Berg, Weston et al., *The 2017 State Energy Efficiency Scorecard*, American Council for an Energy Efficient Economy (Report U1710), September, 2017

- MEC-32 Neme, Chris and Jim Grevatt, The Next Quantum Leap in Efficiency: 30 Percent Electric Savings in Ten Years, The Regulatory Assistance Project, February 2016.

- MEC-33 MECMRDCSCDE-1.24

- MEC-34 MECNRDCSCDE-1.3bi + Attachment (U-18419-MECNRDCSCDE-1.3bi_DSMore Analysis – Group=ALL 2 Percent.xlsx, Test Results tab)

- MEC-35 MECNRDCSCDE-11.11b + Attachment

- MEC-36 MECNRDCSCDE-1.3bi + Attachment (U-18419-MECNRDCSCDE-1.3bi-DSMore Analysis – Group=All 1.5 Percent.xlsx, Test Results tab)

- MEC-37 MECNRDCSCDE-7.7

- MEC-38 MECNRDCSCDE-11.5

- MEC-39 MECNRDCSCDE-7.10

II. Testimony Overview

Q: What is the purpose of your testimony?

A: My testimony addresses the energy efficiency component of the integrated resource plan (IRP) that DTE Electric Company (DTE) prepared in support of its request for a certificate of necessity for a new gas-fired combined cycle power plant. I discuss several problems with the way that DTE has characterized and analyzed potential future efficiency scenarios. I also describe a more appropriate alternative set of efficiency assumptions, which I provided to MEC/NRDC/SC witness George Evans for use in Strategist modeling scenarios that he presents in his testimony.

Q: What are your summary findings?

A: I find that DTE's analysis of energy efficiency in its IRP has several fundamental flaws. As discussed in more detail both in Mr. Evan's testimony and later in my testimony, those flaws lead to a nearly $3 billion underestimate of the potential impacts and benefits that future efficiency programs could provide relative to DTE's preferred plan; they also raise serious questions regarding the purported need for DTE's proposed new power plant.

Q: What are the key flaws in DTE's analysis of energy efficiency in its IRP?

A: The four most important flaws in DTE's characterization and analysis of efficiency scenarios are as follows:

1. **DTE significantly overstates the amount of future efficiency program savings embedded in its load forecast**. DTE assumes that about 1.15% of new efficiency

program savings each year is embedded in its load forecast for 2016 through 2030.[1] This assumption is based on the fact that the Company achieved average annual savings of about 1.15% per year from 2009 to 2015. However, the connection between savings levels in the 2009 to 2015 timeframe and the Company's forecast of future demand is tenuous at best. To begin with, key elements of the Company's load forecast methodology do not use statistical analysis of historic sales to predict future consumption. For example, DTE's residential forecast is not based on regression modeling or any other statistical analysis of historic sales data. Instead, it is an end use forecast that adjusts future end use consumption levels downward for only some end uses and, with one minor exception, only to include the effects of federal product efficiency standards and voluntary national efficiency standards adopted by industry; no explicit adjustments are made to reflect continued annual achievement through 2030 of levels of residential efficiency program impacts achieved from 2009 through 2030. And even when the Company uses a statistical technique that is based on historic sales, such as the regression analysis that it used to develop portions of its commercial and industrial sales forecast, it typically uses consumption data going back to the 1990s – i.e. including many years in which it likely produced little to no significant efficiency program savings. The result is a gross overstatement of the amount of savings embedded in its forecast. That, in turn, leads to a significant understatement of the

[1] Though DTE repeatedly states that 1.15% incremental annual savings is embedded in its 2016 Reference Case, DTE actually assumes average annual savings of 1.21% through 2030. However, for the sake of clarity and consistency, I use the same 1.15% savings nomenclature DTE uses (but without changing the actual 1.21% average annual savings values DTE also uses) when referring to DTE's assumption regarding what is in its Reference Case forecast.

amount by which the load forecast could be reduced through deployment of future efficiency programs.

2. **DTE makes an unreasonably conservative assumption regarding the amount of new energy savings that it could achieve between now and 2030**. The Company assumes that the maximum energy savings it can achieve from future efficiency programs is equal to an annual average of about 1.25% of sales each year through 2030 because that is the level of savings that its efficiency potential study quantified as achievable. Though the Company adopts what it calls a 1.50% level of savings per year as part of its preferred plan, and also states that it analyzed a 2.00% per year savings scenario, those labels are misleading because DTE inappropriately assumes that both 1.50% and 2.00% annual savings levels are only possible for a limited number of years (fewer years in the 2.00% case), after which savings are assumed to have to decline to between 0.6% and 0.7% per year in order to stay within the limits of what DTE's potential study suggested was possible by 2030. This approach ignores the fact that the Company's potential study, by its own admission, did not quantify the maximum amount of savings that was cost-effectively achievable.[2] It only quantified the amount of savings achievable with financial incentive levels consistent with incentive levels the Company was already offering.[3] DTE did not consider in its IRP whether it could get greater savings with more aggressive incentive levels – even if those higher incentives would still be very cost-effective relative to supply alternatives – or by addressing a variety of other conservatisms in its potential study. The significant limitations of the

[2] DTE Exhibit A-32, p. 46 (footnote 29)

[3] DTE Exhibit A-32, p. 46 (footnote 29).

Company's potential study, the extremely high cost-effectiveness of the level of savings the Company has included in its IRP, and the experience and plans of leading jurisdictions all suggest that significantly higher levels of savings are possible and should have been analyzed.

3. **DTE unreasonably assumes that all of the new savings that it achieves – under any efficiency scenario – would last fifteen years**. DTE's own efficiency program plans for 2018 and 2019 consist of a group of measures that have an average annual savings life of about 12 years and includes many individual efficiency measures with savings that last far shorter than that. Indeed, nearly 12% of the savings are expected to last only one year. This diversity of measure lives must be reflected in forecasts of efficiency impacts on the system or mistaken conclusions will be drawn regarding the timing of future energy and capacity needs.

4. **DTE fails to capture the full economic value of efficiency in its comparative analysis of different resources**. Specifically, in its IRP analyses, DTE ignores the avoided transmission and distribution (T&D) cost and avoided ancillary service cost savings that efficiency programs provide.

I discuss each of these issues in greater detail in the following sections of my testimony.

Q: What changes do you propose be made to address each of these flaws?

A: I suggest the first three flaws be addressed through changes to DTE's analysis of efficiency options in Strategist. The specific changes I recommend are as follows:

1. The future efficiency program savings embedded in DTE's load forecast should be assumed to be no more than half of the 1.15% per year that DTE has assumed. Nominally, this will nearly triple the amount of additional savings a 1.5% savings per year scenario would produce and increase the amount of additional savings a 2.0% savings per year scenario would produce by roughly 75%.

2. Include in the IRP an analysis of the impact of sustaining 2.0% savings per year *for every year* from 2018 through 2030. That would produce about 40% more savings by 2030 than assumed possible by DTE (with most of the increase occurring in the mid- to late-2020s).

3. Account for the diversity of measure lives in current and future efficiency program portfolios. Correcting this flaw in DTE's analysis (but without the preceding two adjustments) reduces the estimated cumulative annual impacts of efficiency programs by about 10% by 2020, nearly 15% by 2025 and more than 20% by 2030.

Note that the first and third of these adjustments are included in Alternative Strategist Case 0 (the efficiency, demand response and renewables corrections case) run by Mr. Evans. All three are included in Mr. Evans Alternative Strategist Cases 1, 7 and 8.

In addition, I suggest that the T&D, ancillary services and any other quantifiable benefits (or costs) that efficiency and/or other resource choices produce also be included in the Company's IRP analyses. To the extent that such impacts are not captured in Strategist modeling, that may require exogenous adjustments to the Strategist results. Note that because Mr. Evans testimony focuses exclusively on Strategist runs, the economic results he presents also do not include T&D and ancillary service cost savings and therefore also require exogenous adjustments.

Q: What is the combined impact on energy savings of the three adjustments to Strategist inputs that you recommend?

A: As **Table 1** shows, the combined effects of those three adjustments is about a 2-fold increase in the amount by which DTE estimated that a 2.0% annual energy efficiency savings level could reduce its base case load forecast by 2020, a three-fold increase by 2025, a more than 40-fold increase by 2030. There are also much higher levels of savings post-2030.

Table 1: Impact of Adjustments to DTE's Analysis of 2% Efficiency Scenario

		2020	2025	2030
DTE Analysis				
	2.00% EE (GWh)	4,249	7,548	9,289
	EE in basecase forecast (GWh)	2,990	6,043	9,139
	Increase in savings (GWh)	1,259	1,505	150
Corrected Analysis				
	2.00% EE (GWh)	3,788	7,447	10,252
	EE in basecase forecast (GWh)	1,349	2,602	3,639
	Increase in savings (GWh)	2,438	4,845	6,613
Change Resulting from Corrections				
	2.00% EE (GWh)	-461	-101	963
	EE in basecase forecast (GWh)	-1,641	-3,441	-5,500
	Increase in savings (GWh)	1,179	3,340	6,463
	Increase in savings - multiplier	~2x	~3x	~40x

Q: What is the combined impact on utility system costs of the four adjustments to analysis of efficiency alternatives that you recommend?

A: As Mr. Evans shows with his Strategist modeling results, a corrected 2.0% Energy Efficiency plan could defer the Company's proposed new power plant until the year 2030 and save $2.354 billion as compared to the Company's preferred plan. In addition, based on the Company's own avoided T&D cost and avoided ancillary service cost assumptions (developed by DTE to analyze efficiency benefits, but not used in its IRP), I estimate that a sustained 2.0% efficiency scenario (i.e. one that address all three adjustments to Strategist modeling described above) would provide about $0.5 billion more net present value (NPV) economic benefits than DTE's preferred plan (including its 1.5% efficiency scenario). In other words, the total benefit of a sustained 2.0% per year efficiency scenario is on the order of $2.85 billion in cost savings relative to the Company's preferred plan.

III. Flaws in DTE's Analysis of Energy Efficiency Potential

A. DTE Overstates Efficiency Savings Embedded in its Load Forecast

Q: What does DTE assume about the amount of savings from future efficiency programs that is embedded in its base case load forecast?

A: For its 2016 Reference Case, DTE states that it assumes 1.15% savings per year is implicitly embedded in its load forecast.[4]

Q: Why is the amount of future efficiency program savings embedded in DTE's forecast important?

A: The amount of future efficiency program savings assumed to be embedded in DTE's load forecast is critically important because it defines the incremental impact assumed to be available from deployment of different efficiency scenarios, particularly more aggressive ones. The more that is assumed to be embedded in the load forecast, the lower the impact that more aggressive efficiency scenarios can have in reducing forecast loads in DTE's IRP modelling. For example, nominally, a 1.50% annual savings level will only provide a 0.35% increase in annual savings if it is reasonable to assume (which it is not) that 1.15% savings per year is already included in the base case forecast. Alternatively, if only 0.5% savings per year is actually embedded in the base case forecast, then a 1.50% scenario would provide roughly three times as much additional savings (i.e. 1.00% per year). As I discuss further in Section IV of my testimony and as Mr. Evans and Mr. Fagan show in their testimony, that difference in the incremental impact of

[4] Ex MEC-18, 19, 20, 21, 22, 23, 24 (DTE responses to MECNRDCSCDE-1.5, 1.6, 1.7 Attachment, 1.28, 4.5eii, 4.9, 7.4a).

efficiency can have a major effect on conclusions regarding when new generating capacity may be needed.

Q: What basis does the Company provide for its assumption that 1.15% incremental annual savings are implicitly embedded in its load forecast?

A: DTE suggests that 1.15% incremental annual savings is implicitly embedded in its load forecast based on the Company's assumptions about "the effects of energy efficiency programs as seen in historical sales data."[5] DTE further explains that it "uses regression-based modeling which includes historical data" and "[t]his historical data includes the impact of historical energy efficiency programs."[6] 1.15% is approximately the average annual savings achieved by the Company's efficiency programs from 2009 through 2015.[7] In short, the Company appears to be assuming that because it based its forecast sales in part on regression modeling that includes sales data from 2009 through 2015, that the forecast implicitly includes the effects new annual savings at levels similar to those experienced from 2009 through 2015 in all future years starting in 2016.

Q: Is that a reasonable assumption?

A: No. It is highly problematic for several reasons.

First, the Company only used regression-based modeling for its forecast of commercial and industrial customer sales. As **Table 2** shows, from 2009 through 2015 less than half of the

[5] Ex MEC-21 (DTE Response to MECNRDCSCDE 1.28b).

[6] Ex MEC-25 (DTE Response to MECNRDCSCDE 4.8a).

[7] See data provided in Ex MEC-26, Attachment to DTE response to MECNRDCSCDE 1.1civ.

Company's energy efficiency program savings came from commercial and industrial customers. Thus, even if its regression-based modeling were to fully embed the average level of savings since 2009 in its forecast of future sales, it would have captured less than half of its historic savings in this way. DTE does not use regression modeling to forecast residential sales.

Table 2: DTE Historic Efficiency Savings by Year and Sector

Year	Res/LI	C&I	Pilot/Ed	Total	% Res	% C&I	Source
2009	123,221	77,111	5,072	205,404	62%	38%	U-16358, Romine Testimony p. 17
2010	208,000	174,000	20,000	402,000	54%	46%	U-16359, Romine Testimony p. 18
2011	307,000	261,000	38,000	606,000	54%	46%	U-16737, Campbell Testimony p. 21
2012	300,000	256,000	55,000	611,000	54%	46%	U-17282, Campbell Testimony p. 21
2013	313,000	258,000	43,000	614,000	55%	45%	U-17602, Campbell Testimony p. 18
2014	312,000	328,000	41,000	681,000	49%	51%	U-17832, Campbell Testimony p. 18
2015	282,000	295,000	44,000	621,000	49%	51%	U-18023, Boladian testimony, p. 20
2009-2015	1,845,221	1,649,111	246,072	3,740,404	53%	47%	

Second, DTE did not even use regression-based modeling to forecast all of its commercial and industrial sales. 16% of its commercial sales and 40% of its industrial sales were forecast in a different manner.[8] The Company has provided no explanation for how forecast sales for those business customers could have implicitly included the level of future program savings it has assumed.

Third, even for the portion of commercial and industrial sales for which the Company's forecast is based on regression-based modeling, it is far from clear why such forecasts would implicitly embed the average level of savings achieved from those sectors since 2009 because the Company's regression-based models are not just based on historic sales since 2009. Instead, they used historic data for time periods going back at least to 2002 and as far back as 1990 for

[8] Ex MEC-28 (DTE response to MECNRDCSCDE 7.5b).

some market segments.[9] It is my understanding that the Company produced no significant energy savings from programs for a decade or more prior to 2009.[10] DTE claims that it did run some efficiency programs in the 1990s; it just did not track or report the savings from such programs.[11] However, it is hard to imagine that those programs would have produced savings anywhere close to the 1.15% annual level DTE is assuming to be embedded in its load forecast.[12] DTE certainly has provided no evidence to suggest that is the case. In other words, DTE's regression-based forecasts of sales to commercial and industrial customers were based on more years with very little savings than on years with savings on the order of the 1.15% it assumes is implicit in its forecast.

Fourth, DTE based its forecast of residential sales on an end-use forecast that was not adjusted at all for expected impacts of future efficiency programs. Instead, the only adjustments to consumption per appliance that DTE made were (1) to account for impacts of federal product efficiency standards; (2) to refrigerators to reflect an Energy Information Administration (EIA)

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[9] Ex MEC-23 (DTE response to MECNRDCSCDE-4.9b); DTE response to MECNRDCSCDE-7.6a.

[10] Indeed, total utility efficiency savings in the state of Michigan was equal to 0.01% of sales in 2008 (Molina, Maggie et al., *The 2010 State Energy Efficiency Scorecard*, ACEEE Report Number E107, October 2010, http://aceee.org/research-report/e107) and 0.00% of sales – i.e. no savings whatsoever – in 2007 (Eldridge, Maggie et al., *The 2009 State Energy Efficiency Scorecard*, ACEEE Report Number E097, October 2009, http://aceee.org/research-report/e097).

[11] DTE responses to MECNRDCSCDE-7.6b-c and MECNRDCSCDE-11.3a-h.

[12] Though DTE ran some efficiency programs in the early to mid-1990s, the level of effort was considerably lower than in the 2009 to 2015 period. For example, the approved budgets for 1994 was only $7.6 million (MPSC Order in Case U-10102, Aug. 5, 1998), or less than 10% of what the Company spent in the last few years in order to achieve savings greater than 1.0% per year. The Company then petitioned to lower spending to just $4.9 million, which the Commission approved (MPSC order in Case U-10671, July 31, 1995). The Company's efficiency programs were then terminated in 1996 (MPSC order in Case U-10932, September 12, 1996). Furthermore, in the mid-2000s even most leading states – and Michigan was not among them – were not achieving savings in the 1.15% per year range. Indeed, in 2006, only one state was achieving annual savings as high as 1.2% and only 3 states were achieving savings of more than 0.8%. Of the top fourteen states - which did not include the state of Michigan – one was achieving savings of only 0.1% and another was at only 0.3% (Kushler, Martin et al., Meeting Aggressive New State Goals for Utility Sector Energy Efficiency: Examining Key Factors Associated with High Savings, ACEEE Report Number U091, March 2009 http://aceee.org/meeting-aggressive-new-state-goals-utility-sector-energy-efficiency-examining-key-factors-associated).

forecast; (3) for DVRs, cable TV boxes and satellite dishes to account for voluntary efficiency standards adopted by industry nationally; and (4) to miscellaneous end uses.[13] And the miscellaneous sales forecast was adjusted upwards quite dramatically (by 33% from 2015 to 2016 and by more than 100% from 2015 to 2025).[14] It is hard to see how this approach and set of assumptions implicitly accounts for any future residential efficiency program savings – let alone a level equal to about half of its historic total (all sector) savings levels.

In sum, while it is impossible to make a definitive estimate of how much future efficiency program savings actually is embedded in the Company's load forecast, given the data available it is unreasonable to conclude that it could be anything close to the 1.15% the Company is assuming. I offer an alternative assumption in Section IV.B of my testimony.

Q: Did DTE perform any analysis to validate its assumption that 1.15% annual efficiency program savings are embedded its forecast?

A: No. DTE did not attempt to explicitly validate or test whether that assumed level of efficiency was actually embedded in its forecast.[15] The Company simply assumes that level of future efficiency program savings is embedded in its forecast because the forecast is based on and/or supposedly consistent with historic sales data.[16]

Q: How should DTE have developed its forecast to enable accurate modeling of future energy efficiency program impacts?

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[13] Ex MEC-27 (DTE response to MECNRDCSCDE-4.10ei).

[14] Ex MEC-29 (Attachment to DTE's response to MECNRDCDE-1.30a) (CONFIDENTIAL ATTACHMENT)

[15] Ex MEC-23 (DTE response to MECNRDCSCDE-4.9di).

[16] *Id*.

A: DTE should have developed a forecast of future sales absent any efficiency programs, with any adjustments for past efficiency program impacts based on empirical data and analysis rather than unsubstantiated assumptions. This could have been accomplished by reconstituting its historic sales so that any regression-based forecast of load growth was based on what historic sales would have been absent its historic efficiency programs. Any elements of its forecast that are not based on statistical analysis of historic sales data, such as its residential end use forecast, should be assumed not to include any embedded future program impacts absent compelling statistical data and analysis to the contrary. This way, the Company's base case reference forecast would only include impacts of historic efficiency programs – and no impacts from any new programs. That would then allow the Company to characterize the impacts of a full range of future efficiency program savings levels and allow its model to select the least cost alternative from among them.

Q: Is this approach used in other analyses of the impacts of energy efficiency?

A: Yes. For example, the New England Independent System Operator does this, starting with what it call a "gross" load forecast for capacity planning purposes so that efficiency resource providers can compete on a level playing field with generating capacity in the region's competitive capacity market. NE-ISO's description of this process is as follows:

> *"'Gross' load forecasts are developed by first adding the energy savings from behind-the-meter photovoltaics (BTM-PV) and passive demand resources (PDR) back into the historical NEL and daily peak load series before the models are estimated. The process of adding these savings back into historical data is referred to as 'reconstitution', and ensures the*

proper accounting of these resources, which are forecast separately, in the development of the long-term load forecasts.[17]

B. DTE Under-Estimates Achievable Efficiency Savings through 2030

Q: Did the Company analyze levels of energy efficiency that are more aggressive than the 1.15% per year it assumed was embedded in its base case load forecast?

A: The Company analyzed – and ultimately adopted as part of its preferred plan – what it calls a 1.50% energy efficiency scenario. It also analyzed what it called a 2.00% efficiency scenario. However, as an initial matter, those labels are misleading. In these scenarios, DTE did not analyze annual incremental savings of 1.5% and 2.0%, respectively, throughout the planning period. As **Figure 1** shows, while the Company assumed that it would acquire these levels of savings in the near term, DTE also assumed a significant drop in savings starting in the early to mid-2020s, dropping well below the annual savings assumed in the 2016 Reference Case scenario (i.e. to between 0.6% and 0.7% per year). The Company effectively assumed that the total amount of savings it can achieve by 2030 is fixed at a level that will be effectively reached by the 1.15% per year it assumes is embedded in its base case load forecast. Thus, the only thing the nominally more aggressive 1.5% and 2.0% efficiency scenarios do is to change the *timing* of when the savings are achieved, with more of the 2030 fixed total achieved sooner. This is illustrated in **Figure 2**.

[17] Ex. MEC-30 ISO New England System Planning, "Forecast Modeling Procedure for 2017 CELT: ISO New England Long-Run Energy and Seasonal Peak Forecasts", May 4, 2017 (https://www.iso-ne.com/static-assets/documents/2017/05/modeling_procedure_2017.pdf).

Figure 1: Incremental Annual Energy Savings for DTE's Efficiency Scenarios[18]

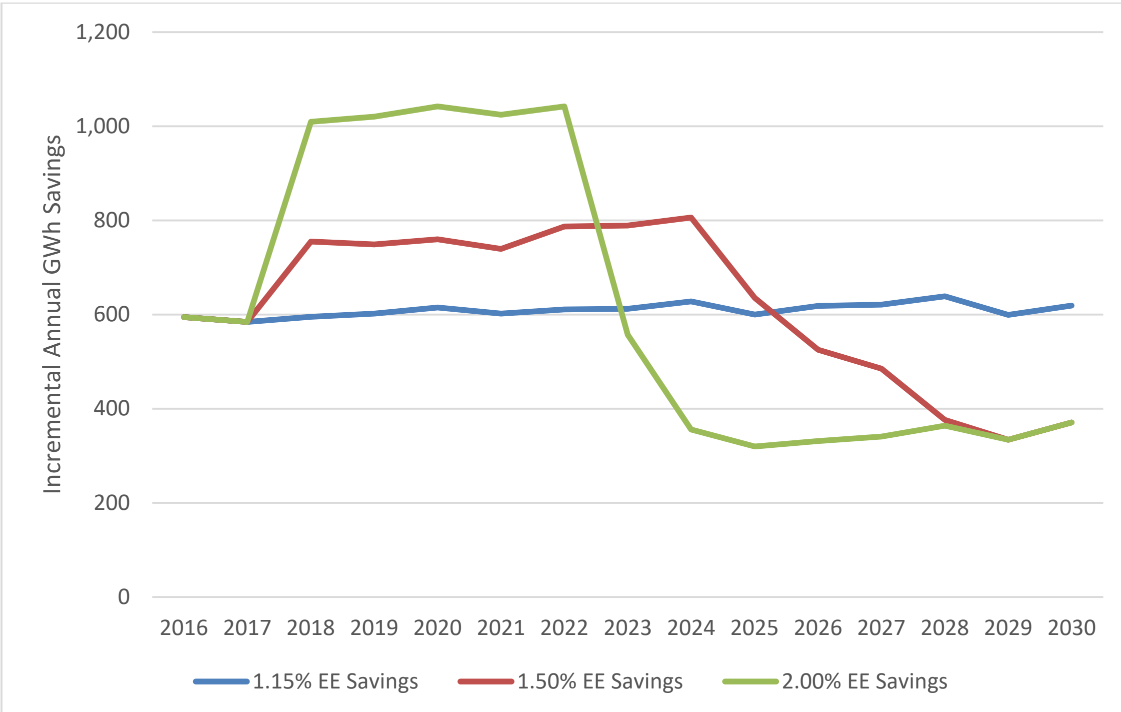
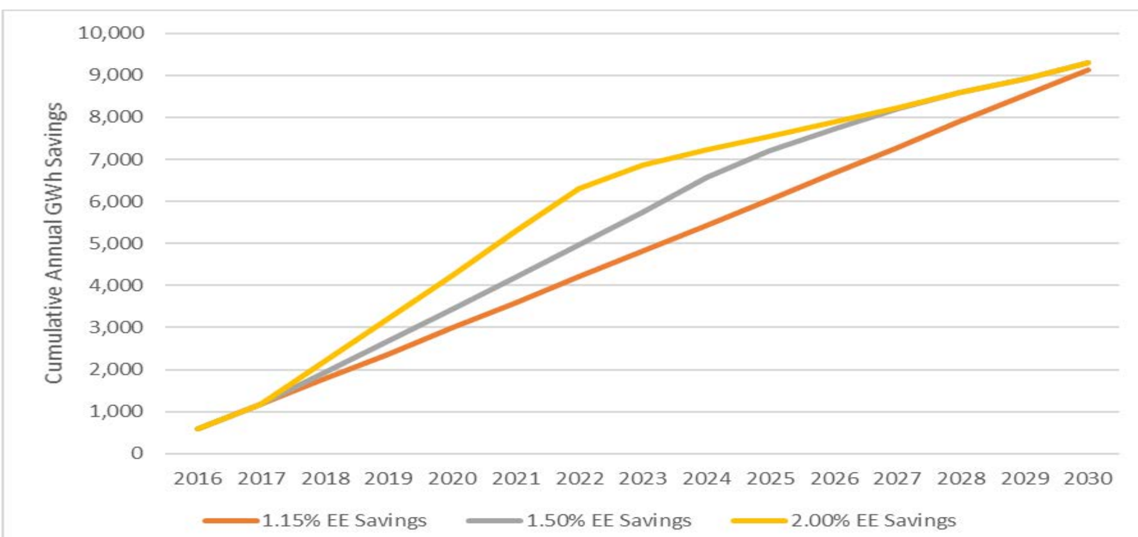


Figure 2: Cumulative Annual Energy Savings for DTE's Efficiency Scenarios[19]



[18] Incremental annual savings values provided by DTE in response to MECNRDCSCDE-1.7 (Ex MEC-20).
[19] Incremental annual savings values provided by DTE in response to MECNRDCSCDE-1.7 (Ex MEC-20).

Q: How did the Company determine the maximum amount of energy savings that could be acquired by 2030?

A: The Company relied on estimates of achievable potential in a study of efficiency potential that was completed by GDS Associates in April 2016.

Q: Are the results of the GDS study a reasonable basis for estimating how much cost-effective savings could be acquired in DTE's service territory by 2030?

A: No. To begin with, as GDS' report explicitly states, the study did not attempt to quantify the maximum amount of efficiency savings that could be cost-effectively acquired.[20] It only quantified the amount of savings achievable with financial incentive levels consistent with incentive levels the Company was already offering.[21] This creates a type of circular reasoning, with the study suggesting that amount of savings that can be achieved each year in the future is (on average) approximately equal to what the Company has achieved each year in the past because the study artificially limited its analysis to the level of financial incentives that Company had historically offered to its customers in the past.

In addition to this limitation, DTE's potential study has a number of other conservatisms that also make its results very conservative. I should note that many of these conservatisms are not unique to DTE's study, but are common to potential studies in general. The result – for both DTE's study and potential studies in general – is a significant underestimate what is really cost-effectively achievable. That does not mean that such studies have no value. For example, potential studies can provide some useful insight into the *relative* importance and cost-

[20] DTE Exhibit A-32, p. 46 (footnote 29).

[21] DTE Exhibit A-32, p. 46 (footnote 29).

effectiveness of different measures and programs. However, I do not believe that potential studies as typically conducted – including DTE's – should dictate assumptions regarding the maximum amount of efficiency savings that can be cost-effectively acquired – especially in the longer-term.

Q: What is the basis for your concern that efficiency potential studies are inherently conservative and commonly underestimate what is really achievable?

A: That conclusion is based on (1) empirical data from the few jurisdictions that have attempted to capture all (or close to all) cost-effective efficiency; and (2) qualitative reviews of such studies that identify a host of methodological practices and assumptions that would bias results downward.

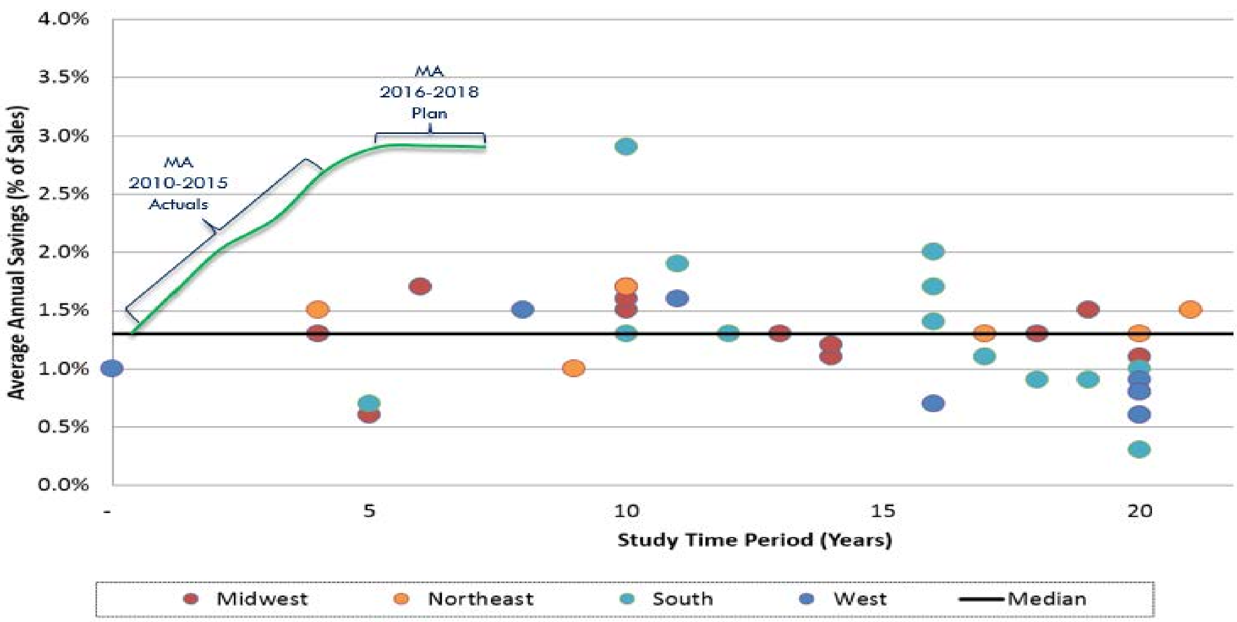
Q: What empirical data support the conclusion that efficiency potential studies are inherently conservative and underestimate achievable savings?

A: Consider **Figure 3,** which graphically shows the results of nearly 40 different efficiency potential studies completed between 2009 and 2013 in different states across the country. The median estimate of achievable potential from those studies was about 1.3% of annual sales (black line). Interestingly, there do not appear to be any large regional differences in these estimates. Even for the Northeast, the region that has arguably been the most aggressive in pursuing efficiency in recent years, the average across six different studies is only slightly higher – about 1.5% – with no study suggesting more than about 1.8% was possible. In contrast, the Massachusetts utilities have ramped up to the point where they achieved 3.0% in 2016[22] – twice

[22] Ex MEC-31, Berg, Weston et al., *The 2017 State Energy Efficiency Scorecard*, American Council for an Energy Efficient Economy (Report U1710), September, 2017 (http://aceee.org/research-report/u1710).

as much as the average northeastern study said was possible and roughly 60% more than even the most optimistic northeastern potential study said was possible. Both Rhode Island (2.85%) and Vermont (2.52%) also achieved significantly more in 2016 than what the most optimistic study said was possible.[23] Moreover, as I discuss in further detail in the next section of my testimony, those three states have sustained such high levels of savings for a number of years and are forecasting that they will continue to do so in the future as well.

Figure 3: Potential Study Results vs. Actual Massachusetts Utility Achievements[24]



[23] *Ibid*.

[24] *See* Ex. MEC-32 Neme, Chris and Jim Grevatt, *The Next Quantum Leap in Efficiency: 30 Percent Electric Savings in Ten Years*, The Regulatory Assistance Project, February 2016 (http://www.raponline.org/wp-content/uploads/2016/05/rap-efg-neme-grevatt-30percentefficiency-2016-feb-1.pdf). Potential study data in the graph are originally from Neubauer, Max, *Cracking the TEAPOT: Technical, Economic, and Achievable EE Potential Studies*, ACEEE Report U1407, August 2014,

http://aceee.org/sites/default/files/publications/researchreports/u1407.pdf. For Massachusetts utilities' savings data see National Grid et al., 2016-2018: Massachusetts Joint Statewide Three-Year Electric and Gas Energy Efficiency Plan, October 30, 2015, filed in Massachusetts Department of Public Utilities Dockets 15-160 through 15-169 (http://ma-eeac.org/wordpress/wp-content/uploads/Exhibit-1-Gas-and-Electric-PAs-Plan-2016-2018-with-App-except-App-U.pdf).

Q: Why did you use Massachusetts as an example in Figure 3 above?

A: In order to empirically demonstrate the degree to which efficiency potential study estimates of maximum achievable energy savings are conservative, one needs to examine actual achievements in jurisdictions that have actually tried to maximize the amount of cost-effective savings. I use Massachusetts in this example because its utilities are among the few in the country that are attempting to capture all cost-effective efficiency. There is no reason, however, to think that other states could not achieve similar results if they attempted to maximize the amount of cost-effective savings from energy efficiency.

Q: Have other efficiency experts also concluded that efficiency potential studies typically understate how much savings is cost-effectively achievable?

A: Yes. In fact, the ACEEE report from which the potential study data in **Figure 3** were taken makes the very same point:

> *"Given the inaccuracy of models and the generally conservative approach of these studies, there is likely a great deal of additional cost-effective potential beyond what is identified."*[25]

Several other experts have reached similar conclusions.[26]

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[25] Neubauer, Max, *Cracking the TEAPOT: Technical, Economic, and Achievable EE Potential Studies*, ACEEE Report U1407, August 2014, http://aceee.org/sites/default/files/publications/researchreports/u1407.pdf.

[26] *See, e.g.*, Goldstein, David, *Extreme Efficiency: How Far Can We Go If We Really Need to?,* ACEEE Summer Study on Energy Efficiency in Buildings, Vol. 10, pp. 44-56; Mosenthal, Phil, *Do Potential Studies Accurately Forecast What is Possible in the Future? Are We Mislabeling and Misusing Them?* For the ACEEE Efficiency As a Resource conference in Little Rock, AR, September 21, 2015; and Kramer Chris and Glenn Reed, *Ten Pitfalls of Potential Studies*, published by the Regulatory Assistance Project, 2012.

Q: What are the methodological practices and assumptions that lead efficiency potential studies in general, and the DTE study in particular, to understate achievable cost-effective efficiency potential?

A: There are a variety of underlying reasons that potential studies – including DTE's – understate efficiency potential, including:

- **An almost universal focus on measures that are known and documentable today – and therefore omission of savings potential from new technologies that will emerge onto the market during the time period the study is covering**. The importance of this omission increases the farther out in time the estimates of savings potential go. Though the DTE study endeavored to address some emerging technologies, it only did so for technologies that were already known but did not yet have a significant market presence.[27] The study did not adjust estimates of future savings potential to account new efficiency technologies or systems that are *not known today* but will emerge in the next 5, 10, or 15 years.[28] This is important because new efficiency technology is constantly emerging. For example, nearly half of the efficiency savings in the Northwest Power and Conservation Council's Draft Seventh Power Plan were from efficiency measures not included in the Council's sixth plan published just five years before.[29]

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[27] DTE Exhibit A-32, pp. 36-37.

[28] The study report states that it includes emerging technology, but that assessment is limited to technology that is already known.

[29] Ex MEC-32, Neme, Chris and Jim Grevatt, *The Next Quantum Leap in Efficiency: 30 Percent Electric Savings in Ten Years*, The Regulatory Assistance Project, February 2016 (http://www.raponline.org/wp-content/uploads/2016/05/rap-efg-neme-grevatt-30percentefficiency-2016-feb-1.pdf).

- **A failure to fully capture savings potential from truly custom measures – those that are unique to specific industries or even to specific sites or facilities**. This potential can only be captured through proxies or adders; it is either impossible or impractical to capture it through the "efficiency measure lists" from which potential studies – including DTE's – typically build up their estimates of savings potential.

- **A failure to fully account for increasing savings (as some technologies evolve) or decreasing costs (driven by economies of scale of production, product familiarity, and other factors) of some measures over time**. DTE's study did not appear to make any assumptions regarding increasing efficiency of any measures, even though performance of – and therefore savings from – commercial LED lighting is forecast to improve significantly over time.[30] Nor, with the exception of screw-in light bulbs, did DTE's study assume any efficiency costs would decline over time.[31]

- **A failure to include all efficiency benefits, even all utility system benefits, in cost-effectiveness analyses that produce economic potential**. For example, DTE's study excluded avoided T&D costs,[32] thereby artificially reducing the portion of efficiency potential that it estimated to be cost-effectively achievable.

- **A failure to account for market transforming effects of some efficiency programs**. The DTE study appears to capture only the effects of offering financial incentives, and not even the potential long-term effects of sustained financial incentive offerings could

[30] In discussing its methodology for estimating savings per measure, the GDS report makes no mention of accounting for potential improvements in savings over time. (DTE Exhibit 32, pp. 37-38 of 118).

[31] DTE Exhibit 32, p. 38.

[32] Ex MEC-33 (DTE response to MECMRDCSCDE-1.24a).

have on changes in customer awareness and sales and purchasing norms.[33] And it did not include in its "measure list" savings potential that some leading efficiency jurisdictions are currently acquiring by increasing compliance with building codes or advancing either new building codes or new product efficiency standards.

- **An inability to anticipate and forecast the effects of development within the efficiency industry of new and more effective ways to approach efficiency markets**. This is a ubiquitous limitation of all potential studies, including DTE's.

- **Basing assessments of the portion of economic potential that are "achievable" on either (A) overly simplistic and inherently conservative assumptions about market penetrations and/or (B) on artificial limitations regarding how large a financial incentive can be offered or how large a budget can be spent**. For example, as I discussed above, DTE's study estimates how much savings could be acquired with a financial incentive equal to 50% of the efficiency measure's cost, which it states is representative of the Company's historic efficiency program incentive offerings. The potential to acquire greater levels of savings with higher incentive levels for at least some efficiency measures or markets – even if the higher incentive levels were still substantially lower than the cost of energy supply (i.e. very cost-effective) – was not assessed. That is particularly problematic when one considers that DTE's own assessment of the cost-effectiveness of its most aggressive 2.0% efficiency scenario still

[33] GDS's estimates of the portion of customers who will purchase efficiency measures was based entirely on results of surveys of customers' "willingness to pay" for certain levels of efficiency improvement. The potential study report itself acknowledges that this approach is somewhat simplistic because there are many other elements that may influence customer purchases. The study did not consider, for example, the extent to which efficiency program efforts to educate consumers about the impacts efficiency measures can have in improving comfort and safety, lowering maintenance costs, increasing business productivity, etc. could have in increasing participation (DTE Exhibit A-32, pp. 46-49).

had an incredibly high benefit-cost ratio of *7.95.*[34] That, by itself, strongly suggests that there is substantial additional cost-effective savings potential that DTE did not include in its analysis.

Q: With respect to that last point, why does the fact that DTE's most aggressive 2.0% efficiency scenario had a benefit-cost ratio of 7.95 suggest there is substantial additional cost-effective savings potential that the Company did not include in its analysis?

A: By definition, any efficiency resource with a benefit-cost ratio of greater than 1.0 is less expensive than supply alternatives. A benefit cost ratio of 7.95 under the Utility Cost Test (UCT) means that the Company expects to generate nearly $8 in utility system cost savings – from avoided energy costs, avoided capacity costs, avoided T&D costs, avoided ancillary services costs, etc. – for every dollar it spends on acquiring efficiency resources. In other words, its most aggressive efficiency scenario is *extremely* cost-effective.

Typically, as savings levels become more aggressive, benefit-cost ratios under the Utility Cost Test (UCT) used in Michigan to assess efficiency program cost-effectiveness decline, at least somewhat. That is because some of the harder-to-get savings tend to be a little more expensive. Related to that point is the fact that benefit-cost ratios under the UCT will typically be highest when the financial incentives (e.g. rebates) offered to customers to induce them to participate are

[34] Ex MEC-34 (Attachment to DTE's response to MECNRDCSCDE-1.3bi (U-18419-MECNRDCSCDE-1.3bi_DSMore Analysis – Group=ALL 2 Percent.xlsx).

low.[35] As incentive levels are increased, participation and therefore savings typically increase and UCT benefit-cost ratios typically decline – again, at least somewhat.

In this case, with a benefit-cost ratio of almost 8 to 1, the Company could have doubled its assumed financial incentive levels for every efficiency measure – with related increases in program participation and savings levels – and still saved at least four dollars in avoided energy supply costs for every dollar spent. I am not suggesting that it would be necessary or appropriate to double incentive levels for every efficiency measure in every program for every market. In some cases, the incentive levels assumed may have been high enough to capture the overwhelming majority of the cost-effective savings. However, for many other measures that would not be the case. Assessing how much additional savings could be acquired through such selective increases in financial incentive levels would clearly add complexity, time, and cost to the conduct of DTE's potential study. However, the unquestionable result of DTE's failure to analyze how much more savings could be cost-effectively acquired with more aggressive strategies, including higher levels of financial incentives to customers, is that its study under-estimated cost-effective efficiency savings potential. I offer an alternative suggestion regarding how much cost-effective achievable potential should be possible by 2030 in Section IV.C of my testimony.

Q: Could these methodological limitations that inherently bias efficiency potential study results downward be addressed in future potential studies?

A: It may not be possible to completely address all of them. However, it should be possible to address several of the more important ones. Key examples are as follows:

[35] For most efficiency programs, the rebates or other financial incentives offered to customers to encourage them to make investments in efficiency measures typically represent the largest portion of program costs.

- **New technology**. An analysis could be conducted to determine how much of current efficiency program savings (or current potential study estimates of savings) are being captured from measures that were not considered in potential studies conducted 5, 10 or 15 years ago. "Multipliers" to account for new technology could then be applied to the results of new potential studies.

- **Custom measures**. Detailed audits in a random sample of industrial facilities could be conducted to identify an exhaustive list of efficiency savings opportunities available. One could then determine the portion of those opportunities that are so industry-specific and/or site-specific that they would not show up on a typical potential study measure list. That could, in turn, be used to develop an industrial efficiency savings potential multiplier for a new potential study. The same could conceivably be done for at least some commercial market segments for which custom measures may be particularly important.

- **Including all avoided costs**. There is no justification for excluding some of the benefits of efficiency, including (but not limited to) avoided T&D costs, when assessing how much cost-effective efficiency potential can be acquired.

- **Market transformation**. Experience with market transformation efforts in other jurisdictions, including efforts to advance and/or improve compliance with building codes or state-level product efficiency standards, could be leveraged and included in future Michigan potential studies.

- **Customer adoption rates**. Potential studies should not arbitrarily limit estimates of savings potential to what can be acquired with rebates equal to 50% of measure costs.

Whenever appreciably greater levels of participation can be cost-effectively acquired at higher incentive levels, such additional savings should be included. Put another way, if it is a resource comparable to supply, the only relevant questions are how much can be acquired and at what cost. Just as power supply can come in different forms with different costs (gas, coal, wind, solar, etc.), so can efficiency. In that context, it makes no sense to pre-emptively exclude more expensive efficiency (i.e. efficiency acquired by paying 100% of measure costs) rather than to examine whether that more expensive efficiency might still be cheaper than supply alternatives.

In addition to these specific methodological changes, the results of potential studies should be benchmarked against actual achievements and plans of leading jurisdictions.

While some of these changes (e.g. including all avoided costs) would be easy to implement, many of them will require increased analysis, cost, and time. However, if efficiency is to truly be considered a resource that competes with supply alternatives, with the potential to save ratepayers billions of dollars, such increased sophistication in assessing efficiency potential would be appropriate.

C. DTE Over-Estimates Efficiency Savings Life

Q: How long did DTE assume the energy savings from its energy efficiency programs would last?

A: DTE assumed that the average life of the energy savings produced by the efficiency measures it would promote through future efficiency programs would be 15 years.[36] Furthermore, in its

[36] Bilyeu testimony p. 16, lines 4-7.

modeling of the impacts of efficiency programs, the Company assumed that every kWh of energy savings that was produced by its efficiency programs would last exactly 15 years.[37]

Q: Are those reasonable assumptions?

A: No. There are two problems with those assumptions.

First, 15 years is unrealistically long as an average measure life for electric efficiency program savings. The Company says that assumption is based on "the weighted average of DTE Electric's 2018-2019 energy efficiency plan and measure lifespan assumptions used by industry standards."[38] However, the weighted average life of its 2018-2019 plan savings is actually only about 12 years.[39] Also, a recent analysis of electric utility average savings lifetimes across the country found the average to be about 11 years, with the highest of any state being 13.8 years.[40]

Second, whatever the *average* savings life, that average represents a mix of savings lives from a wide range of efficiency measures and programs. Some measure or program savings last only one year, some two to four years, some five to ten years, some eleven to fifteen years and some sixteen to twenty-five years. To properly capture the effects of efficiency program savings on

[37] This is made clear in Ex MEC-20, which includes the attachment provided by DTE in response to MECNRDCSCDE 1.7 (U-18419-MECNRDCSCDE-1.7 Energy Efficiency Savings.xlsx), as the incremental annual savings shown in columns R through U are exactly equal to the year-over-year differences cumulative annual savings shown in columns E through H (post-2030 the incremental annual savings in Columns E through H also clearly decline by the exact amount of incremental annual savings added 15 years earlier).

[38] Bilyeu testimony p. 16, lines 4-7.

[39] The Excel document (Ex MEC-35) attached to DTE's Response to MECNRDCSCDE-11.11b shows the Company's total first year savings and lifetime savings from the program plan filed in U-18262 are 706,721 MWh and 8,658,406 MWh, respectively, for 2018. That represents an average savings life of 12.3 years. The values for 2019 are virtually identical to those for 2018.

[40] Molina, Maggie, *"The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs"*, American Council for an Energy Efficient Economy Report Number U1402, March 2014, p. 26.

near-term and mid-term energy and capacity needs one must account for the fact that not all savings will last as long as the "average savings". In fact, only about 88% of DTE's 2018 plan savings are forecast to still be persisting after just one year, and only 76% are forecast to still be persisting after ten years. On the other hand, some savings are forecast to last longer than 15 years. I discuss how this mixture of savings lives can be addressed in DTE's IRP in Section IV.D of my testimony.

D. DTE Underestimates the Value of Efficiency in its IRP Analyses

Q: Does DTE's IRP analysis consider all of the costs and benefits of energy efficiency resources?

A: No. DTE analyzed resource options primarily through its Strategist model. It also used an Internal Revenue Requirement (IRR) Model developed by the Company "to assess the financial impact of various portfolios."[41] Those models focus on the costs of addressing future energy and capacity needs. However, while energy efficiency can meet future energy and capacity needs, it can also reduce future T&D system investments and ancillary services costs. Neither of those avoided cost benefits of efficiency were included in DTE's Strategist or IRR analyses,[42] though they were quantified in DSMore, a tool that DTE uses to assess the cost-effectiveness of efficiency resources outside of its IRP modeling tools.

Q: What is the implication of omitting those efficiency benefits from DTE's IRP modeling analyses?

[41] Testimony of DTE witness Chreston, p. 37, lines 7-9.

[42] DTE responses to MECNRDCSCDE-4.1.

A: DTE's Strategist and IRR analyses will have understated the economic benefits of all levels of energy efficiency, particularly the higher levels of efficiency analyzed.

Q: How substantial are the omitted benefits of the efficiency scenarios analyzed by DTE?

A: They are quite large. For example, DTE's DSMore analysis of its 1.5% energy efficiency scenario estimated the value of avoided T&D costs to be $1.41 billion and the value of avoided ancillary services costs to be $0.65 billion, for a total of $2.06 billion in savings from just those two benefits of efficiency.[43] The comparable value for DTE's 2.0% efficiency scenario are $1.47 billion in avoided T&D costs and $0.68 billion in avoided ancillary services costs, for a total of $2.15 billion in savings from just those two benefits of efficiency.[44] Extrapolating from these results, I estimate that the value of avoided T&D and ancillary services costs for DTE's 1.15% reference case assumptions would be about $1.98 billion.

Q: Would the inclusion of T&D and ancillary services benefits of efficiency in DTE's IRP analyses have changed the economic analysis regarding DTE's 1.5% and 2.0% efficiency scenarios?

A: Yes. DTE's Strategist analysis suggested that the 2.00% efficiency scenario produced $1.068 billion in cost savings relative to its reference case and its 1.50% efficiency scenario produced $1.004 billion in cost savings relative to the reference case.[45] Just adding in the benefits of avoided T&D cost and avoided ancillary services costs – i.e. not making any of the

[43] Ex MEC-36 (Attachment to DTE response to MECNRDCSCDE-1.3bi (U-18419-MECNRDCSCDE-1.3bi-DSMore Analysis – Group=All 1.5 Percent.xlsx).

[44] Ex MEC-34 (Attachment to DTE response to MECNRDCSCDE-1.3bi (U-18419-MECNRDCSCDE-1.3bi-DSMore Analysis – Group=All 2 Percent.xlsx).

[45] K.J. Chreston testimony, p. 44, Figure 4.

other changes to DTE's analysis of efficiency that I am recommending – would have increased economic benefits of DTE's 1.5% scenario (relative to DTE's 1.15% Reference Case) by about $80 million and would have increased economic benefits DTE's 2.0% scenario (again, relative to DTE's 1.15% Reference Case) by about $170 million. Thus, absent any other changes to DTE's analysis, including the benefits of avoided T&D and ancillary services costs in the IRP would increase the relative economic advantage of DTE's 2.0% efficiency scenario over DTE's 1.5% efficiency scenario by about $90 million, from the $64 million estimated by DTE (or the $82 million value noted by Mr. Evans when selecting the economically optimal Strategist results for each scenario run by DTE),[46] to more than $150 million (or to more than $170 million if using Mr. Evans estimates). As I discuss further in section IV.F of my testimony, the differences are even greater when correcting the other flaws in DTE's analysis of efficiency.

[46] $64 million is the Company's estimate of the difference. Mr. Evans' testimony suggests that the difference when selecting the optimal (or least cost) Strategist results for DTE's 1.5% efficiency and DTE's 2.0% efficiency runs is $82 million.

IV. Alternative Energy Efficiency Assumptions

A. Introduction

Q: In Section III of your testimony you discuss four flaws in the way DTE characterized and analyzed energy efficiency in its IRP. The first three flaws relate to the magnitude of savings that can be acquired. Have you conducted an alternative analysis that corrects for those three flaws?

A: Yes, I have.

Q: Please describe how you corrected for each of the three flaws.

A: I have made three adjustments to DTE's energy efficiency analysis:

1. **More realistic estimate of savings embedded in DTE's forecast**. As discussed in the previous section of my testimony, DTE has assumed that its load forecast has implicitly embedded in it a level of future efficiency program savings of 1.15% per year. Not only is that assumption not supported by any reliable evidence, the methodology that DTE used to develop its forecast suggests that significantly fewer future program savings are likely to be embedded in the forecast. I conservatively assume that only about half that level of future program savings is embedded in DTE's forecast, and estimate the incremental impact of higher levels of savings from that lower level of "base case" or "reference case" savings.

2. **Sustained 2.0% energy savings per year**. As discussed in the previous section of my testimony, DTE's 2.0% efficiency scenario assumes that it can only get savings at or about 2.0% per year from 2018 through 2022. In 2023, the savings under that scenario

drop to about 1.1% of sales. From 2024 through 2030 they range from about 0.6% to 0.7% per year. I have developed estimates of the cumulative annual impact of a sustained 2.0% savings per year from 2018 through 2030.

3. **Proper accounting for the life of energy savings**. As discussed in the previous section of my testimony, DTE assumes that all of the savings it would achieve will last 15 years. That both overstates the actual average life of savings in its current plan (which is more like 12 years) and – perhaps more importantly – fails to account for the mix of measure lives and the effect that shorter-lived savings in its efficiency program portfolio will have on near-term and mid-term energy and capacity needs. I have estimated the future effect of efficiency savings using the actual mix of efficiency measure lives in DTE's 2018-2019 efficiency plan.

B. More Realistic Estimate of New Efficiency Savings in DTE's Forecast

Q: What is the basis for your assumption that only half of the savings DTE assumes is implicitly embedded in its forecast is actually embedded in its forecast?

A: As discussed in the previous section of my testimony, there are a variety of reasons why DTE's claim that 1.15% of new efficiency program savings per year is embedded in its load forecast is unreasonable. The Company suggests that assumption is reasonable because it used "regression-based modeling which incorporates historical energy efficiency programs into the forecast".[47] However, the Company only used regression-based forecasting for only a portion of its commercial and industrial (C&I) customers, and C&I customers accounted for a little less than half of its savings from 2009 through 2015. Its residential forecast is an end-use forecast to

[47] DTE Response to MECNRDCSCDE-1.28c.

which the Company made no adjustments to account for the effects of future efficiency programs. My assumption is consistent with the notion that DTE's commercial and industrial forecast has embedded in it a level of new savings consistent with recent years, but that its residential forecast has no new savings embedded in it.

That said, I should make clear that my 50% adjustment to DTE's assumption is not precise and is likely to be conservatively high – i.e. to still overstate the amount of new efficiency program savings embedded in DTE's load forecast.

Q: Why do you consider it to be conservatively high, meaning still likely to overstate the amount of new efficiency program savings embedded in DTE's load forecast?

A: In a nutshell, and as I discuss at some length in Section III.A of my testimony, it is highly unlikely that DTE's commercial and industrial sales forecasts implicitly include a level of new efficiency program savings equal to the level of commercial and industrial savings that the Company achieved for those customers in recent years.

Q: Given those concerns, why are you assuming that the commercial and industrial portion of 2009 to 2015 efficiency program savings is embedded – as new savings each year – in DTE's forecast?

A: To clarify, I am not making that assumption. I am simply adopting what I consider to be a conservative assumption regarding the total amount of savings, across all sectors, that is embedded in DTE's forecast. The real answer may well be that a lower of new savings in future years – perhaps even significantly lower amount – is actually embedded in DTE's forecast.

Q: Why is it not possible to develop a more definitive estimate of the amount of new efficiency program savings in DTE's load forecast?

A: First, DTE itself has been unable to clearly show the basis for its own forecast. For example, the Company stated that it manually adjusted its regression-based forecast for commercial and industrial sales, but does not even have a record of what manual adjustments were made.[48] Similarly, when asked to provide the underlying assumptions and calculations for key parts of its residential end use forecast, DTE suggests that the values in question were developed at least seven years ago[49] and states that "documentation of sources is not available" for the values in question.[50]

Second, the only way to develop an estimate of how much future efficiency program savings are embedded in DTE's forecast would be to develop a new forecast that was explicitly designed to exclude such impacts and compare it to DTE's current forecast. DTE failed to develop such a forecast.

C. Sustained 2.0% Annual Savings

Q: What is the basis for your assumption that the Company could achieve a sustained level of 2% annual savings from 2018 through 2030?

A: Leading jurisdictions in the Midwest and across the country have achieved and/or are planning to achieve that level of savings. For example, Commonwealth Edison (ComEd), the utility that serves Chicago and surrounding areas, recently filed a plan to comply with new Illinois legislation that would have it achieve incremental annual energy savings from eligible

[48] Ex MEC-23, 37 (DTE responses to MECNRDCSCDE-4.9cii and MECNRDCSCDE-7.7).

[49] Ex MEC-38 (DTE Response to MECNRDCSCDE-11.5).

[50] Ex MEC-39 (DTE response to MECNRDCSCDE-7.10).

customers[51] of about 2.0% per year from 2018 through 2021.[52] Moreover, that same legislation will require even higher levels of savings from 2022 through 2030.[53]

Similarly, from 2013 through 2016 the states of Massachusetts (2.57% per year), Rhode Island (2.84% per year) and Vermont (2.04% per year) all averaged savings in excess of 2.0% per year.[54] Vermont has actually averaged 2.1% per year since 2008 (i.e. a 9 year period).[55] All three have plans to continue to do so this year and into the future.[56]

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[51] Customers with maximum demands in excess of 10 MW are exempt from the efficiency requirements of the bill. They represent roughly 10% of Com Ed's load.

[52] For example, annual sales to the customers served by ComEd's efficiency programs are 78.686 million MWh (testimony of Mike Brandt, ComEd Exhibit 2.0, Illinois Commerce Comission Docket 17-0312, available at https://www.icc.illinois.gov/docket/files.aspx?no=17-0312&docId=254607). Com Ed's net first year MWh savings in 2018 are forecast to be 1.619 million MWh (see ComEd Plan 5 DSMore Batch Files for Docket 17-0312, available on the Illinois Stakeholder Advisory Group website at http://www.ilsag.info/energy-efficiency-dockets.html), or about 2.06% of eligible customer sales.

[53] See Ex. MEC-31 Appendix D to Berg, Weston et al., The 2017 State Energy Efficiency Scorecard, ACEEE Report U1710, September 2017 (http://aceee.org/research-report/u1710), which shows average annual savings as a percent of sales under Illinois' Energy Efficiency Resource Standard to be 1.77% from 2018-2021, 2.08% from 2022-2025 and 2.05% from 2026-2030. Note that the values are statewide averages; Commonwealth Edison has higher targets than the statewide average. As noted above, its most recent filed and approved plan would achieve average annual savings of 2.0% savings from 2018 to 2021. The statewide average value is lower because of much lower targets for Ameren Illinois. Note also that the values also account for the fact that very large customers (>10 MW) are exempt. Such customers account for more than 10% of statewide sales. Thus, savings as a percent of sales to participating Illinois customers are even higher.

[54] These are statewide averages based on ACEEE's annual state energy efficiency scorecards [Ex MEC-31, Berg, Weston et al., *The 2017 State Energy Efficiency Scorecard*, American Council for an Energy Efficient Economy (Report U1710), September 2017 (http://aceee.org/research-report/u1710); Berg, Weston et al., *The 2016 State Energy Efficiency Scorecard*, American Council for an Energy Efficient Economy (Report U1606), September 2016 (http://aceee.org/research-report/u1606); Gilleo, Annie et al., *The 2015 State Energy Efficiency Scorecard*, American Council for an Energy Efficient Economy (Report U1509), October 2015 (http://aceee.org/research-report/u1509); Gilleo, Annie et al., *The 2014 State Energy Efficiency Scorecard*, American Council for an Energy Efficient Economy (Report U1408), October 2015 (http://aceee.org/research-report/u1408)]. These values may somewhat understate the level of savings achieved by investor-owned utilities in Massachusetts and Rhode Island because the statewide averages include municipal utilities which often achieve lower levels of savings.

[55] See additional ACEEE State Efficiency Scorecard reports for 2010 through 2013 at www.aceee.org.

[56] For example, the Massachusetts' utilities electric savings target for 2018 is 2.94% of sales (http://ma-eeac.org/wordpress/wp-content/uploads/2016-2018-Energy-Efficiency-Three-Year-Plan-Order.pdf) and the Rhode Island 2018 savings target is 2.50% of sales (http://rieermc.ri.gov/wp-content/uploads/2017/11/4755-ngrid-eepp2018_11-1-17.pdf). Efficiency Vermont has proposed a three year savings target of 357,400 MWh (Vermont

Three other states – Arizona, Maine, and Maryland – have adopted energy efficiency resource standards that would require savings of 2.0% of sales or greater from 2016 through 2020.[57]

Q: Why are savings levels in other states relevant to Michigan?

A: Savings levels in other jurisdictions are the best indicator available of what can be achieved in Michigan because they represent actual on-the-ground experience and/or detailed planning to deliver programs. Absent compelling reasons to believe such experiences are not applicable to Michigan, they are much more relevant than hypothetical potential studies, especially studies that are as constrained as DTE's.

Q: What about differences between Michigan and the other states you reference?

A: Every state is different in some ways from every other state. The real question is whether those differences will collectively have a material effect on the amount of energy savings potential. I am unaware of any empirical data to suggest that efficiency potential in Michigan would be appreciably different than in Illinois – or even than in New England. In fact, in a recent report I wrote for the Regulatory Assistance Project I examined whether savings potential in Massachusetts and Rhode Island is likely to be representative of potential in other parts of the country and concluded that though there are some factors in those two states that would might

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Energy Investment Corporation, Triennial Plan 2018-2020, filed in Vermont Public Service Board docket 17-4927, November 16, 2017), or an annual average of about 119,000 MWh, for the 2018-2020 period; that represents about 2.2% of 2015 statewide sales of 5.52 million MWh (https://www.eia.gov/electricity/state/Vermont/).

[57] Ex MEC-31, Berg, Weston et al., *The 2017 State Energy Efficiency Scorecard*, American Council for an Energy Efficient Economy (Report U1710), September 2017 (http://aceee.org/research-report/u1710).

lead to higher savings potential than in other states, there were also others that pushed in the opposite direction, with the net effect likely to be very small.[58]

Q: Has DTE identified several potential challenges to achieving high levels of energy savings?

A: Yes, DTE witness Bilyeu identified five potential challenges to achieving savings, especially after 2024.[59]

Q: Do you concur that there are challenges to achieving high levels of savings – particularly 2.0% annual savings through 2030?

A: Some of the challenges identified by Mr. Bilyeu are real and legitimate challenges. However, they all can be overcome and should not be viewed as precluding the ability to meet a sustained 2.0% savings per year. I offer the following responses and solutions to each of them:

- **Depletion of low-cost high potential programs**. This concern implicitly assumes that the pool of available efficiency savings is fixed and that the costs of acquiring efficiency savings is static (or remains unchanged) over time. Neither of those things is true. New technology – as well as new approaches to efficiency program design – are constantly emerging. And the costs of many key efficiency technologies – most notably business applications of LED lighting[60] – can be expected to decline over time. Again, those

[58] See Ex MEC 32, Appendix D to Neme, Chris and Jim Grevatt, *The Next Quantum Leap in Efficiency: 30 Percent Electric Savings in Ten Years*, The Regulatory Assistance Project, February 2016 (http://www.raponline.org/wp-content/uploads/2016/05/rap-efg-neme-grevatt-30percentefficiency-2016-feb-1.pdf).

[59] Bilyeu testimony p. 22, line 25 through p. 23, line 9.

[60] For example, as explained in a report I recently co-authored, in 2015 an LED troffer provided 45% savings relative to a standard T8 linear fluorescent light fixture at a levelized cost of $0.06 per kWh saved at time of natural

changes were not captured in DTE's potential study on which it based its estimates of achievable savings by 2030. In addition, DTE estimates that its efficiency programs are so cost-effective – with a benefit-cost ratio of roughly 8 to 1 for both its 1.5% and 2.0% efficiency scenarios – that there is enormous "headroom" to accommodate even substantial increases in cost (above the increases the Company is already forecasting) and still have efficiency resources be substantially less expensive than supply alternatives.

- **Diminishing lighting potential as a result of the Energy Independence and Security Act (EISA) and the success of market penetration for LEDs**. While it is true that EISA will limit the ability of the Company to acquire new savings from residential lighting, DTE can secure these savings through other measures and programs. For example, Commonwealth Edison's 2018-2021 efficiency plan, which as noted above will achieve 2.0% savings per year, stops promotion of standard LED light bulbs after 2018. It makes up for the loss of savings potential in that market primarily through an increased focus on savings from business customers.

- **Customer baseline installed efficiency keeps rising as efficiency programs and other factors make customers more energy conscious**. That may well be the case. However, in the context of this IRP, that concern would only be relevant if the Company's base case forecast implicitly included in it assumptions regarding such "natural" increases in efficiency. It is not at all clear that the Company's forecast does that, particularly in the

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replacement. By 2020, the technology was forecast to improve to the point that the savings would be 53% and the cost would be $0.03 per kWh saved. By 2025, the savings were forecast to improve to 60% and the cost was forecast to decline to $0.01 per kWh saved. [Ex MEC-32, Neme, Chris and Jim Grevatt (Energy Futures Group), *The Next Quantum Leap in Efficiency: 30% Electric Savings in Ten Years*, published by the Regulatory Assistance Project, February 2016 (http://www.raponline.org/knowledge-center/the-next-quantum-leap-in-efficiency-30-percent-electric-savings-in-ten-years/?sf_data=results&_sf_s=getting+to+30)].

residential sector for which the Company assumes that consumption for most end uses will decline only in response to federal product efficiency standards or related voluntary national industry standards. Absent accounting for such impacts in its forecast, any program-related customer improvements in efficiency should actually be attributable to the utility's programs. In fact, the Company has long argued that its efficiency programs should get credit for such long-term "market effects".[61] Finally, even if such effects were part of DTE's forecast and not attributed to its programs, it is important to recognize that market-wide increases in energy consciousness can have a counter-balancing effect of making trade allies and customers more likely to seek out and invest in new efficiency technology or practices that the Company's programs can promote.

- **Marketing costs increase when attempting to capture hard-to-reach segments**. It is certainly true that marketing costs can increase when attempting to capture savings from harder-to-reach market segments. However, marketing costs typically represent a relatively modest portion of overall program costs. For example, in 2014, marketing costs represented between 2% and 6% of total efficiency program costs – an average of 3.6% – for ten Northeastern states (ranging from Maryland to Maine, but excluding New Jersey and Pennsylvania for which comparable data are not available).[62] And that includes the three states referenced above that are already achieving 2.0% savings per year. Moreover, given DTE's estimate that its 1.5% and 2.0% efficiency scenarios have benefit-cost ratios of about 8 to 1, even if marketing costs had to double relative to those

[61] For example, see testimony of Nick Hall, filed on behalf of The Detroit Edison Company in Case No. U-17049.

[62] Northeast Energy Efficiency Partnerships, Regional Energy Efficiency Database (https://reed.neep.org/).

Northeastern state levels, the impact of that cost increase on the amount of efficiency that is cost-effective to acquire would be negligible.

- **Uncertainty around design and delivery of programs to promote technologies not yet developed**. To be sure, the design and delivery of programs to capture savings from new technologies has to be at least somewhat uncertain. However, utilities, including DTE, have a long track record of being successful at capturing savings from new technology as it emerges. There is no reason to believe that will not be the case in the future as well. Moreover, as noted in the previous section of my testimony, the potential study on which DTE based its estimates of maximum achievable potential by 2030 effectively assumed no savings from technology that is unknown today but will emerge in the future. Thus, any ability to capture savings from such new technology would represent an increase in savings potential relative to what DTE assumed in its IRP analysis.

D. Proper Account for the Life of Efficiency Savings

Q: You stated above that your analysis of the cumulative annual impact of efficiency programs over time is based on the mix of measure lives in DTE's 2018 program plan. What is that mix?

A: The distribution of DTE's 2018 planned efficiency savings by measure life is shown in **Table 3**. As the table shows, nearly 12% of DTE's forecast 2018 program savings will last only one year. That means that only 88% of the new savings produced in any given year will still remain in the following year. Additional increments of savings "expire" or "die off" in most subsequent years.

Table 3: Distribution of DTE 2018 Plan Savings by Measure Life

	Years																		
Sector	1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	20	25	Total
C&I	8	7	2	2	-	-	1	23	10	3	44	0	26	194	49	4	2	1	377
Res	65	-	1	0	20	-	29	1	13	0	2	0	38	134	-	-	0	1	306
Low Inc	9	-	-	-	-	-	-	1	2	-	0	0	-	10	2	-	0	0	23
Total	83	7	2	2	20	-	31	24	25	3	47	0	64	338	51	4	3	2	707
% of Total	11.7%	1.0%	0.3%	0.3%	2.9%	0.0%	4.4%	3.4%	3.5%	0.5%	6.7%	0.1%	9.1%	47.8%	7.2%	0.6%	0.4%	0.2%	
% Remaining	100.0%	88.3%	87.3%	87.0%	86.7%	83.8%	83.8%	79.5%	76.0%	72.5%	72.0%	65.3%	65.3%	56.2%	8.4%	1.2%	0.6%	0.2%	

Q: How do you analyze the cumulative effects over time of that kind of distribution of savings by measure life?

A: As Table 4 shows, I separately estimate the year-by-year savings levels that each new year of programs will produce.

Table 4: Accounting for Measure Life Mix for DTE's 2.0% Efficiency Scenario

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
	Incremental Annual Savings in DTE 2.0% Scenario														
	594	584	1,009	1,020	1,042	1,024	1,042	557	356	320	331	341	364	334	371
	Persisting Savings from Each Efficiency Program Year														
2016	594	525	525	519	517	515	498	498	472	452	431	428	388	388	334
2017		584	516	516	510	508	506	490	490	464	444	423	421	382	381
2018			1,009	891	891	881	878	875	846	846	802	767	732	727	659
2019				1,020	901	901	891	887	884	855	855	811	776	740	735
2020					1,042	920	920	910	906	903	873	873	828	792	755
2021						1,024	904	904	894	891	888	858	858	814	779
2022							1,042	920	920	910	906	903	873	873	828
2023								557	492	492	486	484	483	467	467
2024									356	314	314	311	310	309	298
2025										320	283	283	279	278	277
2026											331	292	292	289	288
2027												341	301	301	298
2028													364	321	321
2029														334	295
2030															371
Total	**594**	**1,109**	**2,049**	**2,946**	**3,860**	**4,749**	**5,639**	**6,041**	**6,260**	**6,447**	**6,614**	**6,776**	**6,905**	**7,015**	**7,087**
	Total Persisting Savings as % of DTE Estimated Cumulative Savings														
	100%	**94%**	**94%**	**92%**	**91%**	**90%**	**89%**	**88%**	**87%**	**85%**	**84%**	**82%**	**80%**	**79%**	**76%**

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
	Incremental Annual Savings in DTE 2.0% Scenario									
	0	0	0	0	0	0	0	0	0	0
	Persisting Savings from Each Efficiency Program Year									
2016	50	7	7	4	4	1	1	1	1	1
2017	328	49	7	7	3	3	1	1	1	1
2018	659	567	85	12	12	6	6	2	2	2
2019	667	666	573	86	12	12	6	6	2	2
2020	751	681	680	585	88	12	12	6	6	2
2021	742	738	669	668	575	86	12	12	6	6
2022	792	755	751	681	680	585	88	12	12	6
2023	443	423	404	401	364	364	313	47	7	7
2024	298	283	271	258	256	233	232	200	30	4
2025	268	268	254	243	232	230	209	209	180	27
2026	287	277	277	263	252	240	238	216	216	186
2027	297	296	286	286	271	259	247	246	223	223
2028	318	317	316	305	305	289	277	264	262	238
2029	295	292	291	290	280	280	265	254	242	241
2030	328	328	324	323	322	311	311	295	282	269
Total	**6,522**	**5,946**	**5,194**	**4,412**	**3,656**	**2,913**	**2,220**	**1,772**	**1,474**	**1,216**
	Total Persisting Savings as % of DTE Estimated Cumulative Savings									
	75%	**73%**	**73%**	**73%**	**72%**	**72%**	**75%**	**73%**	**71%**	**70%**

Properly accounting for the mix of measure lives in a portfolio of efficiency programs in this way reduces the amount of savings assumed to be affecting loads in future years. For example, changing only this aspect of DTE's estimated impacts of its 2.0% efficiency scenario (i.e. keeping DTE's assumed incremental annual savings values for that scenario), this approach results in 9% less cumulative persisting annual savings by 2020, 15% less by 2025, 24% less by 2030 and 30% less by 2040.

E. Combined Effect of Adjustments to DTE's Efficiency Scenario Characterizations

Q: What did DTE estimate to be the amount of additional efficiency savings – over and above what is embedded in its forecast – that it could achieve?

A: The most aggressive efficiency scenario that DTE analyzed was what it called its 2.0% per year scenario. As previously discussed, efficiency savings under that scenario were only at or above 2.0% through 2022 and dropped to between 0.6% and 0.7% per year from 2024 through

2030. DTE assumed that its reference case forecast nominally had embedded in it average annual savings of about 1.15% per year. As **Table 5** shows, the difference between those two scenarios is effectively what DTE modeled in Strategist – i.e. a reduction in total sales of a little more than 2,000 GWh per year by 2022, with the difference then declining to almost nothing by 2030. By 2035, DTE's Reference Case scenario actually achieves greater levels of savings than its 2.0% efficiency scenario.

Table 5: DTE 2.0% Efficiency Scenario vs. Base Case (Cumulative GWh Savings)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2030	2035	2040
DTE Analysis													
2.00% EE (GWh)	594	1,178	2,187	3,207	4,249	5,273	6,315	6,872	7,228	7,548	9,289	5,054	1,746
EE in basecase forecast (GWh)	594	1,178	1,773	2,375	2,990	3,592	4,203	4,815	5,443	6,043	9,139	6,159	3,105
Increase in savings (GWh)	0	0	414	832	1,259	1,681	2,112	2,057	1,785	1,505	150	-1,105	-1,359

Q: What is the combined effect of the three adjustments you have made to DTE's characterization of the amount of additional efficiency savings that could be achieved – relative to what is in its forecast?

A: The combined effect of my adjustments is quite significant. As **Table 6** shows, I estimate that the increased savings relative to the base case forecast under a sustained 2.0% per year savings level would be nearly twice as great from 2020 through 2023, three times as great by 2025 and more than 40 times greater by 2030.

Table 6: Impact of Adjustments to DTE's Analysis of 2.0% Efficiency Scenario

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2030	2035	2040
DTE Analysis													
2.00% EE (GWh)	594	1,178	2,187	3,207	4,249	5,273	6,315	6,872	7,228	7,548	9,289	5,054	1,746
EE in basecase forecast (GWh)	594	1,178	1,773	2,375	2,990	3,592	4,203	4,815	5,443	6,043	9,139	6,159	3,105
Increase in savings (GWh)	0	0	414	832	1,259	1,681	2,112	2,057	1,785	1,505	150	-1,105	-1,359
Corrected Analysis													
2.00% EE (GWh)	698	1,315	2,155	2,981	3,788	4,577	5,333	6,078	6,779	7,447	10,252	6,515	2,919
EE in basecase forecast (GWh)	297	554	818	1,081	1,349	1,610	1,867	2,124	2,375	2,602	3,639	2,318	1,065
Increase in savings (GWh)	401	760	1,337	1,900	2,438	2,967	3,466	3,955	4,403	4,845	6,613	4,197	1,855
Change Resulting from Corrections													
2.00% EE (GWh)	104	137	-32	-226	-461	-696	-982	-794	-449	-101	963	1,461	1,173
EE in basecase forecast (GWh)	-297	-624	-955	-1,294	-1,641	-1,982	-2,336	-2,691	-3,068	-3,441	-5,500	-3,841	-2,040
Increase in savings (GWh)	401	760	923	1,068	1,179	1,286	1,354	1,898	2,618	3,340	6,463	5,302	3,214

Q: Are the values in the "Increase in savings (GWh)" row for the "Corrected Analysis" the values that Mr. Evans used in the Strategist runs in which he modeled different efficiency scenarios?

A: Yes. I provided all three rows of assumptions under the "Corrected Analysis" section of **Table 6** to Mr. Evans for use in his Alternative Strategist Run #1.[63]

Q: What about the cost side of the equation? Did you also estimate the incremental cost of these additional savings?

A: Yes. I estimated both the cost of my adjusted 2.0% efficiency savings per year scenario and the cost of the new efficiency program savings I assumed was embedded in DTE's Reference Case forecast. I provided both of those values, as well as the difference between the two, to Mr. Evans.

Q: What were the additional costs that you estimated would be associated with your 2% efficiency scenario?

A: As shown in **Table 7**, I estimate the costs of a sustained 2.0% efficiency scenario to be about $146 million in 2018 (the first year that the 2.0% savings level is achieved) and to rise steadily to $201 million by 2030.

Those estimates are based on DTE's estimated costs per kWh saved for its 2.0% scenario through 2022 – the last year DTE's 2.0% scenario actually shows savings on the order of 2% -

[63] I also provided Mr. Evans a similar set of values that only corrected the first two flaws that I have identified with DTE's efficiency analysis of its 1.5% efficiency scenario: (1) overstating the amount of efficiency embedded in its reference case forecast; and (2) overstating the life of efficiency savings. He used those values in modeling of his Strategist Case #0.

then escalating at a compound annual growth rate of 3.98%, which is the value DTE suggests it used for long-term modeling of efficiency program costs.[64]

DTE did not provide any estimates of the costs associated with the efficiency program savings it assumed were embedded in its Reference Case forecast. I estimated those costs using DTE's actual 2016 costs per unit of savings,[65] then escalated them at the same 3.98% compound annual growth rate.

Table 7: Incremental Cost of Sustained 2.0% Efficiency Scenario

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Corrected Analysis															
2.00% EE (Millions $)	$89	$93	$146	$153	$153	$157	$158	$163	$167	$172	$177	$184	$189	$195	$201
EE in base forecast (Millions $)	$38	$39	$41	$43	$46	$46	$49	$51	$55	$54	$58	$61	$65	$63	$68
Increase in cost (Millions $)	$51	$55	$105	$110	$107	$111	$109	$111	$113	$118	$119	$123	$124	$132	$133

F. Value of Additional Efficiency Benefits Excluded from DTE Analysis

Q: In section III(D) of your testimony you discuss the fact that DTE did not include the benefits that efficiency resources provide in reducing both T&D costs and ancillary services costs in its IRP analysis. Have you estimated what those differences would be under your revised analysis of the increase in savings that a sustained 2.0% annual level of savings would provide?

A: Yes. Based on the assumptions DTE used to assess cost-effectiveness of its efficiency scenarios (but did not include in its IRP), I estimate that my sustained 2.0% savings per year scenario will produce $2.3 billion in avoided T&D and avoided ancillary services costs. I also estimate that the level of efficiency program savings actually embedded in DTE's Reference

[64] Bilyeu testimony, p. 15, lines 18-20.

[65] Testimony of John Boladian in Case U-18332, p. 19 (for costs) and p. 21 (for savings). Savings were scaled up to account for T&D losses using an estimated 10.7% marginal line loss rate (in turn based on average line losses of 7.1% from Exh A-17, p. 2 and an assumption that marginal losses are about 50% higher than average losses).

Case load forecast would produce approximately $0.8 billion and that a corrected version of DTE's 1.5% efficiency scenario would provide about $1.8 billion in avoided T&D and avoided ancillary services costs.[66] Thus, my 2.0% scenario would provide approximately $1.5 billion more benefits than DTE's 2016 Reference Case and approximately $0.5 billion greater benefits than DTE's preferred 1.5% efficiency plan. Those additional benefits are not included in the Strategist outputs discussed by Mr. Evans.

Q: Does this conclude your testimony?

A: Yes.

[66] In this analysis, as discussed above, the amount of savings embedded in DTE's forecast is assumed to be half of what DTE estimated. For both the savings assumed to be embedded in DTE's forecast and the savings assumed in DTE's 1.5% efficiency scenario, as well as in my own 2.0% sustained efficiency scenario, savings are characterized based on the mix of measure lives discussed above. That is the "correction" to the DTE 1.5% efficiency scenario referenced in this sentence.

CHRISTOPHER NEME, PRINCIPAL

EDUCATION

M.P.P., University of Michigan, 1986
B.A.., Political Science, University of Michigan, 1985

EXPERIENCE

2010-present: Principal (and Co-Founder), Energy Futures Group, Hinesburg, VT
1999-2010: Director of Planning & Evaluation, Vermont Energy Investment Corp., Burlington, VT
1993-1999: Senior Analyst, Vermont Energy Investment Corp., Burlington, VT
1992-1993: Energy Consultant, Lawrence Berkeley National Laboratory, Gaborone, Botswana
1986-1991: Senior Policy Analyst, Center for Clean Air Policy, Washington, DC

PROFESSIONAL SUMMARY

Chris specializes in analysis of markets for energy efficiency, renewable energy and electrification measures and the design and evaluation of programs and policies to promote them. During his 25+ years in the clean energy industry, Mr. Neme has worked for energy regulators, utilities, government agencies and advocacy organizations in nearly 30 states, 5 Canadian provinces and several European countries. He has defended expert witness testimony before regulatory commissions in ten different jurisdictions; he has also testified before several state legislatures.

SELECTED PROJECTS

- ***Green Mountain Power (Vermont).*** Providing technical support on the development and implementation of GMP's plan for compliance with Vermont's RPS "Tier 3" requirement to reduce their customers' direct consumption of fossil fuels, with significant emphasis on strategic electrification strategies. Advisor on "Zero Energy Now" pilot program that simultaneously promotes efficiency, distributed renewables and space heat fuel switching to cold climate heat pumps. Also helped develop new program to introduce ultra-efficient cold-climate heat pumps to Vermont residential and small business markets. (2012 to present)
- ***Green Energy Coalition (Ontario).*** Representing a coalition of environmental groups in various regulatory proceedings. Present recommendations on DSM policies (including integrated resource planning on pipeline expansions), critically review and negotiate with utilities on proposed DSM Plans, and defend expert witness testimony. (1993 to present)
- ***Ontario Energy Board:*** Serve on provincial gas DSM Evaluation and Audit Committee, advisory committee on gas efficiency and heat pump fuel-switching potential study and advisory committee on carbon price forecast and emission abatement costs. Previously served on both provincial Technical Evaluation Committee overseeing gas DSM evaluation planning and Enbridge Gas's annual savings Audit Committee. (2000 to present)
- ***New Jersey Board of Public Utilities.*** Serve on multi-firm management team responsible for administration and delivery of statewide New Jersey Clean Energy Programs (annual budget of >$200 million). Lead strategic planning and program design for the team; also support regulatory filings, cost-effectiveness screening and evaluation work. (2015 to present).

CHRISTOPHER NEME, PRINCIPAL

- ***Natural Resources Defense Council (Illinois, Michigan and Ohio).*** Critically review multi-year DSM plans filed by Illinois, Michigan and Ohio utilities. Draft and defend regulatory testimony on critiques. Represent NRDC in regular stakeholder-utility meetings. Played lead role in development of Illinois clean energy bill adopted in late 2016. (2010 to present)
- ***E4TheFuture.*** Part of five-person team drafting a new National Standard Practice Manual for cost-effectiveness analysis of energy efficiency and other distributed resource measures. Manual will be published in April 2017, following several rounds of external review. (2016 to present)
- ***Regulatory Assistance Project - U.S.*** Provide guidance on efficiency policy and programs. Lead author on strategic reports on what it would take to achieve 30% electricity savings over 10 years, U.S. experience using efficiency to defer T&D system investments, and bidding efficiency resources into capacity markets. Also provide technical assistance to state regulators, technical support to various Energy Foundation grantees across the U.S., and assistance in RAP's work with the U.S. EPA on efficiency's role in carbon emission regulations. (2010 to present)
- ***Regulatory Assistance Project - Europe.*** Providing on-going technical support on efficiency policies and programs in the United Kingdom, Germany, and other countries. Reviewed draft European Union policies on Energy Savings Obligations, EM&V protocols, and related issues. Drafted policy brief on design considerations for efficiency feed-in-tariffs and roadmap for achieving deep retrofits in half the residential building stock. Reviewed "Roadmap 2050" report that examined how grid de-carbonization, vehicle/building electrification, demand response and efficiency could be combined to achieve 2050 carbon emission goals. (2009 to present)
- ***Northeast Energy Efficiency Partnerships.*** Helped managed Regional EM&V forum project estimating savings for emerging technologies, including field study of cold climate heat pumps installed in New Hampshire. Also, led project to assess national best practices and develop policy guidance on the use of efficiency to defer T&D investments. (2009 to 2015)
- ***Ontario Power Authority.*** Managed jurisdictional scans of how efficiency programs leverage building efficiency labeling/disclosure requirements and how non-energy benefits are addressed in cost-effectiveness screening. Also supported staff workshop on the role efficiency can play in deferring T&D investments. Presented assessment of future efficiency policy and program trends for Advisory Council on Energy Efficiency. (2012-2015)
- **Vermont Public Interest Research Group.** Conducted comparative analysis of the economic and environmental impacts of fuel-switching from oil/propane heating to either natural gas or efficient, cold climate electric heat pumps. Filed regulatory testimony on findings. (2014-2015)
- **Toronto Atmopheric Fund.** Drafted four issues papers regarding key aspects of Ontario's gas DSM policy framework. Papers were published by TAF (2014).
- ***National Association of Regulatory Utility Commissioners (NARUC).*** Assessed alternatives first year savings goals to eliminate disincentives to invest in longer-lived (but often more expensive) measures and programs. Work used by Michigan Public Service Commission staff to establish lifetime savings metrics for utility programs. (2013)
- ***New York State Energy Research and Development Authority (NYSERDA).*** Led analyses of residential efficiency potential (over 20 years) for New York State. (2001 to 2010)

MPSC Case No.: U-18419
Respondent: K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.5a
Page: 1 of 1

Question: On p. 14, line 1 of his testimony, Mr. Chreston shows the forecast PRMR for 2022 and 2023 were 10,744 MW and 10,722 MW, respectively.

a. Do these values assume no new energy efficiency program savings? If so, is it no new efficiency savings post-2017 or starting in some other year?

Answer: The values on p.14 of my testimony assumes the1.15% energy efficiency savings program and it is embedded in the load projection or the Forecasted Bundled Non-Coincident Peak Demand.

MPSC Case No.: U-18419
Respondent: K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.5b
Page: 1 of 1

Question: On p. 14, line 1 of his testimony, Mr. Chreston shows the forecast PRMR for 2022 and 2023 were 10,744 MW and 10,722 MW, respectively.

b. Or are these values net of the forecast 1.15% incremental annual savings assumed in the base resource plan or some other level of savings? If this is the case, what would be the comparable PRMR values absent any new efficiency programs post-2017?

Answer: Yes, the values are net of the forecast 1.15% incremental annual energy efficiency savings. The Company has not evaluated excluding any new efficiency programs since the mandated energy efficiency savings target is 1 percent. Therefore, the information needed to provide comparable PRMR values absent any new energy efficiency programs post-2017 does not exist.

MPSC Case No.: U-18419
Respondent: K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.6ai
Page: 1 of 1

Question: Regarding Exhibit A-10:

a. On pp. 1-2 of 6, the "Energy Efficiency Requirement" assumption for the "Proposed Course of Action Summary_2017 Reference Base" is shown as 1.00% each year. This is different than the 1.15% that Mr. Chreston states in his testimony (p. 41, line 10) was the "base resource plan" which was the foundation of "every scenario" run by the company. And both of these values are lower than the 1.50% that Mr. Chreston states in his testimony (p. 12, lines 12-13) "is the proposed course of action based on step 7 of the IRP process".

   i. Please explain the difference between these three values.

Answer: The 1% shown in Exhibit A-10 is the Energy Efficiency Requirement specified by the state. The 1.15% from Mr. Chreston's testimony is the Energy Efficiency level used in the Reference case. Finally, 1.5% is the Energy Efficiency level used in the 2017 Reference Scenario.

MPSC Case No.: U-18419
Respondent: K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.6aii
Page: 1 of 1

Question: Regarding Exhibit A-10:

a. On pp. 1-2 of 6, the “Energy Efficiency Requirement” assumption for the “Proposed Course of Action Summary_2017 Reference Base” is shown as 1.00% each year. This is different than the 1.15% that Mr. Chreston states in his testimony (p. 41, line 10) was the “base resource plan” which was the foundation of “every scenario” run by the company. And both of these values are lower than the 1.50% that Mr. Chreston states in his testimony (p. 12, lines 12-13) “is the proposed course of action based on step 7 of the IRP process”.

   ii. If 1.50% is the Company’s proposed course of action, why is that value not shown in the assumptions on pp. 1-2 of Exhibit A-10?

Answer: We are showing the Energy Efficiency requirement in Exhibit A-10. The legislative mandate is 1.0% energy savings as specified by 2008 PA 295 as amended by 2016 PA 342.

MPSC Case No.: U-18419
Respondent: K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.6aiii
Page: 1 of 1

Question: Regarding Exhibit A-10:

a. On pp. 1-2 of 6, the "Energy Efficiency Requirement" assumption for the "Proposed Course of Action Summary_2017 Reference Base" is shown as 1.00% each year. This is different than the 1.15% that Mr. Chreston states in his testimony (p. 41, line 10) was the "base resource plan" which was the foundation of "every scenario" run by the company. And both of these values are lower than the 1.50% that Mr. Chreston states in his testimony (p. 12, lines 12-13) "is the proposed course of action based on step 7 of the IRP process".

iii. If the answer to subpart "ii" of this question is that A-10 does not include changes made with updated assumptions in the 2017 Reference Scenario run in May-June of 2017 (per Mr. Chreston's testimony p. 33, lines 3-9), please provide a version of Exhibit A- 10 that includes all such updated assumptions and related modeling impacts.

Answer: Please refer to workpaper KJC-29 (EE Summary tab) for forecasted Energy Efficiency kwh savings between 1% and 1.5%.

MPSC Case No.: U-18419
Respondent: K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.6bi
Page: 1 of 1

Question: Regarding Exhibit A-10:

b. On pp. 1-2 of 6, the "annual change in customer energy requirements, GWh" starts off as a negative value (-268), becomes positive in 2020 (+67) and changes between positive and negative in the subsequent two decades.

   i. What are these changes relative to?

Answer: The 'Annual change in customer Energy requirements, GWh' is the GWh difference between the annual Net System Output (NSO) of two subsequent years. Depending on the load forecast year by year, the difference can be positive or negative values.

MPSC Case No.: U-18419
Respondent: K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.6bii
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Question: Regarding Exhibit A-10:

b. On pp. 1-2 of 6, the "annual change in customer energy requirements, GWh" starts off as a negative value (-268), becomes positive in 2020 (+67) and changes between positive and negative in the subsequent two decades.

  ii. What causes the values to alternate between negative and positive values?

Answer: The 'Annual change in customer Energy requirements, GWh' is the GWh difference between the annual Net System Output (NSO) of two subsequent years. Depending on the load forecast year by year, the difference can be positive or negative values.

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu/K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.6ci
Page: 1 of 1

Question: Regarding Exhibit A-10:

c. On pp. 3-4 of 6, the "energy efficiency impact" starts at 1178 MW in 2017, grows to 9289 MW in 2030 and then declines each year thereafter to 2097 MW.

i. Is the Company suggesting that its 2017 efficiency programs will produce 1178 MW of coincident peak savings? If not, what does this value represent?

Answer: No. The units on this exhibit were mislabeled in this section. The correct units are (GWh). Please reference Exhibit A-10 revised, attached. 1,178 represents the GWh attributable to EE in the 1.5% case in 2017.

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu/K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.6cii
Page: 1 of 1

Question: Regarding Exhibit A-10:

c. On pp. 3-4 of 6, the "energy efficiency impact" starts at 1178 MW in 2017, grows to 9289 MW in 2030 and then declines each year thereafter to 2097 MW.

ii. Is the Company suggesting that 1.0% efficiency savings per year will produce 9289 MW of coincident peak demand savings by 2030? If not, what does that value represent?

Answer: No. The units on this exhibit were mislabeled in this section. The correct units are (GWh). Please reference corrected exhibit A-10. 9289 represents the GWh attributable to EE in the 1.5% case in 2030.

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu/K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.6ciii
Page: 1 of 1

Question: Regarding Exhibit A-10:

c. On pp. 3-4 of 6, the “energy efficiency impact” starts at 1178 MW in 2017, grows to 9289 MW in 2030 and then declines each year thereafter to 2097 MW.

iii. Why do the values decline every year after 2030, particularly given that the energy efficiency requirements assumptions on pp. 1-2 of 6 remain constant at 1.0% per year?

Answer: In the IRP modeling, it was assumed that there was no spend and no incremental energy efficiency added after 2030 in all sensitivities. This was done to fully measure the impact of the measures implemented before 2030. The measure lives are assumed to be (15 years average); for modeling purposes cutting the program off at 2030 ensures enough time to observe the payback of the programs.

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu/K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.6civ
Page: 1 of 1

Question: Regarding Exhibit A-10:

c. On pp. 3-4 of 6, the "energy efficiency impact" starts at 1178 MW in 2017, grows to 9289 MW in 2030 and then declines each year thereafter to 2097 MW.

iv. How do the "energy efficiency impact" values for each year compare to the 1444 MW of "demand reduction resources (MW)" shown for 1% EE on p. 5 of 6 of Exhibit A-10?

Answer: The energy efficiency impact values on pp.3-4 of 6 should be in (GWh), and the values on pp. 5 of 6 are in (MW) so they do not compare. See Exhibit A-10 revised, attached. The correct comparison would be 1,444 MW (1.0%) to 1,591 MW (1.5%).

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu/K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.6di
Page: 1 of 1

Question: Regarding Exhibit A-10:

d. On p. 5 of 6, the “demand reduction resource (MW)” shown for EE is 1444 MW for 1%, 1591 MW for 1.5% and 1591 MW for 2%.

i. Are these incremental annual numbers, cumulative numbers through a particular year, or something else? If they are cumulative numbers, through what year are they cumulative?

Answer: These are the max coincident peak of the programs, as stated in footnote 2.

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu/K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.6dii
Page: 1 of 1

Question: Regarding Exhibit A-10:

d. On p. 5 of 6, the “demand reduction resource (MW)” shown for EE is 1444 MW for 1%, 1591 MW for 1.5% and 1591 MW for 2%.

ii. Please provide all workpapers, calculations, analyses and other relevant documentation showing how these 1444 MW for 1.0% EE, 1591 MW for 1.5% EE and 1591 MW for 2.0% EE were calculated.

Answer: Please see the following files provided to all intervenors at the prehearing conference for the calculations:

- Workpaper KJC-65, tab “page 3 Updated”, cell P10 for the 1% EE.
- Workpaper KJC-72, tab “page 3 Updated”, cell P10 for the 1.5% EE.
- Workpaper KJC-84, tab “page 3 Updated”, cell P11 for the 2.0% EE.

The three cells above reference workpaper KJC-29, tab “EE summary”, rows 13,14, and 15. The values from these three rows come from the following workpapers:

- KJC-27, tab ‘kWh Savings 8760’, row 163, and columns AC-BA for the ‘Capped 2%-1%’ case.
- KJC-28, tab ‘kWh Savings 8760’, row 163, and columns AC-BA for the ‘2%-1.5%’ case.
- KJC-25, tab ‘kWh Savings 8760’, row 163, and columns AC-BA for the ‘2% Uncapped’ case.

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu/K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.6ei
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Question: Regarding Exhibit A-10:

e. On p. 6 of 6, the "net demand reduction (MW)_2022" is 1579 for "base", 1522 for less than 1% EE, 1506 for 1.0% EE, 1685 for 1.5% EE and 1685 MW for 2.0% EE.

   i. How many years – and which years – of EE programs do these numbers include?

Answer: These are 14 years of cumulative EE coincident peak values starting in 2009, through 2022.

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu/K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.6eii
Page: 1 of 1

Question: Regarding Exhibit A-10:

e. On p. 6 of 6, the “net demand reduction (MW)_2022” is 1579 for “base”, 1522 for less than 1% EE, 1506 for 1.0% EE, 1685 for 1.5% EE and 1685 MW for 2.0% EE.

   ii. What is “base” and why is its peak savings greater than 1% EE? Is it the 1.15% referenced in Mr. Chreston’s testimony on p. 41, line 10?

Answer: The “base” is referring to the 1.15% EE case used in 2016, referenced in Mr. Chreston’s testimony on p. 41, line 10. It is greater than the 1.0% case because 1.15% is greater than 1.0%.

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu/K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.6eiii
Page: 1 of 1

Question: Regarding Exhibit A-10:

e. On p. 6 of 6, the "net demand reduction (MW)_2022" is 1579 for "base", 1522 for less than 1% EE, 1506 for 1.0% EE, 1685 for 1.5% EE and 1685 MW for 2.0% EE.

iii. How can the reduction from 1% EE be less than for less than 1% EE?

Answer: The higher peak demand reduction in the <1% is a result of the increased savings captured from the high cost-low potential bucket. Although the <1% achieves lower energy savings compared to the 1% scenario, the peak demand savings is higher in 2022 due to the higher savings from the high cost-low potential bucket, which includes end uses with a greater peak demand reduction such has weatherization and HVAC.

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu/K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.6eiv
Page: 1 of 1

Question: Regarding Exhibit A-10:

e. On p. 6 of 6, the "net demand reduction (MW)_2022" is 1579 for "base", 1522 for less than 1% EE, 1506 for 1.0% EE, 1685 for 1.5% EE and 1685 MW for 2.0% EE.

iv. Please provide workpapers showing how each of these values was calculated.

Answer: Please see the following workpapers provided to all intervenors at the prehearing conference:

- KJC-2, tab "page4 Updated", cell K8 for the "base".
- KJC-102, tab "page4 Updated", cell K9 for less than 1% EE.
- KJC-65, tab "page4 Updated", cell K10 for 1.0% EE.
- KJC-72, tab "page4 Updated", cell K10 for 1.5% EE.
- KJC-84, tab "page4 Updated", cell K11 for 2.0% EE.

MPSC Case No.: U-18419
Respondent: K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.7a
Page: 1 of 1

Question: Regarding Mr. Chreston's testimony p. 44, Figure 4:

a. what is the forecast GWh sales per year, from 2017 through 2040, under the base resource plan, as well as the 1.0%, 1.5% and 2% energy efficiency scenario sensitivities?

Answer: Please refer to the attachment identified as "U-18419-MECNRDCSCDE-1.7 Energy Efficiency Savings.xlsx"

MPSC Case No.: U-18419
Respondent: K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.7b
Page: 1 of 1

Question: Regarding Mr. Chreston's testimony p. 44, Figure 4:

b. Please provide calculations underpinning the forecasts for the three energy efficiency scenarios referenced in part "a" of this question.

Answer: Please refer to the attachment identified as "U-18419-MECNRDCSCDE-1.7 Energy Efficiency Savings.xlsx"

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	GWh															
2					**Energy Savings**								**EE Savings applied to load forecast**			
3			Year	Annual NSO with 1.15% EE	1%	1.15%	1.5%	2%			Year	Annual NSO with No EE	1%	1.15%	1.5%	2%
4			2017	44,853	1,178	1,178	1,178	1,178			2017	46,031	44,853	44,853	44,853	44,853
5			2018	45,272	1,773	1,773	1,933	2,187			2018	47,045	45,272	45,272	45,112	44,858
6			2019	45,368	2,375	2,375	2,682	3,207			2019	47,743	45,368	45,368	45,061	44,536
7			2020	45,315	2,990	2,990	3,442	4,249			2020	48,305	45,315	45,315	44,863	44,056
8			2021	45,212	3,506	3,592	4,181	5,273			2021	48,804	45,298	45,212	44,623	43,531
9			2022	45,107	4,030	4,203	4,968	6,315			2022	49,310	45,280	45,107	44,342	42,995
10			2023	45,052	4,553	4,815	5,757	6,872			2023	49,867	45,314	45,052	44,110	42,995
11			2024	45,027	5,090	5,443	6,563	7,228			2024	50,470	45,380	45,027	43,907	43,242
12			2025	45,050	5,600	6,043	7,198	7,548			2025	51,093	45,493	45,050	43,895	43,545
13			2026	45,127	6,125	6,661	7,723	7,879			2026	51,788	45,663	45,127	44,065	43,909
14			2027	45,117	6,652	7,282	8,208	8,220			2027	52,399	45,747	45,117	44,191	44,179
15			2028	45,107	7,196	7,921	8,584	8,584			2028	53,028	45,832	45,107	44,444	44,444
16			2029	45,086	7,702	8,520	8,918	8,918			2029	53,606	45,904	45,086	44,688	44,688
17			2030	45,058	8,225	9,139	9,289	9,289			2030	54,197	45,972	45,058	44,908	44,908
18			2031	45,022	7,633	8,546	8,697	8,697			2031	53,568	45,935	45,022	44,871	44,871
19			2032	44,982	7,070	7,986	8,138	8,138			2032	52,968	45,898	44,982	44,830	44,830
20			2033	44,931	6,455	7,368	7,360	7,105			2033	52,299	45,844	44,931	44,939	45,194
21			2034	44,922	5,852	6,766	6,609	6,084			2034	51,688	45,836	44,922	45,079	45,604
22			2035	44,900	5,245	6,159	5,859	5,054			2035	51,059	45,814	44,900	45,200	46,005
23			2036	44,867	4,733	5,563	5,124	4,029			2036	50,430	45,697	44,867	45,306	46,401
24			2037	44,824	4,197	4,938	4,323	2,976			2037	49,762	45,565	44,824	45,439	46,786
25			2038	44,774	3,675	4,327	3,536	2,420			2038	49,101	45,426	44,774	45,565	46,681
26			2039	44,724	3,151	3,713	2,745	2,082			2039	48,437	45,286	44,724	45,692	46,355
27			2040	44,671	2,634	3,105	2,097	1,746			2040	47,776	45,142	44,671	45,679	46,030

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.28a
Page: 1 of 1

Question: Regarding Exhibit A-17:

a. Does each of these forecasts include the effects of energy efficiency programs?

Answer: Yes, each of the forecasts shown on Exhibit A-17 include the effects of energy efficiency programs.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.28b
Page: 1 of 1

Question: Regarding Exhibit A-17:

b. What level of efficiency program savings per year is assumed in each of these forecasts?

Answer: Each of the forecasts shown on Exhibit A-17 assumes the effects of energy efficiency programs as seen in historical sales data. This historical information is then applied to the forecast.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.28c
Page: 1 of 1

Question: Regarding Exhibit A-17:

c. Please explain how – methodologically – the impacts of assumed future year efficiency program savings are included in the forecasts.

Answer: DTE Electric uses regression-based modeling which incorporates historical energy efficiency programs into the forecast and manually adjust the results based on knowledge about future energy efficiency programs.

MPSC Case No.: U-18419
Respondent: K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.5e
Page: 1 of 1

Question: Refer to DTE's Strategist base case (REF BASE) NPV of the revenue requirements for the 1.0%, 1.5% and 2.0% efficiency alternatives, respectively:

e. Please explain how DTE modeled the 1.5% savings scenario in Strategist.

Answer: For each energy efficiency sensitivity within Strategist, an energy sales transaction is created (EEZero) that effectively adds back the 1.15% energy savings embedded in the load forecast. The 1.5% energy savings program (EPEE) is modeled as a non-dispatch hourly transaction within the generation and fuel module and is equivalent to a system purchase at no cost.

A 1.5% energy efficiency alternative is created in Proview (EPEE) and is tied to the transaction resource (EPEE) modeled in the generation and fuel module.

The net present value of expenses is input into the project data table in the Capital Expenditure and Recovery module. Additional project costs by year are input to the Other Costs ($000) column located in the Project Data – Project, Year table. Refer to work paper KJC-29 for the program costs that were input into the Strategist model.

Please refer to the Strategist SAV file titled “Ref 1.5 pct EE”, which was provided to parties identified as modelers in Attachment 4 to the Protective order, to see details on how the 1.5% energy efficiency program sensitivity was modeled.

MPSC Case No.: U-18419
Respondent: K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.5ei
Page: 1 of 1

Question: Refer to DTE's Strategist base case (REF BASE) NPV of the revenue requirements for the 1.0%, 1.5% and 2.0% efficiency alternatives, respectively:

e. Please explain how DTE modeled the 1.5% savings scenario in Strategist.

i. How were the costs and benefits modeled?

Answer: Please refer to the response to question MECNRDCSCDE-4.5e.

MPSC Case No.:	U-18419
Respondent:	K. J. Chreston
Requestor:	MECNRDCSC
Question No.:	MECNRDCSCDE-4.5eii
Page:	1 of 1

Question: Refer to DTE's Strategist base case (REF BASE) NPV of the revenue requirements for the 1.0%, 1.5% and 2.0% efficiency alternatives, respectively:

e. Please explain how DTE modeled the 1.5% savings scenario in Strategist.

ii. Did DTE embed 1.15% savings in its reference case forecast?

Answer: Yes.

MPSC Case No.: U-18419
Respondent: K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.5eiii
Page: 1 of 1

Question: Refer to DTE's Strategist base case (REF BASE) NPV of the revenue requirements for the 1.0%, 1.5% and 2.0% efficiency alternatives, respectively:

e. Please explain how DTE modeled the 1.5% savings scenario in Strategist.

iii. If so, please state whether DTE modeled the 1.5% savings level by subtracting both the savings and cost associated with the 1.15% savings reference case assumption from the savings and cost of the 1.5% scenario. If not, please explain how the savings and costs of the 1.5% scenario were modeled.

Answer: Please refer to the response to question MECNRDCSCDE-4.5e.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.9a
Page: 1 of 1

Question: In response to MECDE-1.28c, DTE states that it “uses regression-based modeling which incorporates historical energy efficiency programs into the forecast and manually adjust the results based on knowledge about future energy efficiency programs.”

a. Was regression based modeling only used for non-residential sales?

Answer: No. Regression based modeling was also used for many markets in the Commercial and Industrial forecast.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.9b
Page: 1 of 1

Question: In response to MECDE-1.28c, DTE states that it "uses regression-based modeling which incorporates historical energy efficiency programs into the forecast and manually adjust the results based on knowledge about future energy efficiency programs."

b. How many years of historical sales data are included in DTE's regression-based modelling?

Answer: The regression-based models use annual historical data for varying time periods going back to 1990 through 2015.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.9ci
Page: 1 of 1

Question: In response to MECDE-1.28c, DTE states that it "uses regression-based modeling which incorporates historical energy efficiency programs into the forecast and manually adjust the results based on knowledge about future energy efficiency programs."

c. With regard to the manual adjustments:

i. Were such adjustments made only to non-residential sales?

Answer: No, manual adjustments were not only made to non-residential sales.

MPSC Case No.:	U-18419
Respondent:	M. B. Leuker
Requestor:	MECNRDCSC
Question No.:	MECNRDCSCDE-4.9cii
Page:	1 of 1

Question: In response to MECDE-1.28c, DTE states that it "uses regression-based modeling which incorporates historical energy efficiency programs into the forecast and manually adjust the results based on knowledge about future energy efficiency programs."

c. With regard to the manual adjustments:

ii. Please provide a copy of the reference scenario forecast without such manual adjustments, the specific manual adjustments made each year, the resulting final forecast and an explanation of the mathematical or other basis for each manual adjustment.

Answer: Forecasting is an iterative process. DTE Electric did not save a version after every iteration discussed, only the final forecast. Therefore, the reference scenario forecast without manual adjustments does not exist.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.9ciii
Page: 1 of 1

Question: In response to MECDE-1.28c, DTE states that it "uses regression-based modeling which incorporates historical energy efficiency programs into the forecast and manually adjust the results based on knowledge about future energy efficiency programs."c. With regard to the manual adjustments:

iii. Please provide all calculations associated with such manual adjustments in an Excel spreadsheet with formulae intact.

Answer: The requested data is not available. Please refer to response MECNRDCSCDE-4.9cii.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.9di
Page: 1 of 1

Question: In response to MECDE-1.28c, DTE states that it "uses regression-based modeling which incorporates historical energy efficiency programs into the forecast and manually adjust the results based on knowledge about future energy efficiency programs."

d. DTE has suggested that the Reference Scenario has embedded in it an assumed incremental annual efficiency program savings level of 1.15% (response to MECDE-1.6a).

i. Please explain whether DTE has verified hat a 1.15% level of new annual savings per year is embedded in the forecast. If so, please explain how that was done and provide an Excel file showing the calculations underpinning the analysis. If not, explain why not.

Answer: The residential class is developed using an end-use model where the number of residential customers, saturations of major appliances and the average electricity use per appliance is forecasted to yield annual electricity sales. This process is followed for each forecast created. DTE does not explicitly validate an assumed level of energy efficiency for the forecast period, however we implicitly analyze the forecast results with historical performance to ensure consistency and assure historical trends are captured.

The commercial and industrial class use regression-based modeling. Each of these forecasts do not explicitly test for a decline in sales equal to the energy efficiency program savings level of 1.15%, however historical results of energy efficiency programs are captured in the regression models and are used for future forecast development.

MPSC Case No.: U-18419
Respondent: M. B. Leuker/K. J. Chreston
K. L. Bilyeu
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-7.4a
Page: 1 of 1

Question: In response to MECNRDCSCDE-4.8c, DTE states that its load forecast "does not explicitly include savings from future energy efficiency programs," and that forecast savings levels "cannot be extracted from forecasted sales by year." However, in response to MECNRDCSCDE-4-11c, DTE provided attachment "MECNRDCSCDE-4.11c Reconstituted sales and peaks.xlsx," which contains first-year and cumulative energy efficiency levels assumed to be embedded in DTE's sales and load forecast, by year.

a. Please reconcile these responses. Explain how DTE can provide assumed energy efficiency savings levels associated with its Reference load forecast if such levels are embedded in the sales forecast and cannot be extracted from forecasted sales.

Answer: DTE Electric's load forecast did not explicitly include savings from future energy efficiency programs in its sales and peak demand forecasts. The data contained in the file "MECNRDCSCDE-4.11c Reconstituted sales and peaks.xlsx" was calculated to reflect Energy Efficiency levels as they were modeled in the IRP. Multiple Energy Efficiency levels were developed as IRP alternatives and are supported by witness Bilyeu. The file MECNRDCSCDE-4.11c Reconstituted sales and peaks.xlsx is reflective of the impact of the 1.15% EE level in the Reference and the impact of the 1.5% EE level in the 2017 Reference.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.8a
Page: 1 of 1

Question: In response to MECDE-1.28b, which asked what level of efficiency program savings per year is assumed in each of the forecasts in Exhibit A-17, which includes the Reference Scenario, DTE stated that "each of the forecasts…assumes the effects of energy efficiency programs as seen in historical sales data" and that "this historical information is then applied to the forecast."

a. Please explain how the historical information is "applied" to the forecast?

Answer: DTE Electric uses regression-based modeling which includes historical data. This historical data includes the impact of historical energy efficiency programs. These historical sales levels are then used in the regression models to create the forecast.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.8b
Page: 1 of 1

Question: In response to MECDE-1.28b, which asked what level of efficiency program savings per year is assumed in each of the forecasts in Exhibit A-17, which includes the Reference Scenario, DTE stated that "each of the forecasts…assumes the effects of energy efficiency programs as seen in historical sales data" and that "this historical information is then applied to the forecast."

b. Does the use of historic sales data in the regression analyses incorporate the effects of historic efficiency programs? If not, please explain what "applied to the forecast" means and how it was done.

Answer: Yes, the use of historical sales data in the regression analyses does incorporate the effects of historical efficiency programs.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.8c
Page: 1 of 1

Question: In response to MECDE-1.28b, which asked what level of efficiency program savings per year is assumed in each of the forecasts in Exhibit A-17, which includes the Reference Scenario, DTE stated that "each of the forecasts…assumes the effects of energy efficiency programs as seen in historical sales data" and that "this historical information is then applied to the forecast."

c. With regards to each of the load forecasts set forth in Exhibit A-17, identify the level of savings in GWhs from energy efficiency programs that is reflected in the forecasted sales for each year.

Answer: The forecast does not explicitly include savings from future energy efficiency programs. Savings are implicitly included from historical energy efficiency programs; therefore, the requested data cannot be extracted from forecasted sales by year.

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu/K. J. Chreston
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.1civ
Page: 1 of 1

Question: On p. 57, lines 2-10, Mr. Chreston suggests that its 2017 Reference Scenario, which includes 15% renewables by 20201 and 1.5% incremental annual energy efficiency savings, would achieve the statutory target of 35% clean energy by 2025.

c. With regards to energy efficiency's contribution to the 35% by 2025:

iv. Please show all mathematical calculations demonstrating how the efficiency contribution to the 35% by 2025 target was estimated.

Answer: Please see attached document "U-18419-MECNRDCSCDE-1.1civ Energy Efficiency Contribution.xlsx."

YR	Annual Energy Efficnecy Savings	Sum of Annual Energy Efficnecy Savings
2009	0.4%	0.4%
2010	0.90%	1.3%
2011	1.30%	2.6%
2012	1.30%	3.9%
2013	1.30%	5.2%
2014	1.50%	6.7%
2015	1.30%	8.0%
2016	1.30%	9.3%
2017	1.30%	10.6%
2018	1.50%	12.1%
2019	1.50%	13.6%
2020	1.50%	15.1%
2021	1.50%	16.6%
2022	1.50%	18.1%
2023	1.50%	19.6%
2024	1.50%	21.1%
2025	1.25%	22.4%

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.10a
Page: 1 of 1

Question: On pp. 10-11 of his testimony, Mr. Leuker states that the residential sales forecast was developed using an end-use method for which three separate items were forecast: (1) number of residential customers; (2) saturations of major appliances; and (3) average electricity use per appliance. In response to MECDE-1.30, DTE provided an attachment that showed each of those three sets of assumptions. With regard to the third of those factors – i.e., assumed annual kWh consumption per appliance:

a. Please summarize how this factor was developed.

Answer: To determine the decrease in average usage due to an efficiency standard, the expected usage in the year prior to the effective date of the standard is multiplied by the percentage change in the efficiency standard. This determines the total decline in the average usage of that appliance due to the efficiency standard. This amount is then phased in over the average life of the appliance by dividing the total decline by the average life of the appliance in years. This yields the annual drop in usage for the appliance and is subtracted from the prior year's usage each year of the life of that appliance.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.10b
Page: 1 of 1

Question: On pp. 10-11 of his testimony, Mr. Leuker states that the residential sales forecast was developed using an end-use method for which three separate items were forecast: (1) number of residential customers; (2) saturations of major appliances; and (3) average electricity use per appliance. In response to MECDE-1.30, DTE provided an attachment that showed each of those three sets of assumptions. With regard to the third of those factors – i.e., assumed annual kWh consumption per appliance:

b. Was regression analysis used to develop any of the per appliance usage assumptions? If so, please explain how and for which end uses.

Answer: No, regression analysis was not used to develop any of the per appliance usage assumptions.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.10c
Page: 1 of 1

Question: On pp. 10-11 of his testimony, Mr. Leuker states that the residential sales forecast was developed using an end-use method for which three separate items were forecast: (1) number of residential customers; (2) saturations of major appliances; and (3) average electricity use per appliance. In response to MECDE-1.30, DTE provided an attachment that showed each of those three sets of assumptions. With regard to the third of those factors – i.e., assumed annual kWh consumption per appliance:

c. The use per appliance forecast provided in response to MECDE-1.30 identifies a number of end uses and years for which assumptions appear to have been developed in a manner intended to reflect the impact of product efficiency standards (highlighted in yellow). Please explain how these assumptions were derived. To the extent that any mathematical calculations were used to generate each of these annual values, please provide those calculations and each of the assumptions used in those calculations.

Answer: Please refer to response MECNRDCSCDE-4.10a for an explanation of how the assumptions were derived. The impact of product efficiency standards can be seen in the attached Excel file, "U-18419 MECNRDCSCDE-4.10c Residential Efficiency Standard Calculations.xlsx."

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.10d
Page: 1 of 1

Question: On pp. 10-11 of his testimony, Mr. Leuker states that the residential sales forecast was developed using an end-use method for which three separate items were forecast: (1) number of residential customers; (2) saturations of major appliances; and (3) average electricity use per appliance. In response to MECDE-1.30, DTE provided an attachment that showed each of those three sets of assumptions. With regard to the third of those factors – i.e., assumed annual kWh consumption per appliance:

d. The response to MECDE-1.30 reports that the average consumption for central air conditioners was estimated to change from 1558 kWh/year in 2015 to 1544 kWh/year in 2016 to 1530 kWh/year in 2017 and so on down to 1367 kWh/year in 2030. Please explain how DTE estimated that the average annual kWh consumption for central air conditioners would decline by exactly 13 to 14 kWh per year for the next 15 years.

Answer: Please refer to the Excel file, “U-18419 MECNRDCSCDE-4.10c Residential Efficiency Standard Calculations.xlsx”, specifically the CentAC tab, to see how DTE estimated the average annual kWh consumption decline for central air conditioners.

MPSC Case No.:	U-18419
Respondent:	M. B. Leuker
Requestor:	MECNRDCSC
Question No.:	MECNRDCSCDE-4.10ei
Page:	1 of 1

Question: On pp. 10-11 of his testimony, Mr. Leuker states that the residential sales forecast was developed using an end-use method for which three separate items were forecast: (1) number of residential customers; (2) saturations of major appliances; and (3) average electricity use per appliance. In response to MECDE-1.30, DTE provided an attachment that showed each of those three sets of assumptions. With regard to the third of those factors – i.e., assumed annual kWh consumption per appliance:

e. It appears as if the assumed consumption per unit is held constant for every end use other than (1) those affected by product efficiency standards (highlighted in yellow); (2) refrigerators for which a 2013 EIA intensity forecast was used (highlighted in blue): (3) DVRs, cable TV boxes, and satellite dishes for which voluntary efficiency standards were the basis for the assumptions and (4) miscellaneous uses.

i. Is that correct? If not, explain why not.

Answer: Yes, that is correct.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.10eii
Page: 1 of 1

Question: On pp. 10-11 of his testimony, Mr. Leuker states that the residential sales forecast was developed using an end-use method for which three separate items were forecast: (1) number of residential customers; (2) saturations of major appliances; and (3) average electricity use per appliance. In response to MECDE-1.30, DTE provided an attachment that showed each of those three sets of assumptions. With regard to the third of those factors – i.e., assumed annual kWh consumption per appliance:

e. It appears as if the assumed consumption per unit is held constant for every end use other than (1) those affected by product efficiency standards (highlighted in yellow); (2) refrigerators for which a 2013 EIA intensity forecast was used (highlighted in blue): (3) DVRs, cable TV boxes, and satellite dishes for which voluntary efficiency standards were the basis for the assumptions and (4) miscellaneous uses.

ii. Please explain how the forecast accounts for any effects of future residential efficiency programs (i.e. those associated with the 1.15% efficiency savings per year scenario DTE has stated are applied to its reference scenario forecast)?

Answer: Please refer to response MECNRDCSCDE-4.9di.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.10eiii
Page: 1 of 1

Question: On pp. 10-11 of his testimony, Mr. Leuker states that the residential sales forecast was developed using an end-use method for which three separate items were forecast: (1) number of residential customers; (2) saturations of major appliances; and (3) average electricity use per appliance. In response to MECDE-1.30, DTE provided an attachment that showed each of those three sets of assumptions. With regard to the third of those factors – i.e., assumed annual kWh consumption per appliance:

e. It appears as if the assumed consumption per unit is held constant for every end use other than (1) those affected by product efficiency standards (highlighted in yellow); (2) refrigerators for which a 2013 EIA intensity forecast was used (highlighted in blue): (3) DVRs, cable TV boxes, and satellite dishes for which voluntary efficiency standards were the basis for the assumptions and (4) miscellaneous uses.

iii. What is the basis for the miscellaneous end use forecast?

Answer: The miscellaneous end use category captures any changes not accounted for by the other end uses in the model. Appliances that are not specifically considered in the residential model include items such as phones, hair dryers, coffee makers, etc. These are included in the miscellaneous category.

MPSC Case No.:	U-18419
Respondent:	M. B. Leuker
Requestor:	MECNRDCSC
Question No.:	MECNRDCSCDE-4.10eiv
Page:	1 of 1

Question: On pp. 10-11 of his testimony, Mr. Leuker states that the residential sales forecast was developed using an end-use method for which three separate items were forecast: (1) number of residential customers; (2) saturations of major appliances; and (3) average electricity use per appliance. In response to MECDE-1.30, DTE provided an attachment that showed each of those three sets of assumptions. With regard to the third of those factors – i.e., assumed annual kWh consumption per appliance:

e. It appears as if the assumed consumption per unit is held constant for every end use other than (1) those affected by product efficiency standards (highlighted in yellow); (2) refrigerators for which a 2013 EIA intensity forecast was used (highlighted in blue): (3) DVRs, cable TV boxes, and satellite dishes for which voluntary efficiency standards were the basis for the assumptions and (4) miscellaneous uses.

iv. The miscellaneous forecast grows from 901 kWh/year in 2015 by roughly 33% to 1200 kWh/year in 2016. Please explain what accounts for such increase.

Answer: In addition to capturing other appliances, the miscellaneous category can be adjusted to account for changes in customer behavior from previous year actuals in order to forecast forward. The change from 2015 to 2016 was adjusted upward based on an increase in residential sales after consecutive years of sales decline.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-4.10ev
Page: 1 of 1

Question: On pp. 10-11 of his testimony, Mr. Leuker states that the residential sales forecast was developed using an end-use method for which three separate items were forecast: (1) number of residential customers; (2) saturations of major appliances; and (3) average electricity use per appliance. In response to MECDE-1.30, DTE provided an attachment that showed each of those three sets of assumptions. With regard to the third of those factors – i.e., assumed annual kWh consumption per appliance:

e. It appears as if the assumed consumption per unit is held constant for every end use other than (1) those affected by product efficiency standards (highlighted in yellow); (2) refrigerators for which a 2013 EIA intensity forecast was used (highlighted in blue): (3) DVRs, cable TV boxes, and satellite dishes for which voluntary efficiency standards were the basis for the assumptions and (4) miscellaneous uses.

v. The miscellaneous forecast grows from 1200 kWh/year in 2016 to 1819 kWh/year by 2030. Please explain what accounts for such increase.

Answer: The miscellaneous forecast grows because of the increasing adoption of electric vehicles, proliferation of “other” electronic devices and the incorporation of recent trends.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-7.5a
Page: 1 of 1

Question: Refer to your response to MECNRDCSCDE-4-9a.

a. Was regression-based modeling used in any way to develop your residential sales forecast? If so, explain how. If not, explain why not.

Answer: No, regression-based modeling was not used in any way to develop the residential sales forecast. The forecast was developed by using an end use model.

The response to MECNRDCSCDE-4.9a should have stated that regression-based modeling was used only for non-residential sales.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-7.5b
Page: 1 of 1

Question: Refer to your response to MECNRDCSCDE-4-9a.

b. Identify the markets in the Commercial and Industrial forecast for which regression based modeling was used, and what percent of the total Commercial and Industrial forecast used regression based modeling.

Answer: The Commercial forecast includes thirteen markets that use regression based modeling and make up 84% of the total Commercial forecast. These markets include Wholesale, Retail, Other Grocery, Restaurants, Offices, Lodging, Hospitals, Other Medical, Universities, Other Schools, Government, Other Services and Commercial Manufacturing.

The Industrial forecast includes ten markets that use regression based modeling, and make up 60% of the total Industrial forecast. These markets include Automotive Assembly, Automotive Stamping, Automotive Powertrain & Drivetrain, Automotive Technical, Automotive Part Suppliers, Chemical, Rubber & Miscellaneous Plastics, Metal Fabrication, Manufacturing Equipment, and Non-Metal Processing.

MPSC Case No.:	U-18419
Respondent:	M. B. Leuker
Requestor:	MECNRDCSC
Question No.:	MECNRDCSCDE-7.5c
Page:	1 of 1

Question: Refer to your response to MECNRDCSCDE-4-9a.

c. Identify the markets in the Commercial and Industrial forecast for which regression based modeling was not used, and explain why it was not used.

Answer: The Commercial forecast includes seven markets that do not use regression based modeling. The Food Processing, Transportation Communication and Utilities, Supermarkets, and Pumping markets do not produce a reliable regression. The Farms and Agricultural Supply markets are small and do not share a strong relationship with shifts in the local or national economy. The Apartments market is forecasted based on the growth rates of households.

The Industrial forecast includes six markets that do not use regression based modeling. The Automotive Foundry, Other Manufacturing, Mining, and Automotive Big Three Suppliers are small and do not share a strong relationship with shifts in the local or national economy. The Petroleum and Steel markets do not produce a reliable regression.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.30a
Page: 1 of 1

Question: On p. 10-11 of his testimony, Mr. Leuker states that DTE used an end use forecast for the residential sector.

a. Please provide a copy of that forecast, including all assumptions regarding numbers of customers, appliance saturations and average electricity use per appliance for each year of the forecast.

Answer: A copy of the residential forecast is provided in the attached PDF file "U-18419 MECNRDCSCDE-1.30a Residential Forecast".

Case No.: U-18419
Attachment: MECNRDCDE-1.30a
Respondent: M.B. Leuker
File Name: U-18419 MECNRDCDE-1.30a Residential Forecast

DTE Electric Company

3/30/2016 **2016-2040 RESIDENTIAL SALES FORECAST** Attorney/Client Privileged Work Product Prepared in Anticipation of Litigation **2016 Spring Forecast**

RESIDENTIAL SALES SUMMARY

	NO. OF CUSTOMERS (THOUS)	MODELED TOTAL	ACTUAL TN	ANNUAL GROWTH RATE	MODELED kWh PER CUST	ACTUAL TN kWh PER CUST
2000	1,913.4	14,068	13,854		7,352	7,240
2001	1,930.5	14,778	14,314	3.3%	7,655	7,415
2002	1,945.3	14,570	14,884	4.0%	7,490	7,651
2003	1,952.0	14,980	15,465	3.9%	7,674	7,922
2004	1,967.0	15,308	15,744	1.8%	7,782	8,004
2005	1,977.1	15,730	15,851	0.7%	7,956	8,017
2006	1,977.0	15,264	15,717	-0.8%	7,721	7,950
2007	1,967.3	15,300	15,808	0.6%	7,777	8,035
2008	1,950.8	15,356	15,466	-2.2%	7,872	7,928
2009	1,932.4	15,227	15,217	-1.6%	7,880	7,875
2010	1,922.8	14,961	14,980	-1.6%	7,781	7,791
2011	1,922.8	15,152	15,213	1.6%	7,880	7,912
2012	1,926.0	14,936	15,062	-1.0%	7,755	7,820
2013	1,935.1	15,188	15,248	1.2%	7,848	7,880
2014	1,943.9	14,864	15,115	-0.9%	7,646	7,776
2015	1,953.8	14,937	15,055	-0.4%	7,645	7,706
2016	1,960.8	14,871	14,871	-1.2%	7,584	7,584
2017	1,967.6	14,778	14,778	-0.6%	7,511	7,511
2018	1,974.7	14,720	14,720	-0.4%	7,454	7,454
2019	1,981.9	14,662	14,662	-0.4%	7,398	7,398
2020	1,989.2	14,625	14,625	-0.3%	7,352	7,352
2021	1,996.4	14,578	14,578	-0.3%	7,302	7,302
2022	2,003.5	14,540	14,540	-0.3%	7,257	7,257
2023	2,010.3	14,500	14,500	-0.3%	7,213	7,213
2024	2,017.0	14,459	14,459	-0.3%	7,169	7,169
2025	2,023.5	14,435	14,435	-0.2%	7,134	7,134
2026	2,029.8	14,421	14,421	-0.1%	7,104	7,104
2027	2,036.1	14,406	14,406	-0.1%	7,076	7,076
2028	2,042.0	14,392	14,392	-0.1%	7,048	7,048
2029	2,047.7	14,377	14,377	-0.1%	7,021	7,021
2030	2,053.3	14,363	14,363	-0.1%	6,995	6,995
2031	2,058.8	14,349	14,349	-0.1%	6,969	6,969
2032	2,064.2	14,334	14,334	-0.1%	6,944	6,944
2033	2,069.2	14,320	14,320	-0.1%	6,920	6,920
2034	2,074.3	14,306	14,306	-0.1%	6,897	6,897
2035	2,079.3	14,291	14,291	-0.1%	6,873	6,873
2036	2,084.3	14,277	14,277	-0.1%	6,850	6,850
2037	2,089.2	14,263	14,263	-0.1%	6,827	6,827
2038	2,094.0	14,249	14,249	-0.1%	6,804	6,804
2039	2,098.8	14,234	14,234	-0.1%	6,782	6,782
2040	2,103.4	14,220	14,220	-0.1%	6,760	6,760
'15-'16 CAGR	0.4%	-0.4%	-1.2%		-0.8%	-1.6%
'16-'17 CAGR	0.4%	-0.6%	-0.6%		-1.0%	-1.0%
'15-'21 CAGR	0.4%	-0.5%	-0.6%		-0.9%	-1.1%
'15-'26 CAGR	0.4%	-0.4%	-0.4%		-0.7%	-0.8%
'15-'40 CAGR	0.3%	-0.2%	-0.2%		-0.5%	-0.5%

Case No.: U-18419
Attachment: MECNRDCDE-1.30a
Respondent: M.B. Leuker
File Name: U-18419 MECNRDCDE-1.30a Residential Forecast

DTE Electric Company

3/30/2016 **2016-2040 RESIDENTIAL SALES FORECAST** Attorney/Client Privileged Work Product Prepared in Anticipation of Litigation **2016 Spring Forecast**

RESIDENTIAL CUSTOMER MODEL

YEAR	CUST CHANGE (Thous)	DET, AA & MONROE HOUSE PERMITS (Thous)	**RESIDENTIAL CUST (Thous)**	% Growth
2000	19.7	24.1	1913.4	1.04%
2001	17.1	22.5	1930.5	0.89%
2002	14.8	20.5	1945.3	0.77%
2003	6.7	22.3	1952.0	0.35%
2004	15.0	23.6	1967.0	0.77%
2005	10.0	25.7	1977.1	0.51%
2006	0.0	19.0	1977.0	0.00%
2007	-9.8	10.4	1967.3	-0.49%
2008	-16.4	5.3	1950.8	-0.84%
2009	-18.5	3.1	1932.4	-0.95%
2010	-9.5	1.7	1922.8	-0.49%
2011	0.0	3.7	1922.8	0.00%
2012	3.1	4.0	1926.0	0.16%
2013	9.2	4.9	1935.1	0.48%
2014	8.7	7.3	1943.9	0.45%
2015	9.9	7.1	1953.8	0.51%
2016	7.0	7.6	1960.8	0.36%
2017	6.9	7.9	1967.6	0.35%
2018	7.1	7.9	1974.7	0.36%
2019	7.1	8.1	1981.9	0.36%
2020	7.3	8.1	1989.2	0.37%
2021	7.2	7.8	1996.4	0.36%
2022	7.0	7.6	2003.5	0.35%
2023	6.9	7.4	2010.3	0.34%
2024	6.7	7.2	2017.0	0.33%
2025	6.5	7.0	2023.5	0.32%
2026	6.3	6.9	2029.8	0.31%
2027	6.2	6.6	2036.1	0.31%
2028	6.0	6.3	2042.0	0.29%
2029	5.7	6.2	2047.7	0.28%
2030	5.6	6.1	2053.3	0.27%
2031	5.5	5.9	2058.8	0.27%
2032	5.3	5.7	2064.2	0.26%
2033	5.1	5.6	2069.2	0.25%
2034	5.1	5.6	2074.3	0.24%
2035	5.0	5.6	2079.3	0.24%
2036	5.0	5.4	2084.3	0.24%
2037	4.9	5.4	2089.2	0.23%
2038	4.8	5.3	2094.0	0.23%
2039	4.8	5.2	2098.8	0.23%
2040	4.6	5.1	2103.4	0.22%
'15-'16 CAGR	-29.4%		0.4%	
'16-'17 CAGR	-1.7%		0.4%	
'15-'21 CAGR	-6.0%		0.4%	
'15-'26 CAGR	-4.4%		0.4%	
'15-'40 CAGR	-3.0%		0.3%	

YEAR	RESIDENTIAL CUST (Thous)
1999	1893.7

Case No.: U-18419
Attachment: MECNRDCDE-1.30a
Respondent: M.B. Leuker
File Name: U-18419 MECNRDCDE-1.30a Residential Forecast

DTE Electric Company

3/30/2016 **2016-2040 RESIDENTIAL SALES FORECAST** Attorney/Client Privileged Work Product Prepared in Anticipation of Litigation **2016 Spring Forecast**

USE PER APPLIANCE (KWH/YR)

	ROOM AC	CENTRAL AC	DRYER	WASHER	DEHUM	DISH WASHER	FREEZER FF	FREEZER STD	HTG FF	HTG BI	HTG PORT	HP COOL	HP HEAT	LIGHT GEN	VCR
2000	531	1581	817	94	361	288	1220	735	304	1014	203	950	2250	960	200
2001	531	1581	817	94	361	288	1220	735	304	1014	203	950	2250	960	200
2002	534	1581	817	94	361	288	1220	735	295	984	197	950	2250	960	200
2003	532	1581	816	94	359	288	1203	727	295	984	197	940	2250	960	200
2004	530	1581	815	94	357	288	1185	718	295	984	197	930	2250	960	200
2005	529	1581	814	94	355	288	1168	710	295	984	197	920	2250	960	200
2006	527	1560	813	94	353	285	1151	702	290	984	197	912	2229	960	200
2007	525	1548	812	94	351	285	1133	693	290	984	197	903	2209	970	200
2008	524	1536	811	94	349	285	1116	685	290	984	197	895	2188	980	200
2009	522	1524	809	94	347	285	1098	677	285	980	197	880	2160	1221	200
2010	520	1512	808	94	344	277	1081	668	285	980	197	872	2140	1193	200
2011	519	1499	807	94	340	269	1064	660	285	980	197	863	2119	1164	200
2012	556	1595	806	94	337	262	1046	652	253	869	175	855	2099	1135	200
2013	554	1583	805	94	334	251	1029	643	253	869	175	847	2078	1105	200
2014	550	1571	804	94	330	241	1007	628	253	869	175	838	2057	1074	200
2015	546	1558	797	93	327	230	985	613	253	869	175	828	2034	1031	200
2016	542	1544	791	92	326	220	963	598	253	869	175	818	2010	740	200
2017	537	1530	784	91	323	209	942	583	253	869	175	807	1987	667	200
2018	533	1517	778	89	320	199	920	567	253	869	175	797	1963	610	200
2019	529	1503	771	88	317	188	898	552	249	869	175	787	1940	554	200
2020	525	1489	764	86	314	178	876	537	245	869	175	777	1916	508	200
2021	520	1476	758	84	311	167	854	522	241	869	175	767	1892	458	200
2022	516	1462	751	83	308	157	832	507	237	869	175	757	1869	413	200
2023	512	1448	745	81	305	146	810	492	234	869	175	746	1845	369	200
2024	509	1435	738	79	302	144	788	476	230	869	175	745	1842	325	200
2025	507	1421	731	77	299	141	767	461	226	869	175	743	1839	290	200
2026	504	1407	725	76	296	141	745	446	222	869	175	741	1837	290	200
2027	501	1394	718	74	293	141	723	431	218	869	175	739	1834	290	200
2028	499	1380	711	72	290	141	701	416	214	869	175	738	1831	290	200
2029	496	1367	705	71	287	141	679	400	210	869	175	736	1828	290	200
2030	493	1353	698	70	285	141	657	385	206	869	175	734	1825	290	200
2031	491	1339	692	70	282	141	635	370	203	869	175	732	1822	290	200
2032	488	1326	685	70	282	141	613	355	199	869	175	731	1819	290	200
2033	488	1312	685	70	282	141	592	340	195	869	175	731	1819	290	200
2034	488	1298	685	70	282	141	570	324	191	869	175	731	1819	290	200
2035	488	1285	685	70	282	141	565	317	187	869	175	731	1819	290	200
2036	488	1271	685	70	282	141	561	311	183	869	175	731	1819	290	200
2037	488	1257	685	70	282	141	556	304	179	869	175	731	1819	290	200
2038	488	1244	685	70	282	141	556	304	175	869	175	731	1819	290	200
2039	488	1242	685	70	282	141	556	304	172	869	175	731	1819	290	200
2040	488	1241	685	70	282	141	556	304	168	869	175	731	1819	290	200

Reflect Efficiency Standards

Case No.: U-18419
DTE Electric Company **Attachment: MECNRDCDE-1.30a**
Respondent: M.B. Leuker
File Name: U-18419 MECNRDCDE-1.30a Residential Forecast

3/30/2016 **2016-2040 RESIDENTIAL SALES FORECAST** Attorney/Client Privileged Work Product Prepared in Anticipation of Litigation **2016 Spring Forecast**

USE PER APPLIANCE (KWH/YR)

	LIGHT OPL	LIGHT POST	MICRO-WAVE	RANGE SC	RANGE STD	REFRIG FF	REFRIG 2ND	REFRIG STD	SPACE HTG	TV B&W	TV COLOR	WATER BED	WATER HTR	MISC
2000	888	322	210	785	758	1125	768	475	8350	86	502	1300	4000	360
2001	903	320	210	785	758	1120	764	465	8350	86	502	1300	4000	360
2002	914	320	210	785	758	1081	762	457	8324	86	502	1300	4000	403
2003	911	320	210	784	758	1041	760	449	8324	86	502	1300	3990	30
2004	909	320	210	783	755	1002	758	442	8324	86	500	1300	3976	45
2005	908	320	210	782	755	963	756	434	8324	86	500	1300	3962	108
2006	890	320	210	781	755	923	754	426	8324	86	195	1300	3947	592
2007	899	320	210	780	755	884	752	418	8324	86	195	1300	3933	611
2008	911	320	210	779	755	845	750	411	8324	86	195	1300	3919	615
2009	905	320	210	775	750	805	748	403	8324	86	195	1300	3905	318
2010	897	320	210	774	750	766	746	395	8324	86	206	1300	3890	180
2011	916	320	210	773	750	726	744	387	8324		206	1300	3876	477
2012	911	320	210	772	746	687	742	379	7550		206	1300	3862	519
2013	905	320	210	771	746	648	740	372	7550		207	1300	3848	810
2014	903	320	210	770	746	638	730	366	7550		208	1300	3833	747
2015	906	320	210	770	746	629	722	361	7550		209	1300	3811	901
2016	906	320	202	770	746	621	715	356	7550		211	1300	3788	1200
2017	906	320	193	770	746	614	709	352	7550		213	1300	3766	1268
2018	906	320	185	770	746	607	703	348	7550		215	1300	3757	1358
2019	906	320	176	770	746	601	698	345	7550		217	1300	3749	1446
2020	906	320	168	770	746	596	693	342	7550		219	1300	3741	1524
2021	906	320	160	770	746	591	689	339	7550		221	1300	3732	1598
2022	906	320	151	770	746	586	685	337	7550		223	1300	3724	1669
2023	906	320	143	770	746	582	682	334	7550		225	1300	3716	1729
2024	906	320	134	770	746	579	679	332	7550		227	1300	3707	1778
2025	906	320	126	770	746	576	677	330	7550		229	1300	3699	1815
2026	906	320	118	770	746	573	675	329	7550		231	1300	3691	1821
2027	906	320	109	770	746	571	673	328	7550		233	1300	3683	1826
2028	906	320	109	770	746	569	672	327	7550		235	1300	3674	1823
2029	906	320	109	770	746	568	671	326	7550		237	1300	3666	1821
2030	906	320	109	770	746	566	670	325	7550		239	1300	3666	1819
2031	906	320	109	770	746	565	669	324	7550		241	1300	3666	1817
2032	906	320	109	770	746	564	668	323	7550		243	1300	3666	1814
2033	906	320	109	770	746	562	667	323	7550		245	1300	3666	1808
2034	906	320	109	770	746	561	666	322	7550		247	1300	3666	1801
2035	906	320	109	770	746	560	665	322	7550		249	1300	3666	1788
2036	906	320	109	770	746	560	665	322	7550		251	1300	3666	1774
2037	906	320	109	770	746	560	665	322	7550		253	1300	3666	1760
2038	906	320	109	770	746	560	665	322	7550		255	1300	3666	1744
2039	906	320	109	770	746	560	665	322	7550		257	1300	3666	1719
2040	906	320	109	770	746	560	665	322	7550		259	1300	3666	1694

Reflect Efficiency Standards
Reflect 2013 EIA Intensity forecast

Case No.: U-18419
Attachment: MECNRDCDE-1.30a
Respondent: M.B. Leuker
File Name: U-18419 MECNRDCDE-1.30a Residential Forecast

DTE Electric Company

3/30/2016 **2016-2040 RESIDENTIAL SALES FORECAST** Attorney/Client Privileged Work Product Prepared in Anticipation of Litigation **2016 Spring Forecast**

USE PER APPLIANCE (KWH/YR)

	DVR	DVD PLAYER	CABLE TV BOXES	SATELL DISH	FAX MACHINE	POOL PUMP	HOT TUB	DIGITAL TV CONVERT	DESKTOP COMPUT	LAPTOP COMPUT	PRINT/SCAN COPY/FAX
2000									308		
2001									308		
2002									308		
2003	350	41	125	145	174	103	2650		316		
2004	350	41	125	145	174	103	2650		324		
2005	350	41	125	145	174	103	2650		332		
2006	350	41	125	145	174	103	2650		337		
2007	350	41	125	145	174	103	2650		342		
2008	350	41	125	145	174	103	2650		347		
2009	350	41	125	145	174	103	2650	35	325		
2010	350	41	125	145	174	103	2650	35	330		
2011	350	41	125	145	174	103	2650	35	281	54	
2012	267	41	139	110	174	103	2650	35	286	54	
2013	266	41	139	110	174	103	2650	35	159	55	131
2014	256	41	137	108	174	103	2650	35	161	56	133
2015	245	41	135	107	174	103	2650	35	163	57	135
2016	234	41	133	105	174	103	2650	35	163	57	135
2017	223	41	131	103	174	103	2650	35	163	57	135
2018	212	41	129	100	174	103	2650	35	147	51	121
2019	201	41	128	98	174	103	2650	35	132	46	109
2020	201	41	128	97	174	103	2650	35	119	41	98
2021	201	41	128	96	174	103	2650	35	107	37	88
2022	201	41	128	95	174	103	2650	35	97	34	80
2023	201	41	128	95	174	103	2650	35	87	30	72
2024	201	41	128	95	174	103	2650	35	78	27	64
2025	201	41	128	95	174	103	2650	35	78	27	64
2026	201	41	128	95	174	103	2650	35	78	27	64
2027	201	41	128	95	174	103	2650	35	78	27	64
2028	201	41	128	95	174	103	2650	35	78	27	64
2029	201	41	128	95	174	103	2650	35	78	27	64
2030	201	41	128	95	174	103	2650	35	78	27	64
2031	201	41	128	95	174	103	2650	35	78	27	64
2032	201	41	128	95	174	103	2650	35	78	27	64
2033	201	41	128	95	174	103	2650	35	78	27	64
2034	201	41	128	95	174	103	2650	35	78	27	64
2035	201	41	128	95	174	103	2650	35	78	27	64
2036	201	41	128	95	174	103	2650	35	78	27	64
2037	201	41	128	95	174	103	2650	35	78	27	64
2038	201	41	128	95	174	103	2650	35	78	27	64
2039	201	41	128	95	174	103	2650	35	78	27	64
2040	201	41	128	95	174	103	2650	35	78	27	64

Reflect Efficiency Standards
Reflect Voluntary Efficiency Standards

Case No.: U-18419
Attachment: MECNRDCDE-1.30a
Respondent: M.B. Leuker
File Name: U-18419 MECNRDCDE-1.30a Residential Forecast

DTE Electric Company

3/30/2016 **2016-2040 RESIDENTIAL SALES FORECAST** Attorney/Client Privileged Work Product Prepared in Anticipation of Litigation **2016 Spring Forecast**

APPLIANCE SATURATIONS

	ROOM AC	CENTRAL AC	DRYER	WASHER	DEHUM	DISH WASHER	FREEZER FF	FREEZER STD	HTG FF	HTG BI	HTG PORT	HP COOL	HP HEAT	LIGHT GEN	VCR
2000	0.334	0.564	0.339	0.837	0.269	0.566	0.086	0.177	0.806	0.019	0.057	0.005	0.013	1.000	0.889
2001	0.289	0.627	0.340	0.889	0.309	0.617	0.104	0.223	0.823	0.016	0.068	0.007	0.010	1.000	0.906
2002	0.302	0.605	0.314	0.851	0.283	0.599	0.100	0.201	0.823	0.015	0.058	0.006	0.007	1.000	0.894
2003	0.290	0.650	0.360	0.884	0.320	0.608	0.096	0.216	0.818	0.018	0.074	0.006	0.010	1.000	0.888
2004	0.288	0.655	0.394	0.912	0.293	0.610	0.119	0.214	0.811	0.020	0.086	0.005	0.015	1.000	0.864
2005	0.285	0.659	0.428	0.940	0.266	0.611	0.141	0.211	0.804	0.022	0.098	0.004	0.019	1.000	0.840
2006	0.280	0.684	0.400	0.947	0.306	0.641	0.138	0.238	0.829	0.017	0.109	0.006	0.017	1.000	0.836
2007	0.274	0.709	0.372	0.954	0.345	0.670	0.134	0.264	0.853	0.012	0.120	0.007	0.015	1.000	0.832
2008	0.252	0.730	0.368	0.956	0.354	0.715	0.144	0.267	0.859	0.014	0.147	0.009	0.012	1.000	0.782
2009	0.229	0.750	0.364	0.958	0.362	0.760	0.153	0.270	0.865	0.016	0.173	0.011	0.008	1.000	0.731
2010	0.228	0.758	0.376	0.947	0.354	0.732	0.156	0.275	0.865	0.016	0.168	0.010	0.008	1.000	0.681
2011	0.226	0.766	0.387	0.936	0.346	0.704	0.159	0.279	0.865	0.015	0.162	0.009	0.008	1.000	0.630
2012	0.250	0.765	0.394	0.924	0.380	0.718	0.152	0.270	0.855	0.018	0.162	0.010	0.013	1.000	0.529
2013	0.274	0.763	0.402	0.912	0.413	0.731	0.144	0.261	0.845	0.020	0.162	0.011	0.017	1.000	0.427
2014	0.279	0.763	0.409	0.902	0.402	0.731	0.144	0.247	0.835	0.020	0.169	0.011	0.016	1.000	0.392
2015	0.283	0.763	0.416	0.892	0.391	0.730	0.144	0.233	0.824	0.020	0.176	0.011	0.015	1.000	0.357
2016	0.283	0.764	0.416	0.894	0.391	0.731	0.145	0.233	0.825	0.020	0.176	0.011	0.015	1.000	0.307
2017	0.283	0.765	0.416	0.895	0.391	0.732	0.146	0.233	0.826	0.020	0.176	0.011	0.015	1.000	0.257
2018	0.283	0.766	0.416	0.897	0.391	0.733	0.147	0.233	0.827	0.020	0.176	0.011	0.015	1.000	0.207
2019	0.283	0.767	0.416	0.898	0.391	0.734	0.148	0.233	0.828	0.020	0.176	0.011	0.015	1.000	0.157
2020	0.283	0.768	0.416	0.900	0.391	0.735	0.149	0.233	0.829	0.020	0.176	0.011	0.015	1.000	0.107
2021	0.283	0.769	0.416	0.901	0.391	0.736	0.150	0.233	0.830	0.020	0.176	0.011	0.015	1.000	0.057
2022	0.283	0.770	0.416	0.903	0.391	0.737	0.151	0.233	0.831	0.020	0.176	0.011	0.015	1.000	0.007
2023	0.283	0.771	0.416	0.904	0.391	0.738	0.152	0.233	0.832	0.020	0.176	0.011	0.015	1.000	0.000
2024	0.283	0.772	0.416	0.906	0.391	0.739	0.153	0.233	0.833	0.020	0.176	0.011	0.015	1.000	0.000
2025	0.283	0.773	0.416	0.907	0.391	0.740	0.154	0.233	0.834	0.020	0.176	0.011	0.015	1.000	0.000
2026	0.283	0.774	0.416	0.908	0.391	0.741	0.155	0.233	0.835	0.020	0.176	0.011	0.015	1.000	0.000
2027	0.283	0.775	0.416	0.910	0.391	0.742	0.156	0.233	0.836	0.020	0.176	0.011	0.015	1.000	0.000
2028	0.283	0.776	0.416	0.911	0.391	0.743	0.157	0.233	0.837	0.020	0.176	0.011	0.015	1.000	0.000
2029	0.283	0.777	0.416	0.913	0.391	0.744	0.158	0.233	0.838	0.020	0.176	0.011	0.015	1.000	0.000
2030	0.283	0.778	0.416	0.914	0.391	0.745	0.159	0.233	0.839	0.020	0.176	0.011	0.015	1.000	0.000
2031	0.283	0.779	0.416	0.916	0.391	0.746	0.160	0.233	0.840	0.020	0.176	0.011	0.015	1.000	0.000
2032	0.283	0.780	0.416	0.917	0.391	0.747	0.161	0.233	0.841	0.020	0.176	0.011	0.015	1.000	0.000
2033	0.283	0.781	0.416	0.919	0.391	0.748	0.162	0.233	0.842	0.020	0.176	0.011	0.015	1.000	0.000
2034	0.283	0.782	0.416	0.920	0.391	0.749	0.163	0.233	0.843	0.020	0.176	0.011	0.015	1.000	0.000
2035	0.283	0.783	0.416	0.922	0.391	0.750	0.164	0.233	0.844	0.020	0.176	0.011	0.015	1.000	0.000
2036	0.283	0.784	0.416	0.923	0.391	0.751	0.165	0.233	0.845	0.020	0.176	0.011	0.015	1.000	0.000
2037	0.283	0.785	0.416	0.925	0.391	0.752	0.166	0.233	0.846	0.020	0.176	0.011	0.015	1.000	0.000
2038	0.283	0.786	0.416	0.926	0.391	0.753	0.167	0.233	0.847	0.020	0.176	0.011	0.015	1.000	0.000
2039	0.283	0.787	0.416	0.928	0.391	0.754	0.168	0.233	0.848	0.020	0.176	0.011	0.015	1.000	0.000
2040	0.283	0.788	0.416	0.929	0.391	0.755	0.169	0.233	0.849	0.020	0.176	0.011	0.015	1.000	0.000

Saturation Survey data -- weighted by kWh usage and age of head of household

Saturation can not drop below 0

Case No.: U-18419
Attachment: MECNRDCDE-1.30a
Respondent: M.B. Leuker
File Name: U-18419 MECNRDCDE-1.30a Residential Forecast

DTE Electric Company

3/30/2016 **2016-2040 RESIDENTIAL SALES FORECAST** Attorney/Client Privileged Work Product Prepared in Anticipation of Litigation **2016 Spring Forecast**

APPLIANCE SATURATIONS

	LIGHT OPL	LIGHT POST	MICRO-WAVE	RANGE SC	RANGE STD+CNVC	REFRIG FF	REFRIG 2ND	REFRIG STD	SPACE HTG	TV B&W	TV COLOR	WATER BED	WATER HTR	MISC
2000	0.007	0.146	0.945	0.225	0.286	0.895	0.201	0.104	0.016	0.111	0.992	0.045	0.057	1.000
2001	0.006	0.158	0.966	0.247	0.282	0.904	0.260	0.094	0.021	0.095	0.993	0.036	0.061	1.000
2002	0.006	0.144	0.949	0.239	0.272	0.891	0.250	0.108	0.018	0.104	0.986	0.040	0.054	1.000
2003	0.005	0.145	0.958	0.252	0.270	0.911	0.251	0.088	0.018	0.084	0.990	0.031	0.053	1.000
2004	0.005	0.151	0.960	0.232	0.262	0.902	0.269	0.098	0.017	0.076	0.992	0.033	0.050	1.000
2005	0.005	0.156	0.962	0.212	0.253	0.893	0.287	0.108	0.017	0.067	0.994	0.034	0.049	1.000
2006	0.005	0.145	0.965	0.236	0.261	0.906	0.308	0.096	0.017	0.061	0.993	0.030	0.048	1.000
2007	0.005	0.133	0.967	0.259	0.269	0.919	0.329	0.083	0.017	0.054	0.992	0.026	0.047	1.000
2008	0.005	0.140	0.972	0.270	0.261	0.926	0.345	0.075	0.017	0.050	0.994	0.028	0.047	1.000
2009	0.005	0.146	0.976	0.280	0.253	0.933	0.360	0.066	0.017	0.046	0.995	0.029	0.046	1.000
2010	0.005	0.150	0.974	0.310	0.248	0.932	0.370	0.067	0.017	0.046	0.994	0.031	0.046	1.000
2011	0.005	0.154	0.971	0.339	0.242	0.931	0.380	0.067	0.017		0.993	0.033	0.045	1.000
2012	0.005	0.145	0.973	0.318	0.254	0.919	0.371	0.080	0.017		0.991	0.024	0.044	1.000
2013	0.004	0.135	0.975	0.297	0.267	0.906	0.362	0.092	0.017		0.989	0.015	0.044	1.000
2014	0.004	0.132	0.970	0.297	0.267	0.906	0.351	0.092	0.017		0.988	0.013	0.043	1.000
2015	0.004	0.128	0.965	0.297	0.267	0.906	0.340	0.092	0.017		0.986	0.010	0.042	1.000
2016	0.004	0.128	0.966	0.299	0.266	0.907	0.340	0.091	0.017		0.986	0.010	0.042	1.000
2017	0.004	0.128	0.967	0.300	0.264	0.908	0.340	0.090	0.017		0.987	0.009	0.041	1.000
2018	0.004	0.128	0.968	0.302	0.263	0.909	0.340	0.089	0.017		0.987	0.009	0.041	1.000
2019	0.004	0.128	0.969	0.303	0.261	0.910	0.340	0.088	0.017		0.987	0.008	0.040	1.000
2020	0.004	0.128	0.970	0.305	0.260	0.911	0.340	0.087	0.017		0.987	0.008	0.040	1.000
2021	0.004	0.128	0.971	0.306	0.258	0.912	0.340	0.086	0.017		0.988	0.007	0.039	1.000
2022	0.004	0.128	0.972	0.308	0.257	0.913	0.340	0.085	0.017		0.988	0.007	0.039	1.000
2023	0.004	0.128	0.973	0.309	0.255	0.914	0.340	0.084	0.017		0.988	0.006	0.038	1.000
2024	0.004	0.128	0.974	0.311	0.254	0.915	0.340	0.083	0.017		0.988	0.006	0.038	1.000
2025	0.004	0.128	0.975	0.312	0.252	0.916	0.340	0.082	0.017		0.989	0.005	0.037	1.000
2026	0.004	0.128	0.976	0.314	0.251	0.917	0.340	0.081	0.017		0.989	0.005	0.037	1.000
2027	0.004	0.128	0.977	0.315	0.249	0.918	0.340	0.080	0.017		0.989	0.004	0.036	1.000
2028	0.004	0.128	0.978	0.317	0.248	0.919	0.340	0.079	0.017		0.989	0.003	0.036	1.000
2029	0.004	0.128	0.979	0.318	0.246	0.920	0.340	0.078	0.017		0.990	0.003	0.035	1.000
2030	0.004	0.128	0.980	0.320	0.245	0.921	0.340	0.077	0.017		0.990	0.002	0.035	1.000
2031	0.004	0.128	0.981	0.321	0.243	0.922	0.340	0.076	0.017		0.990	0.002	0.034	1.000
2032	0.004	0.128	0.982	0.323	0.242	0.923	0.340	0.075	0.017		0.990	0.001	0.034	1.000
2033	0.004	0.128	0.983	0.324	0.240	0.924	0.340	0.074	0.017		0.990	0.001	0.033	1.000
2034	0.004	0.128	0.984	0.326	0.239	0.925	0.340	0.073	0.017		0.991	0.000	0.033	1.000
2035	0.004	0.128	0.985	0.327	0.237	0.926	0.340	0.072	0.017		0.991	0.000	0.032	1.000
2036	0.004	0.128	0.986	0.329	0.236	0.927	0.340	0.071	0.017		0.991	0.000	0.032	1.000
2037	0.004	0.128	0.987	0.330	0.234	0.928	0.340	0.070	0.017		0.991	0.000	0.031	1.000
2038	0.004	0.128	0.988	0.332	0.233	0.929	0.340	0.069	0.017		0.992	0.000	0.031	1.000
2039	0.004	0.128	0.989	0.333	0.231	0.930	0.340	0.068	0.017		0.992	0.000	0.030	1.000
2040	0.004	0.128	0.990	0.335	0.230	0.931	0.340	0.067	0.017		0.992	0.000	0.030	1.000

Saturation Survey data -- weighted by kWh usage and age of head of household

Saturation can not drop below 0

Case No.: U-18419
Attachment: MECNRDCDE-1.30a
Respondent: M.B. Leuker
File Name: U-18419 MECNRDCDE-1.30a Residential Forecast

DTE Electric Company

3/30/2016 **2016-2040 RESIDENTIAL SALES FORECAST** Attorney/Client Privileged Work Product Prepared in Anticipation of Litigation **2016 Spring Forecast**

APPLIANCE SATURATIONS

	DVR	DVD / B-RAY PLAYER	CABLE TV BOXES	SATELL DISH	FAX MACHINE	POOL PUMP	HOT TUB	DIGITAL TV CONVERT	DESKTOP COMPUT	LAPTOP COMPUT	PRINT/SCAN COPY/FAX
2000			0.321	0.066	0.147	0.044	0.038		0.529		
2001			0.310	0.088	0.173	0.057	0.051		0.646		
2002	0.134		0.267	0.112	0.158	0.056	0.047		0.660		
2003	0.133	0.493	0.260	0.113	0.162	0.052	0.049		0.640		
2004	0.149	0.618	0.292	0.154	0.187	0.056	0.054		0.691		
2005	0.164	0.742	0.324	0.194	0.212	0.059	0.059		0.741		
2006	0.161	0.756	0.249	0.178	0.202	0.060	0.063		0.745		
2007	0.158	0.769	0.173	0.162	0.191	0.061	0.066		0.748		
2008	0.258	0.832	0.170	0.185	0.231	0.084	0.068		0.789		
2009	0.358	0.895	0.166	0.208	0.271	0.107	0.070	0.394	0.829		
2010	0.373	0.826	0.462	0.242	0.215	0.108	0.079	0.470	0.850		
2011	0.388	0.756	0.758	0.275	0.159	0.109	0.087	0.545	0.649	0.498	
2012	0.410	0.760	0.776	0.230	0.159	0.091	0.069	0.511	0.610	0.576	
2013	0.432	0.764	0.793	0.185		0.073	0.050	0.476	0.571	0.654	0.714
2014	0.435	0.744	0.788	0.170		0.078	0.044	0.455	0.518	0.661	0.689
2015	0.437	0.724	0.783	0.154		0.082	0.038	0.434	0.464	0.668	0.664
2016	0.437	0.714	0.783	0.154		0.082	0.039	0.414	0.444	0.670	0.664
2017	0.437	0.704	0.783	0.154		0.082	0.040	0.394	0.424	0.672	0.664
2018	0.437	0.694	0.783	0.154		0.082	0.041	0.374	0.404	0.674	0.664
2019	0.437	0.684	0.783	0.154		0.082	0.042	0.354	0.384	0.676	0.664
2020	0.437	0.674	0.783	0.154		0.082	0.043	0.334	0.364	0.678	0.664
2021	0.437	0.664	0.783	0.154		0.082	0.044	0.314	0.344	0.680	0.664
2022	0.437	0.654	0.783	0.154		0.082	0.045	0.294	0.324	0.682	0.664
2023	0.437	0.644	0.783	0.154		0.082	0.046	0.274	0.304	0.684	0.664
2024	0.437	0.634	0.783	0.154		0.082	0.047	0.254	0.284	0.686	0.664
2025	0.437	0.624	0.783	0.154		0.082	0.048	0.234	0.264	0.688	0.664
2026	0.437	0.614	0.783	0.154		0.082	0.049	0.214	0.244	0.690	0.664
2027	0.437	0.604	0.783	0.154		0.082	0.050	0.194	0.224	0.692	0.664
2028	0.437	0.594	0.783	0.154		0.082	0.051	0.174	0.204	0.694	0.664
2029	0.437	0.584	0.783	0.154		0.082	0.052	0.154	0.184	0.696	0.664
2030	0.437	0.574	0.783	0.154		0.082	0.053	0.134	0.164	0.698	0.664
2031	0.437	0.564	0.783	0.154		0.082	0.054	0.114	0.144	0.700	0.664
2032	0.437	0.554	0.783	0.154		0.082	0.055	0.094	0.124	0.702	0.664
2033	0.437	0.544	0.783	0.154		0.082	0.056	0.074	0.104	0.704	0.664
2034	0.437	0.534	0.783	0.154		0.082	0.057	0.054	0.104	0.704	0.664
2035	0.437	0.524	0.783	0.154		0.082	0.058	0.034	0.104	0.704	0.664
2036	0.437	0.514	0.783	0.154		0.082	0.059	0.014	0.104	0.704	0.664
2037	0.437	0.504	0.783	0.154		0.082	0.060	0.000	0.104	0.704	0.664
2038	0.437	0.494	0.783	0.154		0.082	0.061	0.000	0.104	0.704	0.664
2039	0.437	0.484	0.783	0.154		0.082	0.062	0.000	0.104	0.704	0.664
2040	0.437	0.474	0.783	0.154		0.082	0.063	0.000	0.104	0.704	0.664

Saturation Survey data -- weighted by kWh usage and age of head of household

Saturation can not drop below 0

Case No.: U-18419
Attachment: MECNRDCDE-1.30a
Respondent: M.B. Leuker
File Name: U-18419 MECNRDCDE-1.30a Residential Forecast

DTE Electric Company

3/30/2016 **2016-2040 RESIDENTIAL SALES FORECAST** Attorney/Client Privileged Work Product Prepared in Anticipation of Litigation **2016 Spring Forecast**

MULTIPLE UNIT DATA

	NO. OF CUSTOMERS (THOUS)	ROOM AC	TV B&W	TV COLOR	VCR	DVD / B-RAY PLAYER	DESKTOP COMPUT	LAPTOP COMPUT	PRINT/SCAN COPY/FAX	DIGITAL TV CONVERT
2000	1913.4	1.495	1.180	2.183						
2001	1930.5	1.501	1.120	2.179						
2002	1945.3	1.548	1.175	2.206						
2003	1952.0	1.512	1.174	2.239	1.577		1.318			
2004	1967.0	1.603	1.256	2.308	1.550		1.324			
2005	1977.1	1.694	1.338	2.377	1.523		1.330			
2006	1977.0	1.649	1.355	2.329	1.487		1.343			
2007	1967.3	1.604	1.372	2.281	1.450	1.455	1.356			
2008	1950.8	1.600	1.388	2.303	1.404	1.441	1.398			
2009	1932.4	1.595	1.405	2.326	1.358	1.426	1.440			1.621
2010	1922.8	1.605	1.405	2.265	1.330	1.402	1.500			1.680
2011	1922.8	1.614		2.205	1.301	1.378	1.157	1.375		1.738
2012	1926.0	1.556		2.173	1.277	1.360	1.165	1.388		1.703
2013	1935.1	1.497		2.141	1.254	1.342	1.173	1.401	1.148	1.668
2014	1943.9	1.539		2.128	1.222	1.321	1.171	1.396	1.139	1.644
2015	1953.8	1.580		2.115	1.190	1.300	1.170	1.390	1.130	1.620
2016	1960.8	1.580		2.117	1.155	1.290	1.160	1.391	1.130	1.592
2017	1967.6	1.580		2.119	1.120	1.280	1.150	1.392	1.130	1.564
2018	1974.7	1.580		2.121	1.085	1.270	1.140	1.393	1.130	1.536
2019	1981.9	1.580		2.123	1.050	1.260	1.130	1.394	1.130	1.508
2020	1989.2	1.580		2.125	1.015	1.250	1.120	1.395	1.130	1.480
2021	1996.4	1.580		2.127	1.000	1.240	1.110	1.396	1.130	1.452
2022	2003.5	1.580		2.129	1.000	1.230	1.100	1.397	1.130	1.424
2023	2010.3	1.580		2.131	1.000	1.220	1.090	1.398	1.130	1.396
2024	2017.0	1.580		2.133	1.000	1.210	1.080	1.399	1.130	1.368
2025	2023.5	1.580		2.135	1.000	1.200	1.070	1.400	1.130	1.340
2026	2029.8	1.580		2.137	1.000	1.190	1.060	1.401	1.130	1.312
2027	2036.1	1.580		2.139	1.000	1.180	1.050	1.402	1.130	1.284
2028	2042.0	1.580		2.141	1.000	1.170	1.040	1.403	1.130	1.256
2029	2047.7	1.580		2.143	1.000	1.160	1.030	1.404	1.130	1.228
2030	2053.3	1.580		2.145	1.000	1.150	1.020	1.405	1.130	1.200
2031	2058.8	1.580		2.147	1.000	1.140	1.010	1.406	1.130	1.172
2032	2064.2	1.580		2.149	1.000	1.130	1.000	1.407	1.130	1.144
2033	2069.2	1.580		2.151	1.000	1.120	1.000	1.408	1.130	1.116
2034	2074.3	1.580		2.153	1.000	1.110	1.000	1.409	1.130	1.088
2035	2079.3	1.580		2.155	1.000	1.100	1.000	1.410	1.130	1.060
2036	2084.3	1.580		2.157	1.000	1.090	1.000	1.411	1.130	1.032
2037	2089.2	1.580		2.159	1.000	1.080	1.000	1.412	1.130	1.004
2038	2094.0	1.580		2.161	1.000	1.070	1.000	1.413	1.130	1.000
2039	2098.8	1.580		2.163	1.000	1.060	1.000	1.414	1.130	1.000
2040	2103.4	1.580		2.165	1.000	1.050	1.000	1.415	1.130	1.000

Saturation Survey data -- weighted by kWh usage and age of head of household

Appliance per household cannot go below 1

Case No.: U-18419
DTE Electric Company **Attachment: MECNRDCDE-1.30a**
Respondent: M.B. Leuker
File Name: U-18419 MECNRDCDE-1.30a Residential Forecast

3/30/2016 **2016-2040 RESIDENTIAL SALES FORECAST** Attorney/Client Privileged Work Product Prepared in Anticipation of Litigation **2016 Spring Forecast**

TOTAL SALES BY APPLIANCE (GWh)

	ROOM AC	CENTRAL AC	DRYER	WASHER	DEHUM	DISH WASHER	FREEZER FF	FREEZER STD	HTG FF	HTG BI	HTG PORT	HP COOL	HP HEAT	LIGHT GEN	VCR
2000	507	1706	530	151	186	312	201	249	469	37	22	9	56	1837	340
2001	445	1914	536	161	215	343	245	316	483	31	27	13	43	1853	350
2002	485	1861	499	156	199	336	237	287	472	29	22	11	31	1868	348
2003	455	2006	573	162	224	342	225	306	471	35	28	11	44	1874	547
2004	481	2035	632	169	206	345	276	302	471	39	33	9	64	1888	527
2005	505	2060	689	175	187	348	326	296	469	43	38	7	85	1898	506
2006	480	2109	643	176	213	361	313	329	475	33	42	10	75	1898	491
2007	454	2159	594	176	238	376	299	360	487	23	47	12	65	1908	475
2008	411	2186	582	175	241	398	312	357	486	27	56	16	49	1912	428
2009	369	2208	569	174	243	419	325	353	476	30	66	19	33	2358	384
2010	365	2203	583	171	234	390	324	353	474	29	63	17	33	2293	348
2011	364	2208	601	169	226	365	325	354	474	28	61	15	33	2238	315
2012	417	2349	612	167	246	362	305	339	417	29	55	16	51	2185	260
2013	440	2338	625	166	267	355	287	325	414	34	55	18	68	2137	207
2014	458	2330	639	165	258	342	282	302	410	34	57	18	64	2087	186
2015	477	2322	648	162	250	328	277	279	407	34	60	18	60	2014	166
2016	475	2313	645	161	250	315	274	273	409	34	60	18	59	1452	139
2017	473	2303	642	161	248	301	270	267	411	34	61	17	59	1312	113
2018	471	2294	639	158	247	288	267	261	413	34	61	17	58	1205	89
2019	469	2285	636	156	245	274	263	255	409	34	61	17	58	1098	65
2020	467	2275	632	154	244	260	260	249	404	35	61	17	57	1011	43
2021	464	2265	629	152	243	246	256	243	400	35	61	17	57	915	23
2022	462	2255	626	149	241	232	252	237	395	35	62	17	56	828	3
2023	460	2245	623	147	240	217	248	230	391	35	62	17	56	741	0
2024	459	2234	619	144	238	214	243	224	386	35	62	17	56	655	0
2025	458	2223	616	142	236	211	239	217	381	35	62	17	56	586	0
2026	457	2211	612	139	235	212	234	211	376	35	63	17	56	588	0
2027	456	2199	608	137	233	213	230	204	371	35	63	17	56	590	0
2028	455	2187	604	134	232	214	225	198	366	35	63	17	56	592	0
2029	454	2174	600	133	230	215	220	191	361	36	63	17	56	593	0
2030	453	2161	596	132	228	216	215	184	356	36	63	17	56	595	0
2031	452	2148	592	131	227	216	209	177	350	36	63	17	56	597	0
2032	451	2134	588	132	227	217	204	171	345	36	64	17	56	598	0
2033	452	2120	590	132	228	218	198	164	339	36	64	17	56	600	0
2034	453	2106	591	133	229	219	193	157	334	36	64	17	57	601	0
2035	454	2092	593	133	229	220	193	154	328	36	64	17	57	602	0
2036	455	2077	594	134	230	221	193	151	323	36	64	17	57	604	0
2037	456	2062	595	135	230	221	193	148	317	36	64	17	57	605	0
2038	457	2047	597	135	231	222	194	148	311	36	64	17	57	607	0
2039	458	2052	598	136	231	223	196	149	305	36	65	17	57	608	0
2040	459	2056	599	136	232	224	198	149	299	37	65	17	57	609	0
'15-'16 CAGR	-0.4%	-0.4%	-0.5%	-0.5%	0.0%	-4.1%	-1.2%	-2.1%	0.5%	0.4%	0.4%	-0.9%	-0.8%	-27.9%	-16.2%
'16-'17 CAGR	-0.4%	-0.4%	-0.5%	-0.5%	-0.6%	-4.3%	-1.3%	-2.2%	0.5%	0.4%	0.4%	-0.9%	-0.8%	-9.6%	-18.5%
'15-'20 CAGR	-0.4%	-0.4%	-0.5%	-1.0%	-0.5%	-4.6%	-1.3%	-2.3%	-0.1%	0.4%	0.4%	-0.9%	-0.8%	-12.9%	-23.6%
'15-'25 CAGR	-0.4%	-0.4%	-0.5%	-1.3%	-0.5%	-4.3%	-1.5%	-2.5%	-0.7%	0.4%	0.4%	-0.7%	-0.7%	-11.6%	-100.0%
'15-'40 CAGR	-0.2%	-0.5%	-0.3%	-0.7%	-0.3%	-1.5%	-1.3%	-2.5%	-1.2%	0.3%	0.3%	-0.2%	-0.2%	-4.7%	-100.0%

Case No.: U-18419
DTE Electric Company **Attachment: MECNRDCDE-1.30a**
Respondent: M.B. Leuker
File Name: U-18419 MECNRDCDE-1.30a Residential Forecast

3/30/2016 **2016-2040 RESIDENTIAL SALES FORECAST** Attorney/Client Privileged Work Product Prepared in Anticipation of Litigation **2016 Spring Forecast**

TOTAL SALES BY APPLIANCE (GWh)

	LIGHT OPL	LIGHT POST	MICRO-WAVE	RANGE SC	RANGE STD	REFRIG FF	REFRIG 2ND	REFRIG STD	SPACE HTG	TV B&W	TV COLOR	WATER BED	WATER HTR	MISC
2000	12	90	380	338	415	1927	295	95	256	22	2080	112	436	689
2001	10	98	392	374	413	1955	383	84	339	18	2097	90	471	695
2002	10	90	388	365	401	1873	371	96	291	20	2124	101	420	784
2003	10	91	393	386	400	1852	372	77	292	17	2172	79	413	59
2004	10	95	397	357	388	1778	401	85	283	16	2252	83	391	89
2005	10	99	399	328	378	1699	429	93	284	15	2336	87	381	213
2006	9	91	400	364	390	1654	459	80	282	14	892	77	371	1171
2007	9	84	399	397	400	1598	487	68	280	13	868	66	364	1201
2008	9	87	398	410	384	1526	504	60	276	12	871	70	357	1200
2009	8	90	396	419	367	1452	520	51	273	11	873	73	349	614
2010	8	92	393	461	357	1372	531	51	270	11	893	77	341	346
2011	8	95	392	504	349	1300	544	50	270		869	82	334	918
2012	8	89	394	473	365	1215	530	58	244		856	60	331	1000
2013	8	84	396	443	385	1136	518	66	244		850	38	326	1567
2014	8	82	396	444	387	1123	498	65	244		851	32	322	1453
2015	8	80	396	447	389	1113	480	65	244		853	25	316	1760
2016	8	80	382	451	388	1104	477	64	245		865	24	311	2353
2017	8	81	368	455	388	1096	474	62	246		877	23	307	2495
2018	8	81	353	458	387	1090	472	61	246		890	22	304	2682
2019	8	81	339	462	386	1084	470	60	247		902	21	300	2866
2020	8	81	324	466	385	1080	469	59	248		915	19	297	3032
2021	8	82	309	470	384	1076	468	58	249		928	18	294	3191
2022	8	82	294	474	383	1073	467	57	250		941	17	290	3344
2023	8	82	279	478	382	1070	466	56	251		954	16	287	3476
2024	8	83	264	482	381	1068	466	56	252		966	14	284	3586
2025	8	83	248	486	380	1067	465	55	252		979	13	280	3674
2026	8	83	233	490	379	1067	466	54	253		992	12	277	3696
2027	8	83	217	494	378	1068	466	53	254		1005	11	273	3717
2028	8	84	218	498	377	1069	467	53	255		1018	9	270	3724
2029	8	84	219	501	376	1070	467	52	255		1030	8	266	3730
2030	8	84	220	505	375	1071	468	51	256		1043	7	263	3735
2031	8	84	220	509	373	1072	468	51	257		1056	5	260	3742
2032	8	85	221	513	372	1074	469	50	258		1069	4	257	3745
2033	8	85	222	516	370	1075	469	49	258		1082	3	254	3741
2034	8	85	223	520	369	1077	470	49	259		1094	0	250	3736
2035	8	85	223	524	368	1079	470	48	259		1107	0	247	3718
2036	8	85	224	527	366	1083	472	48	260		1120	0	244	3697
2037	8	86	225	531	365	1086	473	47	261		1133	0	241	3678
2038	8	86	226	535	363	1090	474	46	261		1146	0	237	3652
2039	8	86	226	538	362	1094	475	46	262		1159	0	234	3607
2040	8	86	227	542	360	1097	476	45	262		1172	0	231	3562
'15-'16 CAGR	0.4%	0.4%	-3.6%	0.9%	-0.2%	-0.8%	-0.6%	-2.0%	0.4%		1.4%	-4.7%	-1.4%	33.7%
'16-'17 CAGR	0.4%	0.4%	-3.7%	0.9%	-0.2%	-0.7%	-0.5%	-1.9%	0.4%		1.4%	-4.9%	-1.4%	6.1%
'15-'20 CAGR	0.4%	0.4%	-3.9%	0.9%	-0.2%	-0.6%	-0.5%	-1.8%	0.4%		1.4%	-5.3%	-1.2%	11.5%
'15-'25 CAGR	0.4%	0.4%	-4.6%	0.8%	-0.2%	-0.4%	-0.3%	-1.7%	0.4%		1.4%	-6.4%	-1.2%	7.6%
'15-'40 CAGR	0.3%	0.3%	-2.2%	0.8%	-0.3%	-0.1%	0.0%	-1.4%	0.3%		1.3%	-100.0%	-1.2%	2.9%

Case No.: U-18419
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Respondent: M.B. Leuker
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DTE Electric Company

3/30/2016 **2016-2040 RESIDENTIAL SALES FORECAST** Attorney/Client Privileged Work Product Prepared in Anticipation of Litigation **2016 Spring Forecast**

TOTAL SALES BY APPLIANCE (GWh)

	DVR	DVD PLAYER	CABLE TV BOXES	SATELL DISH	FAX MACHINE	POOL PUMP	HOT TUB	DIGITAL TV CONVERT	DESKTOP COMP	LAPTOP COMPUT	PRINT/SCAN COPY/FAX
2000									312		
2001									384		
2002									395		
2003	91	39	63	32	55	10	253		520		
2004	102	50	72	44	64	11	281		583		
2005	113	60	80	56	73	12	309		647		
2006	111	61	61	51	69	12	327		666		
2007	109	90	43	46	65	12	344		682		
2008	176	96	41	52	78	17	352		746		
2009	242	101	40	58	91	21	358	43	750		
2010	251	91	111	67	72	21	400	53	809		
2011	261	82	182	77	53	22	443	64	406	71	
2012	211	82	208	49	53	18	350	59	391	84	
2013	222	81	213	39		15	256	54	206	98	208
2014	216	78	210	36		16	227	51	190	100	203
2015	209	75	207	32		17	197	48	173	103	198
2016	201	74	205	32		17	203	45	165	104	198
2017	192	73	202	31		17	209	42	157	105	199
2018	183	71	200	31		17	215	40	134	95	180
2019	174	70	198	30		17	221	37	114	86	162
2020	175	69	199	30		17	227	34	97	78	147
2021	176	67	199	29		17	233	32	82	71	132
2022	176	66	200	29		17	239	29	69	64	120
2023	177	65	201	29		17	245	27	58	58	108
2024	177	63	201	29		17	251	25	48	53	98
2025	178	62	202	30		17	257	22	45	53	98
2026	178	61	203	30		17	264	20	41	53	98
2027	179	59	203	30		17	270	18	37	54	98
2028	180	58	204	30		17	276	16	34	54	99
2029	180	57	205	30		17	282	14	30	54	99
2030	181	56	205	30		17	288	12	27	55	99
2031	181	54	206	30		17	295	10	23	55	100
2032	181	53	206	30		17	301	8	20	55	100
2033	182	52	207	30		17	307	6	17	56	100
2034	182	50	207	30		18	313	4	17	56	100
2035	183	49	208	30		18	320	3	17	56	101
2036	183	48	208	30		18	326	1	17	56	101
2037	184	47	209	30		18	332	0	17	56	101
2038	184	45	209	31		18	338	0	17	57	101
2039	185	44	210	31		18	345	0	17	57	101
2040	185	43	210	31		18	351	0	17	57	102
'15-'16 CAGR	-4.1%	-1.8%	-1.1%	-1.1%		0.4%	3.0%	-5.9%	-4.8%	0.7%	0.4%
'16-'17 CAGR	-4.4%	-1.8%	-1.1%	-2.1%		0.4%	2.9%	-6.2%	-5.0%	0.7%	0.4%
'15-'20 CAGR	-3.5%	-1.8%	-0.8%	-1.6%		0.4%	2.9%	-6.5%	-11.0%	-5.4%	-5.8%
'15-'25 CAGR	-1.6%	-1.9%	-0.2%	-0.9%		0.4%	2.7%	-7.4%	-12.7%	-6.4%	-6.8%
'15-'40 CAGR	-0.5%	-2.2%	0.1%	-0.2%		0.3%	2.3%	-100.0%	-8.8%	-2.3%	-2.6%

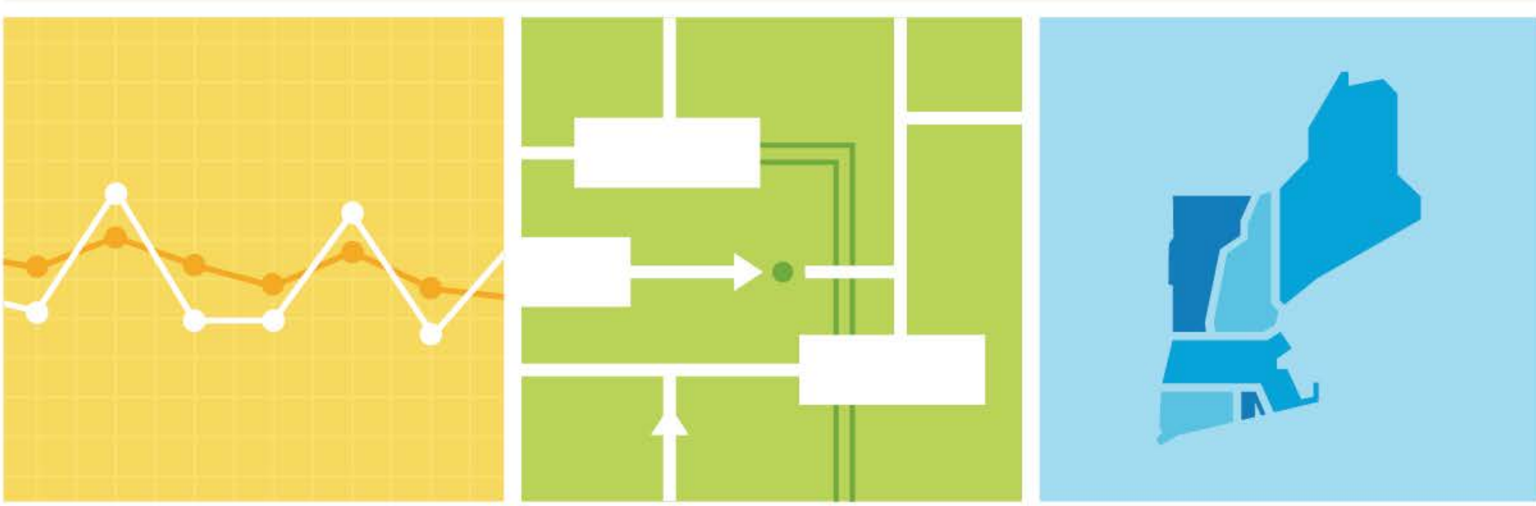
20 years
ISO new england

Forecast Modeling Procedure for 2017 CELT: ISO New England Long-Run Energy and Seasonal Peak Forecasts

System Planning

MAY 4, 2017

ISO-NE PUBLIC



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Section 1
Introduction

ISO-New England prepares forecasts of annual energy and monthly and seasonal peak loads for the region as a whole and each of the six New England states. Forecast models are developed and estimated using econometric methods. Net energy for load (NEL) is modeled as a function of economic and other drivers. As such, it also is used to represent the underlying economic/demographic processes that influence peak load growth.

The peak load models were estimated with historical data from 2002 through 2016. The models were simulated with weather data from a 40-year historical period, generating 1000 weekly observations encompassing the mildest to the most extreme weather conditions.

The net energy for load (NEL) models were estimated with historical data from 1990 through 2016. The economic forecast used in these models was Moody's Analytics' October 2016 release.

Section 2
Gross and Net Forecasts

"Gross" load forecasts are developed by first adding the energy savings from behind-the-meter photovoltaics (BTM-PV) and passive demand resources (PDR) back into the historical NEL and daily peak load series before the models are estimated. The process of adding these savings back into the historical data is referred to as "reconstitution", and ensures the proper accounting of these resources, which are forecast separately, in the development of the long-term load forecasts. The reconstitution for PDR is necessary because these resources are reflected on the supply side in the capacity market and they would otherwise be double counted. BTM-PV reconstitution is needed because the annual long-term BTM-PV forecast includes historical BTM-PV that has reduced loads, and is therefore already embedded in the historical data. Consequently, the historical series needs to be "grossed up" to account for load reductions from BTM-PV to similarly avoid double-counting. While gross forecasts are derived directly from the models developed with data after reconstitution, "net" forecasts are obtained by subtracting exogenous forecasts of BTM-PV and PDR from the gross forecasts, and are therefore representative of the energy and loads expected to be observed in New England.

Section 3
Energy Forecasts

As in years past, the 2017 energy forecast is produced using annual models of total energy consumption within the ISO-NE control area and the New England states. The goal is to specify forecasting models that predict electricity consumption as accurately as possible. To that end, regression models are designed to explain NEL in terms of variables believed to influence consumption. The forecast includes estimates of the impact of new Federal Electric Appliance Standards going forward.

3.1 The Regression Models

Seven annual energy forecasts are prepared for the New England region and the New England states. The models have the same fundamental structure, with some variation across states[1]. The basic theoretical model is as follows:

$Energy_t = f(Energy_{t-1}, Economy_t, EnergyPrice_t, Weather_t, X_t)$, where:

Energy (NEL_) = Annual NEL in year *t*, with PDR and PV added back in. For modeling purposes, NEL is reconstituted in order to capture historical performance of PDR and PV.

Economy (RGSP/RPI) = Economic activity is represented by Gross Regional/State Product adjusted for inflation (RGSP). It is from Moody's Analytics. Gross domestic product is adjusted for inflation by Moody's price deflator series. In the Rhode Island model, real personal income (RPI) is used instead.

EnergyPrice (RP) = Annual Price of Energy adjusted for inflation (RPER), ¢/Kwh. The coefficient on the price of energy is insignificant in most of the models.

Weather = Weather is represented by two variables: Annual Heating Degree Days (HDD) and Annual Cooling Degree Days based on the temperature-humidity index (CDD). While both variables are included in most models, one or both may be considered "insignificant" in some cases[2].

X = Unobservable variables that affect Energy Demand. Binary variables for specific years are included in most models. The relevant variables are determined by examining the residuals: (observed NEL_t – modeled NEL_t). Large outliers are addressed by including a dummy variable for that year.

Sample Period: 1990-2016 for this forecast cycle.

[1] Details and statistics on each model can be found on the ISO-NE CELT webpage, *Regional and State Energy and Peak Model Details 2017*.

[2] Variables may be retained in an estimating equation because they are important theoretically.

3.2 Economic Input Data – Real Gross Regional/State Product

Real gross regional product represents overall economic activity in the energy models. Figure 3-1 presents historical and forecasted real gross regional product for New England used in the 2017 forecast, as compared to last year[3]. Economic activity started to slow in 2007, bottomed out in 2009, and has continued recovering more slowly than previously expected.

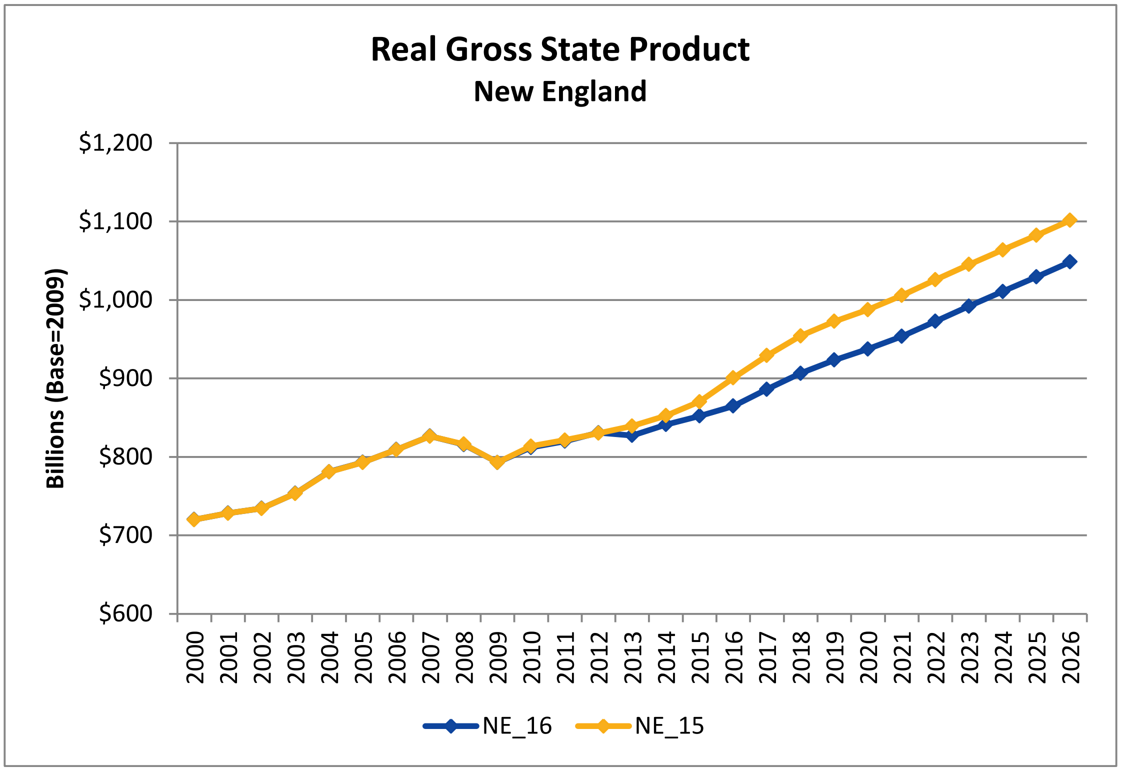

Figure 3-1: Real Gross State Product 2000-2026

[3] The Gross Regional Product series reflects revisions in the historical data by the Bureau of Economic Analysis.

Section 4
Observations Regarding Historical and Projected Energy Consumption

Forecasting electricity demand continues to be challenging as the economic recovery moves more slowly than anticipated. As a result of lower economic forecasts from Moody's, the 2017 NEL forecast projects that weather-normalized energy demand will be lower than expected in the 2016 forecast.

The long-run gross energy growth rate is forecasted to be 0.9%, while the net forecast predicts -0.6% growth. The 2017 energy forecast incorporates the annual energy savings expected from the Federal Appliance Efficiency Standards, which reduces the forecast of electricity demand in 2017 by 105 GWh.

Section 5
Annual Energy to Annualized Monthly Moving Sum Energy

Once the annual energy forecasts are prepared, they are processed further to generate annualized monthly moving sum values for use in the peak forecasting models.

(1) The NEL forecast is prepared for the forecast horizon.

(2) The monthly moving sum is calculated for the latest historical year (2016). For each month, the moving sum for NEL is calculated as the sum of NEL for the current month and the previous 11 months.

(3) Using the forecasting model, weather-normalized annual NEL is estimated for the latest historical year (2016) (WNEL2016).

(4) Annual growth rates are calculated for the forecast period:

$$G_t = \frac{NEL_t}{WNEL_{2015}}, \text{ t=2017,…,2026}$$

(5) G_t is applied to the monthly moving sum NEL in time (t-1,m), $NEL\_SUM_{t-1,m}$

$$NEL\_SUM_{t,m} = NEL\_SUM_{t-1,m} * G_t$$

(6) $NEL\_SUM_{t,m}$ serves as the energy input for the monthly and seasonal peak models.

Section 6
Peak Loads

6.1 Peak Load Forecast Distributions

Weekly peak load forecast distributions are developed by combining output from the daily peak load models with energy forecasts and weekly distributions of weather variables over 40 years. Dry bulb temperatures correspond to the heating season (October-April), while the weighted temperature-humidity index (WTHI) is used for the cooling season (May-September).

6.1.1 Peak Load Distributions and Weather

The expected weather associated with the seasonal peak is considered to be the 50th percentile of the top 10% of the pertinent week's historical weather distribution. The monthly peak load is expected to occur at the weather associated with the 20th percentile of the top 10% of the pertinent week's weather distribution. The "pertinent week" is the week of the month or season with the most extreme weather distribution. For resource adequacy purposes, peak load distributions are developed for each week of the forecast horizon.

6.1.2 Daily Peak Load Models

Daily peak load models are estimated for the New England region as well as each of the New England states, for each season and eight months. There is one summer model for July/August, and one winter model for December/January. Altogether, 10 models are developed for the New England region and each state. While the models have a common theoretical basis, they are individually adjusted for the unique characteristics of the region/state and the sample period[4].

Fundamental Drivers: Annual electric energy (converted to NEL_SUM) and weather variables comprise the foundation of the peak load models. Weather is the predominant observable cause of day-to-day variation in peak load, and also differentiates seasons. Energy serves as the base load, and represents underlying economic and demographic drivers.

Dummy Variables: The sample period comprises *all* days of the week, including holidays and weekends, while the monthly/seasonal peak loads generally occur only on non-holiday weekdays. Including all days in the sample increases the sample size and reduces the number of "gaps" in the data. Significant gaps already exist due to the methodology of estimating separate models for each month and season. To accommodate the sample, dummy variables accounting for holidays and weekends are included in each model.

Sample Size: Because the forecast is based on "normal" weather, the estimation period must be long enough to capture significant variations in the weather; i.e. an abnormally warm or cool year cannot be allowed to unduly influence a long-run forecast. The sample period also must be short enough to assure reasonably consistent relationships between peak loads and the regressors[5].

Peak Load Model: The basic peak load model is a nonlinear function of energy and weather, expressed as:

---

[4] Details and statistics on each model can be found on the ISO-NE CELT webpage, *Regional and State Energy and Peak Model Details 2017*.

[5] Analysis suggests 2002 as a reasonable point for the beginning of the sample period.

$Peak\ Load_d = f(NEL\_SUM_{t,m}, W_d, TW_d, D_{w,d}, D_{h,d}, X_d)$ where:

$Peak\ Load_d$ = Peak Load on day *d*

$NEL\_SUM_{t,m}$ = Annualized monthly moving sum Net Energy for Load for month m in year *t* (see page 1-2 for details).

W_d = Weather at the peak load hour on day *d*

= $(WTHI_d-55)^2$ for the months May-September

= $(65-db_d)^2$ for the months October-April[6]

$WTHI_d$= 3-day weighted temperature-humidity index (THI) measured at the hour of the daily peak loads:

$$WTHI_d = \left\{\frac{[10*THI_d + 5*THI_{d-1} + 2*THI_{d-2}]}{17}\right\} - 55, \text{ and}$$

$$THI_d = 0.5 * DryBulbTemp_d + 0.3 * DewPointTemp_d + 15$$

TW_d = Time Trend * $(WTHI_d-55)^2$ for the months May-September.

Time Trend is a year index; 1992=1, 1993=2, etc.

$D_{w,d}$ = Dummy variable: 1 if day *d* is a weekend, 0 otherwise.

$D_{h,d}$ = Dummy variable: 1 if day *d* is a holiday, 0 otherwise. Holidays take precedence; if day *d* is both a weekend day and a holiday, $D_{w,d}$ = 0 and $D_{h,d}$ = 1.

X_d = Vector of other (unobservable) variables explaining daily peak loads

While Energy and Weather variables explain a substantial amount of the trend and variation in Peak Load, there are many other largely unknowable factors (*X*) that can be included in the model only by proxy, if at all.

The basic non-linear estimating equation with autoregressive error structure is specified as:

$Peak\ Load_d = b_0 + b_1*NEL\_SUM_{t,m} + b_2*W_d + b_3*TW_d + b_4*D_{w,d} + b_5*D_{h,d} + \hat{e}_d$

$\hat{e}_d$ is the error term (residual), which follows an autoregressive process:

$\hat{e}_d = f(e_{d-1}, e_{d-2}, \ldots, e_{d-n})$

[6] In some models, the HDD base point in April and October is different from 65. Also, in some models, HDD is used in place of HDD^2.

Section 7
Observations Regarding the Projected Peak Forecast

The combination of the change in sample period coupled with the lower economic forecast provided by Moody's resulted in lower summer and winter peak forecasts relative to the 2016 CELT. The ISO-NE summer gross forecast for 2017 fell by 0.5% relative to last year's forecast for 2017. The gross forecast for the winter of 2017/2018 fell by 0.6%.

Section 8
Forecast Model Evaluation and Testing

8.1 Peak Model Evaluation and Testing

The process for developing econometric-based peak load forecasting models is discussed in this appendix. The final equation used to forecast seasonal and monthly peak loads is the result of many iterations of the following steps.

(1) Informed by past years' models, a nonlinear econometric model with an autoregressive error structure is specified and the parameters are estimated.

(2) The autoregressive error process is then further identified.

(3) The residuals are examined for extreme outliers.

(4) The residuals are examined to determine if they exhibit any trends or correlations.

(5) Influential observations are identified.

(6) Proxy variables that might help explain the trends and influences in the residuals are evaluated.

(7) Influential observations suspected of biasing the coefficient estimators are removed from the sample.

(8) Statistical tests for goodness-of-fit and significance of the regressors are evaluated.

The modeling process begins with analysis of last year's models. The changes from CELT 2016 to CELT 2017 derive from changes in the sample period and the lower economic forecast.

8.1.1 **Identification of the Autoregressive Error Structure**

The following steps help to identify the autoregressive error process.

(1) Experience over the years has shown that the errors in the daily peak load models follow a process of *at least* AR(1). The first step, then, is to specify a first-order autoregressive model.

(2) Serial correlation in the errors may be evidence of problems with the model specification. Before testing for higher-order serial correlation, the residuals from the AR(1) model are examined for extreme outliers. To the extent possible, the reason for large outliers is determined. Very large residuals can often be explained by severe weather events or abnormalities on the electric system (e.g., distribution line outages causing loss of load during a storm), and these anomalous observations must be eliminated from the sample to prevent biased estimators[7]. In other cases, dummy variables may be introduced as proxies for unobservable variables.

[7] Ordinary Least Squares regression equations fit an "average" model. Extreme outliers carry too much weight, pulling the average in their direction. This biases the regression line in the direction of the outlier.

(3) The Durbin-Watson statistic tests for the presence of first-order autocorrelation. Since the errors are known to follow a process of AR(1) or greater, other evaluation techniques are used to assess the degree of serial correlation.

(4) Based on further analysis, the model is re-specified with the higher-order AR process.

(5) This process is repeated each time the equation is modified.

8.1.2 **Influential Observations**

(1) The residuals are examined for obvious patterns. In some instances, specific holidays or surrounding days need to be accounted for separately. Saturdays and Sundays may need to be specified individually, rather than combined into weekends. The effect of weekends can vary by year, in which case interactive year/weekend dummy variables are called for. The residuals may show patterns within a particular year, which suggests that a dummy variable for that year might improve the model's properties.

(2) Influential observations are identified.

8.1.3 **Goodness-of-Fit and Statistical Significance**

It is important for the model to fit the historical data as closely as possible. Forecasts from an econometric model assume that historical relationships will continue into the future. A model that does not fit the sample data well introduces additional uncertainty into the forecast.

The traditional measure of how well the model fits the data is the R2 statistic. The better the model fits the data, the higher will be the R2 score. The best fitting model is the one that maximizes R2. For the summer peak models, this statistic ranges from 0.87 to 0.95, with a median of 0.93. For the winter peak models, R2 ranges between 0.85 and 0.92, with a median value of 0.89.

The t-test evaluates the statistical significance of each regressor, under the null hypothesis that the coefficient on the regressor is zero. A "rule of thumb" commonly used to indicate the explanatory power of a regressor is $t \geq 2$. However, if a variable is considered to be important in the initial design, careful consideration is given to retaining it in the equation regardless of reported significance. For example, the coefficients on the "Saturday" and "Sunday" variables do not always have t-values greater than 2, but they are important for identifying non-peak days.

8.2 Energy Model Evaluation and Testing

The statistical model evaluation process is somewhat similar to the Peak Load model, but with several exceptions and limitations.

(1) Serial Correlation. The Durbin-Watson statistic tests for first-order autocorrelation in the error terms, and it cannot be used in the presence of lagged dependent variables. The Breusch-Godfrey Serial Correlation LM test checks for higher order serial correlation in the error terms and was evaluated at lag=2.

(2) Standard Statistical Tests. The R^2 goodness-of-fit measure ranges from 0.93 to 0.99. These high values are not unexpected, given the aggregate time-series nature of the data. The t-statistics on the coefficients of most regressors are over 2. Exceptions

include some constant terms and an occasional variable considered *a priori* to be important for model fit.

The 2017 State Energy Efficiency Scorecard

Weston Berg, Seth Nowak, Meegan Kelly, Shruti Vaidyanathan, Mary Shoemaker, Anna Chittum, Marianne DiMascio, and Heather DeLucia

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Executive Summary

While not a topic that typically finds itself in the media spotlight, energy efficiency attracted no shortage of headlines in 2017. States are facing an evolving set of challenges and opportunities as their energy sectors are being transformed. Energy options are becoming more diverse, while innovation is sparking new public interest in energy choices. Many states have pursued energy efficiency for decades to meet growing demand at low cost, and today efficiency continues to provide multiple benefits as the energy landscape evolves. Efficiency improves affordability, reliability, and security while creating millions of jobs. It also gives households and businesses more choice in how they use energy, and it can help those most in need alleviate high energy burdens.

With state leaders embracing efficiency's economic and environmental benefits, utilities across the United States invested approximately $7.6 billion in energy efficiency and saved approximately 25.4 million megawatt-hours (MWh) in 2016. While these levels did not quite match 2015 savings, roughly half the states reported savings surpassing those they posted in 2015, and many adopted and implemented new policies in 2016. Some states are seeing utility efficiency programs taking root for the first time, while others at the leading edge are pioneering data-driven strategies to reach higher levels of savings. A series of state policy decisions at the turn of the year extended and strengthened utility energy efficiency efforts, and many states have seen advancements in building energy codes, transportation, state government financing, and lead-by-example policies.

The 2017 State Energy Efficiency Scorecard highlights these recent developments to call attention to the diverse policy tools available to governors, state legislators, and regulators. Energy efficiency is the nation's third-largest electricity resource, and it has the potential to grow even larger with continued state innovation and leadership.[1] Efficiency has a number of benefits. It creates jobs, not only directly for manufacturers and service providers, but also indirectly in other sectors by saving energy and freeing up funds to support the local economy. Efficiency also reduces pollution, strengthens community and grid resilience, promotes equity, and improves health.

This is the 11th edition of the *State Energy Efficiency Scorecard*. As in the past, this year's *Scorecard* ranks states on their efficiency policies and programs, not only assessing performance but also documenting best practices and recognizing leadership. By providing an annual benchmark of the progress of state policies, the *Scorecard* encourages states to continue strengthening their commitment to efficiency.

The 2017 *Scorecard* assesses state policies and programs that improve energy efficiency in our homes, businesses, industries, and transportation systems. It examines the six policy areas in which states typically pursue energy efficiency:

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[1] M. Molina, P. Kiker, and S. Nowak, *The Greatest Energy Story You Haven't Heard: How Investing in Energy Efficiency Changed the US Power Sector and Gave Us a Tool to Tackle Climate Change* (Washington, DC: ACEEE, 2016). aceee.org/research-report/u1604.

- Utility and public benefits programs and policies
- Transportation policies
- Building energy codes and compliance
- Combined heat and power (CHP) policies
- State government–led initiatives around energy efficiency
- Appliance and equipment standards

KEY FINDINGS

Figure ES1 shows the states' rankings, dividing them into five tiers for easy comparison. Later in this section, table ES1 provides details of each state's scores. An identical ranking for two or more states indicates a tie.

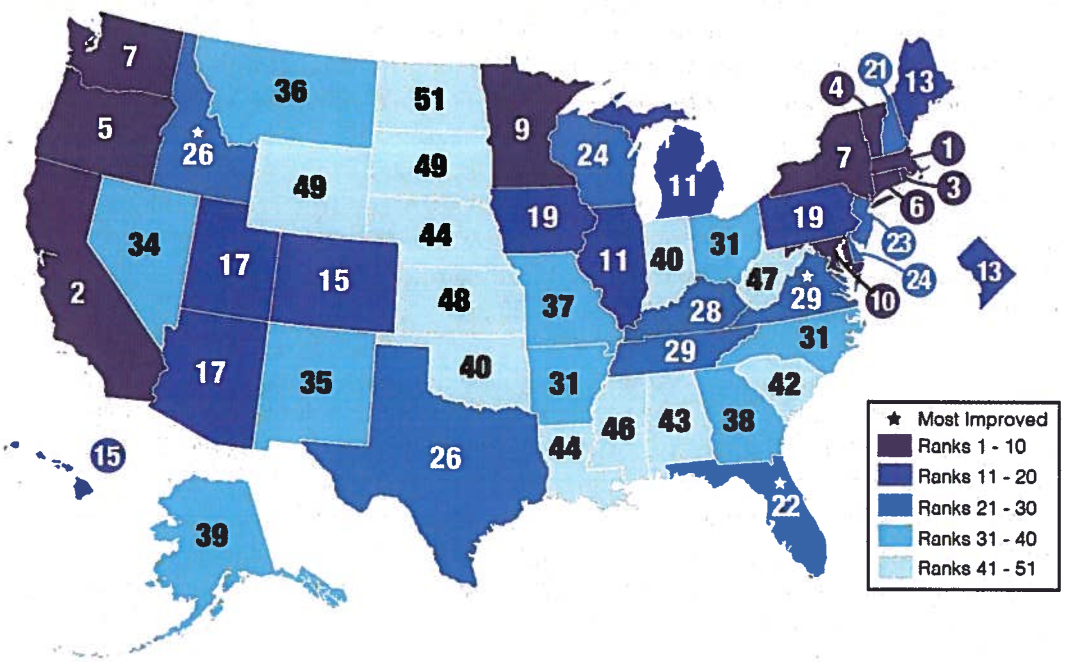

Figure ES1. ***2017 State Scorecard*** **rankings**

After sharing first place with California in last year's *Scorecard*, **Massachusetts** pulled ahead to reclaim the top spot in 2017, posting its highest recorded electricity savings: 3% of sales. The state's Green Communities Act of 2008 continues to drive nation-leading levels of savings through ambitious annual energy efficiency goals. Its program administrators offer some of the most comprehensive services in the country, addressing a range of customers and building types. Having raised the bar on its three-year electricity efficiency targets in 2015, the state continued to roll out the latest components of its $15 million Affordable Access to Clean and Efficient Energy (AACEE) Initiative. AACEE aims to reduce the energy burden and cost variability for low- and moderate-income residents. It includes the Affordable Clean Residential Energy (ACRE) program, a grant initiative to promote low-income customer access to combined air source heat pumps and solar photovoltaic systems. ACRE also evaluates performance data to help integrate energy efficiency and renewable technologies. The state's Zero-Energy Modular Affordable Housing Initiative is a grant program to replace existing manufactured housing with affordable zero-energy modular units.

Having tied with Massachusetts for first place in last year's *Scorecard*, **California** continued its efficiency progress with a series of major policy initiatives. The state undertook new building energy use benchmarking and data sharing mandates under AB 802 legislation. It also continued its work to double energy efficiency savings by 2030 under SB 350. This included efforts to integrate distributed energy resources on the grid and to help low-income customers access energy efficiency and renewable energy investments. In December, California also became the first state to approve efficiency standards for laptops, desktop computers, and monitors. The new standards will begin to take effect in January 2018 when regulations for workstations and small-scale servers are rolled out, followed by standards for notebooks and desktops in January 2019 and for computer monitors later that year.

Adding 2 points to again take third place this year was **Rhode Island**. For the fourth year in a row, the state achieved a perfect 20-out-of-20 score in the utility programs category, thanks again to its ambitious Three-Year Energy Efficiency Procurement Plan, which has helped to drive electric utility savings to levels approaching 3%, among the highest in the country. In December 2016, the Governor's Executive Climate Change Coordinating Council (EC4) issued the Greenhouse Gas Emissions Reduction Plan to help cut emissions 45% by 2035 under the Resilient Rhode Island Act. Among the plan's diverse mitigation strategies are calls for continued investment in all cost-effective efficiency, more stringent vehicle-miles-traveled reduction goals, and an increase in public transit ridership. The state's score also reflects its increased efforts to acquire energy savings from CHP, including specific goals for a number of CHP projects.

Vermont and **Oregon** ranked fourth and fifth, respectively, both posting increases to their nation-leading levels of electricity savings and showing strong performances across nearly every policy area. In the top 10 again this year were Connecticut, New York, Washington, Minnesota, and Maryland. Each of these states has well-established efficiency programs and continues to push the boundaries by redefining the ways in which policies and regulations can enable energy savings.

States Rising and Falling

The most-improved states this year were Idaho, Florida, and Virginia. They posted the largest point increases over their previous year's score.

Idaho added the most to its score this year, rising in the ranks from 33rd to 26th. Although the state's utility savings have yet to rebound to peak levels seen in 2010 and 2011, they have edged upward recently thanks to resurgent levels of spending on demand-side management programs. Idaho has also seen a recent increase in electric vehicle registrations and updates to building energy codes modeled on the 2015 International Energy Conservation Code (IECC), due to take effect in January 2018. This was the state's best finish since 2012.

Also making a notable improvement in 2017 was **Florida** as it prepares to adopt the 6th Edition (2017) Florida Building Code, Energy Conservation, based on the 2015 IECC. In late 2016 the state began a new effort, the Farm Renewable and Efficiency Demonstration

(FRED) Program, which provides free energy evaluations to farmers and grant reimbursements on proposed efficiency measures. Meanwhile, **Virginia** added 2.5 points to its score by taking steps to adopt the 2015 IECC building energy codes. The state has also partnered with the Southeast Energy Efficiency Alliance to conduct a residential energy code field study.

By contrast, 21 states fell in the rankings this year and 20 lost points, both because of changes in their performance and because we adjusted our methodology, including placing more emphasis on energy savings achieved by utilities. **Iowa** fell the farthest, losing 3.5 points. This drop was partly due to the temporary suspension of funding for several efficiency loan and grant programs administered by the Iowa Energy Center. Legislators voted in April to move the center from Iowa State University to the Iowa Economic Development Authority.

Results by Policy Area

Rhode Island, **Massachusetts**, and **Vermont** were the leading states in utility-sector energy efficiency programs and policies (see Chapter 2). These three states also topped this category in 2014, 2015, and 2016. With long records of success, all three continued to raise the bar on cost-effective programs and policies. Massachusetts and Rhode Island both achieved incremental electricity savings at or near 3% of retail sales.

As mentioned above, savings from electricity efficiency programs in 2016 totaled approximately 25.4 million MWh, a 4.2% decrease from the 2015 savings reported in last year's *State Scorecard*. These savings are equivalent to about 0.68% of total retail electricity sales across the nation. Gas savings for 2016 were reported at 341 million therms, a roughly 1.3% decrease from 2015. This year's decrease in electric savings is a departure from several consecutive years of consistent annual increases, though roughly half of the states continued to post increases over savings reported in last year's *Scorecard*.

Total spending for electricity efficiency programs was $6.3 billion in 2016. Adding this to natural gas program spending of $1.3 billion, we estimate total efficiency program expenditures of approximately $7.6 billion, a slight decrease from the $7.7 billion reported for 2015.

Twenty-six states continue to adequately fund and enforce energy savings targets to drive investments in utility-sector energy efficiency programs. In recent months a number of states reaffirmed or strengthened their commitment to efficiency through legislative action. These include **Nevada**, which in June 2017 passed SB 150, directing the Public Utility Commission to establish utility energy savings goals and setting minimum spending levels for low-income efficiency programs. In May, **Colorado** passed legislation extending by another 10 years the requirement that efficiency program savings goals be set for the state's electric utilities.

States in the lower tiers also showed progress. **Louisiana** moved up three spots to 44th, with savings continuing to increase as its utilities transition from the three-year Quick Start phase of their energy efficiency programs to the more comprehensive Phase II. **Mississippi**, which also kicked off quick-start programs in 2014, held proceedings to guide the evolution to full-scale portfolios this year as well. Final action is expected in both states by the end of the year.

In **Illinois**, SB 2814 took effect in July to effectively double the state's energy efficiency targets. SB 428, passed in December 2016 in **Michigan**, extended the state's 1% savings targets through 2021 and added tiered incentives to encourage utilities to exceed 1.5% annual savings. In **Maryland**, lawmakers voted to extend the state's EmPOWER Maryland efficiency program and codify goals set by its Public Service Commission in 2016 that challenged utilities to achieve 2% annual savings by 2020. An effort in **Ohio** to extend a freeze on targets passed by state legislators in 2014 was vetoed in December, effectively reinstating the state's energy efficiency and renewable energy standards.

California, **Massachusetts**, and **New York** continue to lead the way in energy-efficient transportation policies for the second consecutive year (see Chapter 3). California's requirements for reducing greenhouse gas (GHG) emissions have prompted several strategies for smart growth. Massachusetts promoted smart growth development in cities and municipalities through state-delivered financial incentives. New York, Oregon, Washington, and Vermont are among the few states in the nation to have a vehicle-miles-traveled (VMT) reduction target.

California continued to lead in efficient buildings policies, with its latest building energy code updates taking effect in January 2017 and moving the state closer to its goal of achieving net zero energy use for all new residential buildings by 2020 and commercial buildings by 2030 (see Chapter 4). Other leaders include the **District of Columbia**, **New York**, and **Washington**, all of which have adopted the latest model codes, and enforce mandatory building energy benchmarking and disclosure policies for the commercial or residential building sector.

California, **Maryland**, **Massachusetts**, and **Rhode Island** scored highest for their CHP policies (Chapter 5), while **California**, **Connecticut**, **Massachusetts**, **Minnesota**, **Oregon**, and **Washington** led the way in state government initiatives (Chapter 6). All of these states offer financial incentives to consumers and state and local governments, and they also invest in R&D programs focused on energy efficiency.

California continues to lead the nation in setting appliance standards (Chapter 7), having adopted standards for more than 100 products. After completing standards for LEDs, small-diameter directional lamps, and showerheads in April 2016, the state adopted new standards for computers and computer monitors in December 2016 and began rulemaking for other products in the spring of 2017. The California Energy Commission (CEC) is conducting ongoing rulemakings for pool pump motors and portable electric spas and in May 2017 announced a public rulemaking process for eight additional products.

Table ES1 gives an overview of how states performed in each scoring category.

Table ES1. Summary of state scores in the *2017 State Scorecard*

Rank	State	Utility & public benefits programs & policies (20 pts.)	Trans-portation policies (10 pts.)	Building energy efficiency policies (8 pts.)	Combined heat & power (4 pts.)	State government initiatives (6 pts.)	Appliance efficiency standards (2 pts.)	TOTAL SCORE (50 pts.)	Change in rank from 2016	Change in score from 2016
1	Massachusetts	19.5	8	7	4	6	0	44.5	0	-0.5
2	California	13	9	8	4	6	2	42	-1	-3
3	Rhode Island	20	7	5	4	5.5	0	41.5	1	2
4	Vermont	18	6	7	2	5.5	0.5	39	-1	-1
5	Oregon	12.5	7.5	7	2.5	6	1	36.5	2	1.5
6	Connecticut	14.5	6.5	6	2.5	6	0	35.5	-1	0
7	New York	10	8	7.5	3.5	5.5	0	34.5	-2	-1
7	Washington	11.5	7	7.5	2.5	6	0	34.5	1	0
9	Minnesota	14.5	4	6	2.5	6	0	33	1	2
10	Maryland	8.5	6.5	6.5	4	5.5	0	31	-1	-1
11	Illinois	9.5	4.5	6	3	4	0	27	2	0.5
11	Michigan	11.5	4	5.5	1.5	4.5	0	27	0	0
13	District of Columbia	6.5	7.5	7.5	1	3	0	25.5	2	1.5
13	Maine	10.5	5	3	3	4	0	25.5	-2	-1.5
15	Colorado	8	4	4.5	1	5	0.5	23	-1	-1.5
15	Hawaii	10.5	4	5	1	2.5	0	23	0	-1
17	Arizona	10.5	4	3	1.5	3	0	22	1	1
17	Utah	7.5	4	5.5	1	4	0	22	3	2
19	Iowa	9.5	2.5	5	1.5	2	0	20.5	-4	-3.5
19	Pennsylvania	4	5	5	2.5	4	0	20.5	0	0
21	New Hampshire	9.5	2	4	1	3.5	0	20	0	0.5
22	Florida	1.5	4.5	7	1	4.5	0	18.5	3	2.5
23	New Jersey	3.5	5.5	5	1.5	2	0	17.5	1	0
24	Delaware	1.5	6	4	1.5	4	0	17	-2	-2
24	Wisconsin	8	0.5	3	1.5	4	0	17	-2	-2
26	Idaho	5.5	2	5.5	0.5	3	0	16.5	7	3.5
26	Texas	1	3	6.5	1.5	4.5	0	16.5	1	1
28	Kentucky	4.5	1	5	0.5	5	0	16	2	1.5
29	Tennessee	1.5	3.5	4	1	5.5	0	15.5	-4	-0.5
29	Virginia	0	5	5	0	5.5	0	15.5	4	2.5
31	Arkansas	7	0.5	3.5	0	3.5	0	14.5	-4	-1
31	North Carolina	2.5	3	4	1	4	0	14.5	-1	0
31	Ohio	5.5	0.5	3	1.5	4	0	14.5	-2	-0.5
34	Nevada	4	2	3.5	0.5	4	0	14	3	2
35	New Mexico	4.5	1.5	2.5	1.5	3.5	0	13.5	0	1
36	Montana	3.5	0.5	5	1	3	0	13	1	1
37	Missouri	1.5	2	3	1	5	0	12.5	-5	-1
38	Georgia	1.5	4.5	3	0.5	2.5	0	12	-3	-0.5
39	Alaska	1	2	2.5	1	4.5	0	11	2	1
40	Indiana	3.5	2	2	0.5	2	0	10	2	0.5
40	Oklahoma	4	1	2	0	3	0	10	4	2
42	South Carolina	1	2	2.5	0.5	3.5	0	9.5	-2	-1
43	Alabama	0	0.5	5.5	0	3	0	9	-4	-2
44	Louisiana	0.5	2	2.5	1	2.5	0	8.5	3	2
44	Nebraska	0.5	0.5	4.5	0	3	0	8.5	-2	-1
46	Mississippi	1.5	1.5	1.5	0.5	2.5	0	7.5	0	0.5
47	West Virginia	-0.5	2	3.5	0.5	1	0	6.5	-3	-1.5
48	Kansas	0.5	1	2	0.5	2	0	6	0	0
49	South Dakota	3	0.5	0.5	0.5	0.5	0	5	0	0
49	Wyoming	1	1	1	0	2	0	5	1	0.5
51	North Dakota	0	1.5	1	0.5	0.5	0	3.5	0	0.5

As we have since 2015, we included three US territories in our research this year: Puerto Rico, Guam, and the US Virgin Islands. While we did score these territories, we did not include them in our general rankings. All of them have taken some steps toward ensuring that building energy codes meet the requirements of the American Recovery and Reinvestment Act, but they have yet to invest heavily in energy efficiency in other sectors. The best-performing of these, Puerto Rico, would rank 46th if it were a state. Table ES2 shows the territories' scores.

Table ES2. Summary of scores for US territories in the *2017 State Scorecard*

Territory	Utility & public benefits programs & policies (20 pts.)	Transportation policies (10 pts.)	Building energy efficiency policies (8 pts.)	Combined heat & power (4 pts.)	State government initiatives (6 pts.)	Appliance efficiency standards (2 pts.)	TOTAL SCORE (50 pts.)	Change in score from 2016
Puerto Rico	0	2	2.5	0.5	2.5	0	7.5	–0.5
Guam	0	0.5	3	0	1	0	4.5	0
US Virgin Islands	0	0	2.5	0	1	0	3.5	0.5

STRATEGIES FOR IMPROVING ENERGY EFFICIENCY

Establish and adequately fund an energy efficiency resource standard (EERS) or similar energy savings target. EERS policies set specific energy savings targets that utilities or independent statewide program administrators must meet through customer energy efficiency programs. They serve as an enabling framework for cost-effective investment, savings, and program activity. EERS policies can catalyze increased energy efficiency and its associated economic and environmental benefits.

Examples: Massachusetts, Arizona, Hawaii, Michigan

Adopt policies to encourage and strengthen utility programs designed for low-income customers, and work with utilities and regulators to recognize the nonenergy benefits of such programs. Just as many states have established overall savings goals for energy efficiency portfolios, states and public utilities commissions (PUCs) can also include goals specific to the low-income sector, either within an EERS or as a stand-alone minimum acceptable threshold. PUCs can further strengthen programs serving low-income households by designing cost-effectiveness tests that take into account the multiple nonenergy benefits (NEBs) these programs produce.

Examples: Illinois, Pennsylvania, Nevada, New Hampshire

Adopt updated, more stringent building energy codes, improve code compliance, and involve efficiency program administrators in code support. Buildings use more than 40% of the total energy consumed in the United States, making them an essential target for energy savings. Mandatory building energy codes are one way to ensure a minimum level of energy efficiency for new residential and commercial buildings.

Examples: California, Maryland, Illinois, Texas

Adopt California tailpipe emission standards and set quantitative targets for reducing VMT. Like buildings, transportation consumes a substantial portion of the total energy used in the United States. At the state level, a comprehensive approach to transportation energy efficiency must address both individual vehicles and the transportation system as a whole. While federal fuel economy standards are expected to go a long way toward helping to reduce fuel consumption, standards for model years 2022–2025 are currently under review and face an uncertain future. States that adopt California's tailpipe emissions standards will be critical in maintaining progress toward clean, fuel-efficient vehicles. A variety of state-level policy options are available to address transportation system efficiency. These include codifying targets for reducing VMT as well as integrating land use and transportation planning to create sustainable communities with access to multiple modes of transportation.

Examples: California, New York, Massachusetts, Oregon

Treat cost-effective and efficient CHP as an energy efficiency resource equivalent to other forms of energy efficiency. Many states list CHP as an eligible technology within their EERS or renewable portfolio standard, but they relegate it to a bottom tier. ACEEE recommends that states give CHP savings equal footing, which requires that they develop a specific methodology for counting energy savings attributed to its utilization. If CHP is allowed as an eligible resource, EERS target levels should be increased to account for CHP potential and to ensure that CHP does not displace traditional energy efficiency measures.

Examples: Massachusetts, Maryland, Rhode Island

Expand state-led efforts—and make them visible. Initiatives here might include establishing sustainable funding sources for energy efficiency incentive programs; investing in energy efficiency–related research, development, and demonstration centers; and leading by example by incorporating energy efficiency into government operations. States have many opportunities to lead by example, including reducing energy use in public buildings and fleets, demonstrating the market for energy service companies (ESCOs) that finance and deliver energy-saving projects, and funding research centers that focus on breakthroughs in energy-efficient technologies.

Examples: New York, Connecticut, Alaska

Explore and promote innovative financing mechanisms to leverage private capital and lower the up-front costs of energy efficiency measures. Although utilities in many states offer some form of on-bill financing program to promote energy efficiency in homes and buildings, expanding lender and customer participation has been an ongoing challenge. States can help address this challenge by passing legislation, increasing stakeholder awareness, and addressing legal barriers to the implementation of financing programs. A growing number of states are seeking new ways to maximize the impact of public funds and invigorate energy efficiency by attracting private capital through emerging financing models such as Property Assessed Clean Energy (PACE) programs and green banks.

Examples: Missouri, New York, Rhode Island, Connecticut

Introduction

While not a topic that typically finds itself in the media spotlight, energy efficiency attracted no shortage of headlines in 2017. States are facing an evolving set of challenges and opportunities as their energy sectors transform. Energy options are becoming more diverse, while innovation is sparking new public interest in energy choices. Many states have pursued energy efficiency for decades to meet growing demand at low cost, and today efficiency continues to provide multiple benefits as the energy landscape evolves. Efficiency improves affordability, reliability, and security while creating millions of jobs. Efficiency also gives households and businesses more choice in how they use energy and can help those most in need alleviate high energy burdens.

With state leaders embracing efficiency's economic and environmental benefits, utilities across the United States invested approximately $7.6 billion in energy efficiency and saved approximately 25.4 million megawatt-hours (MWh) in 2016. While these levels did not quite match 2015 savings, roughly half the states reported savings surpassing those they posted in 2015, and many adopted and implemented new policies in 2016. Some states are seeing utility efficiency programs taking root for the first time, while others at the leading edge are pioneering data-driven strategies to reach higher levels of savings. A series of state policy decisions at the turn of the year extended and strengthened utility energy efficiency efforts, and many states have seen advancements in building energy codes, transportation, state government financing, and lead-by-example policies.

The 2017 State Energy Efficiency Scorecard highlights these recent developments and trends to call attention to the diverse policy tools available to governors, state legislators, and regulators. Energy efficiency is the nation's third-largest electricity resource, and it has the potential to grow even larger with continued state innovation and leadership (ACEEE 2016). Efficiency has a number of clear benefits. It creates jobs, not only directly for manufacturers and service providers, but also indirectly in other sectors by saving energy and freeing up funds to support the local economy. Efficiency also reduces pollution, strengthens community and grid resilience, promotes equity, and improves health and comfort.

This is the 11th edition of the *State Energy Efficiency Scorecard*. As in the past, this year's *State Scorecard* ranks states on their policy and program efforts, not only assessing performance but also documenting best practices and recognizing leadership. The *State Scorecard* provides an annual benchmark of the progress of state energy efficiency policies and encourages states to continue strengthening their commitment to efficiency, thereby promoting economic growth and environmental benefits. The *Scorecard* is divided into eight chapters. In Chapter 1, we discuss our methodology for scoring states (including changes made this year), present the overall results of our analysis, and provide several strategies states can use to improve their energy efficiency. Chapter 1 also highlights the leading states, most-improved states, and policy trends revealed by the rankings.

Subsequent chapters present detailed results for six major policy areas. Chapter 2 covers utility and public benefits programs and policies. Chapter 3 discusses transportation policies. Chapter 4 deals with building energy code adoption, state code compliance efforts, and building policies. Chapter 5 covers state scores on policies that encourage and enable combined heat and power (CHP) development. Chapter 6 deals with state government initiatives, including financial incentives, lead-by-example policies, and energy-efficiency–focused research and development (R&D). Finally, Chapter 7 discusses appliance and equipment efficiency standards.

In Chapter 8 we offer closing thoughts on the report's findings, expectations for what will emerge from states in the coming year, and potential changes to next year's *State Scorecard*.

Chapter 1. Methodology and Results

Author: Weston Berg

SCORING

States are the test beds for policies and regulations, and no two states are the same. To reflect this diversity, we chose metrics that are flexible enough to capture the range of policy and program options that states use to encourage energy efficiency. The policies and programs evaluated in the *State Scorecard* aim to reduce end-use energy consumption, set long-term commitments for energy efficiency, and establish mandatory performance codes and standards. They also help to accelerate the adoption of the most energy-efficient technologies; reduce market, regulatory, and information barriers to energy efficiency; and provide funding for efficiency programs.

Table 1 lists six of the primary policy areas in which states have historically pursued energy efficiency:

- Utility and public benefits programs and policies[2]
- Transportation policies
- Building energy efficiency policies
- Policies encouraging CHP systems
- State government–led initiatives around energy efficiency
- Appliance and equipment standards

Table 1. Scoring by policy area and metrics

Policy areas and metrics	Maximum score	% of total points
Utility and public benefits programs and policies	20	40%
Incremental savings from electricity efficiency programs	7	14%
Incremental savings from natural gas efficiency programs	3	6%
Spending on electricity efficiency programs	2.5	5%
Spending on natural gas efficiency programs	1.5	3%
Large customer opt-out programs*	(–1)	NA
Energy efficiency resource standards (EERSs)	3	6%
Performance incentives and fixed cost recovery	2	4%
Support of low-income energy efficiency programs	1	2%
Transportation policies	10	20%
Greenhouse gas (GHG) tailpipe emissions standards	1.5	3%
Electric vehicle (EV) registrations	1	2%
High-efficiency vehicle consumer incentives	0.5	1%

[2] A public benefits fund provides long-term funding for energy efficiency initiatives, usually through a small surcharge on electricity consumption collected on customers' bills.

Policy areas and metrics	Maximum score	% of total points
Targets to reduce vehicle miles traveled (VMT)	1	2%
Change in VMT	1	2%
Integration of transportation and land use planning	1	2%
Complete streets policies	0.5	1%
Transit funding	1	2%
Transit legislation	0.5	1%
Freight system efficiency goals	1	2%
Equitable transportation policies	1	2%
Building energy efficiency policies	8	16%
Level of code stringency	4	8%
Code compliance study	1	2%
Code enforcement activities	2	4%
Energy transparency policies	1	2%
Combined heat and power	4	8%
Interconnection standards	0.5	1%
Policies to encourage CHP as a resource	2	4%
Deployment incentives	0.5	1%
Additional supportive policies	1	2%
State government initiatives	6	12%
Financial incentives	3	6%
Lead-by-example efforts in state facilities and fleets	2	4%
Research and development	1	2%
Appliance and equipment efficiency standards	2	4%
Maximum total score	50	100%

*** Large customer opt-out programs allow a class of customers to withdraw from energy efficiency programs, reducing the potential savings available, so we deduct points for these policies.**

We allocated points among the policy areas to reflect the relative magnitude of energy savings possible through the measures scored. We relied on an analysis of scholarly work and the judgment of ACEEE staff and outside experts about the impact of state policies on energy efficiency in the sectors we cover. A variety of cross-sector potential studies have informed our understanding of the energy savings available in each policy area, and in turn have led to ongoing refinements in our scoring methodology (Geller et al. 2007; Neubauer et al. 2009, 2011; Eldridge, Elliott, and Vaidyanathan 2010; Molina et al. 2011; Hayes et al. 2014).

Of the 50 total points possible, we gave 40% (20 points) to utility and public benefits program and policy metrics, 16% (8 points) to building energy efficiency policies, and 8%

(4 points) to improved CHP policies. We used the same methodology to allocate the other policy area points, awarding 10 points for transportation policies and programs and 2 points for state appliance and equipment standards. Savings from the policies and programs measured in our chapter on state initiatives are hard to quantify, but we assigned a significant number of points—6 in total—to this policy area to highlight states that lead by example in making clear and visible commitments to energy efficiency.

Within each policy area, we developed a scoring methodology based on a diverse set of criteria that we detail in each policy chapter. We used these criteria to assign a score to each state. The scores were informed by data requests sent to state energy officials, public utility commission staff, and experts in each policy area. To the best of our knowledge, policy information for *The 2017 State Energy Efficiency Scorecard* is accurate as of July 31, 2017.

The *State Scorecard* is meant to reflect the current policy landscape, incorporating changes from year to year. We do not envision that the allocation of points both across and within sectors will forever remain the same; rather, we will continue to adjust our methodology to reflect the current energy efficiency policy and program landscape. This year we made changes to our scoring methodology in several policy areas. We outline these changes later in this chapter and discuss them in more depth in the relevant policy chapters. Changes in future editions of the *Scorecard* could include revisions to point allocations and the addition or subtraction of entire categories of scoring. In making these changes, we seek to faithfully represent states' evolving efforts to realize the potential for energy efficiency in the systems and sectors of their economies.

STATE DATA COLLECTION AND REVIEW

We continue to improve our outreach to state-level stakeholders to verify the accuracy and comprehensiveness of the policy information that we use to score the states. As in past years, we asked each state utility commission to review statewide data for the customer-funded energy efficiency programs presented in Chapter 2 and the CHP policies detailed in Chapter 5. Forty-four state commissions responded, comparable to the number of responses we received last year.

We also asked each state energy office to review information on transportation policies (Chapter 3), building energy codes (Chapter 4), CHP (Chapter 5), and state government–led initiatives (Chapter 6). We received responses from energy offices in 42 states, slightly fewer than in 2016. In addition, we gave state energy office and utility commission officials the opportunity to review and submit updates to the material in ACEEE's State and Local Policy Database (ACEEE 2017).[3] We also asked them to review and provide comments on a draft version of *The 2017 State Energy Efficiency Scorecard* prior to publication.

We used publicly available data and responses from prior years to evaluate states that did not respond to this year's data request or request for review. In addition, we convened an expert working group to provide further information on building energy codes in all states.

[3] Available at database.aceee.org.

Best-Practice Policy and Performance Metrics

The scoring framework described above is our best attempt to represent the myriad efficiency metrics as a quantitative score. Converting spending data, energy savings data, and policy adoption metrics spanning six policy areas into one score clearly involves some oversimplification. Quantitative energy savings performance metrics are confined mostly to programs run by utilities and third-party administrators using ratepayer funds. These programs are subject to strict evaluation, measurement, and verification standards. States engage in many other efforts to encourage efficiency, but such efforts are typically not evaluated with the same rigor, so it is difficult to capture comprehensive quantitative data for these programs.

Although our preference is to include metrics based on energy savings achieved in every sector, these data are not widely available. Therefore, with the exception of utility policies, we have not scored the other policy areas on reported savings or spending data attributable to a particular policy action. Instead, given the lack of consistent ex post data, we have developed best-practice metrics for scoring the states. Although these metrics do not score outcomes directly, they credit states that are implementing policies likely to lead to more energy-efficient outcomes. For example, we give credit for *potential* energy savings from improved building energy codes and appliance efficiency standards since *actual* savings from these policies are rarely evaluated. We have also attempted to reflect outcome metrics to the extent possible; for example, electric vehicle (EV) registrations and reductions in vehicle miles traveled (VMT) both represent positive results of transportation policies. We include full discussions of the policy and performance metrics in each chapter.

AREAS BEYOND OUR SCOPE: LOCAL AND FEDERAL EFFORTS

Energy efficiency initiatives implemented by actors at the federal or local level or in the private sector (with the exception of investor-owned utilities [IOUs] and CHP facilities) generally fall outside the scope of this report. It is important to note that regions, counties, and municipalities have become actively involved in developing energy efficiency programs, a positive development that reinforces state-level efficiency efforts. ACEEE's biennial *City Energy Efficiency Scorecard* (Ribeiro et al. 2017) captures data on these local actions; we do not specifically track them in the *State Scorecard*. However a few *State Scorecard* metrics do capture local-level efforts, including the adoption of building codes and land use policies, as well as state financial incentives for local energy efficiency initiatives. We also include municipal utilities in our data set to the extent that they report energy efficiency data to the US Energy Information Administration (EIA), state public utility commissions, or other state and regional groups. As much as possible, however, we aim to focus specifically on state-level energy efficiency activities.

The *State Scorecard* has not traditionally covered private-sector investments in efficient technologies outside of customer-funded or government-sponsored energy efficiency initiatives, codes, or standards. However we do recognize the need for metrics that capture the rapidly growing role of private financing mechanisms in new utility business models. As Chapter 6 explains, we continue efforts to move the *Scorecard* in that direction by considering the existence of Property Assessed Clean Energy (PACE) programs and green banks in the scores for state financial incentives. While utility and public programs are critical to leveraging private capital, we found it challenging to develop an independent metric that measures the success of private-sector investment, given the absence of protocols for measuring and verifying energy savings. We hope that as the transparency and reliability of savings data from these private initiatives improve, they will play a larger, more quantifiable role in future *State Scorecards*.

CHANGES IN SCORING METHODOLOGY FROM LAST YEAR

We updated the scoring methodology in five policy areas this year to better reflect potential energy savings and changing policy landscapes.

In Chapter 2, "Utility and Public Benefits Programs and Policies," we added a new 1-point scoring category that considers state and utility policies intended to help bring energy efficiency programs to low-income customers. Research by ACEEE and others has found that low-income and multifamily households spend disproportionate amounts of their income on energy and are also less likely than other households to be served by utility efficiency programs (Drehobl and Ross 2016). While reaching these consumers poses some unique challenges, we seek with this metric to highlight those states that have recognized the important health and societal benefits achieved by engaging these underserved customers and communities. In order to accommodate this additional 1-point metric, we removed 0.5 points each from scoring categories related to utility spending on electric and natural gas efficiency programs. At the same time, in keeping with our ongoing effort to better distinguish states on the leading edge of efficiency investment, we have raised the threshold for the top scoring levels within the metrics for utility spending on electric efficiency programs and for electricity savings targets.

Promoting equitable access to efficiency was also the focus of a new metric included in Chapter 3, "Transportation." Specifically we awarded 0.5 points to states with policies in place to encourage low-income housing in transit-oriented neighborhoods and an additional 0.5 points if states use distance from transit facilities as a criterion to award federal low-income housing tax credits (LIHTC). Although we continued to award points to states with a dedicated transit revenue stream and to those with complete streets statutes, we reduced the number of potential points in these categories to make room for the additional 1-point low-income program metric. We also updated our methodology with regard to freight system efficiency so that states could earn 0.5 points if their freight plans addressed multimodal freight strategies and another 0.5 points if they included energy efficiency performance metrics or freight-specific GHG reduction goals.

In Chapter 4, "Building Energy Codes," our methodology remained relatively unchanged, save for an added discussion regarding states with mandatory energy use transparency policies, a section that appeared within Chapter 6, "State Government–Led Initiatives," in earlier *Scorecards*. We also partnered with the New Buildings Institute (NBI) for the first time this year to preview a new metric based on NBI's Zero Energy Performance Index (zEPI), intended to more accurately quantify each state's building energy code performance. Derived from computer analyses conducted by Pacific Northwest National Labs (PNNL), zEPI quantifies the expected energy use intensity of a building complying with a range of energy code levels and takes into account factors like building type distribution and regional climate zones. More information on methodology is available in Chapter 4, as well as on the NBI website.[4]

In Chapter 7, "Appliance and Equipment Efficiency Standards," we adjusted the scoring methodology to give credit to all states that have adopted a standard whose most recent effective date is within the past five years, instead of the three-year window used in last year's *Scorecard*. A state could also earn an additional bonus of 0.5 points for adopting standards at the state level that back up federal standards—i.e., that mandate the state's continued use of federal standards in the event the latter are rolled back.

We discuss additional details on scoring, including changes to methodology, in each chapter.

2017 State Energy Efficiency Scorecard *Results*

We present the results of the *State Scorecard* in figure 1 and describe them more fully in table 2. In this section, we also highlight some key changes in state rankings, discuss which states are making notable new commitments to energy efficiency, and provide recommendations for states wanting to increase their energy efficiency.

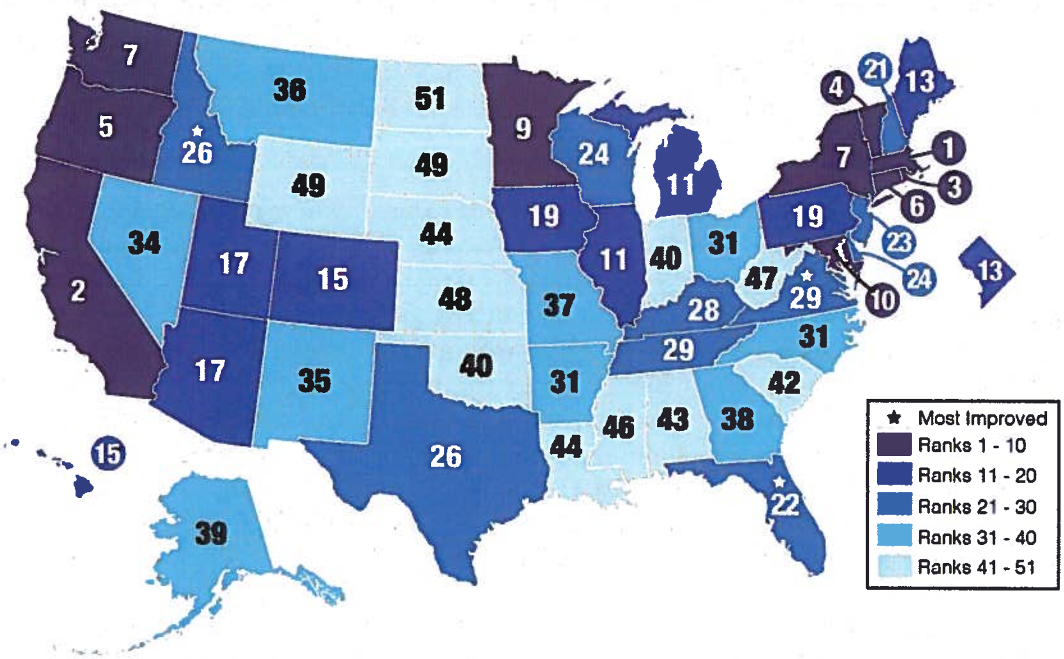

Figure 1. ***2017 State Scorecard*** **rankings**

[4] See newbuildings.org/code_policy/zepi/.

Table 2. Summary of state scores in the *2017 State Scorecard*

Rank	State	Utility & public benefits programs & policies (20 pts.)	Trans-portation policies (10 pts.)	Building energy efficiency policies (8 pts.)	Combined heat & power (4 pts.)	State government initiatives (6 pts.)	Appliance efficiency standards (2 pts.)	TOTAL SCORE (50 pts.)	Change in rank from 2016	Change in score from 2016
1	Massachusetts	19.5	8	7	4	6	0	44.5	0	–0.5
2	California	13	9	8	4	6	2	42	–1	–3
3	Rhode Island	20	7	5	4	5.5	0	41.5	1	2
4	Vermont	18	6	7	2	5.5	0.5	39	–1	–1
5	Oregon	12.5	7.5	7	2.5	6	1	36.5	2	1.5
6	Connecticut	14.5	6.5	6	2.5	6	0	35.5	–1	0
7	New York	10	8	7.5	3.5	5.5	0	34.5	–2	–1
7	Washington	11.5	7	7.5	2.5	6	0	34.5	1	0
9	Minnesota	14.5	4	6	2.5	6	0	33	1	2
10	Maryland	8.5	6.5	6.5	4	5.5	0	31	–1	–1
11	Illinois	9.5	4.5	6	3	4	0	27	2	0.5
11	Michigan	11.5	4	5.5	1.5	4.5	0	27	0	0
13	District of Columbia	6.5	7.5	7.5	1	3	0	25.5	2	1.5
13	Maine	10.5	5	3	3	4	0	25.5	–2	–1.5
15	Colorado	8	4	4.5	1	5	0.5	23	–1	–1.5
15	Hawaii	10.5	4	5	1	2.5	0	23	0	–1
17	Arizona	10.5	4	3	1.5	3	0	22	1	1
17	Utah	7.5	4	5.5	1	4	0	22	3	2
19	Iowa	9.5	2.5	5	1.5	2	0	20.5	–4	–3.5
19	Pennsylvania	4	5	5	2.5	4	0	20.5	0	0
21	New Hampshire	9.5	2	4	1	3.5	0	20	0	0.5
22	Florida	1.5	4.5	7	1	4.5	0	18.5	3	2.5
23	New Jersey	3.5	5.5	5	1.5	2	0	17.5	1	0
24	Delaware	1.5	6	4	1.5	4	0	17	–2	–2
24	Wisconsin	8	0.5	3	1.5	4	0	17	–2	–2
26	Idaho	5.5	2	5.5	0.5	3	0	16.5	7	3.5
26	Texas	1	3	6.5	1.5	4.5	0	16.5	1	1
28	Kentucky	4.5	1	5	0.5	5	0	16	2	1.5
29	Tennessee	1.5	3.5	4	1	5.5	0	15.5	–4	–0.5
29	Virginia	0	5	5	0	5.5	0	15.5	4	2.5
31	Arkansas	7	0.5	3.5	0	3.5	0	14.5	–4	–1
31	North Carolina	2.5	3	4	1	4	0	14.5	–1	0
31	Ohio	5.5	0.5	3	1.5	4	0	14.5	–2	–0.5
34	Nevada	4	2	3.5	0.5	4	0	14	3	2
35	New Mexico	4.5	1.5	2.5	1.5	3.5	0	13.5	0	1
36	Montana	3.5	0.5	5	1	3	0	13	1	1
37	Missouri	1.5	2	3	1	5	0	12.5	–5	–1
38	Georgia	1.5	4.5	3	0.5	2.5	0	12	–3	–0.5
39	Alaska	1	2	2.5	1	4.5	0	11	2	1
40	Indiana	3.5	2	2	0.5	2	0	10	2	0.5
40	Oklahoma	4	1	2	0	3	0	10	4	2
42	South Carolina	1	2	2.5	0.5	3.5	0	9.5	–2	–1
43	Alabama	0	0.5	5.5	0	3	0	9	–4	–2
44	Louisiana	0.5	2	2.5	1	2.5	0	8.5	3	2
44	Nebraska	0.5	0.5	4.5	0	3	0	8.5	–2	–1
46	Mississippi	1.5	1.5	1.5	0.5	2.5	0	7.5	0	0.5
47	West Virginia	–0.5	2	3.5	0.5	1	0	6.5	–3	–1.5
48	Kansas	0.5	1	2	0.5	2	0	6	0	0
49	South Dakota	3	0.5	0.5	0.5	0.5	0	5	0	0
49	Wyoming	1	1	1	0	2	0	5	1	0.5
51	North Dakota	0	1.5	1	0.5	0.5	0	3.5	0	0.5

As in previous years, we did not rank the three territories we included in our research this year, but we did score them in all categories. In general, the territories scored near the bottom, largely because their publicly owned utilities do not offer energy efficiency programs. Although all three have taken some steps toward ensuring building energy codes are in place, they have not invested heavily in energy efficiency in other sectors. Table 3 shows scores for Puerto Rico, Guam, and the US Virgin Islands. Puerto Rico scores highest among territories, although it would rank only 46th if included in the general scoring table.

Table 3. Scores for US territories in the *2017 State Scorecard*

Territory	Utility & public benefits programs & policies (20 pts.)	Trans-portation policies (10 pts.)	Building energy codes (8 pts.)	Combined heat & power (4 pts.)	State government initiatives (6 pts.)	Appliance efficiency standards (2 pts.)	Total score (50 pts.)	Change in score from 2016
Puerto Rico	0	2	2.5	0.5	2.5	0	7.5	–0.5
Guam	0	0.5	3	0	1	0	4.5	0
US Virgin Islands	0	0	2.5	0	1	0	3.5	0.5

How to Interpret Results

Although we provide individual state scores and rankings, the differences among states are most instructive in tiers of 10. The span of states' total scores in the middle tiers of the *State Scorecard* is relatively small: just 4.5 points in the third tier and 4.5 points in the fourth. These tiers also have a significant number of states tied in the rankings. For example, in the third tier Delaware and Wisconsin are tied for 24th, Idaho and Texas are tied for 26th, and Arkansas, North Carolina, and Ohio are tied for 31st. For the states in these middle tiers, small improvements in energy efficiency will likely have a significant effect on their rankings. Conversely, idling states will easily fall behind as other states in this large group ramp up their efficiency efforts.

The top tier, however, exhibits more variation in scoring, with a 13.5-point range between 1st place and 10th. This represents almost a third of the total variation in scoring among all the states. Rhode Island posted its highest-ever score in the *Scorecard* to join Massachusetts and California in the exclusive group of states achieving 40 points or more. Other states in the top tier are also well-established high scorers. Generally speaking, the highest-ranking states have all made broad, long-term commitments to energy efficiency, indicated by their staying power at the top of the *State Scorecard* over the past decade. However it is important to note that retaining one's spot in the lead pack is no easy task, and that all of these states must embrace new, cutting-edge strategies and programs to remain at the top. Notably, the top tier did see some movement this year, with California, Vermont, Connecticut, New York, and Maryland all slipping somewhat in the rankings, while Rhode Island, Oregon, Washington, and Minnesota each drew ahead.

2017 Leading States

After sharing first place with California in last year's *Scorecard*, **Massachusetts** pulled ahead to reclaim the top spot in 2017, posting its highest recorded electricity savings: 3% of sales. The state's Green Communities Act of 2008 continues to drive nation-leading levels of savings through ambitious annual energy efficiency goals. Its program administrators offer some of the most comprehensive services in the country, addressing a range of customers and building types. Having raised the bar on its three-year electricity efficiency targets in 2015, the state continued to roll out the latest components of its $15 million Affordable Access to Clean and Efficient Energy (AACEE) Initiative. AACEE aims to reduce the energy burden and cost variability for low- and moderate-income residents. It includes the Affordable Clean Residential Energy (ACRE) program, a grant initiative to promote low-income customer access to combined air source heat pumps and solar photovoltaic systems. ACRE also evaluates performance data to help integrate energy efficiency and renewable technologies. The state's Zero-Energy Modular Affordable Housing Initiative is a grant program to replace existing manufactured housing with affordable zero-energy modular units.

Having tied with Massachusetts for first place in last year's *Scorecard*, **California** continued its efficiency progress with a series of major policy initiatives. The state undertook new building energy use benchmarking and data sharing mandates under AB 802 legislation. It also continued its work to double energy efficiency savings by 2030 under SB 350. This included efforts to integrate distributed energy resources on the grid and to help low-income customers access energy efficiency and renewable energy investments. In December, California also became the first state to approve efficiency standards for laptops, desktop computers, and monitors. The new standards will begin to take effect in January 2018 when regulations for workstations and small-scale servers are rolled out, followed by standards for notebooks and desktops in January 2019 and for computer monitors later that year.

Surging past 40 points to again take third place this year was **Rhode Island.** For the fourth year in a row, the state achieved a perfect 20-out-of-20 score in the utility programs category, thanks again to its ambitious Three-Year Energy Efficiency Procurement Plan that has helped to drive electric utility savings to levels approaching 3%, among the highest in the country. In December 2016, the Governor's Executive Climate Change Coordinating Council (EC4) issued the Greenhouse Gas Emissions Reduction Plan to help cut emissions 45% by 2035 under the Resilient Rhode Island Act. Among the plan's diverse mitigation strategies are calls for continued investment in all cost-effective efficiency and an increase in public transit ridership. The state's score also reflects its increased efforts to acquire energy savings from combined heat and power (CHP), including specific goals for a number of CHP projects.

Vermont and **Oregon** ranked fourth and fifth, respectively, both posting increases to their nation-leading levels of electricity savings and showing strong performances across nearly every policy area. In the top 10 again this year were Connecticut, New York, Washington, Minnesota, and Maryland. Each of these states has well-established efficiency programs and continues to push the boundaries by redefining the ways in which policies and regulations can enable energy savings.

Table 4 shows the number of years that states have been in the top 5 and top 10 spots in the *State Scorecard* rankings since 2007.

Table 4. Leading states in the *State Scorecard*, by years at the top

State	Years in top 5	Years in top 10
California	11	11
Massachusetts	10	11
Oregon	10	11
Vermont	9	11
New York	7	11
Connecticut	5	11
Rhode Island	5	10
Washington	1	11
Minnesota	0	10
Maryland	0	7
Illinois	0	2
Maine	0	2
New Jersey	0	2
Wisconsin	0	1

In total, 8 states have occupied the top 5 spots, and 14 have appeared somewhere in the top 10, since the first edition of the *State Scorecard*. California is the only state to have held a spot among the top five in all 11 years, followed by Massachusetts and Oregon, both for 10 years, and Vermont for 9 years. New Jersey, Wisconsin, Illinois, and Maine have all placed in the top 10 in the past, but none scored high enough to rank in the top tier this year.

Changes in Results Compared with *The 2016 State Energy Efficiency Scorecard*

Variations from last year's ranking are not solely due to changes in states' efforts. Such shifts stem also from modifications to our scoring methodology. Given the number of metrics in the *State Scorecard* and states' varying efforts, relative movement among the states should be expected.

Table 5 compares the results of *The 2017 State Energy Efficiency Scorecard* to last year's results.

Table 5. Number of states and territories gaining or losing points compared with 2016, by policy area

Policy category	States gaining points		No change		States losing points	
Utility & public benefits	26	48%	16	30%	12	22%
Transportation	15	28%	17	31%	22	41%
Building energy policies	15	28%	24	44%	15	28%
Combined heat and power	4	7%	50	93%	0	0%
State government initiatives	12	22%	25	46%	17	31%
Appliance standards	1	2%	52	96%	1	2%
Total score	24	44%	9	17%	21	39%

Percentages may not total 100 due to rounding.

Overall, 23 states and 1 territory gained points and 20 states and 1 territory lost points compared with last year. Eight states and 1 territory had no change in score.[5] Some of the changes in points were due to our methodological changes, and so the number of states losing points should not necessarily be interpreted as a sign that states are losing ground. This is particularly important to note in the state government initiatives metric, which had a scoring subcategory moved to the building energy policies metric. We also raised the bar to require a higher threshold level of ratepayer-funded electric efficiency spending in order for states to earn top points in the utility and public benefits metric.

The landscape for energy efficiency is in constant flux, and many opportunities remain for states to lead the way. Changes in state scores result from a variety of factors. In some cases they reflect an ever-rising bar for energy efficiency policies and outcomes. In others they stem from changes to our methodology in this edition of the *Scorecard*, for example our consideration of policies to promote equitable access to programs for low-income customers. In another area, several states that had previously received credit for having conducted a building energy codes compliance study lost points in this edition for not having updated this analysis within the past five years.

In total 21 states lost points in this year's *Scorecard*. That said, the overall decrease is not indicative of a lack of progress among states. It is true that several states have backslid in terms of policy; examples include Indiana's 2014 rollback of its energy efficiency resource standards (EERS) and legislation passed this year in Minnesota to exempt small cooperatives from the state's Conservation Improvement Program. Still, several states, including Colorado, Illinois, Michigan, Nevada, and Ohio, renewed, extended, or strengthened energy efficiency targets in recent months to help lay the groundwork for future savings. As mentioned earlier, savings from electric efficiency programs in 2016 totaled approximately 25.4 million MWh a 4.2% decrease from the 2015 savings reported in last year's *State Scorecard*. These savings are equivalent to approximately 0.68% of total retail electricity sales in the United States in 2016. Gas savings for 2016 were reported at 341

[5] The *State Scorecard* looks at all 50 states and the District of Columbia, which, while not a state, is nonetheless treated as such under Department of Energy Program Rule 10 CFR Part 420–State Energy Program. We also score, but do not rank, three US territories, including the US Virgin Islands.

million therms, a roughly 1.3% decrease from 2015. More information on state scores for utility programs is included in Chapter 2.

Most-Improved States

Based on changes in their scores relative to last year, this year's most-improved states were Idaho, Florida, and Virginia. All of these states added more than 2 points to their scores to move up in the rankings. Table 6 shows changes in points and rank compared with last year for these states.

Table 6. Changes from 2016 for most-improved states

	Change in score	Change in rank	2017 ranking	2016 ranking
Idaho	+3.5	+7	26	33
Florida	+2.5	+3	22	25
Virginia	+2.5	+4	29	33

Idaho added the most to its score this year, rising in the ranks from 33rd to 26th. Although the state's utility savings have yet to rebound to peak levels seen in 2010 and 2011, they have edged upward recently thanks to resurgent levels of spending on demand-side management programs. Idaho has also seen a recent increase in electric vehicle registrations and updates to building energy codes modeled on the 2015 International Energy Conservation Code (IECC), due to take effect in January 2018. This was the state's best finish since 2012.

Also making notable improvement in 2017 was **Florida**, as it prepares to adopt the 6th Edition (2017) Florida Building Code, Energy Conservation, based on the 2015 IECC. In late 2016 the state also began making funding available through a new program, the Farm Renewable and Efficiency Demonstration (FRED) Program, which provides free energy evaluations to farmers and grant reimbursements on proposed efficiency measures.

Virginia has also taken steps to adopt the 2015 IECC building energy codes and has partnered with the Southeast Energy Efficiency Alliance to conduct a residential energy code field study.

In addition, this year a variety of states reaffirmed or strengthened their commitment to energy efficiency through legislative decisions that, while not entirely reflected in this year's scores, has them poised to see continued success in the near future. These include SB 150 in **Nevada**, passed in June 2017, which directs the establishment of utility energy savings goals; and **Colorado**'s HB 1227, which extends utility efficiency programs for another 10 years. In **Illinois**, SB 2814 took effect in July to effectively double the state's energy efficiency targets. SB 428, passed in December 2016 in **Michigan**, extended the state's 1% savings targets through 2021 and added tiered incentives to encourage utilities to exceed 1.5% annual savings. And in **Maryland**, lawmakers voted earlier to extend the state's EmPOWER Maryland efficiency program and codify goals set by the state's Public Service Commission (PSC) in 2016 for utilities to achieve 2% annual savings by 2020. **Louisiana** and **Mississippi** both began regulatory processes to move toward comprehensive utility efficiency portfolios. These efforts are still underway.

States Losing Ground

Twenty-one states fell in the rankings this year due to several factors, including policy or program rollbacks, greater progress by other states, and changes to the scoring methodology in two of our policy areas (utilities and transportation). This loss of ground also indicates the complex relationship between changes in total score and changes in rank. Of the 20 states that lost points, 18 fell in the rankings.[6] The ranking of one did not change. The fall in rank of several states—for example, Tennessee, Arkansas, and Missouri—might appear incommensurate with their relatively minor loss of 1 point or less relative to last year. Given the number of metrics covered in the *State Scorecard* and states' differing efforts, relative movement among states should be expected. As mentioned earlier, the difference among states' total scores, particularly in the middle tiers of the *State Scorecard*, is small; as a result, idling states can easily fall behind in the rankings as others ramp up efforts to become more energy-efficient.

Iowa lost 3.5 points, the most noticeable drop in points. This can be attributed in part to the suspension of funding for several efficiency loan and grant programs administered by the Iowa Energy Center, which state legislators this year voted to move from Iowa State University to the Iowa Economic Development Authority. However this change may reflect only a temporary pause in these programs.

A few other states lost points because of a dip in savings. In Wisconsin, for example, savings dropped more than 100,000 MWh due to several factors, including program cycle impacts on the recent year's budget, market availability of LEDs as programs transition away from CFLs, and the effect of rising baselines on efficiency potential. Other states, such as Maryland, cited similar contributing factors.

In general, we see two trends among these states and others losing ground in the *State Scorecard*. First, many of the states falling behind are not increasing energy savings year after year and are therefore being outpaced as other states ramp up programs to meet higher savings targets. States losing ground typically have not fully implemented changes to the utility business model that encourage utilities to take full advantage of energy efficiency as a resource, including decoupling, performance incentives, and energy savings targets.

Second, opt-out provisions have been approved in many of the states falling behind in the *State Scorecard* rankings. These provisions allow large customers to avoid paying into energy efficiency programs, forcing other customers to subsidize them and limiting the amount of energy savings utilities can achieve.

STRATEGIES FOR IMPROVING ENERGY EFFICIENCY

No state received the full 50 points in *The 2017 State Energy Efficiency Scorecard*, reflecting the fact that opportunities remain in all states—including leading states—to improve energy efficiency. For states wanting to raise their standing in the *State Scorecard* and, more

[6] One of the US territories also lost points this year, but they are not included in our rankings.

important, to capture greater energy savings and the associated public benefits, we offer the following recommendations based on the metrics we track.

Establish and adequately fund an EERS or similar energy savings target. These policies set specific energy savings targets that utilities or independent statewide program administrators must meet through customer energy efficiency programs and market transformation. They also serve as an enabling framework for cost-effective investment, savings, and program activity that, as seen in many of the leading states, can have a catalytic effect on increasing energy efficiency and its associated economic and environmental benefits. Although some states opt to include energy efficiency within the integrated resource planning (IRP) process, experience suggests that EERS policies truly drive higher cost-effective efficiency savings than any other method. The long-term goals associated with an EERS send a clear signal to market actors about the importance of energy efficiency resources in utility program planning, creating a level of certainty that encourages large-scale, productive investment in energy efficiency technologies and services. EERS targets should be established alongside rigorous, robust integrated and distributed resources planning. Long-term energy savings targets require leadership, sustainable funding sources, and institutional support to deliver on their goals. Chapter 2 has details.

Examples: Massachusetts, Arizona, Hawaii, Rhode Island

Adopt policies to encourage and strengthen utility programs designed for low-income customers, and work with utilities and regulators to recognize the nonenergy benefits of such programs. Just as many states have established overall savings goals for energy efficiency portfolios, states and public utilities commissions (PUCs) can also include goals specific to the low-income sector, either within an EERS or as a stand-alone minimum acceptable threshold. PUCs can further strengthen programs serving low-income households by designing cost-effectiveness tests that take into account the multiple nonenergy benefits (NEBs) these programs produce, including health and safety, increased comfort, local job creation, and energy affordability. States may also choose to recognize these benefits by exempting low-income programs from traditional cost-effectiveness requirements.

Examples: Illinois, Pennsylvania, Nevada, New Hampshire

Adopt updated, more stringent building energy codes, improve code compliance, and enable efficiency program administrators to be involved in code support. Buildings consume more than 40% of the total energy used in the United States, making them an essential target for energy savings. Mandatory building energy codes are one way to ensure a minimum level of energy efficiency for new residential and commercial buildings. Model codes are only as effective as their level of implementation, however, and improved compliance activities—including training and code compliance surveys—are increasingly important. Another emerging policy driver for capturing energy savings from codes is the enabling of utility and program administrators to support compliance activities. See Chapter 4 for details.

Examples: California, Maryland, Illinois, Texas

Adopt California tailpipe emission standards and set quantitative targets for reducing VMT. Like buildings, transportation consumes a substantial portion of the total energy used in the United States. At the state level, a comprehensive approach to transportation energy efficiency must address both individual vehicles and the transportation system as a whole. While federal fuel economy standards are expected to go a long way toward helping to reduce fuel consumption, standards for model years 2022–2025 are currently under review and face an uncertain future. States that adopt California's tailpipe emissions standards will be critical in maintaining progress toward clean, fuel-efficient vehicles. A variety of state-level policy options are available to address transportation system efficiency. These include codifying targets for reducing VMT as well as integrating land use and transportation planning to create sustainable communities with access to multiple modes of transportation.

Examples: California, New York, Massachusetts, Oregon

Treat cost-effective and efficient CHP as an energy efficiency resource equivalent to other forms of energy efficiency. Several states list CHP as an eligible technology in their EERS or renewable portfolio standard (RPS) but relegate it to a bottom tier, letting other renewable technologies and efficiency resources take priority within the standard. ACEEE recommends that CHP savings be given equal footing, which requires states to develop a specific methodology for counting CHP savings. If CHP is considered an eligible resource, total energy savings target levels should be increased to take CHP's potential into account. Massachusetts has accomplished this in its Green Communities Act.

Example: Massachusetts, Maryland, Rhode Island

Expand and highlight state-led efforts, such as funding for energy efficiency incentive programs, benchmarking requirements for state building energy use, and investments in energy-efficiency-related R&D centers. State-led initiatives complement the existing landscape of utility programs, leveraging resources from the state's public and private sectors to generate energy and cost savings that benefit taxpayers and consumers. States have many opportunities to lead by example here, including by reducing energy use in public buildings and fleets and by enabling the market for energy service companies (ESCOs) that finance and deliver energy-saving projects. States can also fund research centers that focus on energy-efficient technology breakthroughs. See Chapter 6 for details.

Examples: New York, Connecticut, Alaska

Explore and promote innovative financing mechanisms to leverage private capital and lower the up-front costs of energy efficiency measures. While utilities in many states offer some form of on-bill financing program to promote energy efficiency in homes and buildings, expanding lender and customer participation has been an ongoing challenge. States can help address this challenge by passing legislation, increasing stakeholder awareness, and addressing legal barriers to the implementation of financing programs. A growing number of states are seeking new ways to maximize the impact of public funds and invigorate energy efficiency by attracting private capital through emerging financing models such as PACE and green banks.

Examples: Missouri, New York, Rhode Island, Connecticut

Chapter 2. Utility and Public Benefits Programs and Policies

Authors: Weston Berg, Seth Nowak, and Heather DeLucia

INTRODUCTION

The utility sector is critical to implementing energy efficiency. Electric and natural gas utilities and independent statewide program administrators deliver a substantial share of US electricity and natural gas efficiency programs.[7] Utility customers fund these programs through utility rates and statewide public benefits funds. Through these programs, utilities encourage customers to use efficient technologies and thereby reduce their energy waste. Energy efficiency is therefore a resource—just as power plants, wind turbines, and solar panels are. Driven by regulation from state utility commissions, utilities and program administrators in some states have been delivering energy efficiency programs and market transformation initiatives for decades, offering various efficiency services for residential, commercial, industrial, and low-income customers.[8]

Utilities and administrators implement energy efficiency programs in all 50 states and the District of Columbia. Program approaches include financial incentives, such as rebates and loans; technical services, such as audits, retrofits, and training for architects, engineers, and building owners; behavioral strategies; and educational campaigns about the benefits of energy efficiency improvements. Utilities and administrators also continue to develop new and creative ways of delivering energy efficiency to their customers, including some customer segments that have been more difficult to serve, such as small businesses and multifamily housing.

METHODOLOGY

For this chapter, we gathered statewide data on the following:

- Utility energy sales (electricity and natural gas) to customers in 2015 and 2016
- Utility revenues from retail energy sales in 2015 and 2016
- Number of residential natural gas customers in 2015
- Budgets for electricity and natural gas energy efficiency programs in 2016 and 2017
- Actual spending for electricity and natural gas energy efficiency programs in 2015 and 2016
- Incremental net and gross electricity and natural gas energy efficiency program savings in 2015 and 2016[9]
- Policies and regulations to encourage utility investment in energy efficiency

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[7] Other major programs, run by state governments, are discussed in Chapter 6.

[8] For more information on the historical growth of utility energy efficiency programs, see York et al. 2012.

[9] Gross savings are those expected from an energy efficiency program, crediting all installed efficiency measures, including those that would have been installed in the absence of the program. Net savings are those attributable to the program, typically calculated by removing free riders (program participants who would have implemented or installed the measures without incentive, or with a lesser incentive). States differ in how they define, measure, and account for free-ridership and other components of the net savings calculation (Haeri and Khawaja 2012).

- Utility policies and programs related to large customers, including self-direct and opt-out provisions
- Policies and levels of spending related to utility investment in low-income energy efficiency programs
- Data access policies and provisions[10]

Our data sources included information requests completed by state utility commissions, the Consortium for Energy Efficiency (CEE 2012–2017), EIA (EIA 2016b, 2017a, 2017b, 2017c), and regional efficiency groups.[11,12] We sent the data we gathered, along with last year's *State Scorecard* data, to state utility commissions and independent administrators for review. Table 7 shows overall scores for utility programs and policies. Tables 9, 11, 13, and 15 provide data on electricity and natural gas efficiency program savings and spending in the most recent years for which data are available.

SCORING AND RESULTS

This chapter reviews and ranks the states on the basis of their performance in implementing utility-sector efficiency programs and enabling policies that are evidence of states' commitment to energy efficiency. The eight utility scoring metrics are

- Incremental electricity program savings as a percentage of retail sales (7 points)[13]
- Incremental natural gas program savings as a percentage of residential and commercial sales (3 points)
- Electricity program spending as a percentage of statewide electric utility revenues (2.5 points)
- Natural gas program spending per residential gas customer (1.5 points)
- Opt-out provisions for large customers (reduction of 1 point)
- EERS for utilities and statewide program administrators (3 points)
- Utility business models that encourage energy efficiency, including performance incentives and mechanisms for addressing lost revenue (2 points)
- Policies and utility funding in support of low-income energy efficiency programs (1 point)

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[10] We used these data from state responses to present best practices, not to develop scores.

[11] The Consortium for Energy Efficiency (CEE) surveys administrators of public benefits programs annually to capture trends in aggregated budgets and expenditures. CEE has granted ACEEE permission to reference survey results as of a point in time for the purpose of capturing trends in aggregate budget, expenditure, and impacts data, while acknowledging the difficulty of meaningful state-by-state comparison. The full report is at www.cee1.org/annual-industry-reports.

[12] The six regional energy efficiency organizations (REEOs) include the Midwest Energy Efficiency Alliance (MEEA), Northeast Energy Efficiency Partnerships (NEEP), Northwest Energy Efficiency Alliance (NEEA), Southeast Energy Efficiency Alliance (SEEA), South-Central Partnership for Energy Efficiency as a Resource (SPEER), and Southwest Energy Efficiency Project (SWEEP). The REEOs work through funded partnerships with the US Department of Energy and with various stakeholders, such as utilities and advocacy groups, to provide technical assistance to states and municipalities in support of efficiency policy development and program design and implementation.

[13] ACEEE defines incremental savings as new savings from programs implemented in a given year. Incremental savings are distinct from cumulative savings, which are the savings in a given program year from all the measures implemented under the programs in that year and in prior years that are still saving energy.

In this category, a state could earn up to 20 points, or 40% of the 50 total points possible in the *State Scorecard*. We set this point allocation because the savings potential of utility and public benefits programs is approximately 40% of the total energy savings potential of all policy areas scored. Studies suggest that electricity programs typically achieve at least three times more primary energy savings than natural gas programs (Eldridge et al. 2009; Geller et al. 2007; Elliott et al. 2007a; Elliott et al. 2007b). Utility-sector potential studies generally indicate significant untapped potential for natural gas efficiency programs (Neubauer 2011; PG&E 2006; Mosenthal et al. 2014; GDS 2013; Cadmus 2010). Therefore we allocated 9.5 points to performance metrics for electricity programs (annual savings and spending data) and 4.5 points to performance metrics for natural gas programs (annual savings and spending data). In an effort to recognize state policies and programs aimed at strengthening energy efficiency among low-income households—a historically underserved segment of the population—we created a new 1-point scoring category capturing these state efforts while shifting 0.5 points each away from scoring categories for utility spending on electricity and natural gas efficiency programs.

Our scoring methodology for utility-sector efficiency savings has had some unintended impacts that we have tried to correct. It disadvantages several states because of the types of energy used or the types of fuels offered to consumers. Hawaii, for example, consumes almost no natural gas (EIA 2016a), so it aims energy efficiency efforts at reducing electricity consumption only. To correct for this issue, we awarded Hawaii the points for natural gas efficiency spending, savings, and regulatory structures equivalent to the proportion of points it earned for corresponding electricity programs and policies. We gave the same treatment to the three US territories included in this report. Elsewhere, particularly in the Northeast, energy efficiency efforts often aim to reduce the consumption of fuel oil. While we capture these efforts in program spending when they are combined with efficiency programs targeting electricity or natural gas, we have not otherwise accounted for fuel oil savings, but we will consider ways to do so in future iterations of the *State Scorecard*.

We continue our practice of reporting programs' incremental energy savings (new savings from programs in each program cycle) rather than their total annual energy savings (savings in a given year from all current and previously implemented energy efficiency measures still saving energy under applicable programs). We report incremental savings in the *State Scorecard* for two reasons. First, basing our scoring on cumulative energy savings would involve levels of complexity that are beyond the scope of the *State Scorecard*, including identifying the start year for the cumulative series and accurately accounting for the life of energy efficiency measures and the persistence of savings. Second, the *State Scorecard* aims to provide a snapshot of states' current energy efficiency programs, and incremental savings give a clearer picture of recent efforts.

This year, we also requested that our contacts at state utility commissions provide both lifetime savings and cumulative savings from electric and gas energy efficiency programs. Cumulative savings are the savings in a given program year from all measures that have been implemented under the program that year and in prior years that are still saving energy. Lifetime savings look ahead to the expected energy savings over the lifetime of a given installed measure, calculated by multiplying the incremental MWh or therm reduction associated with that measure by its expected lifetime.[14] Although life-cycle savings have the potential to serve as a forward-looking alternative to our current scoring methodology, we did not use these metrics this year because we lacked data for roughly half of the states and because we have concerns about the lifetime estimates used by some states.

There are some other possible metrics we did not use for scoring. We did not attempt to include program cost effectiveness or level of spending per unit of energy savings. All states have cost-effectiveness requirements for energy efficiency programs. However the wide diversity of measurement approaches across states makes comparison less than straightforward. Also, several states require program administrators to pursue all cost-effective efficiency. Although some states have prioritized low acquisition costs and encouraged maximizing the *degree* of cost effectiveness, promoting larger *amounts* of marginally cost-effective energy savings is another valid approach. We also did not adjust savings for variations in avoided costs of energy across states, as there are examples of achieving deep energy savings in both high- and low-cost states.

Note that scores are for states as a whole and therefore may not be representative of the specific efforts of each utility within the state. Within the *State Scorecard*, a single utility, or small set of utilities, may do very well in terms of energy efficiency programs and associated metrics (spending and savings), but when viewed in combination with all utilities in that state, such efforts can be masked by other utilities with lower performance. For more information on the energy savings performance of individual utilities, refer to *The 2017 Utility Energy Efficiency Scorecard* (Relf, Baatz, and Nowak 2017) published by ACEEE in June 2017.

Table 7 lists states' overall utility scores. Explanations of each metric follow.

[14] EIA refers to this type of data as *incremental life-cycle savings*.

Table 7. Summary of state scores on utility and public benefits programs and policies

State	2016 electricity program savings (7 pts.)	2016 gas program savings (3 pts.)	2016 electricity program spending (2.5 pts.)	2016 gas program spending (1.5 pts.)	Opt-out provision (−1 pt.)	Energy efficiency resource standard (3 pts.)	Performance incentives & fixed cost recovery (2 pts.)	Support of low-income programs (1 pt.)	Total score (20 pts.)
Rhode Island	7	3	2.5	1.5	0	3	2	1	20
Massachusetts	7	2.5	2.5	1.5	0	3	2	1	19.5
Vermont	7	1.5	2.5	1.5	0	2.5	2	1	18
Connecticut	5	1.5	1.5	1.5	0	2	2	1	14.5
Minnesota	4.5	3	1	1	0	2	2	1	14.5
California	5	1.5	1.5	0.5	0	1.5	2	1	13
Oregon	4	2.5	1.5	1	0	1.5	1	1	12.5
Michigan	4	2.5	0.5	0.5	0	1.5	1.5	1	11.5
Washington	5	1	2	0.5	0	1.5	1	0.5	11.5
Arizona	4.5	1	0.5	0	0	3	1	0.5	10.5
Hawaii	4.5	2	0.5	0.5	0	1	2	0	10.5
Maine	4.5	1	1	1	−1	2.5	0.5	1	10.5
New York	3.5	0.5	1	1	0	1	2	1	10
Illinois	4	1	1	0.5	−1	2	1	1	9.5
Iowa	3	2	1	1.5	0	1.5	0	0.5	9.5
New Hampshire	1.5	2	0.5	1.5	0	1.5	1.5	1	9.5
Maryland	3	0	1	0.5	0	2	1	1	8.5
Colorado	3	0.5	0.5	0.5	0	1.5	1.5	0.5	8
Wisconsin	2	2	0.5	0.5	0	1	1	1	8
Utah	2.5	2	1	0.5	0	0	1	0.5	7.5
Arkansas	2	1.5	1	0.5	−1	1	1.5	0.5	7
District of Columbia	2	0.5	0.5	1	0	0	1.5	1	6.5
Idaho	3.5	0	1	0	0	0	0.5	0.5	5.5
Ohio	2.5	0	0.5	0.5	−1	1	1.5	0.5	5.5
Kentucky	1.5	1	0.5	0.5	−1	0	1.5	0.5	4.5
New Mexico	1.5	0	0.5	0.5	0	0.5	0.5	1	4.5
Nevada	2	0	0.5	0	0	0	0.5	1	4
Oklahoma	1	0.5	0.5	0.5	−1	0	1.5	1	4
Pennsylvania	2	0	0.5	0	0	0.5	0	1	4
Indiana	1	1	0.5	0.5	−1	0	1	0.5	3.5
Montana	1	0.5	0.5	0.5	0	0	0	1	3.5

State	2016 electricity program savings (7 pts.)	2016 gas program savings (3 pts.)	2016 electricity program spending (2.5 pts.)	2016 gas program spending (1.5 pts.)	Opt-out provision (–1 pt.)	Energy efficiency resource standard (3 pts.)	Performance incentives & fixed cost recovery (2 pts.)	Support of low-income programs (1 pt.)	Total score (20 pts.)
New Jersey	1	0.5	0.5	0.5	0	0	0	1	3.5
South Dakota	0.5	0.5	0	0.5	0	0	1.5	0	3
North Carolina	1.5	0	0.5	0	–1	0	1	0.5	2.5
Delaware	0	0	0	0.5	0	0	0	1	1.5
Florida	0	0	0	1	0	0	0	0.5	1.5
Georgia	0.5	0	0	0	0	0	1	0	1.5
Mississippi	0.5	0	0	0	0	0	0.5	0.5	1.5
Missouri	1	0	0.5	0	–1	0	0.5	0.5	1.5
Tennessee	0.5	0	0	0	0	0	0.5	0.5	1.5
Alaska	0	0	0	0	0	0	0	1	1
South Carolina	1	0	0	0	–1	0	0.5	0.5	1
Texas	0.5	0	0	0	–1	0	0.5	1	1
Wyoming	0.5	0	0	0	0	0	0.5	0	1
Kansas	0	0	0	0	0	0	0	0.5	0.5
Louisiana	0	0	0	0	0	0	0.5	0	0.5
Nebraska	0.5	0	0	0	0	0	0	0	0.5
Alabama	0	0	0	0	0	0	0	0	0
Guam	0	0	0	0	0	0	0	0	0
North Dakota	0	0	0	0	0	0	0	0	0
Puerto Rico	0	0	0	0	0	0	0	0	0
Virgin Islands	0	0	0	0	0	0	0	0	0
Virginia	0	0	0	0	–1	0	0.5	0.5	0
West Virginia	0.5	0	0	0	–1	0	0	0	–0.5

DISCUSSION

History of Utility and Public Benefits Programs and Policies

The structure and delivery of customer-funded electric energy efficiency programs have changed dramatically over the past three decades, mostly in conjunction with electric industry restructuring efforts.[15] In the 1980s and 1990s, such programs were almost exclusively the domain of utilities, but efforts in the mid-1990s to restructure and deregulate the electric utilities led numerous states to implement public benefits charges as a new source of funding for efficiency. These public benefits approaches established new structures and tasked utilities—or, in some states, separate efficiency utilities or other third parties—with administering and delivering energy efficiency, renewable energy, and low-income programs.[16]

Despite such public benefits programs, restructuring still resulted in a precipitous decline in funding for customer-funded electricity energy efficiency programs in the late 1990s, primarily due to regulatory uncertainty and the expected loss of cost-recovery mechanisms for those programs.[17] Generally, utilities did not see customer-funded energy efficiency programs as being compatible with competitive retail markets.

After restructuring efforts slowed in some states, utility commissions placed renewed focus and importance on energy efficiency programs. From their low point in 1998, investments in electricity programs increased more than fourfold by 2010, from approximately $900 million to $3.9 billion. More recently, annual investments in energy efficiency have leveled. In 2016, total spending for electricity efficiency programs was roughly $6.3 billion. Adding natural gas program spending of $1.3 billion, we estimate total efficiency program spending of approximately $7.6 billion in 2016 (see figure 2), slightly less than the $7.7 billion that was reported in 2015.

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[15] By *customer-funded energy efficiency programs*—also known as *ratepayer-funded energy efficiency programs*—we mean energy efficiency programs funded through charges wrapped into customer rates or appearing as some type of charge on customer utility bills. This includes both utility-administered programs and public benefits programs administered by other entities. We do not include data on separately funded low-income programs, load management programs, or energy efficiency R&D.

[16] States that have established nonutility administration of efficiency programs include Delaware, District of Columbia, Hawaii, Maine, New Jersey, New York, Oregon, Vermont, and Wisconsin.

[17] Under traditional regulatory structures, utilities do not have an economic incentive to help their customers become more energy efficient because their revenues and profits fall in line with falling energy sales resulting from energy efficiency programs. To address this disincentive, state regulators allow utilities to recover, at a minimum, the costs of running energy efficiency programs through charges on customer bills. For more on this issue, see York and Kushler (2011).

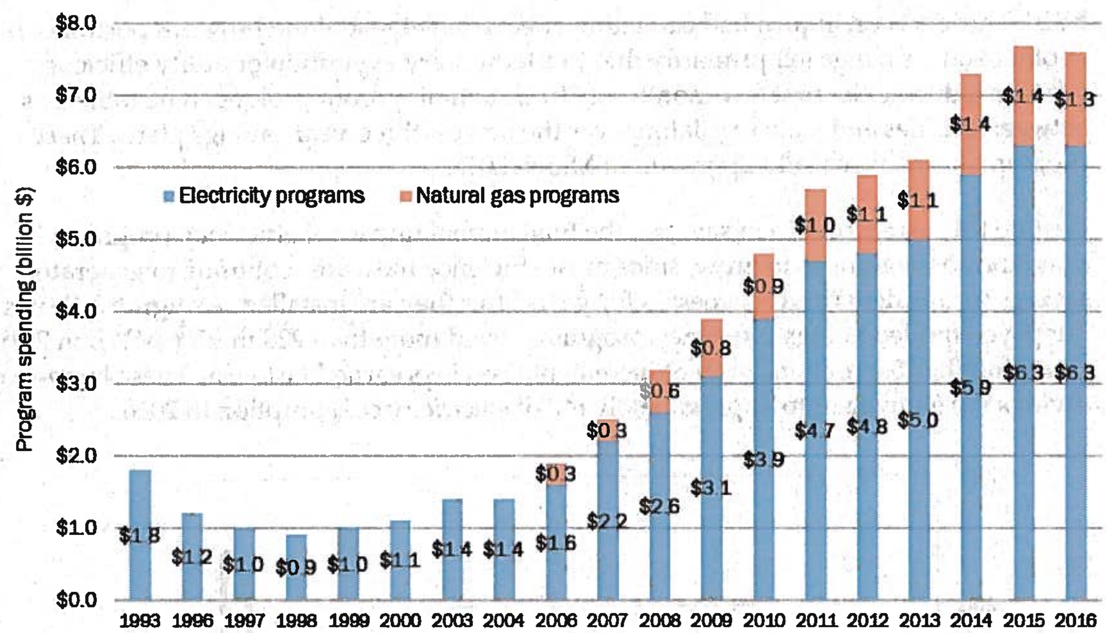

Figure 2. Annual electric and natural gas energy efficiency program spending. Natural gas spending is not available for the years 1993–2004. ***Sources:*** **Nadel, Kubo, and Geller 2000; York and Kushler 2002, 2005; Eldridge et al. 2007, 2008, 2009; CEE 2012, 2013, 2014, 2015, 2016; Gilleo et al. 2015; Berg et al. 2016.**

Nationwide reported savings from utility and public benefits electricity programs in 2016 totaled 25.4 million MWh, equivalent to 0.68% of sales, down approximately 4.2% from the 26.5 million MWh (0.71% of sales) reported last year in this category.

It is important to note that, while 2016 levels of reported savings fell somewhat from 2015 levels, this decline does not indicate diminishing energy efficiency efforts. In fact, half the states continued to see an increase both in levels of efficiency investment and in resulting savings in 2016. The largest contributing factor to this year's decrease in savings was our ongoing effort to equitably compare savings levels among states with varying reporting protocols. One example of this is our treatment of savings that utilities claim for their support of codes and standards (C&S) regulation development. Evaluating and attributing savings from codes and standards is a relatively new practice for program administrators, and ongoing efforts to refine methodologies can affect state results. This year our scoring credited only net savings specifically attributed to utility support of codes and standards. That had a noticeable impact on savings levels reported for California, which previously had included total net C&S savings rather than net C&S savings attributed to specific utility support.

Factors contributing to the leveling of incremental savings varied, although there are some common themes. In some cases, a state's decrease in savings was a direct reflection of decisions in recent years to weaken efficiency budgets. Other states described impacts related to asymmetrical administration of budgets and reported savings across multiyear program cycles, such that expenditures and savings may decrease in a single year but nonetheless remain on target with multiyear goals. One state, for example, described lower savings in the most recent program year related to a surge in demand for LED lighting upgrades in FY15, requiring the administrator to stop accepting applications for most of

FY16. This decision in turn had cascading effects on the rest of the program portfolio. In another state, savings fell primarily due to a temporary expiration of utility efficiency programs during the first few months of 2016, stemming from prolonged negotiations between utilities and state regulators over the newest three-year savings plans. These programs were eventually approved in March 2016.

Despite the near-term dip in savings, the total annual impact of efficiency programs is dramatic and continues to grow, since most efficiency measures continue to generate savings for residents and businesses for years after they are installed. As figure 3 shows, ratepayer-funded energy efficiency programs saved more than 220 million MWh in 2016, including the 25.4 million MWh of incremental savings earned last year. These large-scale savings are equivalent to approximately 6% of electricity consumption in 2016.

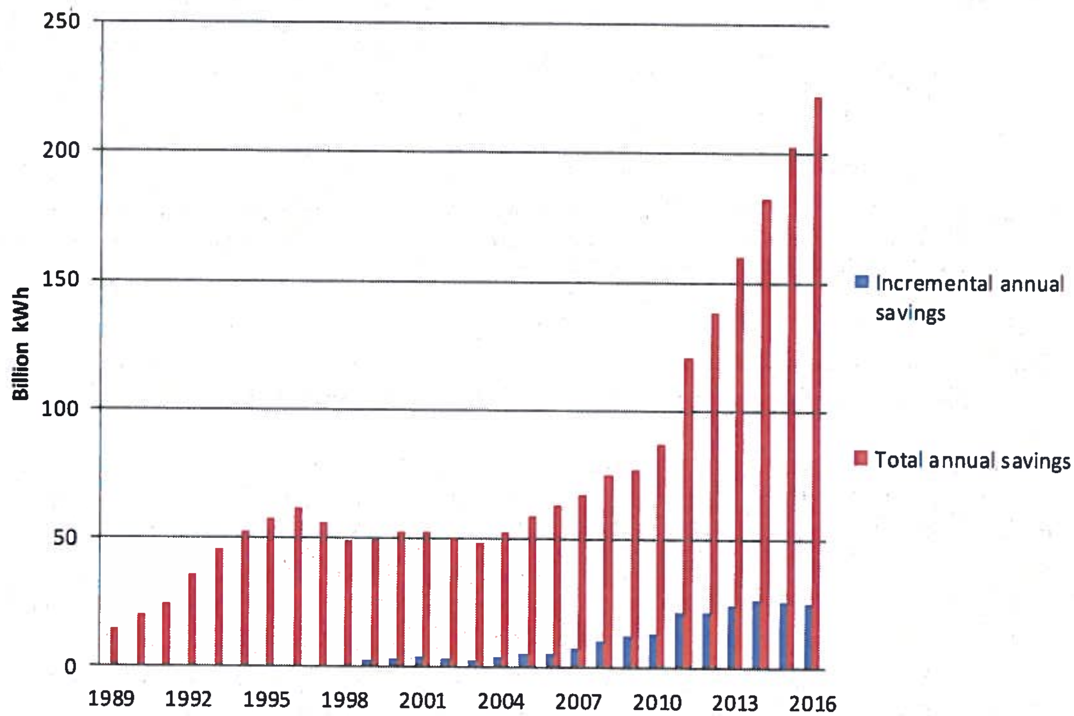

Figure 3. Electric savings from utility-sector energy efficiency programs by year. Incremental annual savings are savings from measures installed that year. Total annual savings are those achieved in a year from measures installed that year and in prior years.

Savings from Electricity and Natural Gas Efficiency Programs

We assess the overall performance of electricity and natural gas energy efficiency programs by the amount of energy saved. Utilities and nonutility program administrators pursue numerous strategies to achieve energy efficiency savings. Program portfolios may initially concentrate on the most cost-effective and easily accessible measure types, such as energy-efficient lighting and appliances. As utilities gain experience, as technologies mature, and as customers become aware of the benefits of energy efficiency, the number of approaches increases. Utilities estimate program energy savings, which are then subject to internal or third-party evaluation, measurement, and verification (EM&V) and are typically reported to the public utility commission on a semiannual or annual basis.

In states ramping up funding in response to aggressive EERS policies, programs typically shift focus from widget-based approaches (e.g., installing new, more-efficient water heaters) to more comprehensive deep-savings approaches that seek to generate more energy efficiency savings per program participant by conducting whole-building or system retrofits. Some deep-savings approaches also draw on complementary efficiency efforts, such as utility support for full implementation of building energy codes.[18] Deep-savings approaches may also add to the emphasis on whole-building retrofits and comprehensive changes in systems and operations by including behavioral elements that empower customers.

SCORES FOR INCREMENTAL SAVINGS IN 2016 FROM ELECTRIC EFFICIENCY PROGRAMS

We report 2016 statewide net energy efficiency savings as a percentage of 2016 retail electricity sales, scoring the states on a scale of 0 to 7, as we did last year. We relied primarily on states to provide these data. Forty-four states and the District of Columbia completed some or all of our data request form. Where no data for 2016 were available, we used the most recent savings data obtainable, whether from state-reported 2015 savings from the *2016 State Scorecard* or from EIA (2017a, 2017b).

As in 2015 and 2016, states that achieved savings of at least 2% of electricity sales earned full points. We continue to see examples of states raising the bar beyond 2% electricity savings. Table 8 lists the scoring for each level of savings.

18 See Nowak et al. (2011) for a full discussion of this topic.

Table 8. Scoring of utility and public benefits electricity savings

2016 savings as % of sales	Score
2% or greater	7
1.86–1.99%	6.5
1.72–1.85%	6
1.58–1.71%	5.5
1.44–1.57%	5
1.30–1.43%	4.5
1.16–1.29%	4
1.02–1.15%	3.5
0.88–1.01%	3
0.74–0.87%	2.5
0.60–0.73%	2
0.46–0.59%	1.5
0.32–0.45%	1
0.18–0.31%	0.5
Less than 0.18%	0

Table 9 shows state results and scores. Nationwide reported savings from utility and public benefits electricity programs in 2016 totaled 25.4 million MWh, equivalent to 0.68% of sales. This is down approximately 4.2% from the 26.5 million MWh (0.71% of sales) reported last year in this category.

Table 9. 2016 net incremental electricity savings by state

State	2016 net incremental savings (MWh)	% of 2016 retail sales	Score (6 pts.)	State	2016 net incremental savings (MWh)	% of 2016 retail sales	Score (6 pts.)
Massachusetts	1,569,661	3.00%	7	Kentucky†	344,151	0.47%	1.5
Rhode Island	214,329	2.85%	7	New Jersey†	332,659	0.44%	1
Vermont	138,318	2.52%	7	Indiana†	424,127	0.42%	1
Washington†	1,358,095	1.54%	5	Oklahoma	236,027	0.39%	1
California†	3,909,215	1.54%	5	Missouri	301,909	0.39%	1
Connecticut	442,250	1.53%	5	South Carolina*†	304,919	0.38%	1
Arizona	1,108,273	1.42%	4.5	Montana†	52,593	0.38%	1
Maine†	157,921	1.38%	4.5	South Dakota†	35,708	0.30%	0.5
Hawaii*†	124,399	1.32%	4.5	Wyoming	47,057	0.28%	0.5
Minnesota†	847,830	1.31%	4.5	Georgia†	379,294	0.27%	0.5
Illinois	1,716,876	1.23%	4	Mississippi	126,027	0.26%	0.5
Michigan	1,209,981	1.17%	4	Tennessee†	189,930	0.19%	0.5
Oregon†	537,331	1.16%	4	Nebraska†	56,275	0.19%	0.5
Idaho†	258,598	1.13%	3.5	Texas[2]†	740,430	0.19%	0.5
New York	1,599,900	1.09%	3.5	West Virginia	57,925	0.18%	0.5
Iowa†[1]	482,316	1.01%	3	Florida†	263,116	0.11%	0
Maryland	560,617	0.91%	3	Louisiana†	87,023	0.10%	0
Colorado	487,396	0.89%	3	Virginia*†	99,557	0.09%	0
Ohio	1,284,472	0.87%	2.5	Alabama*†	49,988	0.06%	0
Utah	232,299	0.78%	2.5	Delaware†	1,367	0.01%	0
Pennsylvania	1,058,768	0.73%	2	North Dakota†[3]	1,761	0.01%	0
Arkansas	310,815	0.68%	2	Alaska*†	346	0.01%	0
District of Columbia	73,811	0.65%	2	Kansas*†	440	0.00%	0
Nevada†	227,348	0.63%	2	Guam	–	0.00%	0
Wisconsin	424,177	0.61%	2	Puerto Rico	–	0.00%	0
New Mexico	135,000	0.59%	1.5	Virgin Islands	–	0.00%	0
New Hampshire†	63,338	0.58%	1.5	US total	25,417,008	0.68%	
North Carolina†	759,029	0.57%	1.5	Median	247,313	0.59%	

Savings data are from public service commission staff as listed in Appendix A, unless noted otherwise. Sales data are from EIA Form 861M (2017b). * For these states, we did not have 2016 savings data, so we scored them on 2015 savings as reported in EIA Form 861 (2017a), unless otherwise noted. † At least a portion of savings reported as gross. We adjusted the gross portion by a net-to-gross factor of 0.866 to make it comparable to net savings figures reported by other states. [1] 2016 savings reported for MidAmerican Energy and Interstate Power & Light; 2015 savings reported for municipal utilities and rural electric cooperatives. [2] Texas savings are from 2016, except for 2015 savings reported for CPS Energy and Energy Austin. [3] 2015 savings as reported in North Dakota data request.

We scored states on net incremental electricity savings that resulted from energy efficiency programs offered in 2016.[19] We normalized these data by dividing by total electricity sales. Data for electricity sales were based on EIA's *Monthly Electric Power Industry Report* (2017b) and *Annual Electric Power Industry Report* (2017a). Energy savings were based on survey responses from state utility commissions and statewide utility program administrators.

States use different methodologies for estimating energy savings, which can produce inequities when making comparisons.[20] A state's EM&V process plays a key role in determining how savings are quantified. This is particularly true of a state's treatment of free-ridership (savings attributed to a program that would have occurred even in the absence of the program) and spillover (savings *not* attributed to a program that would *not* have occurred without it). States report energy savings as either net or gross, with net savings accounting for free riders and free drivers, and gross savings not accounting for these.[21] The *State Scorecard* specifically focuses on net savings.

In a national survey of evaluation practices, ACEEE researchers found that, of the 45 jurisdictions at the time with formally approved customer-funded energy efficiency programs, 21 jurisdictions reported net savings, 12 reported gross savings, and 9 reported both (Kushler, Nowak, and Witte 2012).[22] These findings point to several important caveats to the electric program savings data. First, a number of states do not estimate or report net savings. In these cases, we have applied a standard factor of 0.866 to convert gross savings to net savings (a net-to-gross ratio).[23] Doing so allows a more straightforward comparison with other states that report net electricity savings. Savings (or some portion of savings) reported as gross are marked by a dagger (†) in table 9.[24] Although Arizona, Minnesota, New Hampshire, and Iowa report gross savings as net to state regulators, we applied the conversion factor to these states because the studies they reference in setting net savings equal to gross savings are outdated or unavailable.

SCORES FOR INCREMENTAL SAVINGS IN 2016 FROM NATURAL GAS EFFICIENCY PROGRAMS

Utilities are increasing the number and size of natural gas programs in their portfolios. However data on savings resulting from these programs are still limited. In this category,

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[19] Incremental electricity savings are new savings achieved from measures implemented in the reporting year. We substituted 2015 savings data for states that could not report 2016 data. Readers should also note that programs that have been running for several years at a high level of funding are achieving the highest levels of *cumulative* electricity savings (total energy savings achieved to date from efficiency measures). *Incremental* savings data, which measure new savings achieved in the current program year, are the best way to directly compare state efforts due to the difficulty in tracking the duration of programs and their savings.

[20] See Sciortino et al. (2011).

[21] *Free drivers* are utility customers who install energy efficiency measures as a result of a program but are not themselves participants in the energy efficiency program.

[22] This includes 44 states and the District of Columbia. Three states did not respond to this question.

[23] We based the 0.866 net-to-gross factor used this year on the median net-to-gross ratio calculated from those states that reported figures for both net and gross savings in this year's data request. These included Connecticut, District of Columbia, Maryland, Missouri, Montana, New York, Oklahoma, Oregon, Pennsylvania, Utah, West Virginia, and Wisconsin. We applied this conversion factor to all states reporting only gross savings.

[24] Savings were determined to be gross on the basis of Kushler, Nowak, and Witte (2012) as well as responses to our survey of public utility commissions.

we awarded points to states that were able to track savings from their natural gas efficiency programs and that realized savings of at least 0.2% as a percentage of sales in the residential and commercial sectors. We relied on data from state utility commissions. Table 10 lists scoring criteria for natural gas program savings. As we did last year, we awarded a maximum 3 points to states reporting savings of 1.2% of sales or greater.

Table 10. Scoring of natural gas program savings

Natural gas savings as % of sales	Score
1.20% or greater	3
1.00–1.19%	2.5
0.80–0.99%	2.0
0.60–0.79%	1.5
0.40–0.59%	1
0.20–0.39%	0.5
Less than 0.20%	0

Table 11 shows states' scores for natural gas program savings.[25]

[25] As we did with electric savings, we applied a net-to-gross (NTG) factor to all states reporting only gross natural gas savings. In this case, the NTG factor was 0.873 based on states that reported figures for both net and gross natural gas savings in this year's data request. These included Connecticut, Maryland, Montana, New York, Oklahoma, Oregon, Utah, and Wisconsin.

Table 11. State scores for 2016 natural gas efficiency program savings

State	2016 net incremental gas savings (MMTherms)	% of commercial and residential retail sales	Score (3 pts.)
Minnesota†	30.63	1.40%	3
Rhode Island	4.18	1.26%	3
Massachusetts	27.30	1.13%	2.5
Michigan	52.39	1.05%	2.5
Oregon	6.72	1.03%	2.5
New Hampshire†	1.66	0.92%	2
Wisconsin	19.20	0.85%	2
Utah	8.27	0.85%	2
Iowa†	9.80	0.84%	2
Hawaii[1]	–	–	2
Vermont	0.76	0.75%	1.5
California	48.80	0.74%	1.5
Connecticut	7.10	0.66%	1.5
Arkansas	5.04	0.60%	1.5
Arizona	3.68	0.55%	1
Kentucky	4.30	0.49%	1
Maine†	0.62	0.47%	1
Indiana	10.07	0.46%	1
Washington	5.77	0.46%	1
Illinois	27.57	0.43%	1
New York	30.92	0.39%	0.5
Colorado	6.96	0.38%	0.5
District of Columbia	1.04	0.33%	0.5
Oklahoma	3.11	0.30%	0.5
South Dakota	0.61	0.27%	0.5
New Jersey†	10.74	0.26%	0.5
Montana	0.96	0.24%	0.5
Mississippi	0.79	0.18%	0
Ohio*	7.11	0.15%	0
New Mexico*	0.75	0.12%	0
Maryland	1.65	0.10%	0
North Carolina	1.13	0.09%	0
Idaho	0.19	0.05%	0
North Dakota	0.10	0.04%	0
Nevada†	0.23	0.03%	0
Pennsylvania	0.76	0.02%	0
Delaware†	0.00	0.00%	0
Alabama	0.00	0.00%	0
Alaska	0.00	0.00%	0
Florida	0.00	0.00%	0
Georgia	0.00	0.00%	0
Guam	0.00	0.00%	0
Kansas	0.00	0.00%	0
Louisiana	0.00	0.00%	0
Missouri	0.00	0.00%	0
Nebraska	0.00	0.00%	0
Puerto Rico	0.00	0.00%	0
South Carolina	0.00	0.00%	0
Tennessee	0.00	0.00%	0
Texas	0.00	0.00%	0
Virgin Islands	0.00	0.00%	0
Virginia	0.00	0.00%	0
West Virginia	0.00	0.00%	0
Wyoming	0.00	0.00%	0
US total	**340.89**	**0.42%**	
Median	**0.96**	**0.24%**	

Savings data were reported by contacts at public utility commissions as listed in Appendix A, unless otherwise noted. All sales data are from EIA Form 176 (2017a). States that did not report natural gas savings for 2015 or 2016, and for which data were not available elsewhere, were treated as having no savings. * These states did not report 2016 savings and were scored on 2015 savings as reported by public utility commission contacts. † At least a portion of savings reported as gross. We adjusted the gross portion by a net-to-gross factor of 0.873 to make it more comparable to net savings figures reported by other states. [1] Hawaii and the US territories use limited natural gas and therefore earn points commensurate with electric efficiency savings scores.

Electricity and Natural Gas Efficiency Program Funding

In this category, we scored states on 2016 electricity efficiency program spending for customer-funded energy efficiency programs. These programs are funded through charges included on utility customers' bills. Our data include spending by investor-owned, municipal, and cooperative utilities; public power companies or authorities; and public benefits program administrators. We did not collect data on federal grant allocations received by states through the Department of Energy's Weatherization Assistance Program. We did include revenues from the Regional Greenhouse Gas Initiative (RGGI), which contributes to customer-funded energy efficiency program portfolios of member states and to energy efficiency programs funded through AB32 and Proposition 39 in California.[26] Where RGGI funds were channeled to energy efficiency initiatives implemented by state governments, we included them in Chapter 6, "State Government–Led Initiatives."

This year we continue to report energy efficiency spending data rather than energy efficiency *budgets*—an important change we made in 2015 to more accurately capture state energy efficiency funding.[27] For the six states that did not provide data for 2016 spending on energy efficiency programs for electric or natural gas utilities, we used 2015 spending data from CEE (2017) or data supplied by our state contacts in their 2016 utility data request responses.

Please note that spending data are subject to variation across states, which poses an ongoing challenge to our efforts to equitably score states based on a common and reliable metric. Several states report performance incentives paid to utilities or other program administrators as part of utility efficiency program spending, resulting in higher spending numbers. While most performance incentives are based on shared net benefits—viewed as an expense—the relative amounts of the incentives are in the range of 5–15% of program spending (Nowak et al. 2015). For this reason we ask states to disaggregate program spending from these incentives. We did not credit this spending in our scoring this year in an effort to more accurately reflect funds directly dedicated to energy efficiency measures. As in past years, we sent spending data gathered from the above sources to state utility commissions for review. Tables 13 and 15 below report electricity and natural gas efficiency program spending, respectively.

SCORES FOR ELECTRIC PROGRAM SPENDING

States could receive up to 2.5 points for their energy efficiency spending as a percentage of 2016 electric utility revenues.[28] Formerly a 3-point category, this metric, as well as the natural gas program spending metric, was decreased by 0.5 points in order to accommodate the addition of 1 point to be earned for utility support of low-income energy efficiency

[26] AB32 is California's GHG reduction bill that resulted in a cap-and-trade program. Proposition 39 grants significant funding to energy efficiency programs targeting schools. Both programs are subject to evaluation, measurement, and verification at least as stringent as the EM&V for utility programs.

[27] Prior to 2010, we depended on EIA for actual spending data, which entailed a two-year time lag.

[28] Statewide revenues are from EIA Form 861M (EIA 2017c). We measure spending as a percentage of revenues to normalize the level of energy efficiency spending. Blending utility revenues from all customer classes gives a more accurate measure of utilities' overall spending on energy efficiency than does expressing budgets per capita, which might skew the data for utilities that have a few very large customers. An alternative metric, statewide electric energy efficiency spending per capita, is presented in Appendix B.

programs (described later in this chapter). In addition, the threshold savings for the uppermost scoring category was raised this year, from 4.0 to 5.0% of revenues, to recognize the efforts of states making high levels of investment in efficiency. At the same time, we slightly decreased the threshold savings required for the 0.5-point scoring category, from 1.0 to 0.8%, to more appropriately acknowledge states that may fall toward the bottom in terms of performance but are nonetheless making significant efforts to achieve savings. For every 1.05% less than 5%, a state's score decreased by 0.5 points. Table 12 lists the scoring bins for each spending level.

Table 12. Scoring of electric efficiency program spending

2016 spending as % of revenues	Score
5.00% or greater	2.5
3.95–4.99%	2
2.90–3.94%	1.5
1.85–2.89%	1
0.80–1.84%	0.5
Less than 0.80%	0

Table 13 shows state-by-state results and scores for this category.

Table 13. 2016 electric efficiency program spending by state

State	2016 spending ($million)	% of statewide electricity revenues	Score (2.5 pts.)	State	2016 spending ($million)	% of statewide electricity revenues	Score (2.5 pts.)
Vermont	54.0	6.84%	2.5	North Carolina	144.6	1.17%	0.5
Rhode Island	78.4	6.42%	2.5	Montana	13.5	1.09%	0.5
Massachusetts	538.9	6.25%	2.5	Ohio	141.0	0.98%	0.5
Washington	291.2	4.29%	2	Wisconsin	74.1	0.98%	0.5
Connecticut	191.9	3.85%	1.5	Indiana	87.0	0.97%	0.5
Oregon	156.6	3.79%	1.5	District of Columbia	13.0	0.96%	0.5
California	1,364.1	3.50%	1.5	Florida	178.1	0.76%	0
Iowa	119.2	2.86%	1	Wyoming	10.1	0.74%	0
Idaho	49.8	2.67%	1	Texas[2]	194.1	0.60%	0
Minnesota	161.9	2.50%	1	Tennessee	52.5	0.58%	0
Maryland	186.8	2.49%	1	South Dakota	5.8	0.49%	0
Maine	32.3	2.21%	1	Georgia	57.9	0.45%	0
Utah	55.1	2.11%	1	West Virginia	12.3	0.43%	0
Illinois	262.8	2.05%	1	Delaware*	5.3	0.43%	0
New York	425.2	2.00%	1	Nebraska	11.6	0.43%	0
Arkansas	68.7	1.86%	1	Mississippi	17.2	0.40%	0
Hawaii[1]	37.0	1.64%	0.5	South Carolina[3]	29.8	0.39%	0
Colorado	87.2	1.63%	0.5	Louisiana[4]	17.0	0.26%	0
New Mexico*	34.3	1.62%	0.5	Alabama[5]	16.2	0.19%	0
Nevada	49.0	1.62%	0.5	Virginia	0.1	0.00%	0
Michigan	182.1	1.58%	0.5	Alaska	0.0	0.00%	0
Arizona	126.7	1.56%	0.5	Guam	0.0	0.00%	0
Pennsylvania	229.4	1.55%	0.5	Kansas	0.0	0.00%	0
New Jersey	154.0	1.53%	0.5	North Dakota	0.0	0.00%	0
Oklahoma*	70.2	1.50%	0.5	Puerto Rico	0.0	0.00%	0
New Hampshire	23.2	1.36%	0.5	Virgin Islands	0.0	0.00%	0
Kentucky	72.9	1.21%	0.5	US total	6,272.6	–	
Missouri	88.4	1.20%	0.5	Median	56.5	1.20%	

Statewide revenues are from EIA Form 861-M (EIA 2017c). Spending data are from public service commission staff as listed in Appendix A. * Where 2016 spending was not available, we substituted 2015 spending as reported by states, except where noted. [1] 2015 spending from CEE 2017. [2] 2016 spending, except for 2015 spending from CPS Energy and Energy Austin. [3] 2015 spending from CEE 2017. [4] 2016 spending, except for 2015 spending from Entergy New Orleans. [5] 2015 spending from CEE 2017.

SCORES FOR NATURAL GAS PROGRAM SPENDING

We scored states on natural gas efficiency program spending by awarding up to 1.5 points based on 2016 program spending data gathered from CEE (2017) and a survey of state utility commissions and independent statewide administrators. Previously a 2-point category, this metric received a 0.5-point decrease this year to help accommodate the addition of a 1-point category for utility support of low-income energy efficiency programs. To directly compare spending data among the states, we normalized spending by the number of residential natural gas customers in each state in 2016, as reported by the state. When this figure was not available, we relied on 2015 figures from EIA (2016).[29] Table 14 shows scoring bins for natural gas program spending. As in last year's *State Scorecard*, states posting spending levels of at least $50 per customer were awarded the maximum number of points possible.

Table 14. Scoring of natural gas utility and public benefits spending

2016 gas spending per customer	Score
$50 or greater	1.5
$27.50–49.99	1
$5.00–27.49	0.5
Less than $5.00	0

After seeing a significant uptick in 2014, natural gas program spending levels have remained relatively flat in recent years, although 2016 spending was down slightly, about $70 million shy of the $1.4 billion reported in 2015. Natural gas efficiency spending remains significantly lower than spending for electricity energy efficiency programs. Table 15 shows states' scores.

[29] We use spending per residential customer for natural gas because reliable natural gas revenue data are sparse, and use of per capita data unfairly penalizes states that offer natural gas service to only a portion of their population (such as Vermont). State data on the number of residential customers are from EIA (2016).

Table 15. 2016 natural gas efficiency program spending by state

State	2016 gas spending ($million)	$ per 2016 residential customer	Score (2 pts.)	State	2016 gas spending ($million)	$ per 2016 residential customer	Score (2 pts.)
Massachusetts	201.7	$136.52	1.5	New Mexico	4.4	$7.61	0.5
Rhode Island	24.6	$104.09	1.5	Kentucky*	4.9	$6.41	0.5
Connecticut	43.8	$80.43	1.5	Hawaii[1]	0.0	$0.00	0.5
Vermont	2.8	$63.73	1.5	Mississippi	1.9	$4.60	0
Iowa	54.9	$63.37	1.5	Pennsylvania	9.6	$3.50	0
New Hampshire	6.3	$53.16	1.5	Arizona	4.2	$3.49	0
District of Columbia	5.4	$36.95	1	Missouri	4.4	$3.46	0
Minnesota	53.8	$35.94	1	Idaho	1.0	$2.75	0
New York	158.4	$35.68	1	Virginia*	3.0	$2.53	0
Florida	23.7	$33.73	1	North Carolina	2.0	$1.72	0
Oregon	23.9	$33.25	1	North Dakota*	0.1	$0.93	0
Maine	1.0	$31.60	1	Texas*	3.9	$0.87	0
California	294.0	$26.80	0.5	Nevada	0.6	$0.74	0
Utah	23.3	$25.82	0.5	Wyoming*	0.1	$0.58	0
Michigan	81.2	$24.95	0.5	South Carolina*	0.3	$0.55	0
Arkansas	13.2	$24.16	0.5	Alabama	0.0	$0.00	0
New Jersey	70.7	$23.60	0.5	Alaska	0.0	$0.00	0
Washington	22.1	$19.51	0.5	Georgia	0.0	$0.00	0
Illinois	63.9	$16.49	0.5	Guam	0.0	$0.00	0
Oklahoma	13.8	$16.07	0.5	Kansas	0.0	$0.00	0
Maryland	16.3	$14.37	0.5	Louisiana	0.0	$0.00	0
Ohio*	44.2	$13.42	0.5	Nebraska	0.0	$0.00	0
Wisconsin	18.5	$10.76	0.5	Puerto Rico	0.0	$0.00	0
Montana	2.8	$10.24	0.5	Tennessee	0.0	$0.00	0
Colorado	17.0	$9.93	0.5	Virgin Islands	0.0	$0.00	0
South Dakota	1.7	$9.10	0.5	West Virginia	0.0	$0.00	0
Indiana	15.0	$8.80	0.5	US total	1,339.6	-	
Delaware*	1.3	$8.04	0.5	Median	4.3	$8.42	

Spending data are from public service commission staff as listed in Appendix A, unless noted otherwise. * Where 2016 spending data were not available, we substituted 2015 spending as reported by CEE 2017 or by public service commission staff. [1] Hawaii is awarded points commensurate with points received for electricity spending.

Opt-Out Provisions for Large Customers

As we have since the *2014 State Scorecard*, we also provide an assessment of opt-out and self-direct provisions for large customers. Increasingly, large customers are seeking to opt out of utility energy efficiency programs, asserting that they have already captured all the energy efficiency that is cost effective. However this is seldom the case (Chittum 2011). Opt-out differs from self-direct in that those customers who opt out do not have to pay into energy efficiency funds at all; self-direct allows some customers to spend their efficiency fees internally in their own business operations.

Opt-out policies have several negative consequences. Failure to include large customer programs in an energy efficiency portfolio increases the cost of energy savings for all customers and reduces the benefits (Baatz, Relf, and Kelly 2017). In effect, allowing large customers to opt out forces other consumers to subsidize them. It also prevents utilities from capturing all highly cost-effective energy savings; this can contribute to higher overall system costs through the use of more expensive supply resources. While the ideal solution is for utilities to offer programs that respond to the needs of these large consumers, ACEEE's research suggests that this does not always happen (Chittum 2011). When it does not, we suggest giving these customers the option of self-directing their energy efficiency program dollars.[30] This option provides a path for including large customer energy efficiency in the state's portfolio of savings, while encouraging utilities to improve program offerings to better respond to all customers' needs. We provide examples of self-direct programs in Appendix C.

SCORES FOR LARGE CUSTOMER OPT-OUT PROVISIONS

This year, we again included opt-out as a category in which states may lose rather than gain points. We subtracted 1 point for states that allow electric or natural gas customers, or both, to opt out of energy efficiency programs.[31]

We did not subtract points for self-direct programs. When implemented properly, these programs can effectively meet the needs of large customers. Self-direct programs vary from state to state, with some requiring more stringent measurement and verification of energy savings than others (Chittum 2011). In the future, we may examine these programs with a more critical eye and subtract points from states that lack strong evaluation and measurement. Table 16 shows states with opt-out programs.

[30] Self-direct programs allow some customers, usually large industrial or commercial ones, to channel energy efficiency fees usually paid on utility bills directly into energy efficiency investments in their own facilities instead of into a broader, aggregated pool of funds. These programs should be designed to include comparable methods to verify and measure investments and energy savings. For more information, see aceee.org/sector/state-policy/toolkit/industrial-self-direct.

[31] By default, most large gas customers already are opted out because they take wholesale delivery (frequently directly from transmission) and are thus outside the purview of state government. We did not subtract points in these cases.

Table 16. Provisions allowing large customers to opt out of energy efficiency programs

State	Opt-out description	Score
Arkansas	Under Act 253, passed in 2013, customers with more than 1 MW or 70,000 therms in monthly demand may opt out. Only nonmanufacturing customers must offer documentation of planned or achieved savings. Large manufacturers that file under Act 253 do not have to document. Large commercial and industrial customers not meeting the definition of manufacturing and customers who have filed under Section 11 of the state's Rules for Conservation and Energy Efficiency Programs must file an application showing how savings have been or will be achieved. More than 50 large customers have opted out, constituting a significant share of overall sales that varies by utility. In 2017, HB 1421 added state-supported higher-education institutions to the list of customers eligible to opt out.	–1
Illinois	Illinois specifically exempts large customers under recent electric savings targets passed in SB 2814. These exemptions remove an estimated 10% of ComEd's and 25% of Ameren's load from programs. The exemption weakens participation even more than an opt-out policy in that these electric utility customers do not have the opportunity to participate in programs.	–1
Indiana	Opt-out applies to the five investor-owned electric utilities. Eligible customers are those that operate a single site with at least one meter constituting more than 1 MW demand for any one billing period within the previous 12 months. Documentation is not required. No evaluation is conducted. Approximately 70–80% of eligible load has opted out.	–1
Kentucky	Opt-out is statewide for the industrial rate class. Documentation is not required. Approximately 80% of eligible load has opted out, with the remaining 20% made up primarily of TVA customers.	–1
Maine	Large customers that take transmission and subtransmission service are automatically opted out of Maine's efficiency programming. These customers do not pay into Maine's cost-recovery mechanism. However federal stimulus funds and money collected from the RGGI have allowed Efficiency Maine to offer energy efficiency programming to the state's largest industrial customers. At the same time, last year's passage of LD 1398 has weakened this effort, increasing the amount of RGGI funds returned to business ratepayers from 15% to 55%.	–1
Missouri	Opt-out is statewide for only investor-owned electric utilities. Eligibility requires one account greater than 5 MW, or aggregate accounts greater than 2.5 MW and demonstration of the customer's own demand-side savings. Also, interstate pipeline pumping stations of any size are eligible. To maintain opt-out status, documentation is required for customers whose aggregate accounts are greater than 2.5 MW. The staff of the Missouri Public Service Commission perform a desk audit of all claimed savings and may perform a field audit. No additional EM&V is required.	–1
North Carolina	All industrial-class electric customers are eligible to opt out. Also, by Commission Rule R8-68 (d), large commercial-class operations with 1 million kWh of annual energy consumption are eligible to opt out. Customers electing to opt out must notify utilities that they have implemented or plan to implement energy efficiency. Opted-out load represents approximately 40–45% of industrial and large commercial load.	–1

State	Opt-out description	Score
Ohio	As of January 2015, Ohio Senate Bill 310 allows certain customers to opt out of energy efficiency programs entirely. Large customers may opt out of a utility's energy efficiency provisions if they receive service above the primary voltage level (e.g., GSU and GT rate schedules). They may opt out if they are a commercial or industrial customer with more than 45 million kWh usage through a meter, or through more than one meter at a single location, for the preceding calendar year. A written request is required to register as a self-assessing purchaser pursuant to section 5727.81 of the Revised Code.	–1
Oklahoma	All transportation-only gas customers are eligible to opt out. For electric utilities, all customers whose aggregate usage, which may include multiple accounts, is equal to or greater than 15 million kWh annually, may opt out. Some 90% of eligible customers opt out.	–1
South Carolina	Industrial, manufacturing, or retail commercial customers with at least 1 million kWh annual usage are eligible to opt out. Only self-certification is required. Approximately 50% of eligible companies opt out, representing roughly 50% of the eligible load.	–1
Texas	In Texas, for-profit customers that take electric service at the transmission level are not allowed to participate in utilities' energy efficiency programming and therefore do not pay for it. Instead, industrial customers develop their own energy efficiency plans if desired and work with third-party providers to implement and finance energy efficiency investments. Although such investments are not measured or monitored, SPEER is developing a voluntary program that would allow these customers to report and verify savings related to their private investments.	–1
Virginia	Certain large customers are exempt from paying for the costs of new energy efficiency programs. Dominion Power customers may qualify by having average demands between 500 kW and 10 MW; customers with more than 10 MW do not participate in the state's energy efficiency programming by law. Once customers opt out, they cannot take advantage of existing programming nor be charged for it. Customers must show that they have already made energy efficiency investments or plan to in the future. Customers must submit measurement and verification reports yearly in support of their opting out of programs funded by a cost-recovery mechanism.	–1
West Virginia	Opt-out is developed individually by utilities. Customers with demand of 1 MW or greater may opt out. Participants must document that they have achieved similar/equivalent savings on their own to retain opt-out status. Claims of energy and/or demand reduction are certified to utilities, with future evaluation by the PSC to take place in a later proceeding. The method has not been specified. Twenty large customers have opted out.	–1

Energy Efficiency Resource Standards

Energy efficiency targets for utilities, often called EERSs, are critical to encouraging savings over the near and long terms. States with an EERS policy in place have shown average energy efficiency spending and savings levels more than three times as high as those in states without an EERS policy (Molina and Kushler 2015). Twenty-six states now have fully funded EERS policies establishing specific energy savings targets that utilities and program administrators must meet through customer energy efficiency programs. These policies set multiyear targets for electricity or natural gas savings, such as 1% or 2% incremental savings per year or 20% cumulative savings by 2025.[32]

EERS policies differ from state to state, but each is intended to establish a sustainable, long-term role for energy efficiency in the state's overall energy portfolio. ACEEE considers a state to have an EERS if it has a policy in place that

1. Sets clear, long-term (3+ years) targets for electricity or natural gas savings
2. Makes targets mandatory
3. Includes sufficient funding for full implementation of programs necessary to meet targets

Several states have chosen to mandate all cost-effective efficiency, requiring utilities and program administrators to determine and invest in the maximum amount of cost-effective efficiency feasible.[33] ACEEE considers states with such requirements to have EERS policies in place once these policies have met all the criteria listed above.

EERS policies aim explicitly for quantifiable energy savings, reinforcing the idea that energy efficiency is a utility system resource on par with supply-side resources. These standards also help utility system planners more clearly anticipate and project the impact of energy efficiency programs on utility system loads and resource needs. Energy savings targets are generally set at levels that push efficiency program administrators to achieve higher savings than they otherwise would, with goals typically based on analysis of the energy efficiency savings potential in the state to ensure that the targets are realistic and achievable. EERS policies maintain strict requirements for cost effectiveness so that efficiency programs are guaranteed to provide overall benefits to customers. These standards help to ensure a long-term commitment to energy efficiency as a resource, building essential customer engagement as well as the workforce and market infrastructure necessary to sustain the high savings levels.[34]

SCORES FOR ENERGY EFFICIENCY RESOURCE STANDARDS

In this category we credited states that had mandatory savings targets codified in EERS policies. Our research relied on legislation and utility commission dockets.

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[32] *Multiyear* is defined as spanning three or more years. EERS policies may set specific targets as a percentage of sales, as specific gigawatt-hour energy savings targets without reference to sales in previous years, or as a percentage of load growth.

[33] The seven states that have chosen to require all cost-effective efficiency are California, Connecticut, Maine, Massachusetts, Rhode Island, Vermont, and Washington. In addition, New Hampshire's EERS has set forth a long-term goal of achieving all cost-effective efficiency, which is anticipated to be met through planning and goal-setting in future implementation cycles.

[34] The ACEEE report *Energy Efficiency Resource Standards: A New Progress Report on State Experience* analyzed current trends in EERS implementation and found that most states were meeting, or were on track to meet, energy savings targets (Downs and Cui 2014).

A state could earn up to 3 points for its EERS policy. As table 17 shows, we scored states on a sliding scale based on their electricity savings targets. States could earn an additional 0.5 points if natural gas was included in the savings goals.

Some EERS policies contain cost caps that limit spending, thereby reducing the policy's effectiveness. This year, we did not subtract points for the existence of a cost cap, although we do note whether a cost cap is in place in the results table below. Most of the states with these policies in place have found themselves constrained. As a result, regulators have approved lower energy savings targets. In these cases, we score states on the lower savings targets approved by regulators that take the cost cap into account, rather than on the higher legislative targets.

In an effort to distinguish states pushing the boundaries of innovation in energy efficiency with ambitious goals, this year we raised the threshold for the top level of points to energy savings targets of 2.5% of sales or greater. Multiple states have proved that long-term savings of more than 2% are feasible and cost effective.

Table 17. Scoring of energy savings targets

Electricity savings target	Score
2.5% or greater	2.5
2–2.49%	2
1.5–1.99%	1.5
1–1.49%	1
0.5–0.99%	0.5
Less than 0.5%	0

Other considerations	Score
EERS includes natural gas	+0.5

To aid in comparing states, we estimated an average annual savings target over the next three years or the period specified in the policy. For example, Arizona plans to achieve 22% cumulative savings by 2020, so the average incremental savings target is 2.5% per year.

States with pending targets had to be on a clear path toward establishing a binding mechanism to earn points in this category. Examples of a clear path included draft decisions by commissions awaiting approval within six months, or agreements among major stakeholders on targets. For example, though Nevada passed legislation in 2017 to raise efficiency goals, the commission has yet to establish or determine the level of these new targets. Delaware has also passed EERS legislation, but final implementation rules are still pending.

Long-term energy savings targets require leadership, sustainable funding sources, and institutional support for states to achieve their goals. Several states currently have or in the past have had EERS-like structures in place but have lacked one or more of these enabling elements, and thus have undercut the achievement of their savings goals. States in this situation include Florida and New Jersey, neither of which earned points in this category this year.[35] Most states with EERS policies or other energy savings targets have met their goals and are on track to meet future goals (Downs and Cui 2014).

See table 18, below, for scoring results and Appendix D for full policy details. (As we show later in table 19, two unscored factors can also affect a policy's outcome.)

Table 18. State scores for energy efficiency resource standards

State	Approximate annual electric savings target (2016–2020)	Cost cap	Natural gas	Score (3 pts.)
Massachusetts	2.9%		•	3
Rhode Island	2.6%		•	3
Arizona	2.5%		•	3
Maine	2.4%		•	2.5
Vermont	2.1%		•	2.5
Maryland	2.0%			2
Illinois	1.7%	•	•	2
Connecticut	1.5%		•	2
Minnesota	1.5%		•	2
Washington	1.5%			1.5
Colorado	1.3%		•	1.5
Oregon	1.3%		•	1.5
California	1.2%		•	1.5
Iowa	1.2%		•	1.5
Michigan	1.0%		•	1.5
New Hampshire	1.0%		•	1.5
Hawaii	1.4%			1
Ohio	1.0%			1
Arkansas	0.9%		•	1
Wisconsin	0.8%	•	•	1
New York*	0.7%		•	1
Pennsylvania	0.8%	•		0.5

[35] In 2014 Florida utilities proposed reducing efficiency efforts from 2010 levels by at least 80%. The Florida Public Service Commission approved this proposal. In New Jersey available funds for energy efficiency are far below the amount necessary to meet savings targets laid out by state legislators.

State	Approximate annual electric savings target (2016–2020)	Cost cap	Natural gas	Score (3 pts.)
New Mexico	0.6%			0.5
Nevada	0.4%			0
North Carolina	0.4%			0
Texas	0.1%	•		0

States with voluntary targets are not listed in this table. Targets in states with cost caps reflect the most recent approved savings levels under budget constraints. See Appendix D for details and sources. * Reflects targets proposed by utilities under current Reforming the Energy Vision (REV) proceeding.

MAJOR UPDATES FOR STATE UTILITY POLICIES AND PROGRAMS

Several states have reaffirmed or strengthened utility savings targets since the release of the 2016 *Scorecard*.

The Midwest in particular was home to a flurry of activity over the past year. SB 2814, signed in Illinois last December, raises the state's efficiency standards considerably from current incremental goals of roughly 0.7% to almost 1.8%. Looking ahead to 2030, Commonwealth Edison and Ameren Illinois are required to reduce energy use by 21.5% and 16%, respectively. However the legislation also limits efforts to capture savings from all customer classes by including a sizable exemption for large consumers, effectively removing 10% of ComEd's load and 25% of Ameren's from programs. Also in December, Michigan passed legislation renewing and bolstering both its EERS and RPS, extending the state's 1% savings target for electric utilities through 2021, adding tiered incentives to encourage utilities to exceed 1.5% annual savings, and removing a previous cap on spending.

Following two years of inaction, Ohio's energy efficiency and renewable energy standards survived efforts by some lawmakers to extend the legislative freeze originally passed in 2014; the standards resumed at the start of the year thanks to a veto by the governor. By allowing the freeze to end, the veto reinstates the requirement that utilities meet efficiency standards, which continue at 1% annually through 2020 and increase to 2% annually in 2021.

Some Midwest states also stepped backward on energy efficiency. Earlier in the year, the Minnesota legislature voted to exempt certain cooperative and small municipal utility providers from participation in the Conservation Improvement Program, the state's ratepayer-funded program to help customers use electricity and natural gas more efficiently. And in June, the first utility effort to create an energy efficiency program under the Kansas Energy Efficiency Investment Act was largely rejected by the Kansas Corporation Commission when proposed programs from Kansas City Power & Light (KCP&L) were turned down due to cost-effectiveness concerns. The proposed programs were designed on the basis of similar programs KCP&L currently runs in neighboring Missouri.

In the Northeast, New Hampshire, which approved its first-ever EERS in 2016, began convening Energy Efficiency & Sustainable Energy Board (EESE) workshops earlier this year to address details of implementing the standard, which takes effect in 2018. In early April, an expansion of Maryland's EmPOWER efficiency program passed into law, extending the program through 2023 and codifying goals set by the state's PSC in 2016 for utilities to achieve 2% annual savings by 2020.

New York continues to push ahead on efforts to lay the regulatory foundations for the utility system of the future through its Reforming the Energy Vision (REV) proceeding, but concrete energy efficiency targets are still pending. As part of the REV proceeding, the commission carried 2015 electric savings goals for utilities into 2016 and called on utilities to propose targets over the following two years that were at least as high as current savings levels.[36] Because the commission has made it clear that—at least over the next three years—savings targets will continue to be an important and mandatory measure of performance, we continue to give credit for an EERS policy. However stakeholders have expressed concerns and uncertainty in recent months regarding lack of a centralized process for planning energy efficiency resources, complying with targets, and establishing responsibilities for key actors. The PSC issued several orders over the past year related to upgrading its distributed generation regulatory framework and implementing the state's Clean Energy Standard. In November 2016, the PSC's Clean Energy Advisory Council proposed metrics for measuring energy efficiency savings, although details regarding the role efficiency will play in meeting the standard continue to take shape.

In the Southeast, savings continued to ramp up for Louisiana thanks to quick-start energy efficiency programs first rolled out in 2014. In 2017 the Pelican State continued work to transition from its quick-start phase to comprehensive Phase II programs, as the PSC sought input on a rulemaking to address topics related to program design, cost recovery mechanisms, and EM&V. Mississippi, which also kicked off quick-start programs in 2014, held proceedings to guide the evolution to full-scale portfolios this year as well, including consideration of targets for future program years.

Progress continued in all corners of the western region as well. In addition to ongoing work in California on design and implementation of programs in support of the state's new SB 350 energy efficiency goals, other states also made significant advances. In May, Colorado's HB 1227 extended utility efficiency programs to call for 5% energy savings by 2028. Two months later, Governor Hickenlooper followed up with an executive order (D 2017-015) intended to further accelerate the state's transition to a clean energy economy with a series of carbon reduction goals, including achieving 2% electric savings per year by 2020. Nevada, meanwhile, passed SB 150, directing the PUC to set energy savings goals for NV Energy and requiring that at least 5% of energy efficiency expenditures be directed toward low-income customers.

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[36] The New York Public Service Commission's February 2015 order in the REV case directed that "longer-term goals should exceed existing targets." Utilities have filed plans for the 2016–2018 period with incremental electricity savings ranging from 0.4% to 0.9% of retail sales per year. In January 2016, the PSC also authorized NYSERDA's Clean Energy Fund (CEF) Framework, which outlines a minimum 10-year energy efficiency goal of 10.6 million MWh measured in cumulative first-year savings. Some degree of overlap of program savings is anticipated between utility targets and NYSERDA's CEF goals.

Utility Business Model and Energy Efficiency: Earning a Return and Fixed Cost Recovery

Under traditional regulatory structures, utilities do not have an economic incentive to promote energy efficiency. They typically have a disincentive, because falling energy sales from energy efficiency programs reduce utilities' revenues and profits—an effect referred to as *lost revenues* or *lost sales.* Because utilities' earnings are usually based on the total amount of capital invested in certain asset categories—such as transmission and distribution infrastructure and power plants—and the amount of electricity sold, the financial incentives are very much tilted in favor of increased electricity sales and expanding supply-side systems.

This dynamic has led industry experts to devise ways of addressing the possible loss of earnings and profit from customer energy efficiency programs and thereby removing utilities' financial disincentive to promote energy efficiency. Three key policy approaches properly align utility incentives and remove barriers to energy efficiency. The first is to ensure that utilities can recover the direct costs associated with implementing energy efficiency programs. This is a minimum threshold requirement for utilities and related organizations to fund and offer efficiency programs; every state meets it in some form. Given the wide acceptance of program cost recovery, we do not address it in the *State Scorecard.*

The other two mechanisms are fixed cost recovery (decoupling and lost revenue adjustment mechanisms) and performance incentives. Decoupling—the disassociation of a utility's revenues from its sales—aims to make the utility indifferent to decreases or increases in sales, removing what is known as the *throughput incentive.* Although decoupling does not necessarily make the utility more likely to promote efficiency programs, it removes or reduces the disincentive for it to do so.[37] Additional mechanisms for addressing lost revenues include modifications to customers' rates that permit utilities to collect these revenues, either through a lost-revenue adjustment mechanism (LRAM) or other ratemaking approach. LRAM allows the utility to recover lost revenues from savings resulting from energy efficiency programs while simultaneously increasing sales overall. ACEEE prefers the decoupling approach for addressing the throughput incentive and considers LRAM appropriate only as a short-term solution.

Performance incentives are financial incentives that reward utilities (and in some cases nonutility program administrators) for reaching or exceeding specified program goals. These may include a performance incentive based on achievement of energy savings targets and an incentive based on spending goals. Of the two, ACEEE recommends incentives based on achievement of energy savings targets. As table 20 shows, a number of states have enacted mechanisms that align utility incentives with energy efficiency.[38]

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[37] Straight fixed variable (SFV) rate design is often adopted as a simple form of decoupling that collects all costs considered fixed in a fixed monthly charge and collects all variable costs in volumetric rates. However SFV collects the same monthly charge (and fixed costs) for all customers within a class, regardless of customer size. ACEEE discourages the use of SFV as it not cost-based and sends poor price signals to customers to conserve electricity. For this reason, the Scorecard does not recognize SFV in its scoring methodology in this section.

[38] For a detailed analysis of performance incentives, see Nowak et al. (2015). For a detailed analysis of LRAM, see Gilleo et al. (2015).

SCORES FOR UTILITY BUSINESS MODEL AND ENERGY EFFICIENCY

A state could earn up to 2 points in this category: up to 1 point for having implemented performance incentive mechanisms and up to 1 point for having implemented full revenue decoupling for its electric and natural gas utilities. Table 19 describes the scoring methodology. Information about individual state decoupling policies and financial incentive mechanisms is available on ACEEE's State and Local Policy Database (ACEEE 2017).

Table 19. Scoring of utility financial incentives

Decoupling	Score
Decoupling is in place for at least one major utility for both electric and natural gas.	1
Decoupling is in place for at least one major utility, either electric *or* natural gas. There is an LRAM or ratemaking approach for recovery of lost revenues for at least one major utility for both electric and natural gas.	0.5
No decoupling policy has been implemented, although the legislature or commission may have authorized one. An LRAM or ratemaking approach for recovery of lost revenues has been established for a major utility for either electric or natural gas.	0
Performance incentives	**Score**
Performance incentives have been established for a major utility (or statewide independent administrator) for both electric and natural gas.	1
Performance incentives have been established for a major utility (or statewide independent administrator) for either electric or natural gas.	0.5
No incentive mechanism has been implemented, although the legislature or commission may have authorized or recommended one.	0

This year, 29 states offer a performance incentive for at least one major electric utility, and 17 states have incentives for natural gas energy efficiency programs. Some states with third-party program administrators have performance incentives for the administrator rather than the utilities. Thirty states have addressed disincentives for investment in energy efficiency for electric utilities. Of these, 15 have a lost revenue adjustment mechanism and 16 have implemented decoupling. For natural gas utilities, 7 states have implemented an LRAM and 22 have a decoupling mechanism. Table 20 outlines these policies.

Table 20. Utility efforts to address lost revenues and financial incentives

	Decoupling or LRAM			Performance incentives			
State	Electric	Natural gas	Score (1 pt.)	Electric	Natural gas	Score (1 pt.)	Total score (2 pts.)
California	Yes	Yes	1	Yes	Yes	1	2
Connecticut	Yes	Yes	1	Yes	Yes	1	2
Hawaii[1]	Yes	–	1	Yes	–	1	2
Massachusetts	Yes	Yes	1	Yes	Yes	1	2
Minnesota	Yes	Yes	1	Yes	Yes	1	2
New York	Yes	Yes	1	Yes	Yes	1	2
Rhode Island	Yes	Yes	1	Yes	Yes	1	2
Vermont	Yes	Yes	1	Yes	Yes	1	2
Arkansas	Yes†	Yes†	0.5	Yes	Yes	1	1.5
Colorado	Yes	Yes†	0.5	Yes	Yes	1	1.5
District of Columbia	Yes	No	0.5	Yes	Yes	1	1.5
Kentucky	Yes†	Yes†	0.5	Yes	Yes	1	1.5
Michigan	No	Yes	0.5	Yes	Yes	1	1.5
New Hampshire	Yes†	Yes†	0.5	Yes	Yes	1	1.5
Ohio	Yes*	No	0.5	Yes	Yes	1	1.5
Oklahoma	Yes†	Yes	0.5	Yes	Yes	1	1.5
South Dakota	Yes†	Yes†	0.5	Yes	Yes	1	1.5
Arizona	Yes†	Yes*	0.5	Yes	No	0.5	1
Georgia	No	Yes	0.5	Yes	No	0.5	1
Illinois	No	Yes	0.5	Yes	No	0.5	1
Indiana	Yes†	Yes	0.5	Yes	No	0.5	1
Maryland	Yes	Yes	1	No	No	0	1
North Carolina	Yes†	Yes	0.5	Yes	No	0.5	1
Oregon	Yes	Yes	1	No	No	0	1
Utah	No	Yes	0.5	Yes	No	0.5	1
Washington	Yes	Yes	1	No	No	0	1
Wisconsin	No	No	0	Yes	Yes	1	1
Idaho	Yes	No	0.5	No	No	0	0.5
Louisiana	Yes†	No	0	Yes	No	0.5	0.5
Maine	Yes	No	0.5	No	No	0	0.5
Mississippi	Yes†	Yes†	0.5	No	No	0	0.5
Missouri	Yes†	No	0	Yes	No	0.5	0.5
Nevada	Yes†	Yes	0.5	No	No	0	0.5
New Mexico	No	No	0	Yes	No	0.5	0.5
South Carolina	Yes†	No	0	Yes	No	0.5	0.5
Tennessee	No	Yes	0.5	No	No	0	0.5

	Decoupling or LRAM			Performance incentives			
State	Electric	Natural gas	Score (1 pt.)	Electric	Natural gas	Score (1 pt.)	Total score (2 pts.)
Texas	No	No	0	Yes	No	0.5	0.5
Virginia	No	Yes	0.5	No	No	0	0.5
Wyoming	No	Yes	0.5	No	No	0	0.5
Alabama	No	No	0	No	No	0	0
Alaska	No	No	0	No	No	0	0
Delaware	No	No	0	No	No	0	0
Florida	No	No	0	No	No	0	0
Guam	No	–	0	No	–	0	0
Iowa	No	No	0	No	No	0	0
Kansas	Yes†	No	0	No	No	0	0
Montana	No	No	0	No	No	0	0
Nebraska	No	No	0	No	No	0	0
New Jersey	No	No	0	No	No	0	0
North Dakota	No	No	0	No	No	0	0
Pennsylvania	No	No	0	No	No	0	0
Puerto Rico	No	–	0	No	–	0	0
Virgin Islands	No	–	0	No	–	0	0
West Virginia	No	No	0	No	No	0	0

*** Both decoupling and lost revenue adjustment mechanism in place. † No decoupling, but lost revenue adjustment mechanism in place. A yes with neither asterisk nor dagger indicates that only decoupling is in place. [1] Hawaii received full points for both gas and electric because it uses minimal amounts of natural gas.**

Support of Low-Income Energy Efficiency Programs

It is well documented that low-income households live in less-efficient housing and devote a greater proportion of their income to utility bills than do higher-income households. ACEEE research has found that low-income, African-American, Latino, and renter households pay up to three times as much as an average household for home energy costs, with some low-income households spending nearly 20% of their income on their utility bills (Drehobl and Ross 2016).

A variety of factors contribute to this disparity and can exacerbate the home energy burden faced by these households. Many residents live in older, poorly insulated homes with inefficient heating systems. In addition, people living in rental households may lack control over heating and/or cooling systems and appliances, which makes it difficult to influence decisions that might improve the efficiency of their homes. While energy burdens are also driven directly by one's low-income status, ACEEE research has found that for low-income households, including those in multifamily buildings, bringing their housing stock up to the efficiency level of the median household would eliminate 35% of their excess energy burden, dropping it to 13% of income (Drehobl and Ross 2016). Beyond simply lowering energy bills, efficiency upgrades can also improve health and comfort and provide families with more disposable income for other necessities beyond energy. In fact, in its evaluation of the Weatherization Assistance Program, DOE found that the value of nonenergy benefits greatly exceeded the value of energy savings.

Efforts to improve the reach of energy efficiency programs that serve low-income customers face several unique challenges. Among them are the relatively prohibitive up-front costs of such programs and the split incentive between renters and landlords, i.e., the lack of motivation for landlords to invest in efficiency upgrades when they do not themselves pay for utilities. To help overcome these challenges, regulators can play a key role in encouraging utilities to carefully consider and expand the role of low-income energy efficiency programs within their portfolios.

In recognition of the efforts undertaken by states to strengthen low-income energy efficiency programs offered by utilities, we have added an additional scoring metric to this year's *State Scorecard* to highlight examples of effective policy drivers, including

- The adoption of state legislation, regulations, or commission orders establishing a savings goal or minimum required level of spending on low-income energy efficiency programs
- The development of cost-effectiveness rules that account for the additional benefits that energy efficiency delivers to low-income customers, such as NEB quantification, adders, or exemption of these programs from cost-effectiveness testing.

States can utilize a variety of policy mechanisms to ensure that levels of investment in or savings from energy efficiency programs for low-income customers meet a minimum threshold. In the case of Pennsylvania, the public utility commission has incorporated a savings target specific to low-income programs within the state's EERS, which requires each utility to obtain a minimum of 5.5% of its total consumption reduction target from the low-income sector.

In most cases, however, low-income program requirements take the form of some sort of legislative spending set-aside, through either the creation of a separate fund that receives a minimum annual contribution from ratepayers or a requirement that utilities spend a minimum amount or percentage of their revenues on low-income programs. For example, the Future Energy Jobs Bill (SB 2814) passed in Illinois in December 2016 directed ComEd and Ameren Illinois to invest $25 million and $8.35 million, respectively, per year on low-income energy efficiency measures. Similarly, in August 2016, the New Hampshire Public Utilities Commission, in an approved settlement agreement establishing a statewide energy efficiency resource standard, increased the minimum low-income share of the overall energy efficiency budget from 15.5% to 17%. Minnesota legislation requires municipal gas and electric utilities to spend at least 0.2% of their gross operating revenue from residential customers on low-income programs, and investor-owned natural gas utilities must spend 0.4% of their gross operating revenue from residential customers on such programs. In other cases, such as Connecticut and Michigan, utilities are simply required to see that budgets allocated to low-income programs are distributed in levels proportional to the revenues that are expected to be collected from that sector. Descriptions of state rules and regulations establishing minimum levels of investment in low-income energy efficiency can be found in Appendix K.

Our scoring metric also recognizes several methods through which public utility commissions can encourage investment in low-income energy efficiency programs by adapting cost-effectiveness screening and testing to give added consideration to the multiple important nonenergy benefits these programs produce, such as health and safety impacts. In some states, such as Illinois, Iowa, and Michigan, regulations clearly state that low-income programs are exempt from satisfying cost-effectiveness tests; in other states these exemptions may be granted in practice but are not necessarily clearly stated or codified. Given the variation in policies and practices treating cost effectiveness of low-income programs, some of which are established implicitly rather than explicitly within commission orders, we have tried to exercise flexibility in assigning points within this category.

Other approaches taken by program administrators to accommodate the higher costs and unique benefits of low-income programs include lowering the cost-effectiveness threshold for such programs (as in California) or incorporating a percentage adder to approximate the nonenergy benefits that may otherwise be lost in a given cost–benefit calculation (as in Colorado and Vermont). In other cases, states have established methods to measure and calculate specific nonenergy benefits for inclusion in program screening. Others take a hybrid approach, utilizing an adder in addition to incorporating easy-to-measure NEBs. Descriptions of each state's utility cost-effectiveness rules specific to low-income programs can be found in Appendix L.

SCORES FOR SUPPORT OF LOW-INCOME ENERGY EFFICIENCY PROGRAMS

In this year's data request to states and utility commissions, ACEEE asked for information about both of these policy instruments, in addition to requesting information about specific levels of spending on low-income energy efficiency programs by states and utilities. This is distinct from funding provided by federal sources, such as DOE grant allocations for the Weatherization Assistance Program.

A state could earn up to 1 point in this category. To earn full credit, a state must have a legislative or regulatory requirement establishing minimum spending and/or savings levels for efficiency programs targeted specifically at low-income households, as well as established measures to encourage cost-effectiveness screening practices to accommodate or recognize the multiple nonenergy benefits of low-income energy efficiency programs. Alternatively, a state could earn full credit by demonstrating that utility spending for such programs equaled or exceeded $13 per low-income resident, based on the number of state residents below 200% of the federal poverty level according to the US Census Bureau and Bureau of Labor Statistics.

States could earn 0.5 points if they had in place at least one of the two aforementioned policy instruments or demonstrated that spending on low-income programs equaled or exceeded $6.50 per low-income resident.

Table 21 describes the scoring methodology. Information about individual state low-income energy efficiency programs is available in Appendixes K and L and on ACEEE's State and Local Policy Database (ACEEE 2017).

Table 21. Scoring of support of low-income energy efficiency programs

Scoring criteria for low-income energy efficiency programs	Score
Legislative/regulatory requirements have established minimum spending or savings levels for low-income energy efficiency programs, *and* utility cost-effectiveness rules or exceptions have been established to provide flexibility for low-income programs. or Levels of spending on low-income energy efficiency equal or exceed $13 per low-income resident.	1
Legislative/regulatory requirements have established minimum spending or savings levels for low-income energy efficiency programs, *or* utility cost-effectiveness rules or exceptions have been established to provide flexibility for low-income programs. or Levels of spending on low-income energy efficiency equal or exceed $6.50 per low-income resident.	0.5

Table 22 shows the results of ACEEE's analysis, including levels of ratepayer-funded spending on low-income energy efficiency programs for states that provided this information through the *Scorecard* data request. These amounts are distinct from bill assistance programs and refer specifically to programs designed to improve energy efficiency, such as home energy assessments, insulation, and air sealing. These amounts are also separate from federal funding, such as federal Weatherization Assistance Program (WAP) grant allocations. However where utility funds have been deployed to support or supplement WAP programs or projects, we do include these in table 22.

It is important to note that states rely on a variety of funding sources to support energy efficiency measures in low-income households; these include both ratepayer dollars and general funds. For example, although Alaska reports little utility funding for low-income programs, state investment in weatherization on a per-capita basis is among the highest in the nation, thanks to appropriations by the state legislature administered through the Alaska Housing Finance Corporation. In order to credit these efforts within the *State Scorecard* and avoid penalizing states that draw from diverse funding streams, any state-subsidized low-income funds reported by state energy offices in their data request have been combined with ratepayer funding for low-income programs and annotated in table 22.

Table 22. State scores for support of low-income energy efficiency programs

State	Requirements for minimum level of state or utility support for low-income energy efficiency programs	Special cost-effectiveness provisions for low-income energy efficiency programs	2016 spending on low-income energy efficiency programs	2016 spending on low-income energy efficiency programs per low-income resident*	Score (1 pt.)
Massachusetts	Yes[a]	Yes[d]	$104,279,757†	$58.72	1
Rhode Island	No	Yes[d]	$14,264,295	$46.62	1
Connecticut	Yes[abc]	Yes[e]	$37,692,751	$45.58	1
California	Yes[c]	Yes[f]	$422,500,000†	$32.66	1
Vermont	Yes[a]	Yes[f]	$4,796,684	$29.61	1
Alaska	No	No	$4,300,000†	$26.22	1
District of Columbia	Yes[a]	Yes[g]	$5,243,647	$24.97	1
Pennsylvania	Yes[bc]	Yes[e]	$78,737,398	$22.88	1
Maryland	No	Yes[e]	$28,729,842†	$21.47	1
New Hampshire	Yes[a]	Yes[e]	$4,843,564	$19.77	1
Minnesota	Yes[a]	Yes[e]	$22,200,000	$18.50	1
New York	Yes[a]	Yes[e]	$85,400,000	$14.05	1
New Jersey	No	Yes[e]	$29,266,520	$13.43	1
Oregon	Yes[a]	Yes[e]	$12,727,646	$10.30	1
Michigan	Yes[a]	Yes[e]	$25,652,571	$9.01	1
Oklahoma	Yes[a]	Yes[f]	$9,810,725	$6.55	1
Maine	Yes[a]	Yes[d]	$2,038,894†	$5.10	1
New Mexico	Yes[a]	Yes[g]	$1,970,951	$2.37	1
Delaware	Yes[a]	Yes[d]	$489,530†	$1.90	1
Nevada	Yes[a]	Yes[e]	$600,000†	$0.61	1
Illinois	Yes[a]	Yes[e]	—	—	1
Montana	Yes[a]	Yes[e]	—	—	1
Texas	Yes[a]	Yes[e]	—	—	1
Wisconsin	Yes[a]	Yes[e]	—	—	1
Colorado	No	Yes[g]	$15,127,495†	$11.34	0.5
Iowa	No	Yes[e]	$7,642,535	$9.14	0.5
Ohio	No	Yes[e]	$32,880,000	$9.06	0.5
Tennessee	No	Yes[e]	$15,013,215†	$6.49	0.5
Idaho	No	Yes[g]	$2,804,363	$5.21	0.5

State	Requirements for minimum level of state or utility support for low-income energy efficiency programs	Special cost-effectiveness provisions for low-income energy efficiency programs	2016 spending on low-income energy efficiency programs	2016 spending on low-income energy efficiency programs per low-income resident*	Score (1 pt.)
Missouri	No	Yes[e]	$14,297,833†	$4.39	0.5
Washington	No	Yes[e]	$5,556,138‡	$2.79	0.5
Mississippi	No	Yes[e]	$3,188,507	$2.45	0.5
North Carolina	No	Yes[e]	$4,647,605	$1.35	0.5
Utah	No	Yes[g]	$1,048,834†	$1.27	0.5
Florida	No	Yes[e]	$4,538,184	$0.62	0.5
Arizona	No	Yes[e]	–	–	0.5
Arkansas	No	Yes[e]	–	–	0.5
Indiana	No	Yes[e]	–	–	0.5
Kansas	No	Yes[e]	–	–	0.5
Kentucky	No	Yes[e]	–	–	0.5
South Carolina	No	Yes[e]	–	–	0.5
Virginia	No	Yes[e]	–	–	0.5
Alabama	No	No	$7,188,231	$4.06	0
Nebraska	No	No	$430,156	$0.84	0
Louisiana	No	No	$1,430,538	$0.83	0
Georgia	No	No	$2,393,855	$0.64	0
Guam	No	No	–	–	0
Hawaii	No	No	–	–	0
North Dakota	No	No	–	–	0
Puerto Rico	No	No	–	–	0
South Dakota	No	No	–	–	0
West Virginia	No	No	–	–	0
Wyoming	No	No	–	–	0
US Virgin Islands	No	No	–	–	0

* 2015 low-income population based on number of residents below 200% of the federal poverty level according to the US Census Bureau and Bureau of Labor Statistics 2016 Current Population Survey (CPS) Annual Social and Economic (ASEC) Supplement. † At least a portion of spending includes non-ratepayer/state-subsidized program funds. ‡ 2015 ratepayer funds. [a] A required level of spending on low-income energy efficiency has been established. [b] A required savings goal for low-income energy efficiency has been established. [c] A customer participation goal has been established. [d] Quantifiable low-income NEBs included within cost–benefit calculations. [e] Low-income programs not required to pass, or exempted from passing, cost-effectiveness test. [f] Cost-effectiveness threshold lowered to accommodate low-income programs. [g] Multiplicative adder applied to approximate low-income NEBs.

Leading and Trending States: Low-Income Energy Efficiency Programs

Illinois. In late 2016 Illinois passed the Future Energy Jobs Bill (SB 2814) with bipartisan support. This raised overall utility energy efficiency targets and effectively doubled the required annual amount of utility investment in low-income energy efficiency programs to at least $25 million for ComEd and $8.35 million for Ameren Illinois. In 2018 Illinois's electric utilities will take over delivery of low-income programs currently administered by the state Department of Commerce and Economic Opportunity and per SB 2814 will convene advisory committees to help inform the design and delivery of low-income programs.

New Jersey. Since its launch in 2001 by the New Jersey Board of Public Utilities, the state's Comfort Partners Program has helped more than 112,000 income-qualifying families save energy and money by making their homes more energy efficient. Improvements include adding insulation, caulking, weather stripping, energy-saving showerheads and light bulbs, and more, all at no cost to the customer. Prior to Comfort Partners, utilities offered their own separate low-income energy efficiency programs that varied widely in terms of budget levels and types of services offered. By transitioning to a single statewide program model administered cooperatively by seven utility partners, Comfort Partners has helped to establish consistency in service across the state and reduce administrative costs.

Ohio. Ohio's Home Weatherization Assistance Program (HWAP) has long been recognized as one of the most successful programs in the nation for weatherizing homes, thanks to its effective combination and coordination of federal weatherization funds and utility resources to provide comprehensive, streamlined services to low-income families. In addition, the state's Electric Partnership Program (EPP), typically funded with approximately $15 million from electric rider revenues, provides in-home audits and energy efficiency measures for low-income households. The Ohio Development Services Agency (ODSA) administers the EPP, along with federal weatherization funding. Most of Ohio's gas utilities also have weatherization programs, typically coordinated with HWAP.

Pennsylvania. Phase III of Act 129's Energy Efficiency and Conservation Program, approved in 2015, significantly improved the state's commitment to energy efficiency in low-income households. In addition to establishing a cumulative five-year utility energy consumption target of 5.1 million MWh, the order requires that utilities obtain 5.5% of the reduction target from low-income programs. Thanks to this improved mandate, the electric utilities budget for energy efficiency measures for low-income multifamily housing and other low-income households has increased to more than $32 million and $150 million, respectively, over the next five years. In addition, in March 2017 the PUC announced plans to undertake a study regarding affordable home energy burdens for low-income Pennsylvanians. The study will provide a starting point for evaluating the effectiveness of the state's Customer Assistance Program and other Universal Service programs.

Massachusetts. According to Massachusetts's 2008 Green Communities Act, a minimum of 10% of electric utility budgets and 20% of gas utility budgets are required to serve low-income residents. These programs are delivered by the Low-Income Energy Affordability Network (LEAN), an association of Community Action Agencies (CAAs) that coordinates administration of government- and utility-funded energy efficiency services to income-qualified customers, leveraging multiple funding sources and standardizing different program rules and eligibility requirements. LEAN also regularly hosts Best Practices Working Group meetings in which utilities and nonprofit agencies discuss program and funding consistency and review potential new measures. In 2017, LEAN will oversee the delivery of approximately $120 million in ratepayer and federal funds for low-income weatherization and energy efficiency programs.

ADDITIONAL POLICIES

Data Access

The scope of energy usage data that utilities make available to customers and third parties is an area of growing interest first introduced to the *State Scorecard* in 2015. Data access can help customers save energy in homes, large buildings, and communities. Giving customers and building owners access to utility consumption information can provide a baseline for comparing future performance and help inform their decisions about investing in energy efficiency. Similarly, it is important to give third parties and entrepreneurs access to customer data so they can give customers in-depth analyses of the cost effectiveness of energy efficiency products and services, in turn encouraging investment in efficiency by reducing risk. Utilities, public utility commissions, or state legislators can advance access to utility consumption information for customers, building owners, and authorized third parties by providing recommended guidelines or requirements that standardize and streamline data access electronically across a utility territory or state. These guidelines and regulations can also facilitate or require data transmission directly from utilities to third parties with customer permission, while also addressing privacy concerns that may pose barriers to data sharing.

Beyond providing individual customer data to consumers, building owners, and authorized third-party service providers, multiple other use cases exist for which state and local governments should facilitate data sharing by working with utilities to clarify conditions and guidelines for aggregated energy data or related information. For example, a California Public Utilities Commission rulemaking recognizes specific use cases for local governments seeking access to aggregate data in creating climate action plans; for research institutions seeking anonymous energy consumption data to evaluate energy policies; and for environmental groups seeking customer data regarding energy efficiency measures pre- and post-retrofit.[39]

Although state policies can encourage data sharing, the absence of explicit state policies does not mean utilities cannot act. After all, some utilities consider it simply a customer-service obligation to empower consumers with the ability to access and share their own energy data in a digital world. Regardless of explicit policy, utilities can still facilitate these relationships. For example, even without an overt policy mandate, utilities in several states give customers access to their own energy use data through an online portal, offering them the option of electronically and automatically releasing it to third parties for greater analysis.

The data requests we distributed to utility commission contacts posed the following questions.

Do utilities provide energy usage data for customers to download in an electronic format such as Green Button? Are they required to do so? Here we identify those states in which utilities let

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[39] California Public Utilities Commission. *Decision Adopting Rules to Provide Access to Energy Usage–Related Data While Protecting Privacy of Personal Data*. Rulemaking 08-12-2009, May 1, 2014. docs.cpuc.ca.gov/PublishedDocs/Published/G000/M090/K845/90845985.PDF.

customers download and access their energy use data in an electronic format, giving them usage information that is often a prerequisite to their investing in energy efficiency. We also identify those states in which utility commissions are going a step further to explicitly require utilities to provide energy use data to customers in a standardized electronic format. Doing so helps to facilitate sharing with third-party energy management services. For example, utilities are increasingly supporting Green Button, a technical standard for exchanging energy usage data that, as the name suggests, enables customers to download energy usage data by simply clicking on a green button.[40]

Are guidelines or requirements in place regarding the process for third-party access to customer energy use data? Such policies remove perceived technical and policy barriers to third-party access, specifically by addressing privacy concerns among consumers and liability concerns among utilities.

Are utilities required to provide aggregated energy use data to owners of separately metered commercial or multifamily properties, or to public agencies? If so, what are the terms and details of the requirements? Separately metered buildings make up a significant portion of the built environment in many cities and thus represent a significant opportunity to promote energy efficiency. By having access to whole-building energy data, building owners can benchmark energy consumption and identify opportunities to improve energy efficiency. Unfortunately, when attempting to track energy use data within buildings, owners and operators often encounter privacy-related obstacles related to tenant-occupied spaces, where the tenant is the utility customer of record. Clarifying privacy protection and information-sharing practices through data aggregation requirements can help address these concerns.

Table 23 summarizes the responses to these questions. We did not score states on their responses this year, although we will likely score this metric in the future.[41]

[40] Green Button comes in two varieties: *Green Button Download My Data*, which allows customers to download their energy use data (and upload it to a third-party application), and *Green Button Connect My Data*, which allows customers to automate the secure transfer of their usage data to third parties.

[41] Complete information on data access as reported by states can be found at database.aceee.org.

Table 23. Guidelines and requirements for provision of energy usage data

State	Guidelines established regarding process for third-party access to customer energy data	Requirement for provision of individual energy use data to customers, in a common electronic format (e.g., Green Button)	Requirement for provision of individual energy use data to third parties, upon authorization by the customer	Utilities provide energy usage data for customers to download in an electronic format	Requirement for provision of aggregate data to owners of multitenant buildings	Requirement for provision of aggregate data to public agencies
Alabama				•		
California	•	•	•	•	•	•
Connecticut	•	•	•	•		•
District of Columbia	•	•	•	•	•	
Georgia	•				•	
Illinois	•	•	•	•		•
Maine	•	•	•	•		•
Maryland	•			•		
Massachusetts	•			•		
Nebraska	•		•	•	•	•
Nevada				•		
New Hampshire	•	•	•	•	•	•
New Jersey	•		•	•		•
New York					•	
North Carolina	•			•		
North Dakota				•		
Oklahoma			•	•		
Oregon	•	•		•	•	
Pennsylvania	•		•			
Rhode Island				•		
Texas	•			•		
Utah				•		
Vermont				•		
Washington	•					

Complete information on data access policies can be found in the ACEEE State and Local Policy Database (ACEEE 2017). States that have no policies in place or that did not provide responses are not included in the table.

States that have taken notable steps toward clarifying guidelines for the provision of customer energy usage data are described below.

Leading and Trending States: Data Access

Colorado. The Public Utilities Commission approved a settlement agreement in June 2017 among Xcel Energy, consumer advocates, the solar and environmental communities, and other parties. The agreement approves advanced metering infrastructure (AMI) to be deployed across the utility's service territory from 2020 to 2024. Xcel Energy will provide a new web portal that will enable customers to access their data and provide that data to third parties in a manner consistent with the Green Button Connect My Data standard.

Ohio. In February the Public Utilities Commission of Ohio (PUCO) approved AEP Ohio's gridSMART Phase 2 project, which will install almost 900,000 smart meters in 31 communities throughout the state over four years and provide residential and small business customers with access to Green Button Download My Data. The agreement also establishes a gridSMART Collaborative, which, among other activities, will review customer and third-party access to interval data and consider possible ways for customers to connect in-home technologies with real-time electric usage data.

District of Columbia. The Sustainable DC Act of 2014 included a provision that mandates both electric and gas utilities to provide aggregated whole-building data upon request to a building owner, making it the first jurisdiction in the country to do so. These data are then made available for download and through automated upload to ENERGY STAR® Portfolio Manager. Data are aggregated at the whole-building level for five or more accounts, to address any privacy concerns and simplify the process of benchmarking multitenant buildings.

California. In September 2015, California passed Assembly Bill 802, invigorating the state's benchmarking program by increasing transparency and public access to energy data. The bill required utilities to make available whole-building aggregated energy consumption data when requested to by building owners. Meanwhile, Green Button Connect My Data continues to gain traction across the state, graduating from earlier, limited pilot programs to general availability across the investor-owned electric utilities.

Illinois. In March 2016, the Illinois Commerce Commission issued an order directing Commonwealth Edison Company and Ameren to take the first steps to give customers with smart meters the ability to authorize and share their energy usage data with registered third-party companies using Green Button Connect My Data. Commission order 15-0073 establishes the process by which Illinois consumers can obtain and control access to their electricity usage data. Customers of Commonwealth Edison with smart meters could begin using Green Button Connect My Data as of May 2016. (All customers will have a smart meter by the end of 2018.)

New York. The New York Public Service Commission issued a March 2016 order approving an advanced metering infrastructure (AMI) business plan by ConEd under the condition that the utility both provide Home Area Network (HAN) functionality and implement Green Button Connect My Data. A subsequent order directed utilities with AMI deployment plans to submit a proposed implementation plan, budget, and timeline for implementing Green Button Connect My Data or an alternate standard offering similar functionality. Utilities without AMI deployment plans were directed to identify other tools that could be used to improve customer and authorized third-party access to customer data in their initial diversified stock income plans. In November 2016, the state's utilities filed an update on data sharing in their Supplemental Distributed System Implementation Plan, which includes a summary of Green Button Connect deployment plans by utility.

Chapter 3. Transportation Policies

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INTRODUCTION

Transportation energy use accounts for approximately 28% of overall energy consumption in the United States and is the biggest consumer of energy after the electric power sector (EIA 2017a). At the federal, state, or local level, a comprehensive approach to transportation energy efficiency must address both individual vehicles and the transportation system as a whole, including its interrelationship with land use policies. In recent years, the federal government has addressed vehicle energy use through joint GHG and fuel economy standards for light- and heavy-duty vehicles. However with those federal standards at risk of rollback, the role of states in maintaining progress on fuel efficiency is in the spotlight. States and local governments continue to lead the way in creating policies for other aspects of transportation efficiency.

The energy efficiency score for the transportation category reflects state actions that go beyond federal policies to achieve a more energy-efficient transportation sector. These may be measures to improve the efficiency of vehicles purchased or operated in the state, policies to promote more-efficient modes of transportation, or the integration of land use and transportation planning to reduce the need to drive.

SCORING AND RESULTS

While substantial increases in fuel economy and GHG standards for light-duty vehicles are in place at the national level through 2025, the possibility of these standards' being weakened means that states' role in ensuring continued progress toward high-efficiency vehicles has become all the more critical.[42] We awarded states that have adopted California's GHG vehicle emissions standards 1 point. Given the efficiency gains achievable through vehicle electrification, we gave states that also adopted California's Zero Emission Vehicle (ZEV) program an additional 0.5 points. States with more than 30 registered EVs per 100,000 people qualified for an additional 0.5 points, while those with more than 70 EVs per 100,000 earned 1 full point. We awarded 0.5 points to states with consumer incentives for the purchase of high-efficiency vehicles.

States can lead the way in improving not only vehicle fuel efficiency but also the efficiency of transportation systems more broadly. Opportunities include steps to promote the use of fuel-efficient transportation modes. States that have a revenue stream dedicated to transit earned 0.5 points in this year's *State Scorecard*. Twenty-three states have statutes in place that provide sustainable funding sources for capital and/or operating expenses. For details, see Appendix G. States also received points based on the magnitude of their transit spending: relatively large per capita spending ($100 or more) received 1 point, while spending ranging from $20 to $99.99 per capita received 0.5 points.

Policies that promote compact development and ensure the accessibility of major destinations are essential to reducing transportation energy use in the long term. States with

[42] Fuel economy standards adopted for model years 2022–2025 were provisional, and both fuel economy and GHG emissions standards for these model years are currently under review.

smart growth statutes earned 1 point; 24 states and Puerto Rico earned points in this category. These statutes include the creation of zoning overlay districts such as the Massachusetts Chapter 40R program, as well as various other incentives to encourage development patterns that do not increase the need to drive. See the ACEEE State and Local Policy Database for further details (ACEEE 2017).

States that adopted reduction targets for vehicle miles traveled (VMT) or transportation-specific GHG reduction goals statewide were also eligible for 1 point. Only six states earned points in this category. Among them is Vermont, which earned 1 point for the VMT goals outlined in its Comprehensive Energy Plan, adopted in 2011 and updated in 2016. This update sets objectives for 2030, one of which is to hold VMT to 2011 levels.

We awarded an additional 1 point to states whose average 10-year VMT per capita figure fell by 5% or more between 2014 and 2016. A reduction of between 1% and 4.99% earned 0.5 points; 20 states earned full points for this metric. We also awarded 0.5 points to states with complete streets statutes, which ensure proper attention to the needs of pedestrians and cyclists in all road projects.

Regarding freight system efficiency, we changed our methodology this year so that states could earn 0.5 points if their freight plans addressed multimodal freight strategies and another 0.5 points if their freight plans included a fuel-efficiency or GHG reduction goal.

For the first time this year, we evaluated state policies that encourage equitable access to efficient transportation options. States earned 0.5 points if they have policies in place to encourage low-income housing in transit-oriented neighborhoods and an additional 0.5 points if they use distance from transit facilities as a criterion to award federal low-income tax credits to qualifying property owners.

Table 24 shows state scores. ACEEE recognizes that variations in geography and urban/rural composition mean that some states cannot feasibly implement some of the policies mentioned in this chapter. Nevertheless, every state can make additional efforts to reduce their transportation energy use, and this chapter illustrates a number of approaches. Additional details on and incentives for the purchase of high-efficiency vehicles, state transit funding, and transportation policies, are included in Appendixes E, F, and G, respectively.

Table 24. State scores for transportation policies

State	GHG tailpipe emissions standards and ZEV program (1.5 pts.)[1]	EV registrations per 100,000 people (1 pt.)[2]	High-efficiency vehicle consumer incentives (0.5 pts.)[3]	VMT targets/GHG reduction goals (1 pt.)[4]	Average % change in VMT per capita (1 pt.)[5]	Integration of transportation and land use planning (1 pt.)[6]	Complete streets legislation (0.5 pt.)[7]	Transit funding (1 pt.)[8]	Dedicated transit revenue stream statutes (0.5 pts.)[9]	Freight system efficiency goals (1 pt.)[10]	Policies supporting equitable access to transportation (1 pt.)[11]	Total score (10 pts.)
California	1.5	1	0.5	1	0.5	1	0.5	0.5	0.5	1	1	9
Massachusetts	1.5	0.5	0.5	1	0	1	0.5	1	0.5	0.5	1	8
New York	1.5	0.5	0.5	1	1	1	0.5	1	0.5	0	0.5	8
District of Columbia	1.5	1	0.5	0	1	1	0.5	1	0	0.5	0.5	7.5
Oregon	1.5	1	0	1	1	1	0.5	0	0.5	0.5	0.5	7.5
Rhode Island	1.5	1	0.5	0	1	1	0.5	0.5	0	0.5	0.5	7
Washington	1	1	0.5	1	1	1	0.5	0	0.5	0.5	0	7
Connecticut	1.5	0.5	0.5	0	0.5	1	0.5	1	0	0	1	6.5
Maryland	1.5	0.5	0.5	0	0.5	1	0.5	1	0	0.5	0.5	6.5
Delaware	1	0.5	0.5	0	1	1	0.5	1	0	0	0.5	6
Vermont	1.5	0.5	0	1	1	1	0.5	0	0	0.5	0	6
New Jersey	1.5	0.5	0.5	0	0	1	0.5	0.5	0	0.5	0.5	5.5
Pennsylvania	1	0	0.5	0	1	0	0.5	0.5	0.5	0.5	0.5	5
Maine	1.5	0	0	0	0.5	1	0.5	0	0.5	0.5	0.5	5
Virginia	0	0.5	0	0	1	1	0.5	0.5	0.5	0.5	0.5	5
Florida	0	0.5	0	0	1	1	0.5	0	0.5	0.5	0.5	4.5
Georgia	0	1	0.5	0	1	0	0.5	0	0.5	0.5	0.5	4.5
Illinois	0	0.5	0	0	0.5	1	0.5	1	0.5	0	0.5	4.5
Minnesota	0	0.5	0	0	0.5	0	0.5	0.5	0.5	0.5	1	4
Arizona	0	1	0.5	0	1	1	0	0	0	0	0.5	4
Colorado	0	1	0.5	0	1	0	0.5	0	0.5	0	0.5	4
Hawaii	0	1	0	0	0.5	1	0.5	0	0.5	0	0.5	4
Michigan	0	0	0	0	0.5	1	0.5	0.5	0.5	0.5	0.5	4
Utah	0	1	0.5	0	1	0	0.5	0	0.5	0.5	0	4

State	GHG tailpipe emissions standards and ZEV program (1.5 pts.)[1]	EV registrations per 100,000 people (1 pt.)[2]	High-efficiency vehicle consumer incentives (0.5 pts.)[3]	VMT targets/GHG reduction goals (1 pt.)[4]	Average % change in VMT per capita (1 pt.)[5]	Integration of transportation and land use planning (1 pt.)[6]	Complete streets legislation (0.5 pt.)[7]	Transit funding (1 pt.)[8]	Dedicated transit revenue stream statutes (0.5 pts.)[9]	Freight system efficiency goals (1 pt.)[10]	Policies supporting equitable access to transportation (1 pt.)[11]	Total score (10 pts.)
Tennessee	0	0.5	0	0	0.5	1	0.5	0	0.5	0.5	0	3.5
North Carolina	0	0.5	0	0	0.5	1	0.5	0	0.5	0	0	3
Texas	0	0.5	0.5	0	1	0	0.5	0	0	0.5	0	3
Iowa	0	0	0	0	0.5	1	0	0	0.5	0.5	0	2.5
Alaska	0	0	0	0	1	0	0	1	0	0	0	2
Idaho	0	0.5	0	0	0.5	0	0	0	0	0.5	0.5	2
Indiana	0	0	0	0	0	0	0.5	0	0.5	0.5	0.5	2
Louisiana	0	0	0.5	0	0	0	0.5	0	0	0.5	0.5	2
Missouri	0	0.5	0	0	0	0	0.5	0	0	0.5	0.5	2
Nevada	0	1	0	0	0	0	0	0	0	0.5	0.5	2
New Hampshire	0	0.5	0	0	0.5	1	0	0	0	0	0	2
Puerto Rico	0	0	0.5	0	0	1	0.5	0	0	0	0	2
South Carolina	0	0	0	0	1	0	0.5	0	0	0.5	0	2
West Virginia	0	0	0	0	1	0	0.5	0	0.5	0	0	2
Mississippi	0	0	0	0	0.5	0	0.5	0	0	0.5	0	1.5
New Mexico	0	0.5	0	0	0	0	0	0	0	0.5	0.5	1.5
North Dakota	0	0	0	0	0	1	0	0	0	0.5	0	1.5
Kansas	0	0	0	0	0	0	0	0	0.5	0.5	0	1
Kentucky	0	0	0	0	0.5	0	0	0	0	0	0.5	1
Oklahoma	0	0	0	0	1	0	0	0	0	0	0	1
Wyoming	0	0	0	0	1	0	0	0	0	0	0	1
Alabama	0	0	0	0	0	0	0	0	0	0.5	0	0.5
Arkansas	0	0	0	0	0	0	0	0	0.5	0	0	0.5
Guam	0	0	0.5	0	0	0	0	0	0	0	0	0.5
Montana	0	0.5	0	0	0	0	0	0	0	0	0	0.5

State	GHG tailpipe emissions standards and ZEV program (1.5 pts.)[1]	EV registrations per 100,000 people (1 pt.)[2]	High-efficiency vehicle consumer incentives (0.5 pts.)[3]	VMT targets/GHG reduction goals (1 pt.)[4]	Average % change in VMT per capita (1 pt.)[5]	Integration of transportation and land use planning (1 pt.)[6]	Complete streets legislation (0.5 pt.)[7]	Transit funding (1 pt.)[8]	Dedicated transit revenue stream statutes (0.5 pts.)[9]	Freight system efficiency goals (1 pt.)[10]	Policies supporting equitable access to transportation (1 pt.)[11]	Total score (10 pts.)
Nebraska	0	0	0	0	0.5	0	0	0	0	0	0	0.5
Ohio	0	0	0	0	0	0	0	0	0	0.5	0	0.5
South Dakota	0	0	0	0	0.5	0	0	0	0	0	0	0.5
Wisconsin	0	0.5	0	0	0	0	0	0	0	0	0	0.5
US Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0

[1] Clean Cars Campaign 2017; C2ES 2017. [2] IHS Automotive Polk 2017; state data requests. [3] DOE 2017a. [4] State legislation. [5] FHWA 2016. [6] State legislation. [7] NCSC 2016. [8] AASHTO 2016. [9] State legislation. [10] State freight plans. [11] State legislation.

DISCUSSION

Tailpipe Emission Standards and the Zero Emission Vehicle Program

The US Department of Transportation (DOT) has regulated the fuel economy of automobiles since Corporate Average Fuel Economy (CAFE) standards were adopted in 1975. States are not permitted to adopt fuel efficiency standards per se. As a longtime leader in vehicle emissions reduction, however, California has authority to set its own vehicle standards. Other states may choose to follow federal or California standards. In 2002, California passed the Pavley Bill (Assembly Bill 1493), the first law in the United States to address GHG emissions from vehicles. The GHG reductions from this law were to be achieved largely through improved fuel efficiency, making these standards, to a large degree, energy efficiency policies. Given auto manufacturers' preference for regulatory regimes that allow them to offer the same vehicle models nationwide, California has been instrumental in prodding the federal government to establish standards that draw new efficiency technologies into the market.

Pursuant to the *Massachusetts v. EPA* court decision in 2007, the EPA began regulating vehicle GHG emissions as well. Starting in model year 2012, the EPA, DOT, and the California Air Resources Board (CARB) have harmonized their standards for fuel economy and GHG emissions. In 2012, the agencies adopted new GHG and fuel economy standards for model years 2017–2025, calling for a fleet-wide GHG emissions average of 54.5 mpg by 2025, although DOT's CAFE standards for model years 2022–2025 were provisional, and all three programs were to participate in a midterm review of the final four years of the standards. In early 2017, EPA and CARB determined that these standards have remained appropriate. The Trump administration reopened EPA's midterm review, however, and actions regarding both EPA and DOT standards for 2022–2025 are to be proposed in spring of 2018. The federal standards are at risk of being rolled back, so the commitment of all states that have adopted California's standards will be critical in maintaining progress toward clean, fuel-efficient vehicles. California has also updated its ZEV program, requiring an increase in sales of plug-in hybrid, battery electric, and fuel-cell vehicles from 2018–2025, in order to reduce GHG and criteria pollutant emissions. Manufacturers of passenger cars and light trucks (up to 8,500 pounds) must earn a certain number of ZEV credits by meeting state requirements on the number of ZEVs that they must produce and deliver for sale (C2ES 2017).

Fourteen states and the District of Columbia have adopted California's GHG regulations, but two of them, Arizona and Florida, repealed their programs in 2012. The states that now use the California standards are Connecticut, Delaware, the District of Columbia, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Pennsylvania, Rhode Island, Vermont, and Washington (Clean Cars Campaign 2017). Nine of these states and the District of Columbia have adopted California's ZEV requirements as well (C2ES 2017).

Electric Vehicle Registrations

As more EVs become available to drivers, states can help remove the barriers to their widespread adoption. In addition to reducing the high up-front costs of these vehicles, states can provide incentives for the construction of the required fueling infrastructure. Additionally, nonfinancial benefits—such as emissions testing exemptions—make it more convenient to own an EV. The total number of EV registrations in a given state is indicative of the success of the state's policies to increase the uptake of electric vehicles.

Incentives for High-Efficiency Vehicles

When fuel-efficient vehicles contain new, advanced technologies, high purchase price is a barrier to their entry into the marketplace. To encourage consumers to buy fuel-efficient vehicles, states may offer a number of financial incentives, including tax credits, rebates, and sales tax exemptions. Several states offer tax incentives to purchasers of alternative-fuel vehicles—including those that run on compressed natural gas, ethanol, propane, or electricity—and in some cases to purchasers of hybrid vehicles (electric or hydraulic). Although alternative-fuel vehicles can provide environmental benefits by reducing pollution, they do not necessarily increase fuel efficiency, and we did not include policies to promote their purchase in the *State Scorecard*. However we did include incentives for EVs and hybrids, which do generally have high fuel efficiency. With the arrival of a wide range of hybrid and plug-in vehicles in recent years, tax credits are playing an important role in spurring their adoption.

We did not give credit for incentives for the use of high-occupancy vehicle lanes and preferred parking programs for high-efficiency vehicles, as they promote increased vehicle use and consequently may not deliver net energy benefits.

Vehicle Miles Traveled (VMT) Growth and VMT Reduction Targets

Improved vehicle fuel economy will not adequately address energy use in the transportation sector in the long term if growth in total VMT goes unchecked. EIA predicts a 14% increase in light-duty VMT between now and 2030, outpacing anticipated US population growth (EIA 2017a). Demographic changes, increased availability of transportation services based on information and communications technology, and rising mode shares for public transit, biking, and walking after years of decline could reduce future VMT growth (Dutzik and Baxandall 2013).

Reducing VMT growth is key to managing transportation energy use. Several states have taken on this challenge by setting VMT reduction targets. Success in achieving these targets requires the coordination of transportation and land use planning.

Integration of Land Use and Transportation Planning

Sound land use planning is vital to supporting alternatives to driving in the United States. Successful strategies vary among states due to differences in their infrastructure, geography, and political environment; however all states benefit from adopting core principles of smart growth and integrating transportation and land use planning. To reduce fuel use through transportation system efficiency, such approaches should encourage:

- Transit-oriented development, including mixed land uses (mix of jobs, stores, and housing) and good street connectivity to make neighborhoods friendly to all modes of transportation
- Areas of compact development
- Convenient modes of transportation that provide alternatives to driving

- Centers of activity where popular destinations are close together and accessible by multiple modes

Complete Streets Policies

Complete streets policies focus on street connectivity and aim to create safe, easy access to roads for all pedestrians, bicyclists, motorists, and public transportation users. Complete streets foster increased use of alternatives to driving and have a significant impact on a state's fuel consumption. According to the National Complete Streets Coalition, modest increases in biking and walking could save 2.4 billion gallons of fuel annually across the country (NCSC 2012). A complete streets policy directs states' transportation agencies to evaluate and incorporate complete streets principles and tasks transportation planners with ensuring that all roadway infrastructure projects allow for equitable access to and use of those roadways.

State Transit Funding

While states receive some federal funds for public transit, a significant proportion of transit funding comes from state budgets. A state's investment in public transit is a key indicator of its interest in promoting energy-efficient modes of transportation, although realizing the potential for energy savings through transit typically requires land use changes that create denser, more mixed-use communities as well.

Dedicated Transit Revenue Streams

As states find themselves faced with increasingly uncertain federal funding streams and federal transportation policies that remain highway-focused, many have taken the lead in finding dedicated funding sources for long-term public transit expenditures. To generate a sustainable stream of capital and operating funds, a number of states have adopted legislation that identifies specific sources of funding for public transit. For instance, in 2010, New York passed Assembly Bill 8180, which directs certain vehicle registration and renewal fees toward public transportation. This metric lets us track state-level progress that is not represented in the time-lagged state transit funding data described above.

Freight

Many states have freight transportation plans in place. The 2012 federal transportation funding authorization bill, MAP-21, contained a number of new freight provisions. States were eligible for an increased share of federal funding for freight projects that (1) were shown to contribute to the efficient movement of freight and (2) were identified in the state freight plan. Thus, MAP-21 effectively encouraged states to develop and adopt freight plans. However it did not promote saving energy through these plans (MAP-21 2012).

Adopted in 2015, the FAST Act superseded MAP-21, requiring states to develop freight plans that include both immediate and long-range planning activities in order to receive federal funds for freight projects. Plans must be finalized by December 2017. Additionally, FAST creates a separate pool of money for intermodal and rail freight projects. Each state is allowed to set aside up to 10% of federally awarded funds for eligible nonhighway projects (FAST 2015). Pursuant to FAST, states must include multimodal strategies in their freight plans, but these do not need to be finalized by the December 2017 deadline, although many states have already incorporated multimodalism into their freight plans.

These freight plans can be further strengthened by adopting concrete targets or performance measures that establish energy efficiency as a priority for goods movement. Such measures will involve tracking and reporting the fuel used for freight movement in the state as a whole, and they will encourage the use of energy efficiency as a criterion for selecting or evaluating freight projects. States could formulate these performance targets in terms of gallons per ton-mile of freight moved, for example, and targets should reflect performance across all freight modes. Closely related performance measures—such as grams of GHG emitted per ton-mile of freight—should also be included in targets.

Equitable Access to Transportation

As cities have sprawled and jobs have moved away from urban cores in the United States, many low-income communities have become geographically more isolated and inadequately served by affordable, efficient transportation. As a result, household transportation costs as a percentage of total income for these communities are higher than average, as personal vehicles become the only option for travel (Pew Charitable Trusts 2016). Expenditures for vehicles, including fuel consumption, insurance, and maintenance, can be large and unpredictable.

States can use policy levers to ensure fair and equitable access to public transportation and newer shared-use services in a number of ways. Providing incentives to developers who set aside a fixed percentage of housing for low-income families in transit-served areas helps align housing and transportation choices. Similarly, many states use distance from transit services as a key criterion for disbursing federal low-income tax credit funds to qualifying property owners, ensuring that low-income communities are served by a variety of transportation alternatives.

Leading and Trending States: Transportation Policies

California. California is the clear leader in the transportation sector. As part of its plans to implement AB 32 (which calls for the state to reduce global warming pollution to 1990 levels by 2020), California has identified several strategies for smart growth and VMT reduction. In 2016, legislators passed SB 32 and AB 197, which require a 40% greenhouse gas reduction below 1990 levels by 2030; this will necessitate even further cuts in emissions from the transportation sector. In 2008, the state passed SB 375, which requires the California Air Resources Board to develop regional, transportation-specific GHG reduction goals in collaboration with metropolitan planning organizations. The board finalized targets in 2011, recommending a 5–8% reduction in vehicle-associated GHG emissions by 2020 for the state's four largest metropolitan planning organizations. These goals must be reflected in regional transportation plans that create compact, sustainable development across the state and thus reduce VMT growth.

California has also been a leader in providing equitable access to transportation services. The Affordable Housing and Sustainable Communities (AHSC) Program provides funding to incentivize the creation of low-income housing near transit facilities. In addition, the state considers proximity to transit facilities when distributing federal Low-Income Housing Tax Credits to qualifying property owners.

Between 2005 and 2007, California adopted the Goods Management Action Plan (GMAP), emphasizing energy efficiency in goods movement. In 2014, the state created the California Freight Mobility Plan (CFMP), which it structured to address all of the MAP-21 national goals including GHG emissions reductions. On the vehicle efficiency side, California passed AB 118 in 2009, providing a voucher program for the incremental cost of purchasing hybrid medium- and heavy-duty trucks. Vouchers range from $6,000 to $45,000. The state also offers tax rebates of up to $2,500 for light-duty zero-emission EVs and plug-in hybrid EVs on a first-come, first-served basis, effective until 2023.

Massachusetts. Like California, Massachusetts has long been a leader on the transportation front. The state is dedicated to encouraging compact, transit-oriented development through a number of measures. The Massachusetts 40R program provides financial incentives for the use of zoning overlays that promote smart growth development in cities and municipalities. The state also has a GHG reduction target that aims to reduce transportation emissions by 2 million tons by 2020, as well as a comprehensive complete streets statute that incorporates pedestrian and bicycle travel in all road construction projects.

To continue curbing emissions and energy consumption in the transportation sector, Massachusetts adopted the California ZEV program to encourage the use of electric vehicles. With approximately 95 electric vehicles registered per 100,000 residents, the state is making steady progress in promoting electric vehicles as a viable option for drivers.

New York. New York has steadily moved up the ranks in recent years through its strong efforts in transportation efficiency. On the vehicle efficiency side, New York signed a 2013 memorandum of understanding with seven other states to put a combined 3.3 million ZEVs on the road by 2025. This action supplements the California emissions standards for low-emission vehicles that New York adopted in 2005.

The state has also made a number of changes to improve system efficiency. New York is one of the few states in the nation to have a concrete VMT reduction target. A goal set in 2008 calls for a 10% reduction in 10 years. With one of the highest transit ridership rates in the country, the state passed Assembly Bill 8180 in 2010, directing a portion of vehicle registration and license renewal fees to public transportation. The bill also created the Metropolitan Transit Authority Financial Assistance Fund to support subway, bus, and rail services and capital improvements. In 2011, New York adopted a new complete streets policy aimed at providing accessibility for multiple modes of transport.

Leading and Trending States: Transportation Policies (continued)

Oregon. Oregon has made steady progress toward reducing its fuel consumption and VMT in recent years. In 2011, the state adopted transportation-specific GHG reduction goals for six of its largest metropolitan areas; the goals call for a 17–21% reduction from 2005 levels by 2035. In combination with a stringent growth management act, these new goals have helped move Oregon toward the top of the rankings in this policy area.

The state also passed HB 2186 in 2009, calling for all metropolitan planning organizations to create a GHG emissions task force. These task forces look for alternative land use and transportation planning scenarios to meet community growth needs while reducing GHG emissions across the state. Oregon is also one of the first states to pass legislation for a VMT fee program. In an effort to reduce the overall number of miles driven, this voluntary program charges drivers a 1.5-cent-per-mile fee in lieu of the state's 30-cent-per-gallon gas tax.

Washington. Washington has long been a leader in integrating land use and transportation planning to reduce fuel consumption and VMT. The state introduced the Growth Management Act in 1990 in an early attempt to curb suburban sprawl amid rapid population growth. Washington also has an aggressive VMT reduction target, which calls for a 50% reduction in VMT per capita by 2050 relative to 1990 levels. In 2011, the state passed a complete streets law to encourage walkable, multimodal communities. In 2012, the state legislature adopted House Bill 2660, providing grants to public transit agencies to preserve transit service in the state.

Chapter 4. Building Energy Efficiency Policies

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INTRODUCTION

Buildings consume 74% of the electricity and 41% of the total energy used in the United States and account for 40% of US carbon dioxide emissions (DOE 2012). This makes buildings an essential target for energy savings. Because buildings have long life spans and retrofits are often difficult or costly, encouraging building efficiency measures during design and construction is one of the most effective ways to reduce building energy consumption. Mandatory building energy codes target energy efficiency by legally requiring a minimum level of energy efficiency for new residential and commercial buildings. Benchmarking and transparency policies also promote efficiency by informing building owners about their energy consumption practices.

Building Energy Code Adoption

In 1978, California enacted the first statewide building energy code in its Title 24 Building Standard. Several states (including Florida, New York, Minnesota, Oregon, and Washington) followed with their own codes in the 1980s. During the 1980s and 1990s, the International Code Council® (ICC) and its predecessor regional code development organizations developed the Model Energy Code (MEC), later renamed the International Energy Conservation Code® (IECC). Today most states use a version of the IECC for their residential buildings.

Most commercial building codes are based on ASHRAE 90.1 standards, jointly developed by ASHRAE and the Illuminating Engineering Society (IES). The IECC commercial building code tends to include many of the prescriptive and performance requirements of the ASHRAE 90.1 code.

With the publication of each new edition of the IECC and ASHRAE standards, DOE issues determinations on the codes that ascertain their relative impact compared with older standards and establish, if justified, the latest iteration as the commercial base code with which all states must comply. Within two years of the final determination, states are required to send letters certifying their adoption, requesting an extension, or explaining their decision not to comply.

On July 25, 2017, DOE released its most recent commercial code determination showing that ASHRAE Standard 90.1-2016 will lead to 6.7% greater site energy savings than the 2013 edition.[43] Participation in the 2018 ICC code development process was diverse and more expansive than in prior years, and the 2018 IECC for residential construction is expected to yield energy savings that meet or exceed those of the 2015 IECC.

Stimulus funding provided through the DOE State Energy Program under the American Recovery and Reinvestment Act (ARRA) spurred the majority of states to adopt at least the 2009 IECC and ASHRAE 90.1-2007 standards. ARRA required that each state accepting stimulus funding for code implementation and compliance have a plan to achieve

[43] For details, see www.energycodes.gov/development/determinations.

compliance with these codes in 90% of new and renovated residential and commercial building space by 2017. While these federal efforts were successful in leading states to update to 2009 model codes in the years after ARRA, more recent adoption efforts have been the result of direct state leadership.

Building Energy Code Compliance

Robust implementation and enforcement are necessary to ensure that states will reap the benefits of adopted codes. A support network that includes DOE, the Pacific Northwest National Laboratory (PNNL), regional energy efficiency organizations (REEOs), the Building Codes Assistance Project (BCAP), and a variety of other local, regional, and national stakeholder groups provides advocacy, technical training, and educational resources in an effort to help states and communities reach their compliance goals.

DOE provides many resources to help guide states in code compliance efforts. In addition to funding compliance activities in many states through grants, DOE provides technical assistance—such as model adoption policies, compliance software, and training modules—through its Building Energy Codes Program. Among its most recent efforts is an ongoing three-year Residential Energy Code Field Study in eight states that seeks to establish baseline energy use and determine the degree to which investment in building energy code education, training, and outreach programs can produce a significant, measurable change in residential building energy savings. Also ongoing is a DOE-led Multifamily Residential Energy Code Field Study that will develop an approach to better assess energy code compliance in multifamily buildings (DOE 2017c).

REEOs work closely and collaboratively within their regions and with each other to coordinate code-related activities that support adoption and compliance efforts. These include Northeast Energy Efficiency Partnerships (NEEP), the Southeast Energy Efficiency Alliance (SEEA), the Midwest Energy Efficiency Alliance (MEEA), the South-Central Partnership for Energy Efficiency as a Resource (SPEER), the Southwest Energy Efficiency Project (SWEEP), and the Northwest Energy Efficiency Alliance (NEEA).[44] The REEOs have served a vital role in providing technical policy information and analysis regarding cost effectiveness and potential energy savings of energy codes to help inform code adoption efforts. Other pivotal REEO-led initiatives include increasing access to energy code training for builders, code officials, and architects; and overseeing energy code stakeholder groups and collaboratives. The REEOs have also been key contributors to DOE's ongoing residential energy code field studies in states such as Kentucky, Arkansas, and Georgia.

Other important stakeholders providing leadership and technical expertise on code adoption and enforcement include the Building Code Assistance Project (BCAP), the National Association of State Energy Officials (NASEO), and the Responsible Energy Codes Alliance (RECA), among others.

In addition to these regional and national efforts, states can take other measures to support code compliance. These include the following:

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[44] These organizations cover all states except California, West Virginia, Hawaii, and Alaska.

- Conducting a study—preferably every three to five years—to determine actual rates of energy code compliance, identify compliance patterns, and create protocols for measuring compliance and developing best-practice training programs.
- Providing and supporting training programs and outreach for code compliance in order to increase the number and effectiveness of contractors and code officials that implement the code and monitor and evaluate compliance. These are most effective when based on data collected in compliance field studies.
- Establishing a system through which utilities and other stakeholders are encouraged to support code compliance.

Utilities can promote compliance with state and local building codes in a number of ways (Misuriello et al. 2012). Many utilities across the country offer energy efficiency programs that target new construction. Several states with EERS policies have established programs that allow utilities to claim savings for code enhancement activities, both for adoption and for compliance. Utilities can fund and administer training and certification programs, assist local jurisdictions with implementing tools that streamline enforcement, provide funding for purchasing diagnostic equipment, and assist with compliance evaluation. They also can combine code compliance efforts with initiatives to improve energy efficiency beyond code requirements. To encourage utilities to participate, prudent regulatory mechanisms, such as program cost recovery or shared savings policies, must be in place to compensate them for their efforts.

Buildings Energy Use Transparency

Building energy benchmarking and transparency laws require property owners, builders, or sellers to compile information about their buildings' energy use or energy efficiency characteristics and report this data to a centralized database and/or to prospective buyers at the time of sale. This information can then be used to evaluate building energy use patterns and identify energy efficiency opportunities. Several studies demonstrate that benchmarking and transparency policies can be associated with a 3–8% reduction in energy consumption or energy use intensity (ENERGY STAR 2012; Mims et al. 2017).[45] Benchmarking and transparency requirements improve consumers' awareness of the energy use of homes and commercial buildings up for sale or lease. This information can also have an impact on the value of a home or building. Laws requiring building owners and managers to report energy use might also motivate owners to improve their buildings' energy efficiency.

Energy use transparency requirements are a fairly recent policy innovation. Commercial transparency policies are uncommon at the state level, with only California, Washington, and the District of Columbia requiring energy use disclosure upon sale or lease

[45] A study by the EPA showed that benchmarking energy use led to a 7% decrease in consumption across a sample of more than 35,000 buildings (ENERGY STAR 2012). A Lawrence Berkeley National Lab (LBNL) review of state and local benchmarking and transparency studies found these requirements to correlate with a 3–8% reduction in gross energy consumption or energy use intensity over a two- to four-year period of policy implementation. The LBNL review, however, suggested that additional research be conducted in order to confirm energy impacts and determine causal relationships (Mims et al. 2017).

(BuildingRating 2014). Local governments are more likely to pursue these policies, but state governments can also use them to incentivize building stock upgrades.

METHODOLOGY

Our review of state building energy code stringency is based predominantly on publicly available information, such as that provided by BCAP as well as by the DOE Building Energy Codes Program, and on the expert knowledge of individuals who are active in state building energy code policy and evaluation. We also rely on primary data collection in order to verify publicly available data, particularly for very recent or forthcoming code adoptions. We distributed a data request to energy offices and knowledgeable officials in each state, requesting information on their efforts to measure and enforce code compliance.

While model codes are determined at the national level, states often amend these codes during the adoption process, thereby affecting the energy use intensity of buildings constructed to that code. In order to more accurately capture the energy savings impact of these amendments, ACEEE is considering basing building energy code stringency scores in the *2018 Scorecard* on the New Building Institute's Zero Energy Performance Index (zEPI) score, described later in this chapter.[46]

SCORING AND RESULTS

States earned credit on two measures of building energy codes: the stringency of residential and commercial codes and the level of efforts to support code compliance. We also awarded points for benchmarking and energy use transparency laws, basing our review on policy information compiled by the Institute for Market Transformation's BuildingRating.org project (BuildingRating 2014). We awarded points as follows:

- Code stringency
    - Residential energy code (2 points)
    - Commercial energy code (2 points)
- Code compliance
    - Compliance study (1 point)
    - Other compliance activities (2 points)
- Benchmarking and transparency policies
    - Residential policies (0.5 points)
    - Commercial policies (0.5 points)

As in past *Scorecards*, states could earn a maximum of 4 points for stringency and up to 3 points for compliance efforts. The 1-point scoring metric for benchmarking and transparency policies, which previously appeared in Chapter 6 ("State Government–Led Initiatives"), appears here for the first time because of its direct relevance to strengthening buildings efficiency.

[46] The zEPI system is based on a scale presented in a paper by Charles Eley, an energy efficiency advocate and New Buildings Institute fellow. The scale establishes zero net energy as the absolute goal and enables the measurement of a building's progress toward zero net energy performance, as opposed to the traditional percent-better-than-code metric. To learn more about this scale, see Eley et al. 2009. To learn more about the zEPI methodology, see newbuildings.org/code_policy/zepi/.

Table 25 lists states' overall building energy code scores. Explanations of each metric follow.

Table 25. State scores for building energy efficiency policies

State	Residential code stringency (2 pts.)	Commercial code stringency (2 pts.)	Compliance study (1 pt.)	Additional compliance activities (2 pts.)	Benchmarking and transparency (1 pt.)	Total score (8 pts.)
California	2	2	1	2	1	8
District of Columbia	1.5	2	1	2	1	7.5
New York	2	2	1	2	0.5	7.5
Washington	2	2	1	2	0.5	7.5
Florida	2	2	1	2	0	7
Massachusetts	2	2	1	2	0	7
Oregon	2	2	1	2	0	7
Vermont	2	2	1	2	0	7
Maryland	2	2	1	1.5	0	6.5
Texas	2	2	1	1.5	0	6.5
Connecticut	1.5	1.5	1	2	0	6
Illinois	1.5	2	1	1.5	0	6
Minnesota	1.5	1.5	1	2	0	6
Alabama	1	2	1	1.5	0	5.5
Idaho	1	2	1	1.5	0	5.5
Michigan	1.5	2	1	1	0	5.5
Utah	1.5	2	0.5	1.5	0	5.5
Hawaii	1	2	0.5	1	0.5	5
Iowa	1.5	1.5	0	2	0	5
Kentucky	1	1.5	1	1.5	0	5
Montana	1	1.5	0.5	2	0	5
New Jersey	2	2	0	1	0	5
Pennsylvania	1	1	1	2	0	5
Rhode Island	1	1	1	2	0	5
Virginia	1.5	2	0.5	1	0	5
Colorado	1	1	1	1.5	0	4.5
Nebraska	1	1	1	1.5	0	4.5
Delaware	1.5	1.5	0	1	0	4
New Hampshire	1	1	0	2	0	4
North Carolina	1	1.5	1	0.5	0	4

State	Residential code stringency (2 pts.)	Commercial code stringency (2 pts.)	Compliance study (1 pt.)	Additional compliance activities (2 pts.)	Benchmarking and transparency (1 pt.)	Total score (8 pts.)
Tennessee	1	1.5	1	0.5	0	4
Arkansas	1	1	1	0.5	0	3.5
Nevada	1	1	0	1.5	0	3.5
West Virginia	1	1	1	0.5	0	3.5
Arizona	1	1	0	1	0	3
Georgia	1	1	1	0	0	3
Guam	1	1	0	1	0	3
Maine	0.5	1	0	1	0.5	3
Missouri	0.5	0.5	1	1	0	3
Ohio	1	1.5	0	0.5	0	3
Wisconsin	1	1.5	0	0.5	0	3
Alaska	1	0	0	1	0.5	2.5
Louisiana	1	1	0	0.5	0	2.5
New Mexico	1	1	0	0.5	0	2.5
Puerto Rico	1	1	0	0.5	0	2.5
South Carolina	1	1	0	0.5	0	2.5
US Virgin Islands	1	1	0	0.5	0	2.5
Indiana	1	1	0	0	0	2
Kansas	0.5	0.5	0	0.5	0.5	2
Oklahoma	1	0	0	1	0	2
Mississippi	0	1.5	0	0	0	1.5
North Dakota	0.5	0.5	0	0	0	1
Wyoming	0	0	0	1	0	1
South Dakota	0	0	0	0	0.5	0.5

Sources: Stringency scores derived from data request responses (Appendix A), the Building Codes Assistance Project (BCAP 2017), and discussions with code experts as of August 2017. Compliance and enforcement scores are based on information gathered in surveys of state building energy code contacts. See the ACEEE State and Local Policy Database for more information on state codes and compliance (ACEEE 2017).

DISCUSSION

Stringency

We assigned each state a score of 0 to 2 points for residential building energy codes and another 0 to 2 points for commercial building energy codes, with 2 being assigned to the highest levels of stringency, generally aligning with or exceeding the 2015 IECC and ASHRAE 90.1-2013, for a total of 4 possible points in this category. For detailed information on building code stringency in each state, visit ACEEE's State and Local Policy Database.

We have not limited *State Scorecard* credit to codes that have already become effective. A handful of states are still in the process of updating their building energy codes, and we awarded full credit (commensurate with the degree of code stringency) to those states that have exhibited progress and show a clear path to code adoption and implementation within the next year (by August 1, 2018). In table 27, we marked these states with an asterisk. Other states have begun the process of updating their codes but have yet to demonstrate a clear path toward adoption with a definitive implementation date. Although we did not award these states full credit, it is important to note that they have begun the process and are moving along. Table 27 denotes these states with a dagger symbol.

We also awarded credit to states that demonstrated significant local adoption of building energy codes as an alternative to a statewide requirement. Home-rule states—such as Arizona, Colorado, Kansas, and Missouri—adopt and enforce building energy codes at the local level.[47] We have not developed a quantitative method for comparing home-rule states—which may encompass a patchwork of different locally adopted codes—to other states, in part because of a lack of consistent data across states. We recognize that our methodology is limited, but it is important to recognize local adoptions, particularly in states where these represent a large segment of the state population or permit activity. Within Arizona, for example, 54 of the 100 code-adopting jurisdictions have enacted the IECC 2009 or better, according to the ICC. In Missouri, approximately 100 jurisdictions, representing 50% of the state's population, have adopted the 2009 or 2012 IECC or equivalent codes, according to a Missouri Division of Energy survey. Most home-rule states, however, were unable to report levels of code stringency by jurisdiction. We will continue to consider opportunities to improve our methodology and more accurately reflect measurable progress toward building energy code adoption and enforcement.

Table 26 summarizes our scoring methodology for code stringency.

Table 26. Scoring of state residential and commercial building energy code stringency

Residential building code	Commercial building code	Score (2 pts. each)
Exceeds 2012 IECC or meets or exceeds 2015 IECC	Meets or exceeds 2015 IECC or ASHRAE 90.1-2013 or equivalent	2
Meets 2012 IECC or equivalent or has significant adoption of 2015 IECC in major jurisdictions	Meets or exceeds 2012 IECC or equivalent or ASHRAE 90.1-2010 or has significant adoption of 2015 IECC or ASHRAE 90.1-2013 in major jurisdictions	1.5
Meets or exceeds 2009 IECC or equivalent or has significant adoption of 2012 IECC in major jurisdictions	Meets or exceeds 2009 IECC or equivalent or ASHRAE 90.1-2007 or has significant adoption of 2012 IECC or ASHRAE 90.1-2010 in major jurisdictions	1
Has significant adoption of 2009 IECC or equivalent in major jurisdictions	Has significant adoption of 2009 IECC or ASHRAE 90.1-2007 in major jurisdictions	0.5

[47] Home rule decentralizes power, allowing a locality to exercise certain powers of governance within its own administrative area. See database.aceee.org for more information on building codes in home-rule states.

Residential building code	Commercial building code	Score (2 pts. each)
Has no mandatory state energy code, or code precedes 2009 MEC/IECC	Has no mandatory state energy code, or code precedes ASHRAE 90.1-2007 or equivalent	0

Table 27 shows state-by-state scores for this category. We continue our practice, arrived at through consultation with subject matter experts, of awarding only partial credit to states that adopt model codes with amendments that weaken the codes' energy savings impact. One area of increasing concern is the adoption of building energy code amendments with trade-offs that replace energy efficiency with renewable energy. Such trade-offs may encourage overinvestment in generation and neglect cost-effective, common-sense efficiency measures that provide efficiency and comfort to the consumer for the lifetime of the home, such as energy-efficient windows and insulation. Although we have not deducted points for such amendments this year, we plan to revisit this decision in future *State Scorecards*.

Table 27. State scores for code stringency

State	Score (2 pts.)	Residential code description	Score (2 pts.)	Commercial code description	Total score (4 pts.)
California	2	The 2013 Building Energy Efficiency Standards, effective July 1, 2014, are mandatory statewide and exceed the 2012 IECC standards for residential buildings. The 2016 Standards adopted in June 2015 and effective January 1, 2017, have been certified to exceed the 2015 IECC standards for residential buildings.	2	The 2013 Building Energy Efficiency Standards, effective July 1, 2014, are mandatory statewide and exceed ASHRAE/IESNA 90.1-2010 for commercial buildings. The 2016 Building Energy Efficiency Standards, adopted in June 2015 and effective January 1, 2017, have been certified to exceed ASHRAE/IESNA 90.1-2013 for commercial buildings.	4
Florida*	2	The Draft Florida Building Code, Energy Conservation, 6th Edition (2017) is based on the 2015 IECC and Florida-specific amendments (effective December 31, 2017).	2	The Draft Florida Building Code, Energy Conservation, 6th Edition (2017) is based on the 2015 IECC and Florida-specific amendments (effective December 31, 2017).	4
Maryland	2	2015 IECC	2	2015 IECC	4
Massachusetts	2	2015 IECC with strengthening amendments	2	IECC 2015 and ASHRAE standard 90.1-2013 as part of the 9th edition of the Massachusetts building code.	4
New Jersey	2	2015 IECC	2	ASHRAE 90.1-2013	4
New York	2	2015 IECC	2	2015 IECC/ASHRAE 90.1-2013	4
Oregon*	2	The residential portion of the 2014 Oregon Energy Efficiency Specialty Code is equivalent to the IECC 2015. The state is currently reviewing the 2017 Oregon Residential Specialty Code.	2	The commercial portion of the 2014 Oregon Energy Efficiency Specialty Code is within plus or minus 2% of ASHRAE 90.1-2013.	4
Texas	2	2015 International Residential Code (IRC) for single-family homes (effective September 1, 2016) and 2015 IECC for all other residential buildings	2	2015 IECC (effective November 1, 2016); ASHRAE 90.1-2013 for state-funded buildings	4
Vermont	2	2015 IECC	2	2015 IECC with ASHRAE 90.1-2013 as alternative compliance path	4
Washington	2	2015 IECC	2	2015 IECC/ASHRAE 90.1-2013	4

State	Score (2 pts.)	Residential code description	Score (2 pts.)	Commercial code description	Total score (4 pts.)
District of Columbia†	1.5	The 2013 DC Construction Code references the 2012 IECC and the 2012 International Green Construction Code. DC has completed a review of 2015 codes.	2	The 2013 DC Construction Code references the 2012 IECC, ASHRAE 90.1-2010, and the 2012 International Green Construction Code. DC has completed a review of 2015 codes.	3.5
Illinois	1.5	2015 IECC with weakening amendments	2	The commercial provisions of the 2015 IECC or ASHRAE 90.1-2013 Standard are equivalent and acceptable paths to compliance.	3.5
Michigan	1.5	2015 IECC with weakening amendments	2	The state recently approved draft rules with reference to ASHRAE 90.1-2013. New codes are expected to be effective September 20, 2017.	3.5
Utah‡	1.5	2015 IECC with amendments, effective July 1, 2016	2	2015 IECC, effective July 1, 2016	3.5
Virginia*	1.5	2015 IECC with weakening amendments (expected to go into effect March 2018)	2	2015 IECC (expected to go into effect March 2018)	3.5
Alabama‡1	1	An amended version of the 2015 IECC. Several local jurisdictions have adopted the 2015 IECC without the state-adopted amendments.	2	ASHRAE 90.1 2013	3
Connecticut†	1.5	2012 IECC. Currently reviewing the 2015 IECC.	1.5	2012 IECC. Currently reviewing the 2015 IECC.	3
Delaware†2	1.5	2012 IECC. Currently reviewing the 2015 and 2018 IECC, with adoption anticipated in 2017.	1.5	ASHRAE 90.1-2010. Currently reviewing ASHRAE 90.1-2013, with adoption anticipated in 2017.	3
Hawaii3	1	2015 IECC with weakening amendments	2	2015 IECC	3
Idaho*	1	2015 IECC w/weakening amendments. Equivalent to 2009 IECC (effective January 1, 2018).	2	2015 IECC with reference to ASHRAE 90.1-2013 (effective January 1, 2018).	3
Iowa†	1.5	2012 IECC with amendments. Currently reviewing the 2015 IECC.	1.5	2012 IECC with reference to ASHRAE 90.1-2010. Currently reviewing the 2015 IECC.	3
Minnesota‡	1.5	2012 IECC	1.5	The commercial energy code is consistent with ANSI/ASHRAE/IES Standard 90.1-2010 and /or the 2012 IECC.	3

State	Score (2 pts.)	Residential code description	Score (2 pts.)	Commercial code description	Total score (4 pts.)
Kentucky	1	2009 IECC and 2009 IRC with state amendments	1.5	2012 IECC/ASHRAE 90.1-2010	2.5
Montana	1	2012 code with amendments that weaken requirement for residential exterior insulation	1.5	2012 IECC or ASHRAE 90.1-2010	2.5
North Carolina	1	2009 IECC	1.5	2009 IECC with amendments, with reference to ASHRAE 90.1-2010	2.5
Ohio	1	2009 IECC	1.5	2012 IECC/ASHRAE 90.1-2010 (effective November 1, 2017).	2.5
Tennessee	1	2009 IECC	1.5	2012 IECC for commercial and state-owned buildings	2.5
Wisconsin*	1	Wisconsin Uniform Dwelling Code (UDC) is mandatory for one- and two-family dwellings and incorporates the 2009 IECC with state amendments.	1.5	The state is reviewing draft rules that reference the 2015 IECC/ASHRAE 90.1-2013. However the draft rule includes substantial weakening amendments.	2.5
Arizona	1	Significant local adoption of the 2012 IECC	1	Significant local adoption of the 2012 IECC	2
Arkansas‡	1	2009 IECC	1	2009 IECC	2
Colorado	1	Home-rule state: 2003 IECC mandatory only for jurisdictions that have already adopted energy codes. Voluntary otherwise. 67% of all building construction takes place in jurisdictions that have adopted the 2012 or higher code.	1	Home-rule state: 2003 IECC mandatory only for jurisdictions that have already adopted energy codes. Voluntary otherwise. 67% of all building construction takes place in jurisdictions that have adopted the 2012 or higher code.	2
Georgia†	1	2009 IECC. Currently reviewing the 2015 IECC.	1	ASHRAE 90.1-2007. Currently reviewing the 2015 IECC.	2
Guam	1	2009 IECC	1	2009 IECC	2
Indiana	1	2009 IECC	1	ASHRAE 90.1-2007	2
Louisiana	1	Residential buildings must meet the 2009 IRC/2009 IECC. Multifamily buildings 3 storeys or fewer: 2012 IRC and 2009 IECC energy provisions; more than 3 storeys: ASHRAE 90.1-2007.	1	ASHRAE 90.1-2007	2

State	Score (2 pts.)	Residential code description	Score (2 pts.)	Commercial code description	Total score (4 pts.)
Nebraska	1	2009 IECC	1	2009 IECC with reference to ASHRAE 90.1-2007	2
Nevada[4]	1	Significant local adoption of the 2012 IECC	1	Significant local adoption of the 2012 IECC and ASHRAE 90.1-2010	2
New Hampshire	1	2009 IECC	1	2009 IECC with references to ASHRAE 90.1-2007	2
New Mexico†‡	1	2009 IECC with amendments	1	2009 IECC with amendments; ASHRAE 90.1-2007 is acceptable compliance path.	2
Pennsylvania	1	2009 IECC	1	2009 IECC with reference to ASHRAE 90.1-2007	2
Puerto Rico	1	2009 IECC	1	2009 IECC	2
Rhode Island	1	2012 IECC with weakening amendments	1	2012 IECC and ASHRAE 90.1-2010 with weakening amendments	2
South Carolina	1	2009 IECC	1	2009 IECC with reference to ASHRAE 90.1-2007	2
US Virgin Islands	1	2009 IECC	1	2009 IECC	2
West Virginia	1	2009 IECC	1	ASHRAE 90.1-2007	2
Maine[5]†‡	0.5	2009 IECC (but only about 60% of state is covered).	1	2009 IECC/ASHRAE 90.1-2007. Working to adopt 2015 IECC/ASHRAE 90.1-2013.	1.5
Mississippi	0	No mandatory code	1.5	ASHRAE 90.1-2010	1.5
Alaska	1	No mandatory code for new construction; however the state-owned Alaska Housing Finance Corporation requires the projects it finances to meet the state-developed Building Energy Efficiency Standards (BEES). Most new residential construction adheres to BEES, which is based on the 2012 IECC with state-specific weakening amendments.	0	No mandatory code, but all public facilities must comply with the thermal and lighting energy standards adopted by the Alaska Department of Transportation and Public Facilities pursuant to AS44.42020(a)(14).	1

State	Score (2 pts.)	Residential code description	Score (2 pts.)	Commercial code description	Total score (4 pts.)
Kansas	0.5	On the basis of information obtained in a 2013 survey of local jurisdictions and 2011 US Census permit data, it is estimated the almost 60% of residential construction in Kansas meets or exceeds the 2009 IECC.	0.5	In April 2007 the 2006 IECC became the applicable standard for new commercial and industrial structures. Jurisdictions in the state are not required to adopt the code. Many jurisdictions have adopted the 2009 or 2012 IECC.	1
Missouri	0.5	No mandatory code, but significant adoption of 2009 and 2012 IECC in major jurisdictions	0.5	No mandatory code, but significant adoption of 2009 and 2012 IECC in major jurisdictions	1
North Dakota[6]	0.5	No mandatory code, but significant local adoption of 2009 IRC	0.5	No mandatory code, but significant local adoption of 2009 IECC	1
Oklahoma	1	2015 IRC. However the energy chapter references the 2009 IRC.	0	2015 ICC/IBC. However the energy chapter references the 2006 IECC	1
South Dakota	0	Voluntary statewide minimum code	0	Voluntary statewide minimum code	0
Wyoming	0	No mandatory code, but some jurisdictional adoption. The eight most-populated cities and counties in Wyoming have an energy code that meets or exceeds the IECC 2006 or equivalent.	0	No mandatory code, but some jurisdictional adoption. The eight most-populated cities and counties in Wyoming have an energy code that meets or exceeds the IECC 2006 or equivalent.	0

* These states have signed or passed legislation requiring compliance with a new iteration of codes effective by August 1, 2018, or their rulemaking processes are far enough along that mandatory compliance is imminent. We award these states full credit commensurate with the degree of code stringency as noted in table 26. † These states reported they have begun a code adoption process, but were not far enough along in the rulemaking process to indicate a clear and imminent compliance timeline. ‡ These states reported that they have extended building code adoption cycles. [1] Alabama recently adopted the 2015 IECC for residential buildings; because this code is equivalent to the 2009 IRC, the state receives partial credit for residential stringency. [2] In 2016 Delaware was credited for its forthcoming adoption of the 2015 IECC. While the state is currently reviewing the 2018 IECC, it continues to enforce the 2012 IECC and ASHRAE 90.1-2010. We credit Delaware for its currently enforced codes. [3] Hawaii's residential code is closer in stringency to the 2009 IECC, and therefore the state receives partial credit. [4] Although Nevada has adopted the 2012 IECC for residential and commercial buildings, only certain localities have actually adopted and begun enforcing these codes. Nevada receives partial credit for significant local adoption. [5] In 2016 Maine was credited for its forthcoming adoption of ASHRAE 90.1-2013. However the state still enforces the 2009 IECC/ASHRAE 90.1-2007. We credited Maine for its currently enforced commercial codes. [6] While North Dakota recently adopted the 2015 IECC as its voluntary statewide code—without commercial amendments and with weakening amendments—less than half the state population lives in jurisdictions that have adopted this code update. We have maintained North Dakota's credit for significant local adoption of the 2009 IRC and IECC.

Some states regularly adopt the latest iterations of the IECC and ASHRAE 90.1 code standards as they are determined. However other states have recently considered statutory or regulatory requirements to extend code adoption cycles. States unable to adopt the latest building energy codes will miss out on significant energy savings opportunities. ACEEE considered removing points from states with extended code adoption cycles, but most states do not actually update building codes every three years (Athalye et al. 2016). We therefore decided not to penalize those with extended cycles. Several states have made progress toward adopting the most recent DOE-certified codes (or local equivalents) for either residential or commercial new construction. California, Maryland, Massachusetts, New Jersey, New York, Oregon, Texas, Vermont, and Washington have adopted and begun to enforce the 2015 IECC or a code that is at least as stringent for both commercial and residential construction.[48] Connecticut, Florida, Georgia, Iowa, and Virginia are in the process of reviewing the 2015 IECC and ASHRAE 90.1-2013 for residential and commercial buildings. Delaware is reviewing the 2015 and 2018 codes for residential and commercial buildings. Maine and Wisconsin are in the process of reviewing the 2015 IECC for commercial buildings.

At the other end of the spectrum, 10 states lack mandatory statewide energy codes for new residential and/or commercial construction: Alaska, Arizona, Colorado, Kansas, Maine, Mississippi, Missouri, North Dakota, South Dakota, and Wyoming. Some of these home-rule states are nonetheless showing high rates of adoption at the jurisdictional level, including Arizona, Colorado, Kansas, and Missouri. We award these states points accordingly.

[48] Although Hawaii has adopted the 2015 IECC for both residential and commercial buildings, the state included substantial weakening amendments to its residential code. The state's score reflects these weakening amendments.

The zEPI Jurisdictional Score: Looking beyond Codes to Indexed Energy Consumption in the 2018 *State Scorecard*

A zero energy (ZE) building is a home or commercial building that produces as much energy as it uses, usually measured over the course of a year. This performance is achieved through energy efficiency and renewable technologies. In recent years, the concept of ZE has increasingly taken hold among building designers and clean energy communities, prompting a growing pursuit of ZE-related targets and certifications, such as the American Institute of Architects' 2030 Challenge, the International Living Future Institute's Living Building Challenge (LBC), and DOE's Zero Energy Ready Homes Program. States and localities have also developed more stringent building energy codes, such as California's ZE goals for residential and commercial new construction, the District of Columbia's proposed net-zero energy code path, and city- and county-led efforts in Idaho and Colorado. As building energy codes are amended to deepen energy savings and move states closer to ZE goals, it will be important to be able to calculate the energy savings that result from these building code improvements.

To develop a common baseline against which the energy performance of code-compliant buildings can be compared across states, the New Buildings Institute (NBI) has refined the Zero Energy Performance Index (zEPI). The resulting zEPI Jurisdictional Score uses data from Pacific Northwest National Labs (PNNL) and quantifies the expected energy use intensity in kBtu/ft^2 by accounting for building type and distribution and regional climate zones for each state. zEPI sets the scale's zero value at zero energy consumption, with a baseline roughly equivalent to the average building in the year 2000. Minor credits are awarded for stretch code adoption in local jurisdictions, which have the effect of improving the overall performance level of mandatory energy code adoptions within a state base.

Beginning next year, ACEEE plans to transition to the zEPI Jurisdictional Score as the new basis for ranking state building energy performance in an effort to more accurately assess the levels of savings achieved by each state's adopted building energy codes. With their absolute baseline and common zero value, the zEPI scores will allow the *Scorecard* to look beyond simple code status and actually monitor how states are improving the performance of their codes. See table 28 for a preview of how state residential and commercial codes currently rank on the zEPI scale, based on adopted codes effective as of January 2017.

This revision to the scoring methodology will help align the *Scorecard* with the efficiency industry's increasing focus on ZE goals. It will also help resolve many of the challenges our current methodology faces in objectively scoring state adoption of varying model codes and corresponding amendments that may strengthen or weaken their relative performance. The ultimate impacts that these code updates and amendments have on energy savings can vary significantly due to local environmental factors—factors that zEPI will account for and quantify more effectively than the *Scorecard*'s current approach.

Table 28. State zEPI Scores based on building code stringency

State	zEPI score	Residential code
Vermont	49.7	2015 IECC with amendments
Massachusetts	51.5	2015 IECC with amendments
Minnesota	51.9	2012 IECC with amendments
Nevada	53.1	2012 IECC
New York	53.4	2015 IECC
Delaware	53.9	2012 IECC
Iowa	54.9	2012 IECC with amendments
Washington	55.1	2015 Washington State Energy Code*
Connecticut	55.9	2012 IECC with amendments
Maryland	55.9	2015 IECC
Oregon	56.4	2014 Oregon Residential Specialty Code*
Montana	56.5	2012 IECC with amendments
Michigan	57.0	2012 IECC with amendments
Texas	58.4	2015 IECC
Illinois	59.3	2015 IECC with amendments
California	59.6	2013 California State Code*
New Jersey	62.7	2015 IECC with amendments
Florida	62.8	2012 IECC
Virginia	63.0	2012 IECC with amendments
Alabama	63.4	2015 IECC with amendments
Wisconsin	63.6	2009 IECC with amendments
District of Columbia	63.6	2012 IECC with amendments
Idaho	64.5	2012 IECC with amendments
North Carolina	64.6	2009 IECC with amendments
South Carolina	64.8	2009 IECC
Rhode Island	65.2	2012 IECC
Utah	65.5	2015 IECC with amendments
Oklahoma	65.6	2009 IECC with amendments
Hawaii	66.2	2015 IECC with amendments
Maine	67.5	2009 IECC
Georgia	67.7	2009 IECC with amendments
New Mexico	67.8	2009 IECC
Louisiana	68.0	2009 IECC
New Hampshire	68.0	2009 IECC with amendments
Pennsylvania	68.1	2009 IECC
Kentucky	68.4	2009 IECC
Nebraska	68.4	2009 IECC
Indiana	68.5	2009 IECC
Ohio	68.6	2009 IECC
Arkansas	68.7	2009 IECC with amendments
West Virginia	68.9	2009 IECC
Tennessee	75.0	IECC 2006
Alaska	-	None statewide
Arizona	-	Home rule
Colorado	-	Home rule
Kansas	-	Home rule
Mississippi	-	None statewide
Missouri	-	Home rule
North Dakota	-	Home rule
South Dakota	-	Home rule
Wyoming	-	Home rule
Guam	-	2009 IECC
Puerto Rico	-	2009 IECC
U.S. Virgin Islands	-	2009 IECC

State	zEPI score	Commercial code
Hawaii	51.1	2015 IECC with amendments
Massachusetts	51.7	2015 IECC with amendments and ASHRAE 90.1-2013
California	51.7	2013 California Energy Code
Washington	51.9	2015 Washington State Energy Code
New Jersey	52.0	ASHRAE 90.1-2013
Texas	52.9	2015 IECC and ASHRAE 90.1-2013
Illinois	53.1	2015 IECC with amendments and ASHRAE 90.1-2013
Alabama	53.7	ASHRAE 90.1-2013
Utah	54.6	2015 IECC and ASHRAE 90.1-2013
Vermont	55.0	2015 IECC with amendments and ASHRAE 90.1-2013 with amendments
Maryland	55.3	2015 IECC with amendments and ASHRAE 90.1-2013
New York	55.7	2015 IECC with amendments and ASHRAE 90.1-2013 with amendments
Mississippi	56.8	ASHRAE 90.1-2010
Iowa	57.2	2012 IECC and ASHRAE 90.1-2010
Minnesota	57.3	2012 IECC with amendments and ASHRAE 90.1-2010
Connecticut	58.0	2012 IECC with amendments and ASHRAE 90.1-2010
Kentucky	58.6	2012 IECC and ASHRAE 90.1-2010
Ohio	59.0	2012 IECC with amendments and ASHRAE 90.1-2010 with amendments
Florida	59.0	2012 IECC with amendments and ASHRAE 90.1-2010
Tennessee	59.2	2012 IECC and ASHRAE 90.1-2010
Oregon	59.5	2014 Oregon Energy Efficiency Specialty Code
Delaware	59.7	2012 IECC and ASHRAE 90.1-2010
Montana	60.0	2012 IECC and ASHRAE 90.1-2010
Rhode Island	60.0	2012 IECC with amendments
Virginia	60.8	2012 IECC with amendments and ASHRAE 90.1-2010
Idaho	61.7	2012 IECC and ASHRAE 90.1-2010
North Carolina	63.6	2009 IECC with amendments and ASHRAE 90.1-2010
Colorado	64.0	Home rule
District of Columbia	65.6	2012 IECC with amendments and ASHRAE 90.1-2010
Nevada	65.6	2012 IECC and ASHRAE 90.1-2010
Pennsylvania	66.2	2009 IECC and ASHRAE 90.1-2007
Maine	66.3	2009 IECC and ASHRAE 90.1-2007
Arkansas	66.5	2009 IECC and ASHRAE 90.1-2007
New Hampshire	66.8	2009 IECC and ASHRAE 90.1-2007
Georgia	66.9	2009 IECC with amendments and ASHRAE 90.1-2007
Nebraska	67.0	2009 IECC and ASHRAE 90.1-2007
South Carolina	67.3	2009 IECC and ASHRAE 90.1-2007
Michigan	67.8	2009 IECC and ASHRAE 90.1-2007
Wisconsin	68.2	2009 IECC with amendments and ASHRAE 90.1-2007
New Mexico	68.5	2009 IECC and ASHRAE 90.1-2007
West Virginia	68.8	ASHRAE 90.1-2007
Indiana	69.0	ASHRAE 90.1-2007 with amendments
Louisiana	70.0	ASHRAE 90.1-2007
Oklahoma	74.5	2006 IECC and ASHRAE 90.1-2004
Alaska	-	None statewide
Arizona	-	Home rule
Kansas	-	Home rule
Missouri	-	Home rule
North Dakota	-	Home rule
South Dakota	-	Home rule
Wyoming	-	Home rule
Guam	-	2009 IECC
Puerto Rico	-	2009 IECC
U.S. Virgin Islands	-	2009 IECC

Compliance

It is difficult to score states in this area because consistent data on actual compliance rates are lacking and other compliance metrics are largely qualitative. Still, as always, we continue to seek ways to have scores reflect tangible improvements in energy savings.

In 2015 we updated our scoring methodology to award more credit to states that had completed compliance studies in recent years. The reasoning behind this decision was that, as the 2017 deadline under ARRA approached for states to demonstrate 90% compliance with 2009 IECC and ASHRAE 90.1-2007 codes, compliance rates should reflect a state's code enforcement efforts. We employ the same methodology this year. However, to motivate states to reach and exceed the 90% compliance goal, ACEEE intends revisit this metric next year to determine how it might be improved to equitably score states on the basis of actual levels of compliance reported. For more information on state compliance efforts, visit ACEEE's State and Local Policy Database (ACEEE 2017).

Table 29 shows our scoring methodology for assessing state compliance studies.

Table 29. Scoring of state efforts to assess compliance

Compliance study	Score (1 pt.)
Compliance study has been completed in the past five years, follows standardized protocols, and includes a statistically significant sample.	1
Compliance study has been completed in the past five years but does not follow standardized protocols or is not statistically significant.	0.5
No compliance study has been completed in the past five years.	0

Table 30 shows our scoring methodology for additional activities to improve and enforce energy code compliance. A state can earn 0.5 points for each compliance strategy it engaged in during the past year, up to a total of 2 points.

Table 30. Scoring of efforts to improve and enforce code compliance

Additional metrics for state compliance efforts	Score (2 pts.)
Assessments, gap analysis, or strategic compliance plan	0.5
Stakeholder advisory group or compliance collaborative	0.5
Utility involvement	0.5
Training and outreach	0.5

Given that several states have recently completed compliance studies demonstrating 90% or higher compliance rates for residential and/or commercial buildings, it could well be argued that states demonstrating compliance rates approaching 100% should receive full credit within this metric, regardless of whether they do or don't engage in the additional strategies to enforce compliance listed in table 30. However we believe the current methodology is a valid approach in the near term for several reasons.

First, while we plan to award more points in the future to states based on their compliance studies' results, we also want to recognize the enormous value in a state's maintaining a robust policy framework. Such a framework can support ongoing efforts to provide training and education to staff, actively monitor code changes, and provide up-to-date information to stakeholders through strong coordination. Second, we want to avoid inadvertently penalizing states with lower compliance rates under newer or more stringent codes; this would work against the *Scorecard*'s goal of rewarding states operating at the leading edge of energy efficiency. As we look ahead to future *Scorecards*, we plan to address these important methodological questions, as well as others—including how best to compare the results of compliance studies conducted using differing methodologies (e.g., prescriptive versus performance-based) and how to update our data request accordingly.

Table 31 shows how states scored for each compliance metric. Details on state activities in these areas are given in the ACEEE State and Local Policy Database (ACEEE 2017).

Table 31. State scores for energy code compliance efforts

State	Compliance study (1 pt.)	Gap analysis (0.5 pts.)	Stakeholder group (0.5 pts.)	Utility involvement (0.5 pts.)	Training (0.5 pts.)	Total score (3 pts.)
California	•	•	•	•	•	3
Connecticut	•	•	•	•	•	3
District of Columbia	•	•	•	•	•	3
Florida	•	•	•	•	•	3
Massachusetts	•	•	•	•	•	3
Minnesota	•	•	•	•	•	3
New York	•	•	•	•	•	3
Oregon	•	•	•	•	•	3
Pennsylvania	•	•	•	•	•	3
Rhode Island	•	•	•	•	•	3
Vermont	•	•	•	•	•	3
Washington	•	•	•	•	•	3
Alabama	•		•	•	•	2.5
Colorado	•		•	•	•	2.5
Idaho	•	•	•		•	2.5
Illinois	•		•	•	•	2.5
Kentucky	•		•	•	•	2.5
Maryland	•	•	•		•	2.5

State	Compliance study (1 pt.)	Gap analysis (0.5 pts.)	Stakeholder group (0.5 pts.)	Utility involvement (0.5 pts.)	Training (0.5 pts.)	Total score (3 pts.)
Montana	o	•	•	•	•	2.5
Nebraska	•		•	•	•	2.5
Texas	•		•	•	•	2.5
Iowa		•	•	•	•	2
Michigan	•		•		•	2
Missouri	•		•		•	2
New Hampshire		•	•	•	•	2
Utah	o		•	•	•	2
Arkansas	•				•	1.5
Hawaii	o		•		•	1.5
Nevada			•	•	•	1.5
North Carolina	•				•	1.5
Tennessee	•				•	1.5
Virginia	o		•		•	1.5
West Virginia	•				•	1.5
Alaska		•			•	1
Arizona			•		•	1
Delaware			•		•	1
Georgia	•					1
Guam		•			•	1
Maine			•		•	1
New Jersey				•	•	1
Oklahoma		•			•	1
Wyoming			•		•	1
Kansas			•			0.5
Louisiana					•	0.5
New Mexico					•	0.5
Ohio		•				0.5
Puerto Rico					•	0.5
South Carolina					•	0.5
US Virgin Islands					•	0.5
Wisconsin					•	0.5
Indiana						0

State	Compliance study (1 pt.)	Gap analysis (0.5 pts.)	Stakeholder group (0.5 pts.)	Utility involvement (0.5 pts.)	Training (0.5 pts.)	Total score (3 pts.)
Mississippi						0
North Dakota						0
South Dakota						0

Data from state responses to data requests (see Appendix A). States receiving half credit for compliance studies are indicated with an unfilled circle. See State and Local Policy Database (ACEEE 2017) for more details on each activity.

According to our survey results, almost every state in the country makes some effort to support code compliance, whether a statewide code is mandatory or not. Nearly every state uses at least one of the strategies for boosting compliance discussed above, and a growing number of states use many or all of them. For states that did not respond to this year's survey or that provided partial responses, we referred to last year's data to complement information in some cases. States that received zero points for compliance are those that did not respond to our survey or could not report compliance activities.

SCORES FOR BENCHMARKING AND ENERGY TRANSPARENCY REQUIREMENTS

We previously credited this metric under Chapter 6, "State Government–Led Initiatives," but we moved it into this chapter because it pertains to private-sector building efficiency. States with mandatory energy use benchmarking and transparency laws received 0.5 points for a policy covering either commercial or residential buildings. States with those policies in place for some or all of their commercial *and* residential buildings received 1 point. Table 32 presents the state disclosure policies.

Table 32. State benchmarking and energy transparency policies

State	Disclosure type	Building energy use transparency requirements	Score (1 pt.)
District of Columbia	Commercial, residential, multifamily	The Clean and Affordable Energy Act of 2008 requires privately owned commercial buildings to be benchmarked using EPA ENERGY STAR Portfolio Manager on an annual basis. Results are publicly available in the Build Smart DC database.	1
California	Commercial, residential, multifamily	Assembly Bill 1103 requires nonresidential building owners or operators to benchmark their buildings' energy use with EPA ENERGY STAR Portfolio Manager and to disclose this information to buyers, lenders, and lessees. Assembly Bill 802 replaces this legislation and expands the requirement to any building with five or more active utility accounts, including residential multifamily buildings.	1
Alaska	Residential	Alaska statute AS.34.70.101 requires the release of utility data for residential buildings at the time of sale.	0.5
Hawaii	Residential	§508D-10.5 requires residential property owners to disclose energy efficiency consumer information at the time of sale or lease.	0.5
Kansas	Residential	HB 2036 requires builders or sellers of new residential single-family homes or multifamily buildings of four units or fewer to	0.5

State	Disclosure type	Building energy use transparency requirements	Score (1 pt.)
		disclose information regarding the energy efficiency of the structure to prospective buyers prior to the signing of a purchase contract.	
Maine	Residential rental	H.P. 1468 requires the disclosure of an energy efficiency checklist upon request by tenant or lessee and allows for the release of audit information on residential rental properties, both at the time of rental.	0.5
New York	Residential	Beginning in 1981, the Truth in Heating law required the release of residential buildings' utility data upon request by prospective purchasers at the time of sale.	0.5
South Dakota	Residential	SB 64 (2009) established certain energy efficiency disclosure requirements for new residential buildings at the time of sale.	0.5
Washington	Commercial	SB 5854 (2009-10) requires all nonresidential customers and qualifying public agency buildings to benchmark their buildings' energy use using ENERGY STAR Portfolio Manager and to disclose this information to buyers, lenders, and lessees.	0.5

Policies based on BuildingRating 2014 and data requests to state energy offices.

Several states have taken the lead in requiring benchmarking and energy use transparency, but no additional disclosure policies have been adopted since last year's *Scorecard*. The District of Columbia and California are the only jurisdictions we surveyed that have such requirements for both the commercial and residential multifamily sectors. As benchmarking and energy use transparency policies become more common, more states will likely expand their scope to target more buildings across both markets. However local jurisdictions are more likely to pursue these policies. Most recently, Kansas City, Missouri; Portland, Oregon; and Seattle adopted benchmarking ordinances.[49]

Leading and Trending States: State Benchmarking and Energy Use Transparency Policies

California. In 2015 California enacted an improved statewide benchmarking program, replacing an earlier program established by AB 1103, that covered only nonresidential buildings. The new policy expands the state benchmarking requirement to residential multifamily and mixed-use buildings. It also makes it easier for utilities to provide whole-building energy use data to property owners and requires them to do so when requested.

District of Columbia. Since 2014 the District has required all commercial and multifamily buildings over 50,000 square feet and all city government buildings over 10,000 square feet to report annual energy and water use to the District Department of Energy and Environment. In March 2016, the city published energy and water consumption data for 1,498 buildings, representing more than 278 million square feet. The District uses EPA's ENERGY STAR Portfolio Manager to measure total building energy use, energy intensity, and carbon emissions.

[49] For more information on how municipalities are encouraging building energy disclosure, see Ribeiro et al. (2015) and Cluett and Amann (2013).

Chapter 5. Combined Heat and Power

Authors: Meegan Kelly and Anna Chittum

INTRODUCTION

CHP systems generate electricity and thermal energy in a single, integrated system. CHP is more energy-efficient than generating electricity and thermal energy separately because heat that is normally wasted in conventional generation is captured as useful energy. That recovered energy can then be used to meet a thermal demand for onsite processes, such as heating or cooling a building or generating steam to run a manufacturing process. CHP systems can save customers money and reduce net emissions. The majority are powered by natural gas, but many are fueled by biomass, biogas, or other types of fossil fuels.

SCORING AND RESULTS

States can encourage or discourage CHP in many ways. Financial, technical, policy, and regulatory factors affect the extent to which CHP systems are deployed. Our scoring methodology emphasizes CHP as an energy resource, which we believe is the most important policy driver for increasing the use of highly efficient CHP in the United States.

Our methodology is based on four policy categories:

- Interconnection standards for electrically connecting CHP systems to the grid
- Encouraging CHP as a resource
- Deployment incentives
- Additional supportive policies

The second point, encouraging CHP as a resource, is an umbrella category with the greatest weight. In this category, states are scored on activities and policies that actively identify CHP as an energy resource and integrate CHP into system planning and energy resource acquisition efforts. The full scoring methodology is outlined below and described in detail later in this chapter.

A state could earn up to 4 points based on the above categories. We awarded points for:

- The presence and design of interconnection standards (0.5 points)
- The extent to which CHP is identified and encouraged as an energy resource, based on four subcategories:
  - Eligibility of CHP within an energy efficiency resource standard or other, similar regulatory requirement (0.5 points)
  - The presence of utility-run or program administrator-run CHP programs designed to acquire CHP energy resources (0.5 points)
  - The presence of state-approved production goals or program budgets for acquiring a defined amount of kWh savings from CHP (0.5 points)
  - Access to production incentives, feed-in tariffs, standard offer programs, or other revenue streams linked to CHP system kWh production (0.5 points)
- Deployment incentives—including rebates, grants, and financing—or a net metering standard that applies to CHP (0.5 points)

- Additional supportive policies, including certain streamlined air permitting processes, technical assistance, goals for CHP in critical facilities, resiliency efforts, and policies that encourage the use of renewable or opportunity fuels in conjunction with CHP (1 point)

We also assessed, but did not score, the number of recent CHP installations in each state and the total CHP capacity installed.

Some states have recently adopted new and improved policies or regulations, while others are still developing or improving them. Generally we did not give credit for a policy unless a legislative body enacted it or an agency or regulatory body promulgated it as an order. We considered policies in place as of July 2017 and relied on primary and secondary sources for data collection. Primary sources included public utility commission dockets and responses to data requests from state energy offices. Secondary sources included policy databases such as the Database of State Incentives for Renewables and Efficiency (DSIRE 2017) and the EPA's CHP Policies and Incentives Database (EPA 2017).

Table 33 lists each state's total score and its point distribution in each of the above categories. Detailed information on the policies and programs that earned points in each category is available in the CHP section of the online ACEEE State and Local Policy Database (ACEEE 2017).

Table 33. Scores for CHP

		Encouraging CHP as a resource						
State	Intercon-nection (0.5 pts.)	EERS treatment (0.5 pts.)	CHP program (0.5 pts.)	Produc-tion goal (0.5 pts.)	Revenue streams (0.5 pts.)	Deployment incentives (0.5 pts.)	Supportive policies (1 pt.)	Total score (4 pts.)
California	0.5	0.5	0.5	0.5	0.5	0.5	1	4
Maryland	0.5	0.5	0.5	0.5	0.5	0.5	1	4
Massachusetts	0.5	0.5	0.5	0.5	0.5	0.5	1	4
Rhode Island	0.5	0.5	0.5	0.5	0.5	0.5	1	4
New York	0.5	0.5	0.5	0.5	0	0.5	1	3.5
Illinois	0.5	0.5	0	0.5	0.5	0	1	3
Maine	0.5	0.5	0	0.5	0	0.5	1	3
Connecticut	0.5	0.5	0	0	0	0.5	1	2.5
Minnesota	0.5	0.5	0	0	0	0.5	1	2.5
Oregon	0.5	0.5	0	0	0	0.5	1	2.5
Pennsylvania	0	0.5	0	0	0.5	0.5	1	2.5
Washington	0.5	0.5	0	0	0	0.5	1	2.5
Vermont	0.5	0.5	0	0	0	0.5	0.5	2
Arizona	0	0.5	0	0	0	0.5	0.5	1.5
Delaware	0.5	0	0	0	0	0.5	0.5	1.5

State	Intercon-nection (0.5 pts.)	Encouraging CHP as a resource: EERS treatment (0.5 pts.)	Encouraging CHP as a resource: CHP program (0.5 pts.)	Encouraging CHP as a resource: Produc-tion goal (0.5 pts.)	Encouraging CHP as a resource: Revenue streams (0.5 pts.)	Deployment incentives (0.5 pts.)	Supportive policies (1 pt.)	Total score (4 pts.)
Iowa	0.5	0	0	0	0	0	1	1.5
Michigan	0.5	0	0	0	0	0	1	1.5
New Jersey	0	0	0	0	0	0.5	1	1.5
New Mexico	0.5	0	0	0	0	0.5	0.5	1.5
Ohio	0.5	0.5	0	0	0	0.5	0	1.5
Texas	0.5	0	0	0	0	0	1	1.5
Wisconsin	0.5	0	0	0	0	0	1	1.5
Alaska	0	0	0	0	0	0	1	1
Colorado	0.5	0	0	0	0	0	0.5	1
District of Columbia	0.5	0	0	0	0	0.5	0	1
Florida	0	0	0	0	0	0.5	0.5	1
Hawaii	0	0.5	0	0	0	0	0.5	1
Louisiana	0	0	0	0	0	0	1	1
Missouri	0	0	0	0	0	0	1	1
Montana	0.5	0	0	0	0	0	0.5	1
New Hampshire	0	0	0	0	0	0.5	0.5	1
North Carolina	0.5	0	0	0	0	0	0.5	1
Tennessee	0	0	0	0	0	0	1	1
Utah	0.5	0	0	0	0	0	0.5	1
Georgia	0	0	0	0	0	0	0.5	0.5
Idaho	0	0	0	0	0	0	0.5	0.5
Indiana	0.5	0	0	0	0	0	0	0.5
Kansas	0	0	0	0	0	0	0.5	0.5
Kentucky	0	0	0	0	0	0	0.5	0.5
Mississippi	0	0	0	0	0	0	0.5	0.5
Nevada	0	0	0	0	0	0	0.5	0.5
North Dakota	0	0	0	0	0	0.5	0	0.5
Puerto Rico	0	0	0	0	0	0.5	0	0.5
South Carolina	0	0	0	0	0	0	0.5	0.5
South Dakota	0.5	0	0	0	0	0	0	0.5
West Virginia	0	0	0	0	0	0.5	0	0.5
Alabama	0	0	0	0	0	0	0	0
Arkansas	0	0	0	0	0	0	0	0

State	Encouraging CHP as a resource: Intercon-nection (0.5 pts.)	EERS treatment (0.5 pts.)	CHP program (0.5 pts.)	Produc-tion goal (0.5 pts.)	Revenue streams (0.5 pts.)	Deployment incentives (0.5 pts.)	Supportive policies (1 pt.)	Total score (4 pts.)
Guam	0	0	0	0	0	0	0	0
Nebraska	0	0	0	0	0	0	0	0
Oklahoma	0	0	0	0	0	0	0	0
US Virgin Islands	0	0	0	0	0	0	0	0
Virginia	0	0	0	0	0	0	0	0
Wyoming	0	0	0	0	0	0	0	0

Massachusetts, California, Maryland, and Rhode Island tied for the top score this year, with each state earning the full 4 points. Notably, Rhode Island rose in rank this year in part because it is more deliberately working to acquire energy savings from CHP and has established goals around a specific number of CHP projects. These states and Maine, Illinois, and New York were the only ones to receive credit for a state-approved production goal for CHP generation, which is a strong policy driver for encouraging utilities and program administrators to acquire generation from CHP. However even the top-scoring states can do more to encourage CHP. For example, California meets all the criteria in our scoring methodology, but barriers to deployment still exist, especially around air permitting, and state policies and programs could be improved to more effectively treat CHP as an energy efficiency resource. One of California's longest-running efforts to support distributed energy resources, the Self-Generation Incentive Program (SGIP), updated its requirements for combustion technologies this year and now mandates that a portion of input fuel be renewable fuel, with the required proportion rising over time. This may constrain projects that can access the SGIP to those with access to cost-effective biogas resources, for instance.

New York earned the second-highest score, with 3.5 points, and has shown greater support for the use of CHP as a means to avoid distribution system costs. New York continued to offer its suite of CHP programs, though it reduced the maximum size of eligible systems to 3 MW for its main incentive program. Illinois, where electric and gas utilities began to offer CHP programming to commercial and industrial customers, improved to 3 points to join Maine in sixth place. All of the highest-scoring states (those earning 3–4 points) define CHP as an eligible resource in an energy efficiency resource standard, have implemented a standard for connecting CHP systems to the grid, and have a state-approved CHP production goal. Connecticut, Minnesota, Oregon, Washington, and Pennsylvania rounded out the 12 highest-scoring states.

The majority of states have some kind of policy in place to encourage CHP; only seven states scored zero points in the CHP chapter. Sixteen states clearly define energy savings from CHP as eligible to contribute to a statewide energy savings target. It is noteworthy that all utilities running CHP programs are operating in states where CHP is an eligible technology for reaching utility savings goals. Of the 52 largest electric distribution utilities (by retail sales volume), approximately 15 offer CHP programs (Relf, Baatz, and Nowak 2017).

DISCUSSION

Interconnection Standards

States received 0.5 points for having an interconnection standard that explicitly established parameters and procedures for the electrical interconnection of CHP systems. To earn points in this category, a state's interconnection standard had to

- Be adopted by utilities serving the majority of the state's customers
- Cover all forms of CHP, regardless of fuel
- Have multiple tiers of interconnection and some kind of fast-track option for smaller systems
- Apply to systems of 10 MW or greater

Having multiple levels (or tiers) of interconnection is important because larger CHP systems are more complex than smaller ones. Because of the potential for impacts on the utility grid, the interconnection of larger systems requires more extensive approvals. These are unnecessary and financially burdensome for smaller systems, which can benefit from a faster and often cheaper path toward interconnection. Scaling transaction costs to project size makes economic sense. Additionally, CHP developers prefer interconnection standards that have higher size limits and are based on widely accepted technical industry standards, such as IEEE 1547.[50]

Encouraging CHP as a Resource

While CHP is known for its energy efficiency benefits, few states actively identify it as an energy resource akin to more traditional sources such as centralized power plants. CHP can offer energy, capacity, and even ancillary services to grids to which they are connected, but to maximize those benefits, states must first identify CHP as a resource and integrate it into system planning and energy resource acquisition efforts.[51] One of the best ways to do this is to include CHP within state energy efficiency goals and utility programs.

States could receive up to 2 points for activities and policies that encourage CHP as an energy resource. We considered the following subcategories in awarding points:

EERS treatment. We awarded 0.5 points if CHP was clearly defined as eligible in a binding EERS or similar requirement. Most states with EERS policies set goals for future years. These goals are generally a percentage of total electricity sold that must be derived from efficiency resources, with the percentage of these resources increasing over time. To receive

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[50] This standard establishes criteria and requirements for interconnection of distributed energy resources with electric power systems. Its requirements are relevant to the performance, operation, testing, safety, and maintenance of the interconnection. For more information, visit www.ieee.org.

[51] The Federal Energy Regulatory Commission (FERC) defines ancillary services as "those services necessary to support the transmission of electric power from seller to purchaser, given the obligations of control areas and transmitting utilities within those control areas, to maintain reliable operations of the interconnected transmission system. Ancillary services supplied with generation include load following, reactive power-voltage regulation, system protective services, loss compensation service, system control, load dispatch services, and energy imbalance services." For more information, visit www.ferc.gov/market-oversight/guide/glossary.asp.

credit, a state's EERS must explicitly apply to CHP powered by natural gas, be technology neutral, and be a binding obligation.

CHP resource acquisition programs. We awarded 0.5 points for programs designed to acquire cost-effective CHP in a way similar to the acquisition of other energy efficiency resources. For a state to earn this half point, a majority of its energy customers must have access to clearly defined CHP programming offered by major utilities or other program administrators. We did not give credit if only a small selection of customers have access to a CHP program or if a state has a custom commercial or industrial incentive program that could theoretically be used for CHP but is not marketed as a CHP program. To earn credit, states have to be actively reaching out to potential CHP users and developers to market the program, and they must be acquiring new CHP resources as a result.

Production goal. We awarded 0.5 points for the existence of either a state-approved production goal (kWh) from CHP resources or a program budget for the acquisition of a defined amount of kWh savings from CHP by utilities or program administrators. The presence of either (or both) of these indicates that a state has identified CHP as a resource and, importantly, has given utilities a clear signal to develop and deploy programming designed to acquire CHP. In many states, utilities report receiving mixed signals about whether their regulators are actually supportive of program spending tied to CHP. This subcategory addresses this particular issue of utility incentives and disincentives to pursue CHP programming.

Revenue streams. We awarded 0.5 points to states that provide access to favorable revenue streams for CHP, including production incentives ($/kWh), feed-in tariffs, standard offer programs, or other revenue streams linked to kWh production. These incentives are specifically designed to encourage measurable energy savings from CHP. Production incentives are linked directly to a CHP system's production or to some calculated amount of energy savings relative to an established baseline. Feed-in tariffs usually specify $/kWh payments to CHP operators for exporting electricity to the grid, providing price certainty and long-term contracts that can help finance CHP systems (EPA 2015). Standard offer programs offer a set price for qualifying CHP production and often have a program cap or point at which the standard offer will no longer be available. Revenue streams through net metering are treated in a separate category described later in this chapter.

In general, we did not give credit for custom program offerings marketed to commercial and industrial sectors that could only *potentially* be used for CHP, as the spending and savings for these programs are reflected in other parts of the *State Scorecard*. However we did give credit for programs that included a specific CHP-focused component, such as the identification of and outreach to potential sites for CHP installations.

To earn points in any of the four subcategories outlined above, a state policy or program must be usable by all customer classes and apply to CHP systems powered by natural gas. Detailed information on the policies and programs that earned points in this category is available in the CHP section of the ACEEE State and Local Policy Database (ACEEE 2017).

Deployment Incentives

States could receive 0.5 points for the presence of deployment incentives that improve the economics of a CHP investment but are not necessarily tied to resource acquisition efforts by utilities. Deployment incentives can encourage CHP at the state level in a variety of ways, and the leading states have multiple types of incentive programs. To earn points in this category, at least one available incentive must

- Apply to all CHP, regardless of fuel
- Be an investment tax credit, a credit for installed capacity, a loan or loan guarantee, a project grant, or a net metering standard
- Apply to both the commercial and the industrial sectors

Tax incentives for CHP can take many forms but are often credits taken against business or real estate taxes. In previous years, the US Internal Revenue Service (IRS) administered a federal business energy investment tax credit (ITC) that incentivized CHP systems by offering a credit for 10% of CHP project costs (DSIRE 2017). Systems placed in service between October 3, 2008, and December 31, 2016, were eligible, but the credit for CHP technologies was not extended in the Consolidated Appropriations Act in December 2015. Tax credits administered by a state can also provide support for CHP deployment.

State grants can further support CHP deployment by providing financing for capital and other costs. Some grant awards and other simple incentive programs offer rebates or payments linked to the installation of CHP capacity with amounts set in $/kW. Many of these programs are administered in conjunction with production incentives. Low-interest loan programs, loan guarantees, and bonding authorities are other strategies states can use to make CHP systems financially attractive and reduce the cost of financing. To earn points for these programs, a state must clearly identify CHP as an eligible project type and market it to CHP project developers who then take advantage of the financing opportunity.

Net metering regulations can also incentivize CHP deployment by allowing owners of small distributed generation systems to get credit for net excess electricity that they produce and export to the grid. We gave credit to states that explicitly list CHP as an eligible technology and offer at least wholesale net metering to all CHP systems, regardless of fuel, in all customer classes. Some states are transitioning away from net metering and are developing new methods for valuing and compensating distributed energy resources, including CHP. Future editions of the *Scorecard* may consider new mechanisms that replace net metering approaches.

Detailed information on incentives for CHP is available from the EPA's CHP Policies and Incentives Database (EPA 2017) and from the Database of State Incentives for Renewables and Efficiency (DSIRE 2017).[52]

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[52] EPA's database is available at www.epa.gov/chp/policies/database.html. The DSIRE database is available at www.dsireusa.org.

Additional Supportive Policies

A state could receive up to 1 point for activities or additional policies that support the deployment of CHP. Because barriers to deployment and opportunities to encourage CHP vary from state to state, this category recognizes a wide variety of efforts that states can undertake. States earned 0.5 points for the presence of any one of the following supportive policies, or 1 point for the presence of two or more.

- Policies that encourage the use of opportunity fuels in conjunction with CHP technologies, such as biomass, biogas, anaerobic digester gas, landfill gas, wood, and other waste (including waste heat)
- Streamlined air permitting procedures, including permit-by-rule, for CHP systems for multiple major pollutants
- Dedicated CHP-focused technical assistance
- Requirements that public buildings and/or other critical facilities consider CHP during times of upgrade and new construction
- Policies and programs that specifically encourage CHP for its resiliency and reliability benefits

States could earn points for RPSs and other policies that encourage the use of renewable-fueled CHP as an additional supportive policy. The availability of biomass and biogas resources is often local, and some states are better suited to use these resources than others. Natural gas is available nearly everywhere in the United States and is the predominant fuel used by CHP systems. While natural gas CHP systems do not generally benefit from RPS treatment, biomass or biogas systems often do, and we recognize the use of these and other opportunity fuels in this category.

States could also earn points for streamlined air permitting, including permit-by-rule processes. These are alternatives to conventional air permits that help reduce the time and cost involved in permitting eligible CHP units. Additional information about approaches to streamline air permitting for CHP is available in an EPA fact sheet (EPA 2014).

States could earn points for several other supportive policies in this category. Such policies can include targeted technical assistance programs, education campaigns, or other state-led special efforts that support CHP. To earn credit for technical assistance, a state's efforts must go beyond the critical services provided by DOE's CHP Technical Assistance Partnerships. States could also earn points for requirements to consider CHP for public buildings and critical facilities during times of upgrade or new construction, or for programs that encourage consideration of CHP's resiliency benefits during grid outages. The ACEEE State and Local Policy Database's CHP section contains state-by-state descriptions of these policies (ACEEE 2017).

ADDITIONAL METRICS

We noted two additional metrics—the number of individual CHP systems installed and the total capacity (MW) installed in each state—but did not use them in our scoring.[53] We believe information on actual installations is useful for comparing CHP activity but does not in itself fully indicate a state's CHP friendliness. Table 34 shows the number of new CHP systems and installed CHP capacity over the past two years.

Various economic considerations determine how many CHP projects are installed, but the retail price of energy is a major factor in their economic attractiveness. Higher electricity prices may improve the case for CHP in some states, where self-generation can be more cost effective than purchasing electricity from the grid. In other states, lower and stable natural gas prices can help hasten investment in CHP systems, since many are fueled by natural gas.

While not assessed in the *Scorecard* since states cannot control the price of electricity or gas that customers pay, these prices drive a state's CHP market to varying degrees. Policymakers can implement policies that help overcome economic barriers raised in part by lower electricity prices or higher gas prices. Future editions of the *State Scorecard* may account for these factors by scoring states on their installed CHP capacity relative to some measure of technical or economic potential, or by assessing the degree to which unfavorable economics are minimized by certain regulatory or policy treatments.

Table 34. Number of new CHP systems and installed CHP capacity by state, 2015–2016

State	Number of new CHP installations in 2015	New capacity installed in 2015 (MW)	Number of new CHP installations in 2016	New capacity installed in 2016 (MW)	Total number of new CHP installations	Total new capacity installed (MW)
Alabama	0	0.0	2	75.1	2	75.1
Alaska	6	2.8	8	59.0	14	61.8
Arkansas	1	5.2	0	0.0	1	5.2
Arizona	1	0.1	1	0.1	2	0.2
California	35	119.1	19	35.9	54	155.0
Colorado	2	2.9	2	0.4	4	3.3
Connecticut	8	4.3	7	23.2	15	27.4
District of Columbia	2	18.6	2	0.3	4	18.9
Delaware	2	4.5	1	2.0	3	6.5
Florida	0	0.0	2	22.9	2	22.9
Georgia	1	30.5	1	1.0	2	31.5
Hawaii	1	1.0	0	0.0	1	1.0

[53] We use data from the DOE CHP Installation Database maintained by ICF International. The data reflected in the *State Scorecard* were released June 1, 2016 and reflect installations as of December 31, 2016 (DOE 2016).

State	Number of new CHP installations in 2015	New capacity installed in 2015 (MW)	Number of new CHP installations in 2016	New capacity installed in 2016 (MW)	Total number of new CHP installations	Total new capacity installed (MW)
Iowa	1	2.8	1	38.5	2	41.3
Idaho	2	5.6	2	0.4	4	6.1
Illinois	0	0.0	2	7.1	2	7.1
Indiana	0	0.0	3	3.5	3	3.5
Kansas	3	50.1	0	0.0	3	50.1
Kentucky	1	0.5	0	0.0	1	0.5
Louisiana	0	0.0	1	39.2	1	39.2
Massachusetts	6	13.4	27	26.4	33	39.8
Maryland	0	0.0	7	19.5	7	19.5
Maine	2	1.1	3	9.4	5	10.5
Michigan	2	13.2	3	6.7	5	19.9
Minnesota	1	52.3	0	0.0	1	52.3
Missouri	1	1.0	1	2.0	2	3.0
Mississippi	0	0.0	0	0.0	0	0.0
Montana	1	0.1	0	0.0	1	0.1
North Carolina	1	1.6	1	5.2	2	6.8
North Dakota	0	0.0	0	0.0	0	0.0
Nebraska	0	0.0	0	0.0	0	0.0
New Hampshire	0	0.0	0	0.0	0	0.0
New Jersey	11	1.1	7	3.7	18	4.8
New Mexico	0	0.0	0	0.0	0	0.0
Nevada	0	0.0	1	0.1	1	0.1
New York	46	10.2	39	19.7	85	29.9
Ohio	4	19.0	1	0.2	5	19.2
Oklahoma	0	0.0	0	0.0	0	0.0
Oregon	1	0.4	1	1.7	2	2.1
Pennsylvania	2	0.4	11	13.2	13	13.5
Rhode Island	1	1.0	2	1.3	3	2.3
South Carolina	1	5.5	0	0.0	1	5.5
South Dakota	0	0.0	0	0.0	0	0.0
Tennessee	2	8.6	1	0.4	3	9.0
Texas	7	193.8	4	12.2	11	205.9

State	Number of new CHP installations in 2015	New capacity installed in 2015 (MW)	Number of new CHP installations in 2016	New capacity installed in 2016 (MW)	Total number of new CHP installations	Total new capacity installed (MW)
Utah	0	0.0	6	45.1	6	45.1
Virginia	2	29.3	0	0.0	2	29.3
Vermont	0	0.0	0	0.0	0	0.0
Washington	3	20.7	1	0.0	4	20.7
Wisconsin	4	2.1	2	1.0	6	3.1
West Virginia	0	0.0	1	0.0	1	0.0
Wyoming	0	0.0	0	0.0	0	0.0
Total	**164**	**622.6**	**173**	**476.4**	**337**	**1,099.1**

Source: DOE 2016

In general, states enacted few notable policies to enhance CHP's attractiveness in the year since we published the *2016 State Scorecard*. However activities did increase support for CHP in some states, and we describe a sampling of these efforts in the text box below.

Leading and Trending States: Policies to Encourage CHP Development

Minnesota. The Minnesota Department of Commerce, Division of Energy Resources led efforts to ensure that utilities proposed fair and effective standby rate practices after identifying standby rates as a priority issue in the state's 2015 CHP Action Plan (Minnesota Department of Commerce 2015). Standby rates—fees paid to utilities by customers that operate onsite generation systems for services including access to supplemental, standby, and backup power—can vary significantly across utilities and may prevent companies from investing in CHP. Stakeholders examined the issue in December 2016 and January 2017 during two workshops that evaluated different elements of the proposed standby tariffs of Otter Tail Power, Xcel Energy, Minnesota Power, and Dakota Electric Association. Participants examined how the rates are calculated and how different tariffs impact customers with onsite CHP systems under various scenarios. The workshops were well attended and provided an important public forum for initiating guidance and best practices on standby rates to support greater CHP deployment in Minnesota.

Maryland. The EmPOWER Maryland initiative was recently extended to 2023 and is a good model for how states can work with utilities to encourage CHP. Electricity savings generated from CHP systems are eligible to count toward savings goals established in the EmPOWER legislation, and utilities are running CHP programs to help meet their targets. The overall EmPOWER program is expected to save homeowners and businesses $4 billion on their utility bills and create 68,000 new jobs in the state (Barrett and Baatz 2017). The Maryland Energy Administration (MEA) also administers a grant program that complements the EmPOWER initiative and supports CHP growth. In 2017, the program will allocate up to $4.025 million in three areas: $1.525 million for CHP projects at industrial facilities; $1.5 million for CHP at critical infrastructure, including health care, wastewater treatment, and essential state and local government facilities; and $1 million for projects that leverage biomass or biogas as a fuel source (MEA 2016).

New York. Several innovative approaches that encourage CHP are underway in New York through collaborations at the Public Service Commission, the state energy office, and the state's utilities. Within the Reforming the Energy Vision (REV) proceeding, the commission is encouraging utilities to pursue distributed energy resources, including CHP, as alternatives to large capital investments in traditional infrastructure. For example, as part of its Brooklyn Queens Demand Management (BQDM) Program, Con Edison encouraged CHP deployment in a targeted area of its service territory by offering a new program in 2016 that matched existing state CHP incentives offered by the New York State Energy Research and Development Authority (NYSERDA), effectively doubling incentive levels. Moving forward, the commission now requires all utilities to propose non-wire alternative (NWA) pilots that test the use of CHP and other distributed resources to lower distribution costs and improve system operations (NY PSC 2015). The commission also ordered utilities to review current standby rates and recommended the implementation of a standby rate pilot program that provides an exemption for CHP systems, depending on the efficiency the system achieves (NY PSC 2016).

NYSERDA also continues to lead the way on community resiliency efforts through its NY Prize Community Grid Competition. In 2016 it awarded $1 million to 11 microgrids that advanced to Stage 2 of the competition. Funding will cover the cost of engineering designs and business plan development (Wood 2017). The majority of microgrids supported by NY Prize use CHP.

Chapter 6. State Government-Led Initiatives

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INTRODUCTION

State legislatures and governors can advance energy efficiency policies and programs that affect the utilities, transportation, buildings, and CHP sectors discussed in previous chapters. In this chapter, we focus on energy efficiency initiatives that are designed, funded, and implemented by state entities, including energy offices, public universities, economic development agencies, and general services agencies.

We focus on three initiatives commonly undertaken by state governments: financial incentive programs for consumers, businesses, and industry; lead-by-example policies and programs to improve the energy efficiency of public facilities and fleets; and R&D for energy efficiency technologies and practices. In this chapter in previous years, we credited policies that require building owners or managers to be transparent in their energy use. Since these policies pertain to private-sector buildings, we have moved this metric to Chapter 4 ("Building Energy Efficiency Policies"), as discussed earlier.

SCORING AND RESULTS

States could earn up to 6 points in this policy area for the following:

- Financial incentives offered by state agencies (3 points)
- Lead-by-example policies (2 points)
- Publicly funded R&D programs focused on energy efficiency (1 point)

Table 35 presents the overall results of scoring on state initiatives.

Table 35. Summary of scores for government-led initiatives

State	Financial incentives (3 pts.)	Lead by example (2 pts.)	R&D (1 pt.)	Total score (6 pts.)
California	3	2	1	6
Connecticut	3	2	1	6
Massachusetts	3	2	1	6
Minnesota	3	2	1	6
Oregon	3	2	1	6
Washington	3	2	1	6
Maryland	3	1.5	1	5.5
New York	3	1.5	1	5.5
Rhode Island	3	2	0.5	5.5
Tennessee	2.5	2	1	5.5
Vermont	3	2	0.5	5.5
Virginia	3	1.5	1	5.5

State	Financial incentives (3 pts.)	Lead by example (2 pts.)	R&D (1 pt.)	Total score (6 pts.)
Colorado	2	2	1	5
Kentucky	3	1.5	0.5	5
Missouri	2.5	1.5	1	5
Alaska	3	1	0.5	4.5
Florida	2	1.5	1	4.5
Michigan	3	1	0.5	4.5
Texas	1.5	2	1	4.5
Delaware	1	2	1	4
Illinois	1	2	1	4
Maine	2	1.5	0.5	4
Nevada	2.5	1	0.5	4
North Carolina	1	2	1	4
Ohio	2.5	1	0.5	4
Pennsylvania	3	0	1	4
Utah	1	2	1	4
Wisconsin	1.5	1.5	1	4
Arkansas	2	1.5	0	3.5
New Hampshire	1.5	2	0	3.5
New Mexico	1.5	2	0	3.5
South Carolina	2	1.5	0	3.5
Alabama	1	1.5	0.5	3
Arizona	1	1	1	3
District of Columbia	1	1.5	0.5	3
Idaho	2	0.5	0.5	3
Montana	1.5	1.5	0	3
Nebraska	1.5	0.5	1	3
Oklahoma	1.5	1.5	0	3
Georgia	0	1.5	1	2.5
Hawaii	0.5	1.5	0.5	2.5
Louisiana	1	1.5	0	2.5
Mississippi	1	1	0.5	2.5
Puerto Rico	0	1.5	1	2.5
Indiana	1	0.5	0.5	2
Iowa	0.5	0.5	1	2

State	Financial incentives (3 pts.)	Lead by example (2 pts.)	R&D (1 pt.)	Total score (6 pts.)
Kansas	0	1	1	2
New Jersey	0	1	1	2
Wyoming	1.5	0.5	0	2
Guam	0.5	0.5	0	1
US Virgin Islands	0.5	0.5	0	1
West Virginia	0.5	0	0.5	1
North Dakota	0.5	0	0	0.5
South Dakota	0	0.5	0	0.5

DISCUSSION

Financial Incentives

While utilities offer ratepayer-funded energy efficiency programs, many states also provide financial incentives to spur the adoption of technologies and practices in homes and businesses. These incentives can be administered by various state agencies, but they are most often coordinated by state energy offices. Incentives can take many forms: rebates, loans, grants, or bonds for energy efficiency improvements; income tax credits and deductions for individuals or businesses; and sales tax exemptions or reductions for eligible products. Financial incentives can lower the up-front cost and shorten the payback period for energy efficiency upgrades, shrinking two barriers for consumers and businesses that hope to make cost-effective efficiency investments. Incentives also raise consumer awareness of eligible products, encouraging manufacturers and retailers to market these products more actively and to continue to innovate. As economies of scale improve, prices of energy-efficient products fall, and the products eventually compete in the market without the incentives.

SCORES FOR FINANCIAL INCENTIVES

We relied primarily on the Database of State Incentives for Renewables and Efficiency for information on current state financial incentive programs (DSIRE 2017). We supplemented these data with information from a survey of state energy officials and a review of state government websites and other online resources.

We did not give points in this category for utilities' customer-funded financial incentive programs, which we covered in Chapter 2. Acceptable sources of funding included state appropriations or bonds, oil overcharge revenues, auction proceeds from the RGGI or California's cap-and-trade program, other noncustomer sources, and tax incentives. While state and customer funding sometimes overlap—for example, where state incentives are funded through a systems benefits charge—we designed this category to capture energy efficiency initiatives not already covered in Chapter 2.

We recognize growing state efforts to leverage private dollars for energy efficiency programs by awarding points for loans offered by green banks with active energy efficiency programs and giving credit for the PACE financing programs enabled by state-level legislation. From 2009 to 2016, energy efficiency projects accounted for 51% of PACE financing (PACENation 2016). State legislatures pass and amend legislation enabling residential and/or commercial PACE, and localities and private program administrators typically run the programs, depending on the jurisdiction.[54] Sometimes states play a more prominent role in PACE coordination by administering a statewide program or offering guidance to PACE providers (Fazeli 2016). Because programs are usually locally administered, we did not give extra credit for multiple active PACE programs; however we indicate in table 36 whether state PACE activity is in the residential or commercial market or both. We discuss other energy efficiency financing efforts in more detail at the end of this chapter.

States earned up to 3 points for major financial incentive programs that encourage the purchase of energy-efficient products.[55] We judged these programs on their relative strength, customer reach, and impact. Incentive programs generally received 0.5 points each, but several states have major incentive programs that we deemed worth 1 point each; these include Arizona, Connecticut, Idaho, Nebraska, Nevada, New York, Texas, Washington, and Wisconsin. States that have enabled PACE and have at least one active PACE program were awarded 0.5 points. Table 36 describes our scoring of state financial incentives.

It should be noted that the number of financial incentive programs a state implements may not fully reflect the robustness of its efforts. Accordingly, this year we attempted to collect additional information from state energy offices regarding state budgets for financial incentives, program participation rates, verified savings from incentives, and leveraging of private capital. These data are presented in Appendixes H, I, and J. For additional information, see the end of this chapter, where we discuss potential new metrics for state-led initiatives.

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[54] Currently, 33 states plus Washington, DC, authorize PACE (PACENation 2017). While most states' PACE activity is in the commercial market, there have been several residential PACE programs over the past several years. In July 2016, the Federal Housing Administration, the DOE, and the Department of Veterans Affairs issued new guidance and best practices on residential PACE, and these are expected to lay the groundwork for future residential PACE programs. For more information on these announcements, part of the White House's Clean Energy Savings for All Americans initiative, visit www.whitehouse.gov/the-press-office/2016/07/19/fact-sheet-obama-administration-announces-clean-energy-savings-all.

[55] Energy-efficient products include any product or process that reduces energy consumption. While renewable energy technologies such as solar hot-water heating may reduce energy consumption, they are often rolled into larger programs that focus on renewable energy rather than energy efficiency. ACEEE would like to credit states for renewable energy technologies that reduce energy consumption, but they are often difficult to distinguish from broader renewable energy incentives that fall outside the scope of the *State Scorecard*. As a result, they are not included at this time.

Table 36. State scores for major financial incentive programs

State	Major state financial incentives for energy efficiency	Score (3 pts.)
Alaska	Home rebate program; five loan programs; one grant program	3
California	California Infrastructure and Economic Development–led bond program for public buildings; four grants; one public-sector loan; two loan loss reserves for public buildings; one loan loss reserve for small businesses; one rebate program; one tax incentive for advanced transportation technologies; commercial and residential PACE financing	3
Connecticut	Connecticut Green Bank–led programs, including three loans, three financing options for multifamily and low- to moderate-income residential projects, commercial PACE financing; one loan for multifamily housing properties; two loans for multifamily and low-income residential projects	3
Kentucky	Personal and corporate energy efficiency tax credits; grants, loans, and bonds for farms, schools, and local governments; Kentucky Green Bank–funded loan for state government; sales tax exemption for energy-efficient products; commercial PACE financing	3
Maryland	Loans and grant programs for agricultural, residential, multifamily, commercial, and industrial sectors; Smart Energy Communities Program; loans for state agencies; commercial PACE financing	3
Massachusetts	Alternative Energy and Energy Conservation Patent Exemption (personal and corporate); one bond; four grants	3
Michigan	Three loans; five grants; commercial PACE financing	3
Minnesota	Five loans; two revolving loans; one loan loss reserve; commercial PACE financing	3
New York	Green Jobs Green NY Program; loan, grant, financing, rebate, and incentive programs; Energy Conservation Improvements Property Tax Exemption; Green Bank; and commercial PACE financing	3
Oregon	Several residential and business energy tax credits; one loan program; one grant program; commercial PACE financing	3
Pennsylvania	Alternative Energy Investment Fund; Pennsylvania Sustainable Energy Finance Program; several grant and loan programs	3
Rhode Island	Rhode Island Infrastructure Bank–led programs, including two revolving loan programs and commercial PACE financing; two grants; one rebate	3
Vermont	Three Sustainable Energy Loan Fund programs; Energy Loan Guarantee Program; Weatherization Trust Fund; Heat Saver Loan	3
Virginia	Energy Leasing Programs for state-owned facilities; Clean Energy Manufacturing Grant Program; one loan program; personal tax incentive; financing for innovative energy technologies; commercial PACE financing	3
Washington	Major grant program for energy efficiency in public facilities and local communities; several loans and grants	3

State	Major state financial incentives for energy efficiency	Score (3 pts.)
Missouri	One loan program; one loan loss reserve; one revolving loan; one personal tax deduction; commercial and residential PACE financing	2.5
Nevada	Wide-reaching property tax abatement for green buildings; Home Energy Retrofit Opportunities for Seniors (HEROS); loans for state employees; Revolving Loan Program	2.5
Ohio	Two loans and one grant program; property tax exemption for energy-efficient projects; commercial PACE financing	2.5
Tennessee	Energy Efficient Schools Initiative (loans and grants); two grants, one loan program	2.5
Arkansas	Three loans; commercial PACE financing	2
Colorado	Loan loss reserve program; school loan program; Agricultural Energy Efficiency Program; commercial PACE financing	2
Florida	Two rebates for agricultural efficiency projects; Renewable Energy and Energy Efficient Technologies (REET) Grant Matching Program; commercial and residential PACE financing	2
Idaho	Income tax deduction for energy efficiency improvements; grant program for school districts; one major low-interest loan program	2
Maine	Residential rebate and incentive; advanced building incentive; commercial and industrial incentive	2
South Carolina	Tax credits for new energy-efficient manufactured homes; sales tax cap on energy-efficient manufactured homes; two loan programs	2
Montana	Energy conservation installation tax credit; tax deduction for energy-conserving investment; Alternative Energy Revolving Loan Program	1.5
Nebraska	Major loan program (Dollar and Energy Savings Loans), commercial PACE financing	1.5
New Hampshire	Two revolving loan funds; commercial PACE financing	1.5
New Mexico	Sustainable Building Tax Credit (corporate and personal); bond program	1.5
Oklahoma	Three loan programs	1.5
Texas	Major loan program (Texas LoanSTAR); commercial PACE financing	1.5
Wisconsin	Major loan program (Clean Energy Manufacturing Loan Program); commercial PACE financing	1.5
Wyoming	Two grant and one loan program	1.5
Alabama	Alabama SAVES Revolving Loan Program; WISE Home Energy Program (loans)	1
Arizona	Property tax exemption for energy-efficient building components and CHP	1
Delaware	Home Energy Loan Program; Energy Efficiency Investment Fund Rebates	1
District of Columbia	Green Light Grant; commercial PACE financing	1

State	Major state financial incentives for energy efficiency	Score (3 pts.)
Illinois	Renewable Energy and Energy Efficiency Project Financing; Green Energy Loans	1
Indiana	Tax credit for purchase and installation of residential insulation; Green Project Reserve Revolving Loan Fund	1
Louisiana	Home Energy Loan Program (HELP); Energy Fund Loan Program	1
Mississippi	One loan program; one public-sector lease program for energy-efficient equipment	1
North Carolina	One rebate and one loan program	1
Utah	Two loan programs for state-owned buildings and schools	1
Guam	Appliance rebate	0.5
Hawaii	GreenSun Hawaii loan program	0.5
Iowa	Energy Bank Revolving Loan Program	0.5
North Dakota	Energy Conservation Grant	0.5
US Virgin Islands	Energy Efficiency & Renewable Energy Rebate Program	0.5
West Virginia	West Virginia Division of Energy and the West Virginia University College of Engineering and Mineral Resources partnership	0.5
Georgia	None	0
Kansas	None	0
New Jersey	None	0
Puerto Rico	None	0
South Dakota	None	0

Leading and Trending States: Financial Incentives

Tennessee. In partnership with Pathway Lending, Tennessee provides low-interest energy efficiency loans to businesses and local government entities through the Pathway Lending Energy Efficiency Loan Program (EELP). Pathway Lending operates and manages this revolving loan fund, to which the state of Tennessee committed $15 million, the Tennessee Valley Authority committed $14 million, and Pathway Lending committed $5 million. Loans issued in 2016 as part of this program saved participants more than 8,000 MWh and $800,000. The state also offers grants to utility districts and state and local governments for projects that promote energy efficiency or clean energy technologies. Through the Energy Efficiency Schools Initiative, Tennessee uses excess state lottery funds for grants and loans to school systems for capital outlay projects that meet energy efficiency guidelines. To date, 95% of school districts have participated in one or more grant programs.

Florida. Through its Farm Energy and Water Efficiency Realization (FEWER) program, the Florida Department of Agriculture and Consumer Services offers farmers free energy audits to determine the potential for renewable energy, energy efficiency, and water-saving measures. Eligible agricultural producers can receive up to $25,000 for implementing recommended measures. Florida also offers both commercial and residential PACE financing as well as matching funds for entities to conduct research, development, demonstration, and commercialization projects on energy efficiency in vehicles or commercial buildings.

Missouri. With a $720 million budget, the Missouri Linked Deposit Program provides low-interest loans to businesses, farming operations, and multifamily housing to finance energy efficiency measures in building renovations, repairs, and maintenance and for the purchase of equipment and facilities. The Missouri state treasurer administers this program and leverages capital from private lending institutions. In addition, the state offers energy efficiency tax incentives for homeowners, a revolving loan fund for public buildings, a loan loss reserve fund for livestock farmers, and both commercial and residential PACE financing.

West Virginia. Through a partnership between the West Virginia Division of Energy and the West Virginia University College of Engineering and Mineral Resources, engineering students have worked to improve the energy efficiency and productivity of manufacturers, commercial establishments, school districts, and municipalities in the state. Students have participated in more than 90 energy efficiency projects that have resulted in an estimated savings of more than $500,000 per year for West Virginia businesses.

Lead by Example

State governments can advance energy-efficient technologies and practices in the marketplace by adopting policies and programs to save energy in public-sector buildings and fleets, a practice commonly referred to as "lead by example." In the current environment of fiscal austerity, lead-by-example policies and programs are a proven strategy for improving the operational efficiency and economic performance of states' assets. Lead-by-example initiatives also reduce the negative environmental and health impacts of high energy use and promote energy efficiency to the broader public.[56]

[56] Energy efficiency reduces society's need to burn fossil fuels to generate electricity, thereby reducing harmful pollutants from fossil fuel combustion. ACEEE and Physicians for Social Responsibility explore this connection in a joint fact sheet at aceee.org/fact-sheet/ee-and-health.

Many states show leadership in energy efficiency policy through the development of state energy plans. Governors often issue executive orders or form planning committees to evaluate state energy needs, goals, and opportunities. Sometimes legislatures initiate the process. These actions help establish a statewide vision for energy use. States that have completed such plans or begun developing them include Connecticut, Delaware, the District of Columbia, Hawaii, Idaho, Iowa, Michigan, Mississippi, Montana, Nebraska, Nevada, North Carolina, North Dakota, Oregon, South Carolina, and Vermont.[57] We do not award points purely on the basis of the development of a state energy plan, but we do consider the formal executive orders and policies that execute energy efficiency initiatives included in such plans.

SCORES FOR LEAD BY EXAMPLE

States could earn up to 2 points in this category: 0.5 points each for energy savings targets in new and existing state buildings, benchmarking requirements for public facilities, ESPC activities, and fleet fuel efficiency mandates. We based our review of states' lead-by-example initiatives on a survey of state energy officials as well as independent research.

STATE BUILDING REQUIREMENTS

States often adopt policies and comprehensive programs to reduce energy use in state buildings. State governments operate numerous facilities, including office buildings, public schools, colleges, and universities, the energy costs of which can account for as much as 10% of a typical government's annual operating budget. In addition, the energy consumed by a state's facilities can account for as much as 90% of its GHG emissions (DOE 2008). Only a handful of states have not yet implemented an energy efficiency policy for public facilities. Mandatory energy savings targets for new and existing state government facilities are the most widely adopted state measures. These energy savings requirements encourage states to invest in the construction of new, efficient buildings and retrofit projects, lowering energy bills and promoting economic development in the energy services and construction sectors.

To earn credit, energy savings targets must commit state government facilities to a specific energy reduction goal over a distinct time period. We also gave 0.5 points to states that require state buildings to exceed the statewide energy code or meet a green building criterion like Leadership in Energy and Environmental Design (LEED) certification.

BENCHMARKING REQUIREMENTS FOR PUBLIC BUILDINGS

Proper building energy management is a critical element of successful energy efficiency initiatives in the public sector. Benchmarking energy use in public-sector buildings through tailored or widely available tools such as ENERGY STAR Portfolio Manager ensures a comprehensive set of energy use data that can drive cost-effective energy efficiency investments.[58] Comparing building energy performance across agencies can also help prioritize energy efficiency projects.

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[57] For more information on states with active energy plans, visit the National Association of State Energy Officials' website: www.naseo.org/stateenergyplans.

[58] Some states have their own databases of public building energy use that integrate with the ENERGY STAR Portfolio Manager. For example, Maryland's EnergyCAP database compiles the energy use (based on utility

Through benchmarking policies, states and cities require all buildings to undergo a regular energy audit or have their energy performance tracked using Portfolio Manager or another recognized tool. We awarded 0.5 points for energy benchmarking policies and large-scale benchmarking programs for public-sector facilities.

Energy Savings Performance Contracting Policies and Programs

If state governments have the necessary support, leadership, and tools in place, they can help projects overcome information and cost barriers to implementation by financing energy improvements through energy savings performance contracts (ESPCs). The state may enter into an ESPC with an energy service company (ESCO), paying the company for its services with money saved on lower energy bills from energy conservation measures. A designated state agency may serve as the lead contact for implementing the contract.[59]

We based scores for ESPC activities on three metrics: support, leadership, and tools. To promote performance contracting, states must provide an enabling framework (support), in addition to the guidance and resources (leadership and tools) to get these projects off the ground. We awarded states 0.5 points if it satisfied at least two of the three criteria. Table 37 describes qualifying actions.

Table 37. Scoring of ESPC policies and programs

Criterion	Qualifying action
Support	The state explicitly promotes the use of ESPCs to improve the energy efficiency of public buildings through statutory requirements, recommendations, or explicit preferences for ESPC use; executive orders that promote or require ESPCs; and/or financial incentives for agencies seeking to use ESPCs.
Leadership	A state program directly coordinates ESPCs, or a specific state agency serves as lead contact for implementing ESPCs.
Tools	The state offers documents that streamline and standardize the ESPC process, including a list of prequalified service companies, model contracts, and/or a manual that lays out the procedures required for state agencies to utilize ESPCs.

States must satisfy at least two of the three criteria above to receive credit.

Efficient Fleets

In addition to lead-by-example initiatives in state government buildings, many states also enact policies encouraging or requiring efficient vehicle fleets to reduce fleet fuel costs and hedge against rising fuel prices. Collectively, state governments own approximately 500,000 vehicles, with a median fleet size of about 3,500. Operation and maintenance costs for these fleets every year exceed $2.5 billion nationwide, ranging from $7 million to $250 million per

bills) of all public buildings in the state and provides a means of comparing buildings occupied by various state agencies.

[59] For a full discussion of ESPCs, the ESCO market, and actual implementation trends, see Stuart et al. 2016. For additional best practices on state and local establishment and implementation of ESPC programs, see DOE's ESPC Toolkit (betterbuildingssolutioncenter.energy.gov/espc/home) and guidelines for state ESPC program development (betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/ESPC-Program_Guidelines_Final.pdf).

state (NCFSA 2007). In response to these costs, states often adopt an efficiency standard specifically for state vehicle fleets that reduces fuel consumption and GHG emissions.

For this category, states received credit only if the plan or policy for increasing the efficiency of the state's fleet contains a specific, mandatory requirement. For example, states could qualify for 0.5 points if fleet policies specify fuel economy improvements that exceed existing corporate average fuel economy (CAFE) standards. Other policies that earned the half point include binding goals to reduce petroleum use by a certain amount over a given time frame, meaningful GHG reduction targets for fleets, and procurement requirements for hybrid-electric or all-electric vehicles. Because state adoption of such targets does not guarantee they will be achieved, we might need to revisit this metric. We will continue to seek data on state progress toward meeting these goals. We did not credit requirements for procuring alternative-fuel vehicles, because they may not result in improved fuel economy.

OVERALL SCORES FOR LEAD BY EXAMPLE

Table 38 presents states' scores for lead-by-example initiatives.

Table 38. State scores for lead-by-example initiatives

State	New and existing state building requirements	Benchmarking requirements for public buildings	ESPC policy and programs	Efficient fleets	Score (2 pts.)
California	•	•	•	•	2
Colorado	•	•	•	•	2
Connecticut	•	•	•	•	2
Delaware	•	•	•	•	2
Illinois	•	•	•	•	2
Massachusetts	•	•	•	•	2
Minnesota	•	•	•	•	2
New Hampshire	•	•	•	•	2
New Mexico	•	•	•	•	2
North Carolina	•	•	•	•	2
Oregon	•	•	•	•	2
Rhode Island	•	•	•	•	2
Tennessee	•	•	•	•	2
Texas	•	•	•	•	2
Utah	•	•	•	•	2
Vermont	•	•	•	•	2
Washington	•	•	•	•	2
Alabama		•	•	•	1.5
Arkansas	•	•	•		1.5

State	New and existing state building requirements	Benchmarking requirements for public buildings	ESPC policy and programs	Efficient fleets	Score (2 pts.)
District of Columbia	•	•		•	1.5
Florida		•	•	•	1.5
Georgia	•	•	•		1.5
Hawaii		•	•	•	1.5
Kentucky	•	•	•		1.5
Louisiana	•		•	•	1.5
Maine	•		•	•	1.5
Maryland	•	•	•		1.5
Missouri	•		•	•	1.5
Montana	•	•	•		1.5
New York	•	•	•		1.5
Oklahoma	•	•	•		1.5
Puerto Rico	•	•	•		1.5
South Carolina	•	•	•		1.5
Virginia	•	•	•		1.5
Wisconsin	•		•	•	1.5
Alaska	•	•			1
Arizona	•		•		1
Kansas	•		•		1
Michigan		•	•		1
Mississippi		•		•	1
Nevada		•	•		1
New Jersey		•	•		1
Ohio		•	•		1
Guam		•			0.5
Idaho			•		0.5
Indiana	•				0.5
Iowa		•			0.5
Nebraska		•			0.5
South Dakota		•			0.5
US Virgin Islands			•		0.5
Wyoming			•		0.5

State	New and existing state building requirements	Benchmarking requirements for public buildings	ESPC policy and programs	Efficient fleets	Score (2 pts.)
North Dakota					0
Pennsylvania					0
West Virginia					0

Leading and Trending States: Lead-by-Example Initiatives

Rhode Island. In 2015, Governor Gina Raimondo signed Executive Order 15-17, establishing the Lead by Example program within the state's Office of Energy Resources (OER) to oversee efforts to reduce energy consumption and GHG emissions in state facilities. This executive order also requires state agencies to reduce energy consumption by 10% by FY 2019, from a 2014 baseline. OER must establish interim goals, publicly disclose state energy data, and provide agencies with technical assistance. In 2017 OER hosted its inaugural Lead by Example Awards to recognize 11 state agencies, quasi-public agencies, and municipalities for their renewable energy and energy efficiency achievements.

Utah. In 2015, the Utah State Legislature enacted a requirement that all state buildings annually report their utility expenditures, energy and water consumption, and cost information at the building level. Each state agency must develop strategies for improving energy efficiency and designate a staff member responsible for coordinating these efforts. The State Building Board sends annual progress reports to the governor and the legislature. In addition, the state provides performance contracting technical support to public entities through a list of prequalified ESCOs, a list of prequalified third-party ESCO service reviewers, and the reinstatement of the Utah Chapter of the Energy Services Coalition.

Kentucky. With more than $1 billion in ESPC investments since enabling legislation in 1996, Kentucky has one of the largest performance contracting industries in the nation. Through the Local Government Energy Retrofit Program, the Kentucky Department for Energy Development and Independence is working with the Kentucky Department for Local Government to facilitate energy efficiency in smaller municipalities through ESPCs. All state-supported universities and colleges in the community and technical college system have ESPCs. The state also tracks real-time energy savings in state buildings and makes these data publicly available through the Kentucky Energy Dashboard. To date, the Commonwealth Energy Management and Control System (CEMCS) accounts for 164 buildings and more than 10 million square feet. CEMCS was one of the few state government programs granted an increase in the current biennium so that more buildings could be included.

New Hampshire. In 2016 New Hampshire joined DOE's Energy Savings Performance Contracting Accelerator in order to expand technical support for agencies interested in engaging ESPCs, do more projects with limited resources, and have agencies take ownership of ESPC projects. In order to provide agencies with better information and energy efficiency advocates, the state has developed and is using an ESPC Champions Toolkit. In addition, New Hampshire requires every agency and department that is financially responsible for utility expenses to benchmark energy and water use.

R&D

R&D programs drive advances in energy-efficient technologies, and states play a unique role in laying the foundation for such progress. By leveraging resources in the public and private sectors, state government programs can foster collaborative efforts and rapidly create, develop, and commercialize new energy-efficient technologies. These programs can also encourage cooperation among organizations from different sectors and backgrounds to further spur innovation.

Not only do state R&D efforts provide a variety of services to create, develop, and deploy new technologies for energy efficiency, but they also address a number of failures in the energy services marketplace that impede the diffusion of new technologies (Pye and Nadel 1997). In response to the increasing need for state initiatives in energy-related R&D, several state bodies established the Association of State Energy Research and Technology Transfer Institutions (ASERTTI) in 1990. ASERTTI members collaborate on applied R&D and share technical and operational information, emphasizing end-use efficiency and conservation.

Aside from those institutions affiliated with ASERTTI, numerous other state-level entities (including universities, state governments, research centers, and utilities) fund and implement R&D programs to advance energy efficiency throughout the economy. Such programs include research on energy consumption patterns in local industries and the development of energy-saving technologies at state or university research centers and through public–private partnerships.

Individual state research institutions provide expertise and knowledge that policymakers can draw from to advance successful efficiency programs. These institutions enable valuable knowledge spillover to other states through information sharing—facilitated by ASERTTI membership—that allows states to benefit from one another's research. States without R&D institutions can use this shared information as a road map to begin or advance their own efficiency programs. Even leading states can improve or add to their R&D efforts by drawing from other states' programs and best practices.

SCORES FOR R&D

We reviewed state energy efficiency R&D institutions based on information collected from a survey of state energy officials and other, secondary research. This research complemented information we had previously collected from the *National Guide to State Energy Research Centers* (ASERTTI 2012). In scoring this metric, we awarded 0.5 points for each major state government–funded R&D program dedicated to energy efficiency, up to a maximum of 1 point. We included programs administered by state government agencies, public–private partnerships, and universities. Because R&D funding often fluctuates, and because it is difficult to determine the dollar amount that specifically supports energy efficiency, we do not currently score R&D on the basis of program funding or staffing levels.[60] We recognize that the presence of an R&D institution does not guarantee the deployment of technologies being developed or the achievement of actual energy savings. In future *State Scorecards*, we will seek ways to refine this metric through additional quantitative data. For full descriptions of state energy efficiency R&D program activities, visit ACEEE's State and Local Policy Database (ACEEE 2017).

Table 39 presents the scores.

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[60] Institutions that focus primarily on renewable energy technology or alternative-fuel R&D do not receive credit in the *Scorecard*. In addition, programs that serve primarily an educational or policy-development purpose also do not receive points.

Table 39. Scores for R&D institutions with energy efficiency–focused research

State	R&D institutions	Score (1 pt.)
Arizona	Sustainable Energy Solutions Group of Northern Arizona University and Arizona State University's LightWorks Center	1
California	California Energy Commission's Electric Program Investment Charge (EPIC) Program and Natural Gas Research and Development Program; University of California, Davis's Center for Water–Energy Efficiency and Energy Efficiency Center; University of California, Berkeley's Center for the Built Environment; and UCLA's Center for Energy Science and Technology Advanced Research and Smart Grid Energy Research Center	1
Colorado	Colorado State University's Engines and Energy Conversion Lab and Institute for the Built Environment; University of Colorado Boulder's Renewable and Sustainable Energy Institute; Colorado School of Mines' Research in Delivery, Usage, and Control of Energy, and Center for Renewable Energy Economic Development; Colorado Energy Research Collaboratory	1
Connecticut	University of Connecticut's Center for Clean Energy Engineering, DEEP's Energy Efficiency & Renewable Energy Test Bed Program, and Connecticut Center for Advanced Technology	1
Delaware	University of Delaware's Center for Energy and Environmental Policy and Mid-Atlantic Industrial Assessment Center (IAC), and Delaware Technical and Community College's energy facilities	1
Florida	University of Central Florida's Florida Solar Energy Center; Florida State University's Energy and Sustainability Center; University of Florida's Florida Institute for Sustainable Energy and Florida Energy Systems Consortium; University of South Florida's Clean Energy Research Center; and University of West Florida's Community Outreach, Research, and Education	1
Georgia	Southface Energy Institute and Georgia Institute of Technology's Brook Byers Institute for Sustainable Systems	1
Illinois	University of Illinois at Chicago's Energy Resources Center, Illinois Sustainable Technology Center, University of Illinois Urbana–Champaign Department of Urban and Regional Planning and Smart Energy Design Assistance Center, and Gas Technology Institute	1
Iowa	Iowa Energy Center, research support through the Iowa Economic Development Authority, and Center for Energy and Environmental Education	1
Kansas	Studio 804, Inc. and Wichita State University's Center for Energy Studies	1
Maryland	University of Maryland's Energy Research Center and the Maryland Clean Energy Technology Incubator	1
Massachusetts	Massachusetts Energy Efficiency Partnership and University of Massachusetts–Amherst's Center for Energy Efficiency and Renewable Energy	1

State	R&D institutions	Score (1 pt.)
Minnesota	Conservation Applied Research and Development Program, Center for Diesel Research at the University of Minnesota, Center for Sustainable Building Research, and Center for Energy and Environment's Innovation Exchange	1
Missouri	Midwest Energy Efficiency Research Consortium, National Energy Retrofit Institute, and Missouri University of Science and Technology's Energy Research and Development Center	1
Nebraska	Nebraska Center for Energy Sciences Research, Energy Savings Potential program, and University of Nebraska Utility Corporation	1
New Jersey	Edison Innovation Clean Energy Fund and Rutgers Center for Green Building	1
New York	New York State Energy Research and Development Authority, State University of New York's Center for Sustainable & Renewable Energy, Syracuse University's Building Energy and Environmental Systems Laboratory, City University of New York's Institute for Urban Systems, and Albany State University's Energy and Environmental Technology Application Center (E2TAC)	1
North Carolina	North Carolina A&T State University's Center for Energy Research and Technology, and Appalachian State University's Energy Center	1
Oregon	Oregon Built Environment and Sustainable Technologies Center, University of Oregon's Energy Studies in Building Laboratory and Baker Lighting Lab, Portland State University's Renewable Energy Research Lab, Energy Trust of Oregon, and Oregon Transportation Research and Education Consortium	1
Pennsylvania	Leigh University's Energy Research Center, Penn State University's Indoor Environment Center, and Consortium for Building Energy Innovation	1
Puerto Rico	Puerto Rico Energy Center and National Institute for Islands Energy and Sustainability	1
Tennessee	University of Tennessee partnership with Oak Ridge National Laboratory and Electric Power Research Institute, and CURENT	1
Texas	Texas A&M's Engineering Experiment Station and University of Texas–Austin's Center for Energy and Environmental Resources	1
Utah	Alliance for Computationally-Guided Design of Energy Efficiency Electronic Materials (CDE3M) and USTAR Energy Research Triangle Program	1
Virginia	Southern Virginia Product Advancement Center and R&D Center for Advanced Manufacturing and Energy Efficiency	1
Washington	Northwest Building Energy Technology Hub and Clean Energy Fund	1
Wisconsin	Energy Center of Wisconsin, Wisconsin Focus on Energy, and University of Wisconsin's Solar Energy Lab	1
Alabama	University of Alabama's Center for Advanced Vehicle Technologies	0.5
Alaska	Cold Climate Housing Research Center	0.5
District of Columbia	Green Building Fund Grant Program	0.5

State	R&D institutions	Score (1 pt.)
Hawaii	Hawaii Natural Energy Institute at the University of Hawaii	0.5
Idaho	Center for Advanced Energy Studies	0.5
Indiana	Purdue University Energy Efficiency and Reliability Center	0.5
Kentucky	University of Louisville's Conn Center for Renewable Energy Research	0.5
Maine	Maine Technology Institute	0.5
Michigan	Michigan NextEnergy Center	0.5
Mississippi	Mississippi State University's Energy Institute	0.5
Nevada	Center for Energy Research at University of Nevada–Las Vegas	0.5
Ohio	Ohio State University's Center for Energy, Sustainability, and the Environment	0.5
Rhode Island	University of Rhode Island Energy Fellows Program	0.5
Vermont	University of Vermont Smart Grid Research Center	0.5
West Virginia	West Virginia University Energy Institute	0.5

Leading and Trending States: State R&D Initiatives

Colorado. Colorado State University, the University of Colorado, and the Colorado School of Mines each have research centers and facilities dedicated to developing energy efficiency and clean energy technologies. The Center for Renewable Energy Economic Development also plays a major role in Colorado's energy efficiency activities by promoting and supporting new clean-tech companies throughout the state.

Delaware. The University of Delaware has several centers that conduct energy efficiency–related research. Its Mid-Atlantic Industrial Assessment Center (IAC) provides energy, waste, and productivity assessments to small and midsize manufacturers, with an emphasis on energy efficiency. Since its creation, IAC has provided energy efficiency recommendations to more than 100 clients, achieved energy bill reductions of 10–30%, and been recognized by the US Department of Energy as a "Center of Excellence." Faculty and research staff at the university's Center for Energy and Environmental Policy conduct studies on sustainable energy utilities and clean energy futures. In addition, the Delaware Technical and Community College recently opened energy efficiency workforce development centers on three of its campuses.

Florida. Florida's universities host a wide array of energy efficiency research, investing more than $5 million in the institutions that lead this work. The University of Florida's Florida Institute for Sustainable Energy performs research on efficient construction and lighting and has more than 150 faculty members at 22 energy research centers. The University of Central Florida's Florida Solar Energy Center focuses on energy-efficient buildings, schools, and standards and has a similarly large faculty. The state created the Florida Energy Systems Consortium to bring universities together to share their energy-related expertise. Twelve universities participate in the working group, conducting R&D on innovative energy systems that lead to improved energy efficiency and expanded economic development for the state.

New York. The New York State Energy Research and Development Authority (NYSERDA) supports a broad range of technology research, development, and commercialization activities to improve the energy efficiency and expand the energy options for the buildings, industrial, transportation, power, and environmental sectors of the New York economy. NYSERDA invests in scientific research, market analysis, product development, and technology field validation. These investments produce knowledge on the environmental impacts of current and emerging energy options, support early-stage market analysis associated with new technologies, advance clean energy innovations toward market readiness, and stimulate innovation.

Energy Efficiency Programs for Low-Income Households

As discussed in Chapter 2, low-income households often face a disproportionate energy burden that can be alleviated by energy efficiency (Drehobl and Ross 2016). Reducing energy burdens for low-income households not only keeps money in these families' pockets, but also improves their quality of life by creating healthier homes and neighborhoods. These efforts can help states address other priorities such as reduced emissions, economic development, and improved public health.

Energy efficiency programs for low-income households are often supported by a diverse array of funding streams that include federal, state, or ratepayer dollars. They can be administered by utilities, state government, community action agencies, or other organizations. In Chapter 2, we specifically highlight utility- and ratepayer-funded low-income energy efficiency efforts, although in practice these are often combined with other funding streams since non-utility weatherization funding can be used to leverage ratepayer funds and vice versa. State energy offices (SEOs), state housing agencies, and partner agencies also have many options for investing in energy efficiency in low-income communities. These options include:

- Designing energy efficiency programs or incentives specifically for low-income households and investing state resources alongside federal and ratepayer dollars
- Leveraging existing Weatherization Assistance Program delivery channels to expand energy efficiency offerings to program participants
- Providing technical assistance and financial resources to public housing authorities as they work with ESCOs to improve their properties
- Encouraging agencies and organizations allocating federal grants, such as the Low Income Housing Tax Credit, to prioritize energy efficiency in their allocation process

Through ongoing research and outreach, ACEEE is working to help states and utilities identify the challenges and opportunities in delivering energy efficiency to this underserved market. Below, we highlight several examples of states that have enacted policies or programs for low-income communities.

Leading and Trending States: Low-Income Energy Efficiency Policies and Programs

Kentucky. In 2016 the Kentucky State Energy Office used Department of Energy State Energy Program funds to deliver energy efficiency to impoverished coal counties to stimulate job creation and reduce costs for homeowners and businesses. The state offered several programs to reduce energy usage in local government facilities and to inform consumers, teachers, small businesses, and industrial customers about energy efficiency.

Tennessee. The Tennessee Department of Environment and Conservation's Office of Policy and Planning and Office of Energy Programs convene a working group on best practices in low-income multi- and single-family energy efficiency program design and implementation. Through this group, state and local agencies, utilities, and nongovernmental organizations have worked together to develop a low-income energy efficiency program resource manual and toolkit. In addition, in its allocation of the Low-Income Housing Tax Credit, the Tennessee Housing Development Agency prioritizes energy-efficient properties in its selection process, driving applicants to pursue certification by Enterprise Green Communities.

California. The state allocates Greenhouse Gas Reduction Funds to the Department of Community Services and Development (CSD) to help low-income residents in disadvantaged communities reduce their energy use through the Low Income Weatherization Program (LIWP). CSD leverages funding from several sources, including LIWP, ratepayer-funded weatherization programs, and the federally funded Weatherization Assistance Program. CSD collaborates with the California investor-owned utilities and the California Public Utility Commission on opportunities to share information on residential energy usage and more effectively target and qualify households for efficiency and weatherization services.

Wyoming. The state's housing finance agency—Wyoming Community Development Authority (WCDA)—offers its Energy Savers Loan to income-qualified existing single-family homes. WCDA offers loan recipients up to $15,000 for home rehabilitation services, including health and safety repairs, building envelope upgrades, and other energy efficiency improvements (WCDA 2015).

Missouri. The Division of Energy (DE) within the Missouri Department of Economic Development administers utility weatherization program funds on behalf of four investor-owned utilities. To advocate for increased utility funding for low-income energy efficiency programs and to caution against rate designs that negatively impact these consumers, DE intervenes in Missouri Public Service Commission (PSC) proceedings and participates in a commission-established collaborative on demand-side management programs. In addition, the Division participates in the US Department of Energy's Low-Income Accelerator Program and in a coalition of national nonprofits called Energy Efficiency for All.

Connecticut. The Connecticut Green Bank and the Housing Development Fund provide loans and technical assistance to affordable multifamily building owners interested in energy efficiency improvements and clean energy projects. Funded with a $5 million grant from the MacArthur Foundation, the program will finance energy efficiency upgrades and health and safety remediation measures in eligible properties (The Commercial Record 2016). The Connecticut Green Bank is a quasi-public organization created by the state legislature in 2011 as the nation's first green bank. Funding for energy efficiency combines a system benefit charge, RGGI auction proceeds, and ARRA funds.

POSSIBLE NEW METRICS

During the data collection process for the *2017 State Scorecard*, we examined a variety of new metrics that could more accurately and comprehensively reflect state efforts to improve energy efficiency across sectors. We continued attempts to refine our analysis of financial incentives by collecting data on state budgets for incentives and financing programs, participation rates, verified energy savings, dollar savings, and the leveraging of private capital. To collect these data, we relied on our requests to state energy offices. We tried to collect enough information for each potential metric to include it in our analysis, but the data we received were not robust enough to include. For example, savings data were generally program specific rather than portfolio wide, and in several cases savings were projected rather than verified. States often provided budget data at the agency level and reported participation rates without including the number of eligible customers. For a summary of quantitative data received in 2017 for state financial incentives, performance contracting, and public building energy benchmarking, see Appendixes H–J. We will continue to solicit data from states on these potential metrics and refine our financial incentives scoring methodology in the future, as data availability permits.

Energy Efficiency Financing

To an increasing degree, states are leveraging private capital alongside public dollars to incentivize energy efficiency. Green banks, for example, combine public and ratepayer funds to stimulate private investment in clean energy projects.[61] PACE financing is another increasingly popular public–private partnership model for which we now give credit.

One of the obstacles to measuring the success of private energy efficiency financing is the absence of protocols for measuring and verifying energy savings. Non-ratepayer programs—public and private alike—often have less rigorous EM&V protocols than do utility-run programs. In addition, private institutions offering these financing tools often do not prioritize the collection of energy savings data. While we have begun to credit such incentives in a qualitative way when they are appropriately funded, we will continue to solicit quantitative data from states to better understand these programs' effectiveness.

[61] While we do credit evaluated savings from financing programs (including on-bill financing programs) in the utilities chapter, in this chapter we recognize financing programs, such as green banks, that leverage additional, non-ratepayer state resources.

Green Banks

Challenges and Opportunities

State and local governments can create green banks in order to overcome barriers faced by consumers and lenders in financing energy efficiency and renewable energy projects. These financing institutions offer public dollars and leverage private funds to unleash new investment, reduce costs, and increase consumer demand in the clean energy sector. In addition, green banks often provide technical assistance to clean energy projects across sectors to help consumers understand available funding streams and to simplify the process of purchasing these technologies (CGC 2015). Because most state green banks are in the early planning stages and have yet to reach full scale, there is a lack of data on their performance (Gilleo, Stickles, and Kramer 2016). In order to more accurately assess the impacts of financing programs offered by green banks, policymakers and program administrators should collect and standardize data collection efforts on the following metrics:

- *Energy savings*—independently evaluated energy savings achieved as a result of green bank investments
- *Leverage*—the ratio between private loan capital deployed and public or ratepayer funds used.
- *Market penetration*—in particular, whether financing is available to low-income, multifamily, and other underserved markets
- *Coordination with utility programs*—the extent to which green banks and utilities coordinate program offerings.

Leading and Trending States

Connecticut. The Connecticut Green Bank (CGB) is a quasi-public organization created by the Connecticut General Assembly in 2011 as the nation's first green bank. CGB funding comes from a system benefit charge, RGGI auction proceeds, and ARRA funds. CGB administers a statewide PACE program and offers an array of energy efficiency and renewable energy financing options to Connecticut municipalities, businesses, multifamily building owners, and residences—including low-income households. Through mid-2016, CGB had leveraged more than $4.50 in private capital for every dollar of public capital invested. In FY 2016, CGB programs saved almost 420,000 MMBtu and created more than 4,400 clean energy jobs in the state (CGC 2017).

New York. The New York Green Bank (NYGB) was established in 2013 as a state-sponsored specialty financing entity, housed under the New York State Energy and Development Authority (NYSERDA). NYGB combines funds from ratepayers and RGGI to leverage private clean energy capital. NYGB's recent energy efficiency projects include retrofits to the Northpoint School District and New York City Housing Authority developments, a CHP system installation at the Hebrew Home for the Aged, and funding for a residential energy software company called Sealed, Inc. In June 2017 Governor Andrew Cuomo announced that NYGB had turned a $2.7 million profit (New York 2017).

Chapter 7. Appliance and Equipment Efficiency Standards

Author: Marianne DiMascio

INTRODUCTION

Every day we use appliances, equipment, and lighting in our homes, offices, and public buildings. While the energy consumption and cost for a single device may seem small, the extra energy consumed by less-efficient products collectively adds up to a substantial amount. Real and persistent market barriers inhibit sales of more-efficient appliances and equipment to consumers. Appliance efficiency standards overcome these barriers by initiating change in the manufacturers' actions, requiring them to meet minimum efficiency levels for all products and thereby removing the most inefficient products from the market.

States have historically led the way in establishing standards for appliances and other equipment. In 1976 California became the first state to introduce appliance standards. Many others, including New York and Massachusetts, soon followed. The federal government did not establish any national standards until Congress passed the National Appliance Energy Conservation Act of 1987, which included standards based on those adopted by California and several other states. Congress enacted additional national standards in 1988, 1992, 2005, and 2007. In general, these laws set initial standards for specific products and require the DOE to periodically review and, if warranted, strengthen them. Approximately 55 products are now subject to national efficiency standards.

US consumers save about $500 a year on utility bills thanks to standards, or about 16% of the average annual bill in 2015. Businesses saved a total of $23 billion in utility bills that year, or about 8% of total business spending on electricity and natural gas. Total utility bill savings reached $80 billion in 2015. Savings will increase to nearly $150 billion by 2030 as new national standards kick in and the effect of existing ones grows (Mauer 2017).

Historically there has been an inverse relationship between standards activity at the federal level and action at the state level. When federal activity picks up, the impetus for states to set standards decreases, and vice versa. In recent years the DOE has been very active and only a handful of states have proposed or adopted standards. However continued progress at the federal level is uncertain, and we anticipate that some states will again actively pursue standards. States can reference the new ASAP and ACEEE report *States Go First: How States Can Save Consumers Money, Reduce Energy and Water Waste, and Protect the Environment with New Appliance Standards*. This report recommends 21 standards that states can adopt and analyzes potential energy, water, and utility bill savings and emissions reductions.

Federal preemption generally prevents states from setting standards stronger than existing federal requirements for a given product. States that wish to implement their own standards after federal preemption must apply for a waiver; however states remain free to set standards for any products that are not subject to national regulation. State standards can have significant energy efficiency benefits and set precedents for adopting new national standards.

At the state level, California remains the most engaged, with a full slate of standards and labeling regulations in place and more under development. After completing standards for LEDs, small-diameter directional lamps, and showerheads in early 2016, the California

Energy Commission (CEC) adopted new standards for computers and computer monitors in December 2016. In the spring of 2017, CEC began a new public rulemaking process for eight additional products.

Other states have also taken recent steps to apply more stringent appliance standards, with legislators in Massachusetts, New York, Rhode Island, and Vermont filing bills in 2017. The Vermont bill, signed by Governor Phil Scott on May 22, 2017, adopts all federal standards as state law and stipulates that if any federal standard is repealed, Vermont will still enforce it. The Massachusetts and Rhode Island bills included similar protection against federal rollbacks alongside new standards for computers and monitors, plumbing products, and lighting products, among others. The New York Assembly and House bills (A5699/S4597) propose water-saving standards for plumbing products like faucets, showerheads, and urinals. The Massachusetts and New York legislation is still pending.

SCORING AND RESULTS

States could earn up to 2 points for setting state-specific appliance standards or for adopting federal standards (including those for light bulbs due to take effect in 2020) at the state level. This provides an incentive for states to adopt new standards and to backstop federal standards in case of repeal. For state-specific standards, a state could earn up to 2 points for standards not presently preempted by federal standards and for which the effective date (not the adoption date) for *any* state was no more than five calendar years ago or is yet to come.[62] This acknowledges the important role early adopters play in paving the way for other states to adopt similar standards. It also deemphasizes older state standards, some of which were garnering little or no savings.[63]

For example, California adopted the first state battery charger standards in 2012 (effective in 2013), followed by Oregon in 2013 (effective in 2014). Both states get credit for battery charger standards in 2017 because the most recent effective date (2014) is within the past five years. Both states will still get credit for these standards in 2018 and 2019. Unless additional states pass battery charger standards, California and Oregon will not get credit for their standards in 2020 since no compliance dates will be within five calendar years.

We calculated the scores for adoption of state standards on the basis of cumulative per-capita savings (measured in million Btus) through 2030. We used a floating start date that aligns with each state's product compliance date. For example, standards for deep-dimming fluorescent ballasts took effect in California in 2016. Our savings analysis for that product in California covers the period from 2016 to 2030. If another state adopts the same standards with a later effective date, the analysis will begin in the year the standards take effect in that state.

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[62] The effective date is also known as the compliance date.

[63] The 2017 scoring methodology differs from last year's in two ways: We adjusted the methodology to extend the look-back period to five years (from three) and to add credit for adoption of provisions that backstop federal standards at the state level.

If states adopt different standards or tiers for one product, then we consider each standard separately. For example, California set new standards for faucets in 2015 that are more stringent than Colorado's. We consider each a separate standard.

We estimated savings using the bottom-up approach of previous analyses of savings from appliance standards conducted by the Appliance Standards Awareness Project (ASAP) and ACEEE (deLaski et al. 2016). We used estimates of annual shipments, per-unit energy savings, and average product lifetime based on the best available data. To estimate state-by-state shipments, we allocated national shipments to individual states on the basis of population. We also accounted for the portion of sales that had already met the standard at the time the first state standard was established for a given product.

We normalized the savings estimates using the population of each state in order to rank states according to per-capita energy savings. We scored in 0.5-point increments up to a maximum of 2 points.

Table 40 shows the scoring methodology for state standards. Table 41 shows the scoring results, with points allocated for the adoption of both state-specific and federal standards.

Table 40. Scoring of savings from state appliance standards

Energy savings through 2030 (MMBtu/capita)	Score
45 or more	2
30–44.99	1.5
15–29.99	1
0.1–14.99	0.5
No energy savings	0

Table 41. State scores for appliance efficiency standards

State	Energy savings from state standards through 2030 (MMBtu/capita)	Date most recent state standards adopted	Score for adoption of state standards	Score for adoption of federal standards	Total (2 pts. max)
California	53.3	2017	2	0.5	2
Oregon	15.1	2013	1		1
Colorado	5.5	2014	0.5		0.5
Vermont				0.5	0.5

Scoring the maximum of 2 points, California continues to lead on appliance efficiency standards, most recently for computers and computer monitors. Not only has California adopted the greatest number of standards, but many other states' regulations are based on California's. Oregon earned credit for battery chargers and TVs, and Colorado for faucets and showerheads. Vermont earned credit for adopting all federal lighting and appliance efficiency standards.

Over the past eight years, a handful of drought-prone states (California, Colorado, Georgia, and Texas) adopted standards for faucets, showerheads, toilets, and urinals and are on track to save a significant amount of water. The faucet and showerhead standards will also save energy by reducing hot-water consumption.

Leading and Trending States: Appliance and Equipment Efficiency Standards

California. The 1974 Warren–Alquist Act granted the California Energy Commission (CEC) the first-in-the-nation authority to adopt appliance and equipment efficiency standards. Since that time, California has set standards for more than 100 products, many of which have subsequently become federal standards. For more details, see 2016 CEC Appliance Efficiency Regulations, published on January 1, 2017.

In December 2016, California adopted the first-ever state standards for computers and monitors. In May 2017, CEC announced a public rulemaking process for eight additional products. It plans to create efficiency road maps for set-top boxes, solar inverters, and power-saving mode and to set efficiency standards for commercial and industrial fans and blowers, sprinkler spray bodies, tub spout diverters, and irrigation controllers. CEC is also conducting ongoing rulemakings for pool pump motors and portable electric spas.

Vermont. On May 22, 2017, Governor Scott signed into law a protective measure stipulating that the state will enforce federal standards if they are "withdrawn, repealed or otherwise voided" at the federal level. Efficiency measures protected by the new Vermont law include all standards on the federal books as of January 17, 2017, including those that have yet to take effect, like the light bulb standards slated for 2020.

Chapter 8. Conclusions

States continued to serve as important catalysts and test beds of energy efficiency in 2017, spurring investment, cross-pollinating successful strategies, and posting high levels of energy savings. States continued to support major investments in energy efficiency, guided by a recognition of the vast suite of benefits these investments provide, such as lower bills, job creation, and healthier homes.

As one of the most cost-effective means by which to address greenhouse gas emissions and reduce energy waste, energy efficiency has steadily gained followers while growing to become the nation's third-largest electricity resource. In the past two years, US energy use has declined 1% while gross domestic product (GDP) has increased more than 4%. This remarkable decoupling of electricity use from economic growth is a testament both to the success of state and federal energy efficiency standards and to the fourfold increase in utility efficiency spending over the past decade. But it's also an exciting sign of the even greater savings possible with the help of added leadership and investment among states where energy efficiency initiatives are just beginning to build momentum.

While the rise of efficiency and renewable energy technologies has helped control load growth and slow carbon pollution, it has also spurred states and utilities to pursue strategies reimagining the electric grid and traditional business models in order to tie utility rates of return to investment in distributed energy resources and the generation of societal benefits. As trailblazing states like New York, California, and Minnesota continue to lead the way with a variety of emerging grid modernization and integrated system planning efforts, other states have also taken up the mantle in recent months with similar plans of their own. In March, two additional states jumped into the fray, with Rhode Island kicking off its grid-modernizing Power Sector Transformation Initiative, while Illinois initiated Next Grid, an 18-month study to generate recommendations for creating a new and more flexible utility regulatory framework.

At the same time, many states continue to devise new and smarter strategies for leveraging public resources to attract private capital investment and hasten the advance to a clean energy economy. Green banks, which help fill financing gaps for renewable energy and efficiency projects often underserved by traditional lenders, are seeing accelerated demand from private investors thanks to public contributions of debt equity, credit enhancements, and direct investment in projects. Since the creation of the first state-formed green bank in 2011 in Connecticut, similar green banks have taken root in states like Hawaii, Michigan, New York, and Rhode Island.

The Property Assessed Clean Energy (PACE) market has also grown steadily in recent years. Since its inception in 2009, PACE has enabled $3.3 billion in renewable and energy efficiency investments in people's homes, $2.8 billion of which occurred in 2016 alone. In 2016 Nebraska became the latest state to join the PACE movement, passing a law allowing use of the financing tool in communities across the Cornhusker State. In 2017, Omaha, the state's largest city, designated a PACE district and adopted a commercial program. As of June 2017, 33 states, as well as Washington, DC, have PACE-enabling legislation in place, with active programs in approximately 20 states.

Amid this experimentation, we continue to see energy efficiency deliver big savings and a variety of benefits. Although incremental energy savings have leveled overall in recent years, states continue to prove that they can reach high levels of savings using innovative strategies. Several states in the Northeast in particular have shown that electricity savings of 2% — and even as high as 3% — are possible. And all across the country, states are increasingly emphasizing energy efficiency's role in resilience efforts, be it through CHP, lower peak load, or more durable and sustainable buildings.

This year's *State Scorecard* also emphasizes the need to consistently update energy efficiency policies and programs to both embrace advancements and bolster existing policy goals. States continue to update and improve building energy codes, with states like California, Florida, Ohio, Tennessee, and Virginia making major updates to codes this year. Other states, including Connecticut, Louisiana, Oregon, and Idaho, have continued work on updating their own codes in recent months. As of mid-2017, roughly 35% of states had taken major steps toward adopting building codes aligned with or exceeding the 2015 IECC.

Since last year's release of the *2016 Scorecard*, several states have reaffirmed or strengthened utility savings targets. December was a particularly busy month, with the Illinois governor signing into law SB 2814 to double the state's efficiency standards and considerably raise the rate impact cap.[64] Only days later, Michigan passed legislation renewing and bolstering both its EERS and RPS, extending the state's 1% savings target for electric utilities through 2021 and removing the cap on spending. Also that month, Ohio righted course on its energy efficiency programs, thanks to the governor's veto of legislation that would have extended a freeze on the state's renewable energy and energy efficiency standards. By allowing the freeze to end, the veto reinstates the requirement that utilities meet efficiency standards.

Other states have also taken steps to spur utility program portfolios in recent months. In early April, an expansion of Maryland's EmPOWER efficiency program was passed into law, extending the program through 2023 and codifying the goal set by the state's PSC in 2016 for utilities to achieve 2% annual savings by 2020. In May, Colorado also passed legislation extending utility savings targets through 2028. In June, Nevada passed a series of clean energy initiatives including a bill requiring the utility commission to set ambitious annual efficiency targets that are expected to spur an increase in utility energy savings.

New Hampshire, which approved its first-ever EERS in 2016, began convening Energy Efficiency & Sustainable Energy (EESE) Board workshops earlier this year to address details of implementing the standard, which takes effect in 2018. And in New York, the Public Service Commission continued to forge ahead on its Reforming the Energy Vision plan with the issuance of several orders related to upgrading its distributed generation regulatory framework and implementing the state's Clean Energy Standard. In November 2016, the PSC's Clean Energy Advisory Council proposed metrics for measuring energy efficiency

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[64] In an effort to contain costs to consumers, many states include a rate impact cap as part of policies such as energy efficiency resource standards or renewable portfolio standards. A target may be adjusted downward to keep resulting prices below the cap.

savings, although details continue to take shape regarding the role efficiency will play in meeting the standard.

The ongoing flurry of activity at the state level demonstrates that the business case for saving energy and shifting away from fossil fuels is growing increasingly compelling for policymakers even in the absence of a national standard. And while uncertainty remains regarding how the EPA will inevitably choose to fulfill its legal requirement to regulate carbon dioxide, utilities have indicated they intend to look beyond near-term political turbulence and continue to transition and diversify their fuel sources in response to market demand.

Energy efficiency can save consumers money, drive investment across many economic sectors, and create jobs. Several states are consistently leading the way on energy efficiency, and many more are notably increasing their efforts. Still, many opportunities to sustain and expand current efforts remain. Energy efficiency is a resource that is abundant in every state. Reaping its full economic, energy security, and environmental benefits will require continued leadership from all stakeholders, including legislators, regulators, and the utility industry.

DATA LIMITATIONS

The scoring framework we used in this report is our best current attempt to represent the myriad efficiency metrics as a quantitative score. Any effort to convert state spending data, energy savings data, and adoption of best-practice policies across six policy areas into one state energy efficiency score has obvious limitations. Here, we suggest a few areas for future research that will help refine the *State Scorecard* scoring methodology and more accurately represent the changing landscape of energy efficiency in the states.

One of the most pronounced limitations is access to recent, reliable data on the results of energy efficiency work. Because many states do not gather data on the performance of energy efficiency policy efforts, we use a best-practices approach to score some policy areas. As an example, it is difficult to score states on building energy code compliance rates because the majority of them do not collect the relevant data. This year we attempted to gather this information during the data collection process, but only about half of the states were able to provide quantitative data, and many of the numbers were only rough estimates. The current *Scorecard* expands our best-practices approach in this category, but performance metrics would allow for more objective and accurate assessment. While states should be applauded for adopting stringent building energy codes, the success of these codes in reducing energy consumption is unclear without a way to verify actual implementation.

As in the past, we face a similar difficulty in scoring state-backed financing and incentive programs for energy efficiency investments. Though many states have seemingly robust programs aimed at residential and commercial consumers, few are able to relay information on program budgets or energy savings resulting from such initiatives. As a result, we can offer only a qualitative analysis of these programs. This lack of quantitative data is growing increasingly pronounced as many states begin pouring financial resources into green banks. Without comparable results on dollars spent and rigorously evaluated energy savings, it is impossible to assess these programs with the same scrutiny that we bring to bear on utility programs.

We would also like to see spending and savings data for energy efficiency programs targeting home-heating fuel and propane. This year we added questions to our data request asking for savings and spending attributable to efficiency efforts in these areas. Because only a few states responded to these particular queries, we could not include the data in this year's scoring. However we will continue to examine workable metrics for fuel oil and propane efficiency in the future.

POTENTIAL NEW SCORECARD METRICS

We have described relevant potential future metrics or revisions to existing metrics in several chapters of this year's *State Scorecard*. While we believe our data collection and scoring methodology are comprehensive, there is always room for modifications. As the energy efficiency market continues to evolve and data become more available, we will continue to adjust each chapter's scoring metrics. Here, we present some additional metrics that currently fall outside the scope of our report but that nonetheless indicate important efficiency pathways.

State efficiency programs that fall outside utility-sector and public benefits programs are an area in which we continue to revise our data request; our goal is to find ways to transition to a more comprehensive and quantitative assessment. We hope to recognize state government and regulatory efforts to enable home and business owners to finance energy efficiency improvements through on-bill financing and other innovative incentive programs. One possible metric by which to compare state financial incentives is the level and sustainability of budgets for these programs. This information is available in some cases, but gathering it for all programs will continue to present challenges. We may also be able to compare state energy efficiency R&D efforts on the basis of budgets and staffing levels, but data availability is again an issue.

As discussed in Chapter 6, states are increasingly leveraging private capital through mechanisms such as green banks and PACE financing in an effort to harness the free market to fund energy efficiency and clean energy. Here, too, we would like to expand the *Scorecard* to measure the progress of these programs. For example, we would like to better capture efforts to combine public and ratepayer funds to stimulate private investments in clean energy projects. However, as mentioned, these efforts are currently impeded by the absence of protocols for measuring and verifying energy savings when it comes to private financing. Non-ratepayer programs—public and private alike—often have less rigorous EM&V protocols than do utility-run programs. So, while we currently credit these incentives, our ability to do so in a quantitative manner will depend on the quality of available energy savings data.

This was the first year the *Scorecard* has included a metric to assess state policy to improve energy efficiency in low-income households, which can help to relieve the significantly higher energy burden these communities face relative to other homes. We hope this new addition to the *Scorecard* and ACEEE's State and Local Policy Database will serve as a helpful resource for those seeking information on state strategies to encourage energy savings among traditionally underserved utility customers. We acknowledge our scoring effort faced some initial challenges this year due to lack of data or significant variation among states in how funds are administered. We plan to continue improving this metric in the future as more information becomes available.

States are also undertaking significant efforts to develop residential home energy labeling policies and programs and to integrate them with the real estate and appraisal industries. These initiatives are critical to helping the market accurately reflect the value of residential properties by raising awareness regarding home energy performance and informing investments in energy efficiency upgrades. We hope in the near future to use the *Scorecard* to highlight exemplary labeling policies currently being pioneered by select states.

Internet-connected devices, smart meters, and other intelligent efficiency technologies are proliferating in many states. These devices help overcome informational and motivational barriers to consumer uptake of energy efficiency. Similarly, a new industry is emerging that uses social marketing and social media to encourage consumers to save energy—such as by giving customers frequent feedback on their energy use and tailored energy savings tips. Data-focused policies—such as state data privacy policies, disclosure of building energy use, and data-access policies such as the industry-led Green Button standard—can help this promising energy efficiency area grow. The *State Scorecard* began collecting information on data-access policies in 2015 and continued to do so this year. Although we have yet to quantify progress on data access in a scoring methodology, given the rapid advances many states are making in this area, we intend to reexamine how our scoring can account for these achievements in future *Scorecards*.

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Appendix A. Respondents to Utility and State Energy Office Data Requests

State/territory	Primary state energy office data request respondent	Primary public utility commission data request respondent
Alabama	Maureen Neighbors, Director, Energy Division, Alabama Department of Economic and Community Affairs	Rena Caldwell, Electricity Policy Division, Alabama Public Service Commission
Alaska	Katie Conway, Assistant Program Manager, Energy Efficiency and Conservation Program, Alaska Energy Authority	Anne Marie Jensen, Process Coordinator, Regulatory Commission of Alaska
Arizona	—	—
Arkansas	Mitchell Simpson, Director, Arkansas Energy Office	Matthew Klucher, Director, Rates and Demand Resources, Arkansas Public Service Commission
California	Bill Pennington, Deputy Division Chief, Efficiency and Renewable Energy Division, California Energy Commission	Amy Reardon, Senior Regulatory Analyst, California Public Utility Commission
Colorado	Karen Phelan, Deputy Director, Colorado Energy Office	—
Connecticut	Michele Melley, Associate Research Analyst, Connecticut Department of Energy and Environmental Protection	Michele Melley, Associate Research Analyst, Connecticut Department of Energy and Environmental Protection
Delaware	Emily St. Clair, Energy Planner III, Delaware Department of Natural Resources and Environmental Control	Emily St. Clair, Energy Planner III, Delaware Department of Natural Resources and Environmental Control
District of Columbia	Edward Yim, Associate Director of Policy & Compliance, District Department of the Environment	Ben Plotzker, Technical Energy Analyst, Vermont Energy Investment Corporation
Florida	Kelley Burk, Director, Office of Energy, Florida Department of Agriculture and Consumer Services	Tripp Coston, Economic Supervisor, Conservation, Florida Public Service Commission
Georgia	Kristofor Anderson, Senior Program Manager, Georgia Environmental Finance Authority	Jamie Barber, Energy Efficiency and Renewable Energy Manager, Georgia Public Service Commission
Hawaii	—	—
Idaho	Jennifer Pope, Senior Energy Policy Analyst, Idaho Governor's Office of Energy and Mineral Resources	Stacey Donohue, Utility Analyst, Idaho Public Utilities Commission
Illinois	Deirdre Coughlin, Acting Energy Division Manager, Illinois Department of Commerce and Economic Opportunity	David Brightwell, Economist, Illinois Commerce Commission
Indiana	—	Carmen Pippenger, Senior Utility Analyst, Indiana Utility Regulatory Commission
Iowa	Adrienne Ricehill, Program Manager, Iowa Economic Development Authority	Brenda Biddle, Utility Specialist, Iowa Utilities Board
Kansas	—	—

State/territory	Primary state energy office data request respondent	Primary public utility commission data request respondent
Kentucky	Lee Colten, Assistant Director, Kentucky Department for Energy Development and Independence	—
Louisiana	Paul Miller, Director, Technology Assessment Division, Louisiana Department of Natural Resources	Donnie Marks, Utilities Administrator, Louisiana Public Service Commission
Maine	Lisa Smith, Senior Planner, Governor's Energy Office	Laura Martel, Research and Evaluation Manager, Efficiency Maine
Maryland	Kent Mottice, Policy Manager, Maryland Energy Administration	Amanda Best, Assistant Director, Energy Analysis and Planning Division, Maryland Public Service Commission
Massachusetts	Lyn Huckabee, Residential Energy Efficiency Program Coordinator, Massachusetts Department of Energy Resources	Lyn Huckabee, Residential Energy Efficiency Program Coordinator, Massachusetts Department of Energy Resources
Michigan	Robert Jackson, Director, Michigan Energy Office	Karen Gould, Staff, Energy Efficiency Section, Michigan Public Service Commission
Minnesota	Anthony Fryer, Conservation Improvement Program Coordinator, Minnesota Department of Commerce	Anthony Fryer, Conservation Improvement Program Coordinator, Minnesota Department of Commerce
Mississippi	Sumesh Arora, Director of Energy & Natural Resources Division, Mississippi Development Authority	Vicki Munn, Electric, Gas & Communications Division, Mississippi Public Utilities Staff
Missouri	Brenda Wilbers, Program Director, Division of Energy, Department of Economic Development	John Rogers, Utility Regulatory Manager, Missouri Public Service Commission
Montana	Garrett Martin, Senior Energy Analyst, Montana Energy Office	Robin Arnold, Policy Analyst, Montana Public Service Commission
Nebraska	David Bracht, Director, Nebraska Energy Office	David Bracht, Director, Nebraska Energy Office
Nevada	Kelly Thomas, Energy Program Manager, Nevada Governor's Office of Energy	Cristina Zuniga, Economist, Nevada Public Utility Commission
New Hampshire	Myles Matteson, Director, New Hampshire Office of Energy and Planning	Jim Cunningham, Utility Analyst, New Hampshire Public Utility Commission
New Jersey	Michael Winka, Senior Policy Advisor, New Jersey Board of Public Utilities (NJ State Energy Office)	Michael Winka, Senior Policy Advisor, New Jersey Board of Public Utilities (NJ State Energy Office)
New Mexico	Harold Trujillo, Bureau Chief, Energy Technology and Engineering, New Mexico Energy Office	Travis Blecha, Utility Economist, New Mexico Public Regulatory Commission
New York	Robert Bergen, NYSERDA	Robert Bergen, NYSERDA

State/territory	Primary state energy office data request respondent	Primary public utility commission data request respondent
North Carolina	Russell Duncan, Energy Assurance Manager, North Carolina Department of Environmental Quality	Jack Floyd, Engineer, Electric Division, Public Staff, North Carolina Utilities Commission
North Dakota	Norlyn Schmidt, Transportation Planner, North Dakota Department of Transportation	Sara Cardwell, Public Utility Analyst, North Dakota Public Service Commission
Ohio	—	—
Oklahoma	Kylah McNabb, Energy Policy Advisor, Office of the Secretary of Energy & Environment	Kathy Champion, Regulatory Analyst, Oklahoma Corporation Commission
Oregon	Warren Cook, Manager, Energy Efficiency and Conservation, Oregon Department of Energy, and Erik Havig, Planning Section Manager, Oregon Department of Transportation	Warren Cook, Manager, Energy Efficiency and Conservation, Oregon Department of Energy; Jean-Pierre Batmale, Senior Utility Analyst, Oregon Public Utility Commission; and Allison Robbins Mace, Manager, Energy Efficiency Planning & Evaluation, Bonneville Power Administration
Pennsylvania	Libby Dodson, Energy Program Specialist, Department of Environmental Protection	Joseph Sherrick, Supervisor, Policy and Planning, Pennsylvania Public Utility Commission
Rhode Island	Becca Trietch, Chief, Program Development, Rhode Island Office of Energy Resources	Todd Bianco, Principal Policy Associate, Rhode Island Public Utility Commission
South Carolina	—	—
South Dakota	—	Darren Kearney, Utility Analyst, South Dakota Public Utilities Commission
Tennessee	Natalie Dallriva, Grants Analyst, Tennessee Department of Environment and Conservation	Kyle Lawson, Manager, Tennessee Valley Authority
Texas	William (Dub) Taylor, Director, State Energy Conservation Office, Comptroller of Public Accounts	Amy Martin, Vice President Consulting, Frontier Associates
Utah	Shawna Cuan, Energy Efficiency and Programs Manager, Governor's Office of Energy Development	Carol Revelt, Executive Staff Director, Utah Public Service Commission
Vermont	Kelly Launder, Assistant Director, Vermont Public Service Department.	Barry Murphy, Energy Program Specialist, Vermont Public Service Department
Virginia	Barbara Simcoe, State Energy Program Manager, Virginia Division of Energy, Department of Mines, Minerals, and Energy	David Eichenlaub, Deputy Director, Division of Energy Regulation, Virginia State Corporation Commission
Washington	Michael Furze, Assistant Director, Energy Division, Washington Department of Commerce	Jennifer Snyder, Regulatory Analyst, Washington State Utilities & Transportation Commission
West Virginia	Tiffany Bailey, Energy Development Specialist, West Virginia Division of Energy	Michael Dailey, Utilities Analyst, West Virginia Public Service Commission

State/territory	Primary state energy office data request respondent	Primary public utility commission data request respondent
Wisconsin	Vanessa Durant, Grant Specialist, Public Service Commission of Wisconsin	Joe Fontaine, Focus on Energy Performance Manager, Public Service Commission of Wisconsin
Wyoming	Sherry Hughes, Energy Efficiency Program Manager, Wyoming Business Council, State Energy Office	—
Virgin Islands	—	—
Puerto Rico	—	—
Guam	Lorilee Crisostomo, Director, Guam Energy Office	—

Appendix B. Electric Efficiency Program Spending per Capita

State	2016 electric efficiency spending ($million)	$ per capita
Vermont	54.0	86.52
Massachusetts	538.9	79.11
Rhode Island	78.4	74.21
Connecticut	191.9	53.65
Washington	291.2	39.96
Oregon	156.6	38.26
Iowa	119.2	38.02
California	1,364.1	34.75
Maryland	186.8	31.04
Idaho	49.8	29.59
Minnesota	161.9	29.33
Hawaii	37.0	25.89
Maine	32.3	24.27
Arkansas	68.7	23.00
New York	425.2	21.53
Illinois	262.8	20.53
District of Columbia	13.0	19.08
Michigan	182.1	18.34
Arizona	126.7	18.28
Utah	55.1	18.07
Pennsylvania	229.4	17.94
Oklahoma	70.2	17.89
New Hampshire	23.2	17.37
Wyoming	10.1	17.24
New Jersey	154.0	17.22
Nevada	49.0	16.66
New Mexico	34.3	16.48
Kentucky	72.9	16.43

State	2016 electric efficiency spending ($million)	$ per capita
Colorado	87.2	15.75
Missouri	88.4	14.51
North Carolina	144.6	14.25
Indiana	87.0	13.12
Montana	13.5	12.99
Wisconsin	74.1	12.82
Ohio	141.0	12.14
Florida	178.1	8.64
Tennessee	52.5	7.89
Texas	194.1	6.96
West Virginia	12.3	6.72
South Dakota	5.8	6.70
Nebraska	11.6	6.08
South Carolina	29.8	6.01
Mississippi	17.2	5.76
Georgia	57.9	5.62
Delaware	5.3	5.57
Louisiana	17.0	3.63
Alabama	16.2	3.33
Virginia	0.1	0.02
Alaska	0.0	0.00
Guam	0.0	0.00
Kansas	0.0	0.00
North Dakota	0.0	0.00
Puerto Rico	0.0	0.00
US Virgin Islands	0.0	0.00
US total	6,272.6	
Median	56.5	16.46

Appendix C. Summary of Large Customer Self-Direct Programs by State

State	Availability	Description
Arizona	Customers of Arizona Public Service Company (APS), Tucson Electric Power Company (TEP), and Salt River Project (SRP)	APS: Large customers using at least 40 million kWh per calendar year can elect to self direct energy efficiency funds. Customers must notify APS each year if they wish to participate, after which 85% of the customer's demand-side management contribution will be reserved for future energy efficiency projects. Projects must be completed within two years. Self-direct funds are paid once per year once the project is completed and verified by APS. TEP: To be eligible for self-direct, a customer must use a minimum of 35 million kWh per calendar year. SRP: SRP makes self-direct available only to very large customers using more than 240 million kWh per year. For all utilities, a portion of the funds they would have otherwise contributed to energy efficiency is retained to cover self-direct program administration, management, and evaluation costs.
Colorado	Customers of Xcel Energy and Black Hills	Xcel: The self-direct program is available to commercial and industrial (C&I) electric customers who have an aggregated peak load of at least 2 MW in any single month and an aggregated annual energy consumption of at least 10 GWh. Self-direct program customers cannot participate in other conservation products offered by the company. Rebates are paid based on actual savings from a project, up to $525 per customer kW or $0.10 per kWh. Rebates are given for either peak demand or energy savings, but not both and are limited to 50% of the incremental cost of the project. Xcel uses raw monitoring results and engineering calculations to demonstrate actual energy and demand savings. Black Hills: To participate in the C&I self-direct program, customers must have an aggregated peak load greater than 1 MW in any single month and aggregated annual energy usage of 5,000 MWh. Rebates and savings are calculated on a case-by-case basis; with rebate values calculated as either 50% of the incremental cost of the project or $0.30 per kWh savings, whichever is lower.
Idaho	Customers of Idaho Power	Idaho Power offers its largest customers an option to self direct the 4% energy efficiency rider that appears on all customers' bills. Customers have three years to complete projects, with 100% of the funds available to fund up to 100% of project costs. Self-direct projects are subject to the same criteria as projects in other efficiency programs.
Illinois	Statewide for natural gas customers based on NAICS code; pilot program for ComEd electric customers	Self-direct is generally applicable to customers of natural gas utilities subject to the Illinois Energy Efficiency Portfolio Standard. The North American Industry Classification System's Threshold code number is 22111 or any such code number beginning with the digits 31, 32, or 33 and annual usage in the aggregate of 4 million therms or more in the affected gas utility's service territory or with aggregate usage of 8 million therms or more in the state. Customers must agree to set aside for their own use in implementing energy efficiency 2% of the customer's cost of natural gas, composed of the customer's commodity cost and the delivery service charges paid to the gas utility, or $150,000, whichever is less. For evaluation, the Illinois Department of Commerce and Economic Opportunity has the ability to audit compliance and take remedial action for noncompliance.

State	Availability	Description
Michigan	Statewide	Self-direct is available statewide. Customers must have had an annual peak demand in the preceding year of at least 1 MW in the aggregate at all sites. Customers may use the funds that would otherwise have been paid to the utility provider for energy efficiency programs, however they must submit the portion of the energy efficiency funds that would have been collected and used for low-income programs to their utility provider. Customers then calculate the energy savings achieved and provide the funds to their utility provider. The percentage of eligible customers statewide is not calculated, however in 2009 there were 77 large customers who self directed; by 2014 that number had dropped to 24.
Minnesota	Statewide	Minnesota offers a self-direct option, with a full exemption from assigned cost-recovery mechanism (CRM) fees, to customers with 20 MW average electric demand or 500,000 MCF of gas consumption. Customers must also show that they are making "reasonable" efforts to identify or implement energy efficiency and that they are subject to competitive pressures that make it helpful for them to be exempted from the CRM fees. Participating customers must submit new reports every five years to maintain exempt status. The utility is not involved in self-direct program administration; the state Department of Commerce manages self-direct accounts and is the arbiter of whether a company qualifies for self-direct and is satisfying its obligations.
Montana	Statewide (all regulated public utilities)	Customers with average monthly demand of 1,000 kW can self direct universal systems benefits (USB) funds. Self-direct customers are reimbursed for their annual energy efficiency expenditures up to the amount of their annual total of USB rate payments to their utility. The transaction occurs directly between the customer and the utility, and the latter tabulates and summarizes self-directed funds annually. This does not include specifics or evaluation of efficiency projects. Evaluation of savings claims is not required.
New Jersey	Statewide	Eligible customers must have contributed at least $300,000 in energy efficiency fee funds during the previous fiscal year. Customers can aggregate multiple buildings or sites together to meet the threshold. The facilities must also have a total annual billed peak demand of 400 kW or greater to ensure projects are large enough, since the program was designed for only the state's largest commercial and industrial customers. Participants submit a Draft Energy Efficiency Plan (DEEP), which gives the program an overview of the proposed project and serves as a basis for reserving incentives. The incentive structure returns 90% of a participant's NJCEP fund contribution from the previous fiscal year, unless that amount exceeds 75% of total project costs or $0.33 per projected kWh savings.

State	Availability	Description
New Mexico	Statewide in the territories of three investor-owned utilities (IOUs)	Self-direct is available statewide. Customers who use more than 7,000 MWh annually may administer their own energy efficiency projects (Southwestern Public Service). They receive an exemption of, or a credit for, an amount equal to expenditures that they have made at their facilities on and after January 1, 2005. Evaluation is required. Public Service Company of New Mexico reported three self-direct programs in 2015. SPS reported no participants in either 2014 or 2015 and did not foresee any 2016 participants. El Paso Electric reported no participants in 2014.
New York	Statewide (all six electric utilities)	To be eligible, individual customers must have a 36-month average demand of 2 MW or greater. Customers with an aggregated 36-month average demand of 4 MW or greater will also be eligible if one or more of the accounts aggregated has at least a 36-month average demand of 1 MW. Upon enrollment, participants are assigned an Energy Savings Account (ESA) to collect their fee contributions for efficiency assessed on their utility bills, which would otherwise be allocated to the general pool for utility-administered energy efficiency programs. The utility manages the ESA and may retain up to 15% for program administration and M&V. The program runs on a three-year cycle, and participants will have access to at least 85% of their energy efficiency fee contributions to fund eligible projects during that time. Before projects are implemented, participants provide a Project Plan—including details on expected costs, savings, baseline calculation, M&V plan, and schedule—for the utility to review and approve.
Oregon	Customers of Portland General Electric, PacifiCorp, Idaho Power, and Emerald People's Utility District (PUD)	The self-direct option for the Public Purpose Charge is required for two of the three investor-owned utilities. This program is uniform statewide across all impacted utilities. One consumer-owned utility has chosen to design and run a self-direct program. Programs cover approximately 80% of the electric customers in Oregon. Eligible sites must demonstrate an average demand of over 1 MW in the prior year to enter and remain in the program. Participants in the three participating programs have the proposed projects technically reviewed by the Oregon Department of Energy. In two programs, expenditures toward qualified projects are used as credit to offset future Public Purpose Charges. The credit is applied on-bill. In the third program, the utility has a set-aside program in combination with credit toward future Public Purpose Charges. These funds are provided by check and/or on-bill. The Oregon Department of Energy conducts a technical review of claimed savings prior to project construction. It reviews a sampling of projects for actual performance. Of the estimated 230 eligible sites, 17 are participating. Utilities do not publish the percentage of eligible load saved. Total savings for 2015 was 2,743,000 kWh.

State	Availability	Description
Vermont	Statewide for both electric and natural gas customers	For electric energy efficiency, three self-direct options are available statewide: the Self-Managed Energy Efficiency Program (SMEEP), the Customer Credit Program (CCP), and Energy Savings Accounts (ESA). SMEEP is also available for the state's one eligible gas customer. The SMEEP option requires prospective participants or their predecessors to have contributed $1.5 million to the Vermont Energy Efficiency Utility Fund (VEEUF) in 2008 through the Energy Efficiency Charge (EEC) adder on their electric costs. Only one customer meets that standard. Eligible customers must commit to investing a minimum of $3 million over a three-year program cycle. The ESA option allows Vermont businesses that pay an EEC in excess of $5,000 per year (or an average of $5,000 per year over three years) to use a portion of their EEC to support energy efficiency projects in their facilities. For CCP, eligible customers must be ISO 14001 certified and meet several conditions similar to ENERGY STAR® for industrial facilities. Natural gas energy efficiency is available only for transmission and industrial electric and natural gas ratepayers who have a minimum of $1.5 million in customer efficiency charges for electric use. SMEEP allows an eligible customer to be exempt from the (electric) EEC if that customer commits to spending an annual average of no less than $1 million across three years on energy efficiency investments. In addition, the Vermont Public Service Board lets eligible Vermont business customers self-administer energy efficiency through an ESA or the CCP. Customers still pay these funds into the VEEUF; the customers recoup the funds upon completion of an eligible energy efficiency measure. For natural gas, ESA and CCP participants can access a percentage of the funds paid into the VEEUF to undertake approved energy efficiency measures. For the SMEEP electric program, eligible customers must demonstrate that they have a comprehensive energy management program with annual objectives, or that they have achieved ISO 14001 certification. These customers must report to the Public Service Board, detailing the measures undertaken, the estimated energy and cost savings, and any related costs. The Board then reviews and approves the reports. The ESA account operates through Efficiency Vermont; the related savings are reported and verified through the savings verification mechanism. For CCP, eligible customers must be ISO 14001 certified and meet several conditions similar to ENERGY STAR for industrial facilities. Savings are verified through existing mechanisms.
Washington	All utilities have the option to develop self-direct options for industrial and commercial customers, but of the IOUs, only Puget Sound Energy has developed a self-direct program	Puget Sound Energy's self-direct program is available only to industrial or commercial customers on electric rate-specific rate schedules. The self-direct program operates on a four-year cycle comprising two phases: noncompetitive and competitive. During the noncompetitive phase, customers have exclusive access to their energy efficiency funds, which are collected over the four-year period. When this phase ends, any unused funds are pooled together and competitively bid on by the members of the self-direct program. Customers receive payment in the form of a check once the project is complete and verified. Participating customers do not receive any rate relief when they complete energy efficiency investments. The utility pre- and post-verifies 100% of the projects, including a review and revision of savings calculations to determine incentive levels. The program is included in the third-party evaluation cycle like any other utility conservation program.

State	Availability	Description
Wisconsin	Statewide	A self-direct option is open to customers that meet the definition of a large energy customer according to the 2005 Wisconsin Act 141. Under the self-direct option, a true-up at the end of the year returns contributions to participating customers for use on energy efficiency projects. Evaluation is required under Public Service Commission Administrative Code 137, with evaluation plans reviewed by that commission. This option has been available since 2008, but no customers have participated to date.

Appendix D. Details of States' Energy Efficiency Resource Standards

State Year(s) enacted Authority Applicability (% sales affected)	Description	Avg. incremental electric savings target per year (2016 onward)	Stringency	Reference	Score
Arizona 2010 Regulatory Electric and nat. gas IOUs, co-ops (~59%)	Electric: Incremental savings targets began at 1.25% of sales in 2011, ramping up to 2.5% in 2016–20 for cumulative annual electricity savings of 22% of retail sales, 2% of which may come from peak demand reductions. Natural gas: ~0.6% annual savings (for cumulative savings of 6% by 2020). Co-ops must meet 75% of targets.	2.5%	Binding	Docket No. RE-00000C-09-0427, Decision 71436 Docket No. RE-00000C-09-0427, Decision 71819 Docket No. RG-00000B-09-0428 Decision 71855	3
Arkansas 2010 Regulatory Electric and nat. gas IOUs (~53%)	Electric: Incremental targets for PY 2017 and PY 2018 of 0.90% of 2015 retail sales for electric IOUs, increasing to 1.00% for PY 2019. Natural gas: Annual incremental reduction target of 0.50% for 2017–19 for natural gas IOUs.	0.9%	Opt-out	Order No. 17, Docket No. 08-144-U; Order No. 1, Docket No. 13-002-U Order No. 7, Docket No. 13-002-U Order No. 31, Docket No. 13-002-U	1
California 2004, 2009, and 2015 Legislative Electric and nat. gas IOUs (~78%)	Electric: Average incremental savings targets of ~1.15% of retail sales electricity. In October 2015, California enacted SB 350, calling on state agencies and utilities to work together to double cumulative efficiency savings by 2030. Natural gas: Incremental savings target of 0.56%. Utilities must pursue all cost-effective efficiency resources.	1.2%	Binding	CPUC Decision 04-09-060; CPUC Decision 08-07-047; CPUC Decision 14-10-046 AB 995 SB 350 (10/7/15) AB 802 (10/8/15)	1.5

State Year(s) enacted Authority Applicability (% sales affected)	Description	Avg. incremental electric savings target per year (2016 onward)	Stringency	Reference	Score
Colorado 2007 and 2017 Legislative Electric and nat. gas IOUs (~57%)	Electric: Black Hills follows Public Service Company of Colorado (PSCo) incremental savings targets of 0.8% of sales in 2011, increasing to 1.35% of sales in 2015. For the period 2015–20, PSCo must achieve incremental savings of at least 400 GWh per year. HB17-1227 extends programs and calls for 5% energy savings by 2028 compared to 2018. Natural gas: Savings targets commensurate with spending targets (at least 0.5% of prior year's revenue).	1.3%	Binding	Colorado Revised Statutes 40-3.2-101, et seq.; Docket No. 12A-100E Dec. R12-0900; Docket No. 10A-554EG Docket No. 13A-0686EG Dec. C14-0731; HB17-1227	1.5
Connecticut 2007 and 2013 Legislative Electric and nat. gas IOUs (~94%)	Electric: Average incremental savings of 1.51% of sales from 2016–18. Natural gas: Average incremental savings of 0.61% per year from 2016–18. Utilities must pursue all cost-effective efficiency resources.	1.5%	Binding	Public Act No. 07-242 Public Act No. 13-298 2016–18 Electric and Natural Gas Conservation and Load Management Plan	2
Hawaii 2004 and 2009 Legislative Electric Statewide goal (100%)	In 2009, transitioned away from a combined RPS-EERS to a standalone EEPS goal to reduce electricity consumption by 4,300 GWh by 2030 (equal to ~30% of forecast electricity sales, or 1.4% annual savings).	1.4%	Binding	HRS §269-91, 92, 96 HI PUC Order, Docket No. 2010-0037	1
Illinois 2007, 2016 Legislative Electric and nat. gas Utilities with more than 100,000 customers, Illinois DCEO (~88%)	Electric: Incremental savings targets vary by utility, averaging 1.77% of sales from 2018 to 2021, 2.08% from 2022 to 2025, and 2.05% from 2026 to 2030. SB 2814 also sets a rate cap of 4%, allowing targets to be adjusted downward should utilities reach spending limits. Natural gas: 8.5% cumulative savings by 2020 (0.2% incremental savings in 2011, ramping up to 1.5% in 2019).	1.3%	Cost cap	SB 1918 Public Act 96-0033 § 220 ILCS 5/8-103 Case No. 13-0495 Case No. 13-0498 S.B. 2814	2

State Year(s) enacted Authority Applicability (% sales affected)	Description	Avg. incremental electric savings target per year (2016 onward)	Stringency	Reference	Score
Iowa 2009 Legislative Electric and nat. gas IOUs (75%)	Electric: Incremental savings targets vary by utility from ~1.1–1.2% annually through 2018. Natural gas: Incremental savings targets vary by utility, ~0.66–1.2% annually through 2018.	1.2%	Binding	SB 2386 Iowa Code § 476 Docket No. EEP-2012-0001	1.5
Maine 2009 Legislative Electric and nat. gas Efficiency Maine (100%)	Electric: Savings of 20% by 2020, with incremental savings targets of ~ 1.6% per year for 2014–16 and ~2.4% per year for 2017–19. Natural gas: Incremental savings of ~0.2% per year for 2017–19. Efficiency Maine operates under an all cost-effective mandate.	2.4%	Opt-out	Efficiency Maine Triennial Plan (2014–16) Efficiency Maine Triennial Plan (2017–19) HP 1128 – LD 1559	2.5
Maryland 2008 and 2015 Legislative through 2015, regulatory thereafter Electric IOUs (99%)	15% per-capita electricity use reduction goal by 2015 (10% by utilities, 5% achieved independently). 15% reduction in per capita peak demand by 2015 compared to 2007. After 2015, targets vary by utility, ramping up by 0.2% per year to reach 2% incremental savings.	2.0%	Binding	Md. Public Utility Companies Code § 7-211 MD PSC Docket Nos. 9153–9157 Order No. 87082	2
Massachusetts 2009 Legislative Electric and nat. gas IOUs, co-ops, munis, Cape Light Compact (~86%)	Electric: Average incremental savings of 2.93% of electric sales for 2016–18. Natural gas: Average incremental savings of 1.24% per year for 2016–18. All cost-effective efficiency requirement.	2.9%	Binding	DPU 15-160 through DPU 15-169 (MA Joint Statewide Three-Year Electric and Gas Energy Efficiency Plan 2016–2018) MGL ch. 25, § 21;	3
Michigan 2008, 2016 Legislative Electric and nat. gas Statewide goal (100%)	Electric: 1.0% incremental savings through 2021. Natural gas: Incremental savings of 0.75% through 2021.	1.0%	Binding	MGL ch. 25, § 21; Act 295 of 2008 S.B. 438	1.5

State Year(s) enacted Authority Applicability (% sales affected)	Description	Avg. incremental electric savings target per year (2016 onward)	Stringency	Reference	Score
Minnesota 2007 Legislative Electric and nat. gas IOUs, co-ops with more than 5,000 customers, and munis with more than 1,000 customers (~97%)	Electric: 1.5% incremental savings in 2010 and each year thereafter. Senate File 1456 signed in May 2017 exempts some rural utilities from meeting energy efficiency requirements through the Conservation Improvement Program (CIP). Natural gas: 0.75% incremental savings per year in 2010–12; 1% incremental savings in 2013 and each year thereafter.	1.5%	Binding	Minn. Stat. § 216B.241 SF 1456	2
Nevada 2005 and 2009 Legislative Electric IOUs (~62%)	20% of retail electricity sales to be met by renewables and energy efficiency by 2015, and 25% by 2025. Energy efficiency may meet a quarter of the standard through 2014, but allowances phase out by 2025. New targets are pending under SB 150, signed June 2017, directing the Nevada Public Utilities Commission to set new savings goals for NV Energy.	0.4%	Binding	NRS 704.7801 et seq.	0
New Hampshire 2016 Regulatory Electric and nat. gas Statewide goal (100%)	Electric: 0.8% incremental savings in 2018, ramping up to 1% in 2019 and 1.3% in 2020. Natural gas: 0.7% in 2018, 0.75% in 2019, and 0.8% in 2020.	1.0%	Binding	NH PUC Order No. 25932, Docket DE 15-137	1.5
New Mexico 2008 and 2013 Legislative Electric IOUs (68%)	5% reduction from 2005 total retail electricity sales by 2014, and 8% reduction by 2020.	0.6%	Binding	NM Stat. § 62-17-1 et seq.	0.5

State Year(s) enacted Authority Applicability (% sales affected)	Description	Avg. incremental electric savings target per year (2016 onward)	Stringency	Reference	Score
New York 2008 and 2016 Regulatory Electric and nat. gas Statewide goal (100%)	Electric: Under current Reforming the Energy Vision (REV) proceedings, utilities have filed efficiency transition implementation plans (ETIPS) with incremental targets varying from 0.4% to 0.9% for the period 2016–18. In January, the PSC authorized NYSERDA's Clean Energy Fund (CEF) framework, which outlines a minimum 10-year energy efficiency goal of 10.6 million MWh measured in cumulative first-year savings. The PSC issued a REV II Track Order in May prescribing that the Clean Energy Advisory Council also propose utility targets supplemental to ETIPS by October 2016. Some degree of overlap of program savings is anticipated between utility targets and NYSERDA CEF goals. Natural gas: Utilities have filed proposals for varying incremental targets with incremental savings averaging 0.28% for the period 2016–18.	0.7%	Binding	NY PSC Order, Case 07-M-0548 NY PSC Case 14-M-0101 NY PSC Case 14-M-0252 2015 New York State Energy Plan NY PSC Order authorizing the Clean Energy Fund framework	1
North Carolina 2007 Legislative Electric Statewide goal (100%)	Renewable Energy and Energy Efficiency Portfolio Standard (REPS) requires renewable generation and/or energy savings of 6% by 2015, 10% by 2018, and 12.5% by 2021 and thereafter. Energy efficiency is capped at 25% of target, increasing to 40% in 2021 and thereafter.	0.4%	Opt-out	NC Gen. Stat. § 62-133.8 04 NCAC 11 R08-64, et seq.	0
Ohio 2008 and 2014 Legislative Electric IOUs (~89%)	Beginning in 2009, incremental savings of 0.3% per year, ramping up to 1% in 2014 and 2% in 2021. Savings targets resumed in 2017 following a "freeze" (S.B. 310) in 2015–16 that allowed utilities that had achieved 4.2% cumulative savings to reduce or eliminate program offerings.	1.0%	Binding	ORC 4928.66 et seq. SB 221 SB 310	1

State Year(s) enacted Authority Applicability (% sales affected)	Description	Avg. incremental electric savings target per year (2016 onward)	Stringency	Reference	Score
Oregon 2010 Regulatory Electric and nat. gas Energy Trust of Oregon (~70%)	Electric: Incremental targets average ~1.3% of sales annually for the period 2015–19. Natural gas: 0.3% of sales annually for the period 2015–19	1.3%	Binding	Energy Trust of Oregon 2015–2019 Strategic Plan Grant Agreement between Energy Trust of Oregon and OR PUC	1.5
Pennsylvania 2004 and 2008 Legislative Electric Utilities with more than 100,000 customers (~93%)	Varying targets have been set for IOUs amounting to yearly statewide incremental savings of 0.8% for 2016–20. EERS includes peak demand targets. Energy efficiency measures may not exceed an established cost cap.	0.8%	Cost cap	66 Pa C.S. § 2806.1 PUC Order Docket No. M-2008-2069887 PUC Implementation Order Docket M-2012-2289411 PUC Final Implementation Order Docket M-2014-2424864	0.5
Rhode Island 2006 Legislative Electric and nat. gas IOUs, munis (~99%)	Electric: Incremental savings of 2.5% in 2015, 2.55% in 2016, and 2.6% in 2017. EERS MW targets. Natural gas: Incremental savings of 1% in 2015, 1.05% in 2016, and 1.1% in 2017. Utilities must acquire all cost-effective energy efficiency.	2.6%	Binding	RIGL § 39-1-27.7 Docket No. 4443	3
Texas 1999 and 2007 Legislative Electric IOUs (~73%)	20% incremental load growth in 2011 (equivalent to ~0.10% annual savings); 25% in 2012, and 30% in 2013 and onward. Peak demand reduction targets of 0.4% compared to previous year. Energy efficiency measures may not exceed an established cost cap.	0.1%	Cost cap, opt-out	SB 7; HB 3693; Substantive Rule § 25.181 SB 1125	0

State Year(s) enacted Authority Applicability (% sales affected)	Description	Avg. incremental electric savings target per year (2016 onward)	Stringency	Reference	Score
Vermont 2000 Legislative Electric Efficiency Vermont, Burlington Electric (100%)	Average incremental electricity savings of ~2.1% per year for the period 2015–17. EERS includes demand response targets. Energy efficiency utilities must set budgets at a level that would realize all cost-effective energy efficiency.	2.1%	Binding	30 VSA § 209 VT PSB Docket EEU-2010-06 Efficiency Vermont Triennial Plan 2015–17 (2016 Update)	2.5
Washington 2006 Legislative Electric IOUs, co-ops, munis (~81%)	Biennial and 10-year goals vary by utility. Law requires savings targets to be based on the Northwest Power Plan, which estimates potential incremental savings of ~1.5% per year through 2030 for Washington utilities. All cost-effective conservation requirement.	1.5%	Binding	Ballot Initiative I-937 Energy Independence Act, ch. 19.285.040 WAC 480-109-100 WAC 194-37 Seventh Northwest Power Plan (adopted 2/10/16)	1.5
Wisconsin 2011 Legislative Electric and nat. gas Statewide goal (100%)	Electric: Focus on Energy targets include incremental electricity savings of ~0.81% of sales per year in 2015–18. Natural gas: Incremental savings of 0.6% in 2015–18. Energy efficiency measures may not exceed an established cost cap.	0.8%	Cost cap	Order, Docket No. 5-FE-100: Focus on Energy Revised Goals and Renewable Loan Fund (10/15) Program Administrator Contract, Docket No. 9501-FE-120, Amendment 2 (3/16) 2005 Wisconsin Act 141	1

Appendix E. Tax Incentives for High-Efficiency Vehicles

State	Tax incentive
Arizona	EV owners in Arizona pay a significantly reduced vehicle license tax—$4 for every $100 in assessed value—as part of the state's Reduced Alternative Fuel Vehicle License Tax program.
California	AB 118 targets medium- and heavy-duty trucks in a voucher program whose goal is to reduce the up-front incremental cost of purchasing a hybrid vehicle. Vouchers for up to $117,000 are available, depending on vehicle specifications, and are paid directly to fleets that purchase hybrid trucks for use within the state. California also offers rebates of up to $5,000 for light-duty zero-emission EVs and plug-in hybrid EVs on a first-come, first-served basis.
Colorado	On May 4, the Colorado legislature approved HB 1332, a bill that dramatically improves the state's alternative fuel vehicle tax credits. It sets a flat $5,000 credit for the purchase of a light-duty electric vehicle and makes the credits assignable to a car dealer or finance company, effectively turning the credit into a point-of-sale incentive.
Connecticut	Connecticut's Hydrogen and Electric Automobile Purchase Rebate Program provides as much as $3,000 for the incremental cost of the purchase of a hydrogen fuel cell electric vehicle (FCEV), all-electric vehicle, or plug-in hybrid electric vehicle. Rebates are calculated on the basis of battery capacity. Vehicles with a battery capacity of 18 kWh or more earn $3,000, while those with capacities between 7 kWh and 18 kWh earn $1,500. Vehicles with batteries smaller than 7 kWh are eligible for a rebate of $750.
Delaware	As part of the Delaware Clean Transportation Incentive Program, plug-in electric vehicles earn a rebate of $2,200.
District of Columbia	The District of Columbia offers a reduced registration fee and a vehicle excise tax exemption for owners of all vehicles with an EPA-estimated city fuel economy of at least 40 miles per gallon.
Georgia	An income tax credit is available to individuals who purchase new commercial medium- or heavy-duty vehicles that run on alternative fuels including electricity. Medium-duty vehicles qualify for a credit of up to $12,000, while heavy-duty vehicles can earn a credit of up to $20,000.
Guam	A rebate of up to 10% of the base price of a plug-in vehicle is available to residents and businesses.
Louisiana	Louisiana offers an income tax credit equivalent to 50% of the incremental cost of purchasing an EV under the state's alternative fuel vehicle tax credit program. Alternatively, taxpayers may claim the lesser of 10% of the total cost of the vehicle or $3,000.
Maryland	Purchasers of qualifying light-duty all-electric and plug-in hybrid electric vehicles may claim up to $3,000 against the vehicle excise tax in Maryland, depending on the vehicle's battery weight.
Massachusetts	The Massachusetts Offers Rebates for EVs (MOR-EV) program offers rebates of up to $2,500 to customers purchasing plug-in EVs.
New Jersey	All ZEVs in New Jersey are exempt from state sales and use taxes.
New York	Pursuant to legislation passed in April 2016, NYSERDA developed a rebate program for zero emission vehicles. The program launched in March 2017. Rebates of up to $2,000 per vehicle are available for battery electric vehicles, plug-in hybrid electric vehicles, and fuel cell vehicles. New York also started the New York Truck Voucher Incentive Program in 2014. Vouchers of up to $60,000 are available for the purchase of hybrid and all-electric class 3–8 trucks.

State	Tax incentive
Puerto Rico	In 2012, Puerto Rico amended the Internal Revenue Code to allow an excise tax reimbursement of up to 65% for buyers of hybrid and plug-in hybrid vehicles. The reimbursement ranged from $2,000 to $8,000 and was available through 2016. Buyers of all-electric vehicles are waived from paying excise tax altogether.
Rhode Island	Rhode Island offers buyers of plug-in electric vehicles rebates of up to $2,500 depending on battery capacity. Vehicles with battery capacity of 18 kWh or above earn $2,500, vehicles with battery capacity between 7 and 18 kWh earn $1,500, and those with capacity less than 7 kWh qualify for a $500 rebate.
South Carolina	South Carolina offers up to $2,000 in tax credits for the purchase of a plug-in hybrid EV. The credit is equal to $667, plus $111 if the vehicle has at least 5 kWh of battery capacity, and an additional $111 for each kWh above 5 kWh.
Tennessee	Plug-in electric vehicles purchased after June 2015 qualify for a rebate from the Tennessee Department of Environment and Conservation (TDEC). Dealerships will distribute rebates of $2,500 for all-electric vehicles and rebates of $1,500 for plug-in hybrid vehicles.
Texas	EVs weighing 8,500 pounds or less and purchased after September 1, 2013, are eligible for a $2,500 rebate.
Utah	Through 2016, all-electric vehicles were eligible for an income tax credit of 35% of the vehicle purchase price, up to $1,500. Plug-in hybrids qualified for a tax credit of $1,000.
Washington	EVs are exempt from state motor vehicle sales and use taxes under the Alternative Fuel Vehicle Tax Exemption Program.

Source: DOE 2017a

Appendix F. State Transit Funding

State	FY 2014 funding	2014 population*	Per capita transit expenditure
Alaska	$187,652,905	736,732	$254.71
New York	$4,786,084,700	19,746,227	$242.38
Illinois	$3,118,234,749	12,880,580	$242.09
Massachusetts	$1,550,905,555	6,745,408	$229.92
Maryland	$906,699,174	5,976,407	$151.71
Connecticut	$465,086,221	3,596,677	$129.31
Delaware	$100,601,100	935,614	$107.52
District of Columbia	$507,890,000	5,000,000	$101.58
Pennsylvania	$1,237,148,591	12,787,209	$96.75
Minnesota	$418,061,000	5,457,173	$76.61
California	$2,259,430,056	38,802,500	$58.23
Rhode Island	$55,819,226	1,055,173	$52.90
New Jersey	$381,686,937	8,938,175	$42.70
Virginia	$251,381,851	8,326,289	$30.19
Michigan	$245,125,303	9,909,877	$24.74
Wisconsin	$109,228,300	5,757,564	$18.97
Vermont	$7,436,700	626,562	$11.87
Florida	$229,673,093	19,893,297	$11.55
Indiana	$57,909,867	6,596,855	$8.78
Oregon	$32,669,819	3,970,239	$8.23
North Carolina	$79,356,533	9,943,964	$7.98
Tennessee	$49,889,987	6,549,352	$7.62
Washington	$52,956,037	7,061,530	$7.50
North Dakota	$5,216,175	739,482	$7.05
Wyoming	$2,522,468	584,153	$4.32
Iowa	$12,723,031	3,107,126	$4.09

State	FY 2014 funding	2014 population	Per capita transit expenditure
Kansas	$11,000,000	2,904,021	$3.79
New Mexico	$6,643,800	2,085,572	$3.19
Colorado	$14,000,000	5,355,866	$2.61
Nebraska	$4,872,884	1,881,503	$2.59
Oklahoma	$5,750,000	3,878,051	$1.48
West Virginia	$2,677,058	1,850,326	$1.45
South Carolina	$6,000,000	4,832,482	$1.24
Arkansas	$3,550,045	2,966,369	$1.20
Texas	$30,341,068	26,956,958	$1.13
Louisiana	$4,955,000	4,649,676	$1.07
South Dakota	$770,000	853,175	$0.90
Maine	$1,147,845	1,330,089	$0.86
Ohio	$7,300,000	11,594,163	$0.63
Missouri	$3,417,258	6,063,589	$0.56
Mississippi	$1,600,000	2,994,079	$0.53
New Hampshire	$679,281	1,326,813	$0.51
Kentucky	$1,867,907	4,413,457	$0.42
Montana	$377,895	1,023,579	$0.37
Georgia	$3,342,964	10,097,343	$0.33
Idaho	$312,000	1,634,464	$0.19
Alabama	$0	4,849,377	$0.00
Arizona	$0	6,731,484	$0.00
Hawaii	$0	1,419,561	$0.00
Nevada	$0	2,839,099	$0.00
Utah	$0	2,942,902	$0.00

* Population figures represent total area served by transit system. *Source:* AASHTO 2016.

Appendix G. State Transit Legislation

State	Description of transit legislation	Source
Arkansas	Passed in 2001, Arkansas Act 949 established the Arkansas Public Transit Fund, which directs monies from rental vehicle taxes toward public transit expenditures.	ftp://www.arkleg.state.ar.us/acts/2001/htm/ACT949.pdf
California	California's Transportation Development Act provides two sources of funding for public transit: the Location Transportation Fund (LTF) and the State Transit Assistance (STA) Fund. The general sales tax collected in each county is used to fund each county's LTF. STA funds are appropriated by the legislature to the state controller's office. The statute requires that 50% of STA funds be allocated according to population and 50% be allocated according to operator revenues from the prior fiscal year.	www.dot.ca.gov/hq/MassTrans/State-TDA.html
Colorado	Colorado adopted the FASTER legislation in 2009, creating a State Transit and Rail Fund that accumulates $5 million annually. The legislation also allocated $10 million per year from the Highway Users Tax Fund to the maintenance and creation of transit facilities. Colorado subsequently passed SB 48 in 2013, which allowed for the entire local share of the Highway Users Trust Fund (derived from state gas tax and registration fees) to be used for public transit and bicycle or pedestrian investments.	www.leg.state.co.us/clics/clics2009a/csl.nsf/billcontainers/636E40D6A83E4DE987257537001F8AD6/$FILE/108_enr.pdf www.leg.state.co.us/CLICS/CLICS2013A/csl.nsf/fsbillcont3/9D4690717C1FF9DC87257AEE00572392?Open&file=048_enr.pdf
Florida	House Bill 1271 allows municipalities in Florida with regional transportation systems to levy a tax, subject to voter approval, that can be used as a funding stream for transit development and maintenance.	www.myfloridahouse.gov/sections/Bills/billsdetail.aspx?BillId=44036
Georgia	The Transportation Investment Act, enacted in 2010, allows municipalities to pass a sales tax for the express purpose of financing transit development and expansion.	gsfic.georgia.gov/transportation-investment-act
Hawaii	Section HRS 46-16.8 of the Hawaii Revised Statutes allows municipalities to add a county surcharge on state taxes. The surcharge is then funneled toward mass transit projects.	www.capitol.hawaii.gov/hrscurrent/Vol02_Ch0046-0115/HRS0046/HRS_0046-0016_0008.htm
Illinois	House Bill 289 allocates $2.5 billion for the creation and maintenance of mass transit facilities from the issuance of state bonds.	legiscan.com/gaits/text/70761
Indiana	House Bill 1011 specifies that a county or city council may elect to provide revenue to a public transportation corporation from the distributive share of county adjusted gross income taxes, county option income taxes, or county economic development income taxes. An additional county economic development income tax no higher than 0.3% may also be imposed to pay the county's contribution to the funding of the metropolitan transit district. Only six counties within the state may take advantage of this legislation.	legiscan.com/IN/text/HB1011/id/673339

State	Description of transit legislation	Source
Iowa	The Iowa State Transit Assistance Program devotes 4% of the fees for new registration collected on sales of motor vehicles and accessory equipment to support public transportation.	www.iowadot.gov/transit/funding.html
Kansas	Transportation Works for Kansas legislation was adopted in 2010 and provides financing for a multimodal development program in communities with immediate transportation needs.	votesmart.org/bill/11412/30514/transportation-works-for-kansas-program%20%28T-Works%20for%20Kansas%20Program%29
Maine	The Maine Legislature created a dedicated revenue stream for multimodal transportation in 2012. Through sales tax revenues derived from taxes on vehicle rentals, Maine's Multimodal Transportation Fund must be used for the purposes of purchasing, operating, maintaining, improving, repairing, constructing, and managing the assets of nonroad forms of transportation.	www.mainelegislature.org/legis/statutes/23/title23sec4210-B.html
Massachusetts	Section 35T of Massachusetts general law establishes the Massachusetts Bay Transportation Authority State and Local Contribution Fund. This account is funded by revenues from a 1% sales tax.	malegislature.gov/Laws/GeneralLaws/PartI/TitleII/Chapter10/Section35t
Michigan	The Michigan Comprehensive Transportation Fund funnels both vehicle registration revenues and auto-related sales tax revenues toward public transportation and targeted transit demand management programs.	www.legislature.mi.gov/(S(hlkm5k45i240utf2mb0odtzt))/mileg.aspx?page=getObject&objectName=mcl-247-660b
Minnesota	House File 2700, adopted in 2010, is an omnibus bonding and capital improvement bill that provides $43.5 million for transit maintenance and construction. The bill also prioritized bonding authorization so that appropriations for transit construction for fiscal years 2011 and 2012 would amount to $200 million.	wdoc.house.leg.state.mn.us/leg/LS86/CEH2700.1.pdf
New York	In 2010, New York adopted Assembly Bill 8180, which increased certain registration and renewal fees to fund public transit. It also created the Metropolitan Transit Authority financial assistance fund to support subway, bus, and rail.	nyassembly.gov/leg/?bn=A08180&term=2009
North Carolina	In 2009, North Carolina passed House Bill 148, which called for the establishment of a congestion relief and intermodal transportation fund.	www.ncleg.net/sessions/2009/bills/house/pdf/h148v2.pdf
Oregon	Oregon has a Lieu of State Payroll Tax Program that provides a direct ongoing revenue stream for transit districts that can demonstrate equal local matching revenues from state agency employers in their service areas.	www.oregonlegislature.gov/citizen_engagement/Reports/2008PublicTransit.pdf
Pennsylvania	Act 44 of House Bill 1590, passed in 2007, allows counties to impose a sales tax on liquor or an excise tax on rental vehicles to fund the development of their transit systems.	www.legis.state.pa.us/WU01/LI/LI/US/HTM/2007/0/0044..HTM

State	Description of transit legislation	Source
Tennessee	Senate Bill 1471, passed in 2009, calls for the creation of a regional transportation authority in major municipalities. It allows these authorities to set up dedicated funding streams for mass transit either by law or through voter referendum.	state.tn.us/sos/acts/106/pub/pc0362.pdf
Utah	Utah's comprehensive transportation funding bill, passed in 2015, allows counties to implement a 0.25% local sales tax to fund locally identified transportation needs. Of all revenues collected using this mechanism, 40% must be awarded to the county transit agency.	le.utah.gov/~2015/bills/static/HB0362.html
Virginia	House Bill 2313, adopted in 2013, created the Commonwealth Mass Transit Fund, which will receive approximately 15% of revenues collected from the implementation of a 1.5% sales and use tax for transportation expenditures.	lis.virginia.gov/cgi-bin/legp604.exe?131+ful+CHAP0766
Washington	In 2012, Washington adopted House Bill 2660, which created an account to provide grants to public transit agencies to preserve transit service.	apps.leg.wa.gov/documents/billdocs/2011-12/Pdf/Bills/Session%20Laws/House/2660.SL.pdf
West Virginia	In 2013, the West Virginia Commuter Rail Access Act (Senate Bill 03) established a special fund in the state treasury to pay track access fees accrued by commuter rail services operating within West Virginia borders. The funds have the ability to roll over from year to year and are administered by the West Virginia State Rail Authority.	www.legis.state.wv.us/Bill_Status/bills_text.cfm?billdoc=SB103%20SUB1%20ENR.htm&yr=2013&sesstype=RS&i=103

Appendix H. State Progress toward Public Building Energy Benchmarking

State	Percentage benchmarked
California	100% of state-owned, executive branch facilities have been benchmarked since 2013.
Connecticut	42% of state buildings, 100% of the Connecticut Technical High School system, 100% of several K-12 school districts, 100% of Connecticut Community Colleges
Delaware	80%
District of Columbia	Approximately 64% of public buildings
Hawaii	Over 29 million square feet of public facilities
Maryland	100% of state facilities
Massachusetts	100% of about 80 million square feet of state-owned facilities
Michigan	88% of state-owned facilities
Mississippi	95% of agencies covered by the energy and cost data reporting requirements under the Mississippi Energy Sustainability and Development Act of 2013
Missouri	Approximately 50% of square footage managed by the Office of Administration and the Department of Corrections
Nevada	86% of total state building square footage
New Hampshire	95% of state-owned building square footage
New Mexico	Approximately 20%
Oregon	100% of state-owned and occupied buildings greater than 5,000 square feet
Rhode Island	100% of all state, municipal, and public school square footage
Tennessee	23% of state-owned buildings
Utah	Approximately 15% of state government building square footage
Vermont	70% of the state-owned and operated building space that the ENERGY STAR® Portfolio Manager is capable of benchmarking
Washington	55% of state agency square footage, 30% of college square footage, 17% of university square footage

Not all states with benchmarking requirements provided the percentage of buildings benchmarked. All states listed above, except Missouri, require benchmarking in public facilities. Missouri has a voluntary benchmarking program.

Appendix I. State Energy Savings Performance Contracting: Investments and Savings

State	Investments 2015–17 (million $)	2015–17 incremental electricity savings (kWh) for all active ESCO projects	2015–17 annual savings from active projects (kWh)
Arkansas	$74.5	107,000,000 kWh (estimated)	28,600,000 kWh via Arkansas Energy Performance Contracting Program (AEPC) projects
California		In 2015, State of California Executive Branch ESCO projects saved approximately 25% of original facility energy use.	
Colorado	$81.9	35,307,418 kWh	180,148,073 kWh
Connecticut		Incremental savings achieved between 2013 and 2016 include Eversource Municipal Projects: 23,057,135 kWh; United Illuminating Municipal Projects: 1,065,389 kWh; Yankee Municipal Projects: 438,215 therms.	
Delaware	$17.3	7,634,366 kWh	
Florida			657,945,912 kWh
Georgia	$80 worth of state agency projects		331,509.56 million Btus from state agencies (annually)
Kentucky	$152.3		
Maryland	$27.7	11,552,002 kWh	123,487 MWh (annually), including savings for one energy performance contract finished in 2002 that would have come to completion during this time period.
Massachusetts	$214 (state and local)	29,595,503 kWh (state)	
Michigan	$50.2		
Nevada	$40.3	35,493,746 kWh	30,370,368 kWh
New York	$18.1	22,562,673 kWh	35,000,000 kWh
Pennsylvania	$42.8	8,754,864 kWh	32,168,680 kWh
Rhode Island	$29.9 (includes funds for both expended and approved contracts)		
Utah	$17.9	3,970,086 kWh	
Virginia	$153.4		8.3 million kWh

State	Investments 2015–17 (million $)	2015–17 incremental electricity savings (kWh) for all active ESCO projects	2015–17 annual savings from active projects (kWh)
Washington	$186.2	49,937,000 kWh	

We excluded ESPC program budgets as well as projected energy and cost savings from states in order to focus on investments and cost and energy savings already achieved.

Appendix J. Total Energy and Cost Savings from State Financial Incentives

State	Title	Low income-targeted	Program administrator	Program-level annual energy savings (kWh, therms)	Program-level annual monetary savings ($)	Reporting year for these data
Alabama	AlabamaSAVES Revolving Loan Program	No	Abundant Power Solutions, LLC	7,554,092 annual kWh for loans funded in FY2016	1,394,852 for loans funded in FY2016	FY2016 (10/1/15 to 9/30/16)
Alabama	WISE (Worthwhile Investments Save Energy) Home Energy Program	No	Nexus Energy Center		7,543 estimated	2016
Alaska	Weatherization Program	Yes	Alaska Housing Finance Corporation (AHFC)	Approximately 60 MMBtus		
California	Bright Schools Program	No	California Energy Commission		863,392	2016
California	California Clean Energy Jobs Act program (Prop 39 K-12 Program)	No	California Energy Commission	147,137,442 kWh (estimated)	30.6 million (includes kWh, therm, propane, and fuel oil savings)	2016
California	Energy Partnership Program	No	California Energy Commission	923,153 therms (estimated)	112,028	2016
California	Energy Conservation Assistance Act (ECAA)	No	California Energy Commission	8,935,573 kWh; 7,779 therms	803,961	2016
California	Energy Conservation Assistance Act - Education Subaccount (ECAA-Ed)	No	California Energy Commission	2,656,422 kWh	414,296	2016

State	Title	Low income-targeted	Program administrator	Program-level annual energy savings (kWh, therms)	Program-level annual monetary savings ($)	Reporting year for these data
California	Property Assessed Clean Energy (PACE) Loss Reserve Program	No	California Alternative Energy and Advanced Transportation Financing Authority (CAEATFA)	Over 305 million kWh/year (estimated)		2016
California	Sales and Use Tax Exclusion for Advanced Transportation and Alternative Energy Manufacturing Program	No	California Alternative Energy and Advanced Transportation Financing Authority (CAEATFA)		149,993,811 in estimated fiscal benefits to the state	2016
Colorado	Agricultural Energy Efficiency Program	No	Colorado Energy Office	13,500 MMBtus	4.5 million	2016–20
Colorado	Renewable Energy and Energy Efficiency for Schools Loan Program (REEES)	No	Colorado Energy Office	3,500 MMBtus		2017
Connecticut	PosiGen Solar Lease and Energy Efficiency Energy Savings Agreement	Yes	Connecticut Green Bank, PosiGen Solar Solutions	20,303 MMBtus	507,564	2016
Florida	Farm Energy and Water Efficiency Realization (FEWER) program	No	Office of Energy, Florida Department of Agriculture and Consumer Services; Alexander Mack	2,611,755 kWh; 515,250 therms		June 2015 to March 2017
Maryland	Maryland Smart Energy Communities Grant	No	Maryland Energy Administration (MEA)	1,424,552 kWh; 15,066 gasoline gallon equivalent		FY2016

State	Title	Low income-targeted	Program administrator	Program-level annual energy savings (kWh, therms)	Program-level annual monetary savings ($)	Reporting year for these data
				(expected, subject to change)		
Maryland	Commercial and Industrial Grant Program	No	Maryland Energy Administration (MEA)	5,265,660 kWh (expected, subject to change)	629,054 (expected, subject to change)	2016 (July 1, 2015 to June 30, 2016)
Maryland	Mathias Agricultural Energy Efficiency Grant program	No	Maryland Energy Administration (MEA)	99,601 kWh; 17,336 gallons of propane	74,211	FY2015
Maryland	Be SMART Home Efficiency Loan Program	No	Maryland Dept. of Housing and Community Development	130,000 kWh; 6,200 therms; 1,800 gallons of oil; 900 gallons of propane	32,600	July 1, 2016 to June 30, 2017 (estimated)
Maryland	Be SMART Multi-Family Efficiency Loan Program	No	Maryland Dept. of Housing and Community Development	900,000 kWh	115,000	July 1, 2016 to June 30, 2017 (estimated)
Maryland	Jane E. Lawton Conservation Loan Program	No	Maryland Clean Energy Office	1,537,933 kWh; 22,731 therms (projected)	219,931	FY2016 (July 1, 2015 to June 30, 2016)
Maryland	State Agency Loan Program	No	Maryland Energy Administration	3,960,882 kWh; 113,649 therms; 595 gallons of heating oil (projected)	627,065 (projected)	FY2016–17
Maryland	Home Energy Loan Program	No	Maryland Clean Energy Center and Mariner Finance	1,351,000 kWh (estimate)		FY2017

State	Title	Low income-targeted	Program administrator	Program-level annual energy savings (kWh, therms)	Program-level annual monetary savings ($)	Reporting year for these data
Michigan	LED Conversion Building Retrofit Program	No	Michigan Energy Office	55,000 kWh	5,600	2016
Michigan	LED Street Lighting Project	No	Michigan Energy Office	525,000 kWh	54,000	2016
Michigan	Small Business Pollution Prevention Loan Program (P2 Loan Program)	No	Michigan Department of Environmental Quality (MDEQ)		1,790	2016
Michigan	Green Loan Loss Reserve	No	Cinnaire reporting for Michigan Energy Office	3,439,736 kWh; 7,614 therms	598,633	2016
Michigan	Community Energy Management Program	No	Michigan Energy Office	162,312 kWh; 412 kcf	30,000	2016
Minnesota	Energy Savings Partnership Program	No	Saint Paul Port Authority (Peter Berger)		101,819	2016
Missouri	Tax Deduction for Home Energy Audits and Energy Efficiency Improvements	No	Missouri Department of Revenue		352,481	2016
Missouri	Energy Loan Program	No	Missouri Department of Economic Development (DED) Division of Energy (DE)	9,296,298 kWh; 8,464 MMBtus (FY2017)	11.3 million (FY2016); 8.3 million (FY2017)	FY2016–17
Nevada	Home Energy Retrofit Opportunities for Seniors (HEROS)	Yes	Department of Business and Industry, Nevada Housing Division	752,488 kWh; 36,771 therms	133,318	FY2017 (estimated July 2016 to June 2017)

State	Title	Low income-targeted	Program administrator	Program-level annual energy savings (kWh, therms)	Program-level annual monetary savings ($)	Reporting year for these data
Nevada	Green Building Tax Abatement (GBTA) Program	No	Governor's Office of Energy	209,429,307 kWh	39,033,237	FY2016–17
Nevada	Direct Energy Assistance Loan (DEAL) Program	No	Governor's Office of Energy	176,353 kWh; 23,508 therms	47,751	FY2017 (estimated July 2016 to June 2017)
New Mexico	Sustainable Building Tax Credit (Corporate)	No	New Mexico Taxation & Revenue Department; Ken Hughes	9.2 million kWh	92,3000	2016
New York	Green Jobs Green New York	No	NYSERDA	32,645,000 kWh generation, 8,275,000 kWh savings, 357,853 MMBtus	11.8 million in customer bill savings	2016
New York	Cleaner Greener Communities	No	NYSERDA	Annual estimate: 1,218,453 MMBtus	Annual estimate: 13,485,105	2017
New York	Transportation Research	No	NYSERDA			2016
New York	Home Performance with ENERGY STAR®	No	NYSERDA	239,000 kWh, 48,365 MMBtus	1.1 million in customer bill savings	2016
New York	Climate Smart Communities	No	New York State Department of Environmental Conservation			2016
New York	76 West	No	NYSERDA			2016

State	Title	Low income-targeted	Program administrator	Program-level annual energy savings (kWh, therms)	Program-level annual monetary savings ($)	Reporting year for these data
New York	Charge NY	No	NYSERDA		Anticipated benefits include: 5 million in leveraged private capital per year, 400 publicly accessible charging stations, 600 additional PEVs purchased, three customer engagement/awareness campaigns launched, three industry partnerships formed	2016
New York	EmPower New York	Yes	NYSERDA	36,310 MMBtus	823,000 in customer bill savings	2016
Oregon	Residential Energy Tax Credit	No	Oregon Department of Energy	12,829,020 kWh; 320,423 therms		2015
Oregon	Energy Conservation Tax Credits - Competitively Selected Projects (Corporate)	No	Oregon Department of Energy	13,964,193 kWh; 309,426 therms		2015
Pennsylvania	Alternative and Clean Energy Program	No	Commonwealth Financing Authority/ Department of Community and Economic Development	7,702 MMBtus		FY2015–16
Pennsylvania	Alternative Fuels Incentive Grant	No	DEP administers this grant program under the Alternative Fuels Incentive Act (Nov. 29, 2004, P.L. 1376, No. 178).	2.6 million gasoline gallon equivalent		FY2015–16

State	Title	Low income-targeted	Program administrator	Program-level annual energy savings (kWh, therms)	Program-level annual monetary savings ($)	Reporting year for these data
Pennsylvania	Energy Efficiency Loan Program (Keystone HELP/WHEEL)	No	Pennsylvania Treasury Department, Renew Financial	2,079,463 kWh	544,102	NA
Pennsylvania	High Performance Building Incentives Program	No	Department of Community and Economic Development (DCED) and the Department of Environmental Protection (DEP), under the direction of Commonwealth Finance Authority (CFA)	58,800 kBtu	2,529	FY2015–16
Rhode Island	Efficient Buildings Fund	No	RI Infrastructure Bank (RIIB) & RI State Energy Office	25,242,469 kBtu	205,3023	FY2017
Rhode Island	Block Island Saves	No	State Energy Office	182,036 kWh; 2,275 therms	52,600 (estimated)	October 2015 to March 2017
Rhode Island	LED Streetlight Program	No	State Energy Office	20,086,683 kWh (5 municipalities)	3,414,736 (5 municipalities)	2017
Rhode Island	Charge Up! Public Sector Vehicle Electrification Incentive Program	No	State Energy Office	1,346,790 kWh (cumulative savings from EE projects to offset expected charging load)	215,486 (estimated)	July 2016 to May 2017
Tennessee	Energy Efficient Schools Initiative (EESI)—Grants	No	EESI	41 million kWh	4.1 million/year	2016

State	Title	Low income-targeted	Program administrator	Program-level annual energy savings (kWh, therms)	Program-level annual monetary savings ($)	Reporting year for these data
Tennessee	Pathway Energy Efficiency Loan Program (EELP)	No	Pathway Lending Community Development Financial Institution	8,098,341 kWh	827,604	2016
Tennessee	EESI - Loans	No	EESI	172 million kWh (estimated for 15 loan projects for which EESI has data)		2016
Tennessee	Bristol Energy Efficiency Assistance Program	Yes	Tennessee Department of Environment & Conservation, Office of Energy Programs	20,891 kWh	1,111	2016
Tennessee	Clean Tennessee Energy Grant Program	No	Tennessee Department of Environment & Conservation, Office of Sustainable Practices	32 million kWh	3.1 million in energy and maintenance savings	2016
Utah	U-Save Revolving Loan Fund/ Revolving Loan Fund for Energy Efficiency Projects in School Districts and Political Subdivisions	No	Governor's Office of Energy Development	839,489 kWh across loans	198,302 across loans	2016
Utah	State Facility Energy Efficiency Fund	No	Utah State Building Board		1,108,302	2016
Washington	Energy Efficiency and Solar grants	No	Washington Department of Commerce		5,400,000	2015–17 state capital budget period

State	Title	Low income-targeted	Program administrator	Program-level annual energy savings (kWh, therms)	Program-level annual monetary savings ($)	Reporting year for these data
Washington	Energy Revolving Loan Fund Grant	No	Washington Department of Commerce			2015–17 state capital budget period
Washington	Community Energy Efficiency Program	Yes	Washington Department of Commerce, Washington State University Energy Program	12,225 MBtus	277,000	FY2016–17; July 2015 to June 2017

ACEEE excludes individual program budgets from the table because this metric did not allow for a state-by-state comparison of financial incentives. We attempted to collect incentive participation data, but most state respondents were unable to quantify the total number of eligible participants for each program. As a result, participation could not be expressed as a percentage, and we excluded these data from the table.

Appendix K. State Efficiency Spending and Savings Targets for Low-Income Customers

State	Spending/savings requirements for low-income energy efficiency programs
California	California's Long Term Energy Efficiency Strategic Plan, first adopted in 2008 and updated in 2011, establishes a goal that by 2020, 100% of eligible and willing customers will have received all cost-effective low-income energy efficiency measures. The California Department of Community Services & Development (CSD) administers the Low-Income Weatherization Program (LIWP), which installs solar photovoltaics, solar hot-water heaters, and energy efficiency measures in low-income single family and multifamily dwellings in disadvantaged communities to reduce GHG emissions and save energy. LIWP is funded through AB 32 cap-and-trade auction revenues and was allocated a total of $154 million in the 2014–15 and 2015–16 state budgets. SB 350 was passed in 2015 establishing annual savings targets to achieve a cumulative doubling of statewide energy efficiency savings by 2030. The bill mentions no specific low-income energy efficiency targets, but directs the California Public Utilities Commission to publish a study on barriers to energy efficiency and weatherization investments for low-income customers, including those in disadvantaged communities, as well as recommendations on how to increase access to energy efficiency and weatherization investments for these low-income customers.
Connecticut	Utilities are required to allocate the limited income budgets in parity with the revenues that are expected to be collected from that sector. Per Public Act 11-80, Section 33, Connecticut establishes a goal of weatherizing 80% of homes. This goal is not specific to low-income customers, but activity in the low-income program helps the companies achieve this goal. Also, as part of the performance management incentive (PMI) calculation, the utilities are required to spend at least 95% of the low-income budget. Electric, natural gas, oil, and propane savings metrics also fall under the low-income program attached to the PMI calculation.

State	Spending/savings requirements for low-income energy efficiency programs
Delaware	Delaware established legislative energy savings targets in 2009 with the adoption of SB 106, although these have yet to be implemented. The legislation sets up a Sustainable Energy Trust Fund to collect charges assessed by energy providers in service of energy savings goals. SB 106 specifies that 20% of assessment be provided to the Weatherization Assistance Program. Electric utility restructuring legislation passed in 1999 specifies that Delmarva Power and Light collect 0.095 mills per kWh (approximately $800,000 annually) from customers to be forwarded to the Department of Health and Social Services, Division of State Service Centers to be used to fund low-income fuel assistance and weatherization programs. To make low-income energy efficiency programs more accessible, a Guidance Document was drafted in 2016 as part of the merger settlements approved by the PSC between Exelon and Delmarva Power and Light to allocate $4 million of the funds toward low-income customer energy efficiency programs. This Guidance Document applies to DPL customers and funds are available to support organizations delivering energy efficiency programs to low-income ratepayers. Organizations that receive grants to run low-income energy efficiency programs will increase energy efficiency measures for low-income Delaware households, increase statewide electric and gas savings, engage and inform low-income households about the benefits of energy efficiency, develop a community-based approach to address energy efficiency issues in low-income housing by mobilizing public and private sector resources, and ensure to the greatest extent feasible that job training, employment, and contracting generated by this grant will be directed to low-income persons. All settlement-funded low-income programs must be officially recommended by the EEAC and approved by the PSC.
District of Columbia	The DC Council adopted the Clean and Affordable Energy Act (CAEA) of 2008 effective October 1, 2008, which authorizes the Energy Office to contract with a DC "Sustainable Energy Utility" (SEU) for the implementation of energy efficiency programs. The legislation also established a separate Energy Assistance Trust Fund (EATF) to be used solely to fund: "(1) the existing low-income programs in the amount of $3.3 million annually; and (2) the Residential Aid Discount subsidy in the amount of $3 million annually." Sec. 201 of the legislation specifies that the contract with DC SEU shall "improve the energy efficiency of low-income housing in the District of Columbia."
Illinois	In December 2016, the Illinois State Legislature passed the Future Energy Jobs Bill (SB 2814). The legislation directs utilities to implement low-income energy efficiency measures of no less than $25 million per year for electric utilities that serve more than 3 million retail customers in the state (ComEd), and no less than $8.35 million per year for electric utilities that serve less than 3 million but more than 500,000 retail customers in the state (Ameren).
Maine	LD-1559, passed in June 2013, states that Efficiency Maine Trust shall "target at least 10% of funds for electricity conservation collected under subsection 4 or 4-A or $2,600,000, whichever is greater, to programs for low-income residential consumers, as defined by the board by rule."

State	Spending/savings requirements for low-income energy efficiency programs
Massachusetts	In the late 1990s, Massachusetts restructuring law established a low-income conservation fund through a 0.25 mills per kWh charge on every electric customer, while a conservation charge on natural gas customers' bills has funded natural gas low-income energy efficiency programs. In 2010, the program received additional funding through the 2008 Green Communities Act, which required that 10% of electric utility program funds and 20% of gas program funds be spent on comprehensive low-income energy efficiency and education programs. The legislation further directed that these programs be implemented through the low-income weatherization and fuel assistance program network with the objective of standardizing implementation among all utilities. In addition to the WAP-coordinated programs that directly serve low-income clients, the utilities fund the Low-Income Multifamily Retrofit Program, which provides cost-effective energy efficiency improvements to multifamily buildings, including nonprofit and public housing authorities. The program is targeted to 1–4 unit residential buildings where at least 50% of the units are occupied by low-income residents earning at or below 60% of area median income. Eligible projects involve efficiency upgrades for buildings with currently high energy consumption, specifically for space heating, hot water, air sealing, and insulation of building envelopes, lighting, and appliances.
Michigan	SB 438, approved in December 2016, extended the state's 1% annual energy savings requirement for utilities through 2021. The bill does not specify a minimum required level of spending or savings for low-income energy efficiency programs, other than to direct that distribution customers' funding responsibilities for low-income residential programs be proportionate to the distribution customers' funding of the total energy optimization (EO) program: "The established funding level for low-income residential programs shall be provided from each customer rate class in proportion to that customer rate class's funding of the provider's total energy optimization programs."
Minnesota	Minnesota Statute 216B.241 (Subdivision 7) requires both natural gas and electric utilities to provide low-income energy efficiency programs. Both municipal gas and electric utilities must spend at least 0.2% of their gross operating revenue from residential customers on low-income programs. Legislation passed in 2013 raised the minimum low-income spending requirement for investor-owned natural gas utilities from 0.2% to 0.4% of their most recent three-year average gross operating revenue from residential customers.
Montana	SB 150, passed in 2015, made changes to the state's system benefit fund, increasing a public utility's minimum funding level for low-income energy and weatherization assistance and clarifying that eligible projects can be located on tribal reservations. SB 150 increases a public utility's minimum annual funding requirement for low-income energy and weatherization assistance from 17% to 50% of the public utility's annual electric universal systems benefits (USB) level. A cooperative utility's minimum annual funding requirement for low-income energy assistance remains at 17% of its annual USB funding level.

State	Spending/savings requirements for low-income energy efficiency programs
Nevada	In July 2001, Nevada passed AB 661, which created the Nevada Fund for Energy Assistance and Conservation (FEAC) through a universal energy charge (UEC) assessed on retail customers of the state's regulated electric and gas utilities. Nevada's Energy Assistance Code specifies the UEC is 3.30 mills per therm of natural gas and 0.39 mills per kWh of electricity purchased by these customers. NRS 702.270 requires that 25% of the money in the FEAC must be distributed to the Nevada Housing Division for programs of energy conservation, weatherization, and energy efficiency for eligible households. In June 2017, SB 150 was signed into law, which, in addition to directing the PUCN to establish annual energy savings goals for NV Energy, also requires utilities to set aside 5% of efficiency program budgets for low-income customers.
New Hampshire	In August 2016, the New Hampshire Public Utilities Commission approved a settlement agreement establishing a statewide energy efficiency resource standard (EERS). The agreement provides for an increase in the minimum low-income share of the overall energy efficiency budget from 15.5% to 17%.
New Mexico	The state's energy efficiency targets, first established in 2005 within the Efficient Use of Energy Act, were amended in 2013 with the passage of HB 267. The legislation calls for an 8% reduction of energy consumption as a percentage of sales by 2020 and also directs that no less than 5% of the amount received by the public utility for program costs shall be specifically directed to energy efficiency programs for low-income customers.
New York	The EmPower New York program, administered by the New York State Energy Research and Development Authority (NYSERDA) under an agreement with the New York Public Service Commission (PSC), offers no-cost energy services for households with incomes at or less than 60% of state median income. An October 2011 order set systems benefits charge (SBC)/EEPS funding levels for 2012–15, providing EmPower New York with $73.7 million through the electric EEPS and $97.9 million through the gas EEPS, which amounts to approximately 30% of SBC collections attributable to residential customers. As explained in the order, the PSC specifically chose this level based upon recommendations from staff and stakeholders that low-income customers represent approximately 30% of total residential customers. In addition, the January 2016 PSC Order authorizing the Clean Energy Fund Framework requires that NYSERDA "must invest at least $234.5 million of Market Development funds in Low-to-Moderate Income (LMI) initiatives over the initial three year period." Market Development is one of four distinct portfolios supported by the Clean Energy Fund; the others include Innovation & Research, NY-Sun, and the NY Green Bank.
Oklahoma	Under OAC 165:35-41-4, all electric utilities under rate regulation of the Oklahoma Corporation Commission (OCC) must propose, at least once every three years, and be responsible for the administration and implementation of a demand portfolio of energy efficiency and demand response programs within their service territories. The regulations specify that demand portfolios address programs for low-income and hard-to-reach customers "to assure proportionate Demand Programs are deployed in these customer groups despite higher barriers to energy efficiency investments."

State	Spending/savings requirements for low-income energy efficiency programs
Oregon	Legislation (Senate Bill 1149) requiring electric industry restructuring for the state's largest investor-owned utilities was signed into law in July 1999. The law established an annual expenditure by the utilities of 3% of their revenues to fund "Public Purposes," including energy efficiency, development of new renewable energy, and low-income weatherization. Per the legislation, 13% of the public purpose charge would be allocated to low-income weatherization through the Energy Conservation Helping Oregonians (ECHO) program.
Pennsylvania	In June 2015, the Pennsylvania Public Utility Commission (PUC) issued an implementation order for Phase III of the Energy Efficiency and Conservation (EE&C) Program, setting five-year cumulative targets of 5.1 million MWh, equivalent to about 0.77% incremental savings per year through 2020. The order also requires each utility to obtain a minimum of 5.5% of their total consumption reduction target from the low-income sector.
Texas	As amended by SB 1434 in June 2011, Substantive Rule § 25.181 states "...each utility shall ensure that annual expenditures for the targeted low-income energy efficiency program are not less than 10% of the utility's energy efficiency budget for the program year."
Vermont	Efficiency Vermont (EVT), the state's energy efficiency utility established in 1999, is funded through a systems benefits charge on all utility customers' bills. Most of the costs of the electric efficiency measures implemented by EVT and the community-based weatherization agencies are paid for by EVT, with any remaining balances covered by the federal Weatherization Assistance Program (WAP). Other funding for WAP comes from the state's Weatherization Trust Fund, which was created in 1990 through legislative enactment of a gross-receipts tax of 0.5% on all non-transportation fuels sold in the state. As specified by Vermont Law, 50% of the net proceeds from the sale of carbon credits through the Regional Greenhouse Gas Initiative (RGGI) are deposited into a fuel efficiency fund to provide energy efficiency services to residential consumers who have incomes up to and including 80% of the state median income.
Wisconsin	The Reliability 2000 Law, passed in 1999, created a program for awarding grants to provide assistance to low-income households for weatherization and other energy conservation services, payment of energy bills, and the early identification and prevention of energy crises. The law specifies that 47% of total low-income funds must be dedicated to weatherization. The legislation required the Department of Administration to collect $24 million for low-income public benefits services the first year and to calculate a low-income need target in subsequent years. This low-income need target is calculated based on the estimated number of low-income families (households at or below 150% of the poverty level) multiplied by the estimated need per eligible household.

Appendix L. Cost-Effectiveness Rules for Utility Low-Income Efficiency Programs

State	Special cost-effectiveness provisions for low-income energy efficiency programs
Arizona	Since 2011 Arizona Administrative Code Title 14, Chapter 2, Article 24 (R14-2-2412) has directed that "an affected utility's low-income customer program portfolio shall be cost effective, but costs attributable to necessary health and safety measures shall not be used in the calculation."
Arkansas	Arkansas does not require program-level cost effectiveness for low-income programs.
California	Decision 08-11-031 specifies that the cost effectiveness of low-income measures is measured using the UCT and PCm test. Where a measure has a cost-effectiveness figure above 0.25, IOUs may offer it in their LIEE programs, and the CPUC will consider the measures to be consistent with its goal of increasing the energy savings of the program.
Colorado	Decision No. C08-0560 directs the Colorado Public Service Commission to pursue all cost-effective low-income DSM programs, "but to not forego DSM programs simply because they do not pass a 1.0 TRC test." It also directs that, in applying the TRC to low-income DSM programs, "the benefits included in the calculation shall be increased by 20%, to reflect the higher level of non-energy benefits that are likely to accrue from DSM services to low-income customers." To avoid unintended impacts to calculations of benefits pursuant to performance incentives, the decision also allows utilities to exclude these costs in these determinations: "To address this concern we find that the costs and benefits associated with any low-income DSM program that is approved and has a TRC below 1.0 may be excluded from the calculation of net economic benefits. Further, the energy and demand savings may be applied toward the calculation of overall energy and demand savings, for purposes of determining progress toward annual goals."
Connecticut	Connecticut has established formal rules and procedures for evaluation, which are stated in Public Act 11-80 and Evaluation Rules and Roadmap. The Program Administrator test has been the primary cost-effectiveness test in Connecticut. However the Total Resource Cost (TRC) test is the primary test only for the Home Energy Solutions Limited-Income program. Connecticut regulators have repeatedly approved non-cost-effective low-income programs.
Delaware	The EM&V Committee in 2016 recommended specific net-energy impacts, or net-energy benefits for low-income programs. These net-energy benefits include weatherization-reduced arrearages and participant health and safety benefits. Specific values were also applied to the net-energy benefits and are locked in for three years. These net-energy benefits were unanimously recognized and approved by the EEAC.
District of Columbia	While no specific rules are in place for low-income programs per se, programs that are not cost effective may be included in DCSEU's portfolio as long as the overall portfolio is cost effective based on the societal cost test. A 10% adder is applied to program benefits to account for additional nonenergy benefits including comfort, noise reduction, aesthetics, health and safety, ease of selling/leasing home or building, improved occupant productivity, reduced work absences due to reduced illnesses, ability to stay in home/avoid moves, and macroeconomic benefits.
Florida	Program-level cost effectiveness is not required, although the majority of IOU-administered low-income programs in Florida pass both the TRC and RIM cost-effectiveness tests.

State	Special cost-effectiveness provisions for low-income energy efficiency programs
Idaho	In April 2013, the PUC largely adopted its staff's recommendations from an October 2012 report regarding methodology for evaluating LIWAP and the criteria for increased funding (Order No. 32788, Case No. GNR-E-12-01). In this order, the PUC determined that a utility "may, but need not, include a 10% conservation preference adder for their low-income weatherization programs," but that if the utility believes the adder would make its cost-effectiveness calculations inconsistent, then the company need not use the adder. The PUC encouraged the utilities to include nonenergy benefits of LIWAPs when calculating cost effectiveness, but declined to construct a "specific cost-effectiveness test for low-income programs at this time." Instead, the PUC vowed to continue reviewing LIWAPs on a case-by-case basis.
Illinois	Section 8-103B (Energy Efficiency and Demand-Response Measures) of SB 2814 excludes low-income energy efficiency measures from the need to satisfy the total resource cost-effectiveness (TRC) test: "The low-income measures described in subsection (c) of this Section shall not be required to meet the total resource cost test."
Indiana	Under Senate Bill 412 and Indiana Code 8-1-8.5-10(h) an electricity supplier may submit its energy efficiency plan to the commission for a determination of the overall reasonableness of the plan either as part of a general basic rate proceeding or as an independent proceeding. A petition submitted may include a home energy efficiency assistance program for qualified customers of the electricity supplier whether or not the program is cost effective.
Iowa	According to IAC 199 - 35.8(2), "Low-income and tree-planting programs shall not be tested for cost effectiveness, unless the utility wishes to present the results of cost-effectiveness tests for informational purposes."
Kansas	Low-income programs are not required to pass strict benefit–cost analysis so long as they are found to be in the public interest and supported by a reasonable budget.
Kentucky	Requirements for low-income programming are similar to those governing other programmatic offerings, and these were established by precedent in a 1997 proceeding surrounding the approval of LG&E's DSM program portfolio. The rules for benefit–cost tests are stated in Case No. 1997-083. These benefit–cost tests are required for total program-level screening, with exceptions for low-income programs, pilots, and new technologies. The commission also found in Case No. 97-083 that "If [a] filing fails any of the traditional [cost-effectiveness] tests, LG&E and its Collaborative may submit additional documentation to justify the need for the program."
Maine	Maine has not had specific cost-effectiveness guidelines in place for low-income programs. However the cost-effectiveness test for all programs provides for consideration of nonenergy benefits including "reduced operations and maintenance costs, job training opportunities and workforce development, general economic development and environmental benefits, to the extent that such benefits can be accurately and reasonably quantified and attributed to the program or project."

State	Special cost-effectiveness provisions for low-income energy efficiency programs
Maryland	In Order No. 87082 the PUC requires cost-effectiveness screening for limited-income programs, but indicated the programs may still be implemented without satisfying the test, stating: "We accept the recommendation of the Coalition that, while cost-effectiveness screening of the limited income sub-portfolio shall be required in the same manner as with respect to the other EmPOWER sub-portfolios, the results of the limited-income sub-portfolio screening shall serve as a point of comparison to other jurisdictions and past programmatic performance rather than as the basis for precluding certain limited-income program offerings."
Massachusetts	Massachusetts relies on the TRC test as its primary test for DSM programs, but specifically calculates additional benefits from low-income programs in its benefit–cost ratio. DPU 08-50-B specifies that an Energy Efficiency Plan must include calculations of non-electric benefits, specifically those related to: "(A) reduced costs for operation and maintenance associated with efficient equipment or practices; (B) the value of longer equipment replacement cycles and/or productivity improvements associated with efficient equipment; (C) reduced environmental and safety costs, such as those for changes in a waste stream or disposal of lamp ballasts or ozone-depleting chemicals; and (D) all benefits associated with providing energy efficiency services to Low-Income Customers." In 2010, in its 2010–12 Three-Year Plan Order, the Massachusetts Department of Public Utilities (DPU) ordered the program administrators to conduct a more thorough analysis of nonenergy impacts through evaluation studies. The DPU, with few exceptions, approved these studies. A study for the Massachusetts Program Administrators, conducted by NMR Group, incorporates findings from a review of the Non-Energy Impacts (NEI) literature to quantify nonenergy benefits (NEB), including NEBs for low-income programs.
Michigan	Sec. 71 (4)(g) of SB 438 appears to exempt low-income programs from demonstrating cost effectiveness. To demonstrate that the provider's energy waste reduction programs, excluding program offerings to low-income residential customers, will collectively be cost effective, SB 438 states: "An energy waste reduction plan shall...demonstrate that the provider's energy waste reduction programs, excluding program offerings to low-income residential customers, will collectively be cost effective."
Minnesota	The rules for benefit–cost tests are stated in MN Statutes 261B.241 and Rule 7690.0550. The benefit–cost tests are required for portfolio, total program, and customer project-level screening with exceptions for low-income programs. Subd 7(e) of 216B.241 directs that "costs and benefits associated with any approved low-income gas or electric conservation improvement program that is not cost effective when considering the costs and benefits to the utility may, at the discretion of the utility, be excluded from the calculation of net economic benefits for purposes of calculating the financial incentive to the utility. The energy and demand savings may, at the discretion of the utility, be applied toward the calculation of overall portfolio energy and demand savings for purposes of determining progress toward annual goals and in the financial incentive mechanism."
Mississippi	Mississippi does not require program-level cost effectiveness for low-income programs.
Montana	Montana specifies the TRC to be its primary test for decision making. The benefit–cost tests are required for the individual measure level for program screening, but there are exceptions for low-income programs, pilots, and new technologies.

State	Special cost-effectiveness provisions for low-income energy efficiency programs
Nevada	Nevada Housing Division for programs of energy conservation, weatherization, and energy efficiency for eligible households do not require a cost–benefit analysis.
New Hampshire	With respect to nonenergy benefits for low-income programs, as noted in Order No. 23,574, both low-income programs and educational programs could still be approved by the Commission even if they do not surpass a 1.0 benefit–cost ratio given their additional hard-to quantify benefits."
New Jersey	Implementation of a low-income energy efficiency program is required by N.J.S.A. 48:3-61. The New Jersey Board of Public Utilities does not require Comfort Partners Program to meet any cost-effectiveness tests.
New Mexico	The utility cost test (UCT) is conducted in New Mexico and is considered to be the primary test for decision making and evaluating program cost effectiveness. HB 267 directs that "…In developing this test for energy efficiency and load management programs directed to low-income customers, the commission shall either quantify or assign a reasonable value to reductions in working capital, reduced collection costs, lower bad-debt expense, improved customer service effectiveness and other appropriate factors as utility system economic benefits." It was later codified in New Mexico Administrative Code that: "In developing the utility cost test for energy efficiency and load management measures and programs directed to low-income customers, unless otherwise quantified in a commission proceeding, the public utility shall assume that 20% of the calculated energy savings is the reasonable value of reductions in working capital, reduced collection costs, lower bad-debt expense, improved customer service, effectiveness, and other appropriate factors qualifying as utility system economic benefits" [17.7.2.9 NMAC - Rp. 17.7.2.9 NMAC, 1-1-15].
New York	New York screens programs at the measure level and requires each to have a TRC score of at least 1.0 with some exceptions. It appears that New York's TRC test does not explicitly address nonenergy benefits of low-income programs. However the New York PSC has generally recognized and considered low-income specific benefits in deciding on funding for utility low-income programs. For example, in a 2010 Order, the commission approved a low-income program with a TRC ratio of 0.91, finding that "As a general principle, all customers should have reasonable opportunities to participate in and benefit from EEPS programs. It is also important that supplemental funding be provided to address gas efficiency measures in this program."
North Carolina	North Carolina low-income programs are generally not required to meet cost-effectiveness thresholds in order that utilities would provide EE programs to a sector of the population that would likely not otherwise participate in energy efficiency.
Oklahoma	OAC 165:35-41-4 directs that demand programs targeted to low-income or hard-to-reach customers may have lower threshold cost-effectiveness results than other efficiency programs.
Oregon	The rules for benefit–cost tests are stated in Docket UM 551, Order 94-590, which lays out a number of situations where the PUC may make exceptions to the standard societal test calculation. Order 15-200, signed June 23, 2015, concerns Idaho Power Company's request for cost-effective exceptions to its DSM programs. The commission adopted the recommendation of staff that cost-effectiveness requirements in Order 95-590 do not apply to low-income weatherization programs, such as the Weatherization Assistance for Qualified Customers Program (WAQC).

State	Special cost-effectiveness provisions for low-income energy efficiency programs
Pennsylvania	In Order M-2015-2468992, the PUC specifies 2016 total resource cost test requirements. Pennsylvania relies on the total resource cost (TRC) test and considers it to be its primary cost-effectiveness test. A benefit–cost test is required for portfolio-level screening. The commission requires that the electric distribution companies provide benefit and cost data for both low-income and estimated non-low-income residential program savings in their annual reports and that TRC tests be calculated for all low-income programs and all residential programs. However the commission does not require a separate PA TRC test calculation for the low-income sector.
South Carolina	South Carolina does not require program-level cost effectiveness for low-income programs.
Texas	In an order adopted September 28, 2012, the commission directed that low-income programs would not be required to meet the cost-effectiveness standard in Substantive Rule § 25.181, but rather would only need to meet standards required by the Savings-to-Investment ratio (SIR) methodology. All measures with an SIR of 1.0 or greater qualify for installation. The SIR is the ratio of the present value of a customer's estimated lifetime electricity cost savings from energy efficiency measures to the present value of the installation costs, inclusive of any incidental repairs, of those energy efficiency measures.
Utah	The rules for benefit–cost tests are stated in Docket No. 09-035-27. Utah uses the total resource cost (TRC) test, utility cost test (UCT), participant cost test (PCT), and ratepayer impact measure (RIM). Approval of individual DSM programs or portfolios of programs should be based on an overall determination that the program or portfolio is in the public interest after consideration of all five tests and the passage of the threshold test, the UCT. In addition, Utah also utilizes the PacifiCorp TRC (PTRC) test, which follows the Northwest convention of adding 10% to the avoided costs to account for unquantified environmental and transmission and distribution impacts.
Vermont	Vermont specifies the societal cost test to be its primary test for decision making. A 15% adjustment is applied to the cost-effectiveness screening tool for low-income customer programs.
Virginia	Virginia does not require program-level cost effectiveness for low-income programs.
Washington	Per WAC 480-109-100, low-income weatherization is not included in the portfolio or sector-level cost-effectiveness analysis. Companies may implement low-income programs that have a TRC ratio of 0.67 or above. The rules for benefit–cost tests are directed by the Energy Independence Act of 2006, codified in Chapter 194-37 WAC, which specifies that the TRC test include all nonenergy impacts that a resource or measure may provide that can be quantified and monetized. Washington also applies an additional 10% benefit to account for non-quantifiable externalities, consistent with the Northwest Power Act. In Docket UE-131723, signed March 12, 2015, the commission revised the rule language to allow, rather than require, utilities to pursue low-income conservation that is cost effective consistent with the procedures of the Weatherization Manual finding that, "...in recognition that low-income conservation programs have significant nonenergy benefits, we find it appropriate for utilities to maintain robust low-income conservation offerings despite the unique barriers these programs face."

State	Special cost-effectiveness provisions for low-income energy efficiency programs
Wisconsin	We Energies' Residential Assistance Program (RAP) has historically not been cost effective based on the Total Resource Cost test used by the Public Service Commission to assess cost effectiveness. However the commission has generally determined that such programs remain appropriate for inclusion in program portfolios in order to provide those customers equitable opportunities for participation in energy efficiency programs. (Docket 6630-GF-136)

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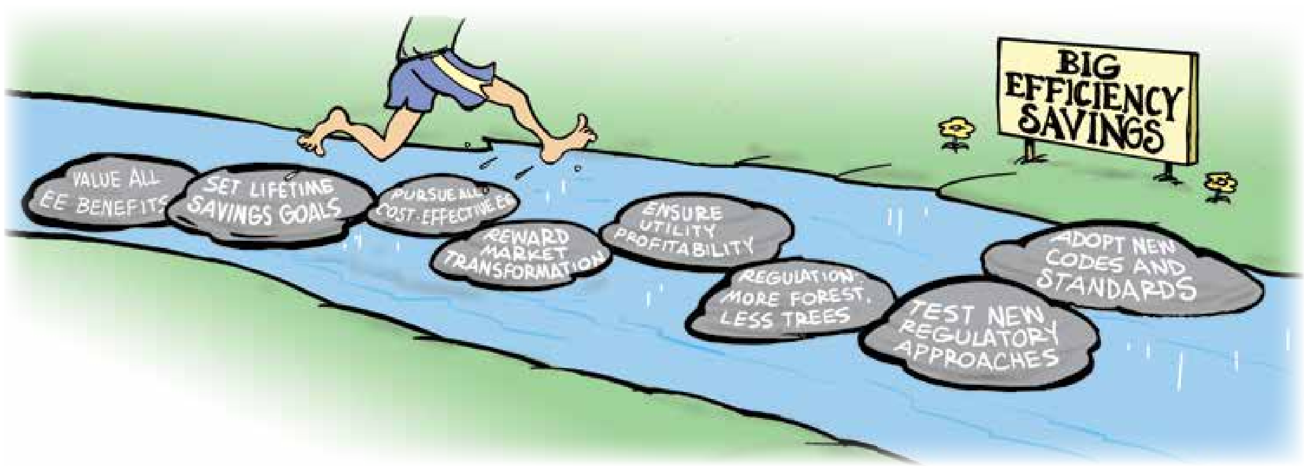

30 Percent Electric Savings in Ten Years

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Cover image by Tim Newcomb

The Next Quantum Leap in Efficiency: 30 Percent Electric Savings in Ten Years

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Acronyms

ACEEE	American Council for an Energy-Efficiency Economy
CHP	Combined heat and power
CVR	Conservation voltage reduction
EERS	Energy efficiency resource standard
EM&V	Evaluation, measurement, and verification
kWh	Kilowatt-hour
SEM	Strategic energy management
T&D	Transmission and distribution
TRC	Total resource cost
US EPA	US Environmental Protection Agency

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I. Introduction

Energy efficiency is the cheapest electricity resource. As Figure 1 shows, the cost of savings from electric ratepayer-funded efficiency programs is currently only one-half to one-third of the average cost of electricity from new power plants. Energy efficiency also provides substantial economic benefits to the electric utility system resulting from reduced investments in transmission and distribution (T&D) infrastructure,[1] reduced exposure to fuel price volatility and other forms of risk,[2] price suppression effects,[3] and reductions in environmental compliance costs,[4] which will become even more important in the future given the US Environmental Protection Agency's (EPA) recently-issued Clean Power Plan regulations. There are also substantial additional benefits to homeowners and businesses (e.g., gas savings, water savings, and improvements to comfort, health and safety, building durability, and business productivity) as well as environmental, public health, low income energy affordability, local economic development, and other societal benefits.[5]

Recognition of the value of energy efficiency has grown considerably over the past decade. In 2006, annual spending on US electric ratepayer-funded efficiency programs was just $1.6 billion[6] and only three states' ratepayer-funded electric efficiency efforts were achieving first year electric savings of greater than 0.8 percent of annual sales.[7] By 2014, spending on ratepayer-funded electric efficiency programs had nearly quadrupled to $5.9 billion and 18 different states achieved

1 For example, the New England Independent System Operator recently identified over $400 million in previously planned transmission system investments in just Vermont and New Hampshire that it is now deferring beyond its ten-year planning horizon as a result of those states' efficiency programs; see Neme, C., & Grevatt, J. (2015). *Energy Efficiency as a T&D Resource: Lessons from Recent US Efforts to Use Geographically Targeted Efficiency Programs to Defer T&D Investments.* Lexington, MA: Northeast Energy Efficiency Partnerships. Many jurisdictions now routinely include avoided T&D costs in efficiency program screening, with values averaging about $70 per kW-year; see The Mendota Group. (2014). *Benchmarking Transmission and Distribution Costs Avoided by Energy Efficiency Investments.* Prepared for Public Service Company of Colorado. Moreover, a growing number of jurisdictions are now deploying geographically targeted efficiency programs specifically for the purpose of cost-effectively deferring upgrades to specific elements of their T&D systems; see Neme, C., & Grevatt, J. (2015); and Neme, C., and Sedano, R. (2012). *US Experience with Efficiency as a Transmission and Distribution System Resource.* Montpelier, VT: The Regulatory Assistance Project.

2 For example, Vermont regulators require that the costs of efficiency measures be reduced by ten percent to account for their risk mitigating advantages relative to supply-side investments.

3 In regions with competitive wholesale markets, reductions in demand lower market-clearing prices for electric energy and/or capacity, at least in the short to medium term. A number of studies have found this effect to initially be on the order of a one to three percent drop in prices for every one percent drop in demand; see Chernick, P., & Griffiths, B. (2014). *Analysis of Electric Energy DRIPE in Illinois.* Memo to Chris Neme, Energy Futures Group; Rebecca Stanfield, Natural Resources Defense Council; and David Farnsworth, Regulatory Assistance Project. This is sometimes called the demand reduction-induced price effect (DRIPE).

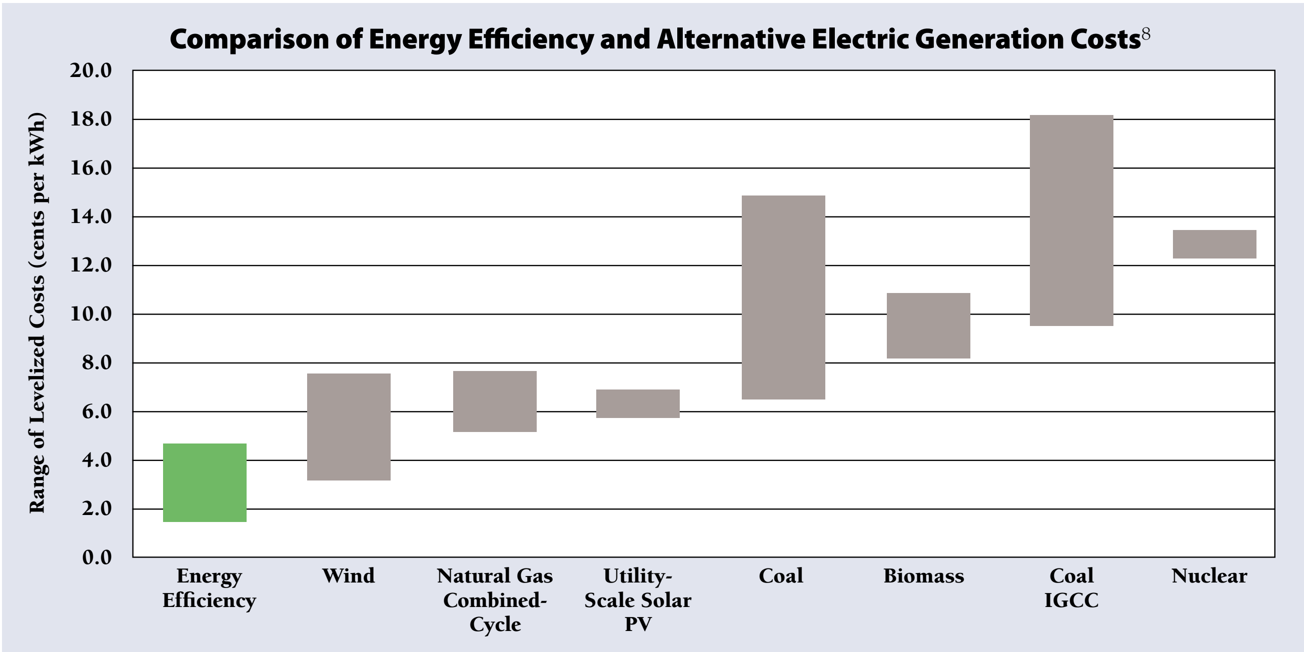
4 For example, see Woolf, T., Steinhurst, W., Malone, E., & Takahashi, K. (2012). *Energy Efficiency Cost-Effectiveness Screening: How to Properly Account for 'Other Program Impacts' and Environmental Compliance Costs.* Montpelier, VT: The Regulatory Assistance Project.

5 For a full discussion of the benefits of efficiency, see Lazar, J., & Colburn, K. (2013). *Recognizing the Full Value of Energy Efficiency.* Montpelier, VT: The Regulatory Assistance Project.

6 Gilleo, A., Nowak, S., Kelly, M., Vaidyanathan, S., Shoemaker, M., Chittum, A., & Bailey, T. (2015). *The 2015 State Energy Efficiency Scorecard.* (ACEEE Report U1509).

7 Connecticut and Rhode Island achieved 1.2 percent savings; Vermont achieved 1.1 percent.

Figure 1



electric savings of more than 0.8 percent of sales. Two states—Massachusetts and Rhode Island—were at or above 2.5 percent.[9] Five others—Arizona, California, Connecticut, Maryland, and Vermont—have policies in place that will require 2.0 percent annual savings or better in the coming years.[10]

This study examines whether the bar could be raised substantially again. Specifically, we examine whether it would be possible to meet 30 percent of electricity system needs in ten years. Though very aggressive—requiring 50 percent to 100 percent more savings than what even the leading states are pursuing today—we conclude that this goal is likely to be achievable, but only with both an unwavering commitment to promoting efficiency whenever it is cost-effective and with innovative thinking and approaches to a variety of topics, including:

- the range of efficiency measures which are considered appropriate to promote;
- the currently strong regulatory emphasis on short-term resource acquisition in the context of long-term goals;

8 See http://aceee.org/topics/energy-efficiency-resource. For efficiency, the costs shown are the utility costs. Under the total resource cost and societal cost tests, one must also consider both additional costs and additional benefits experienced by efficiency program participants. Experience suggests that the net effect of considering both additional participant costs and additional participant benefits will be to reduce the net levelized resource cost of electric efficiency programs. For example, for 2014, Efficiency Vermont reported its levelized utility cost of acquiring savings as 4.6 cents/kWh, but its levelized net resource cost—i.e., after adjusting for both participant costs and savings—was only 0.9 cents/kWh. Efficiency Vermont. (2015). *Savings Claim Summary 2014.*

9 Gilleo et al., 2015.

10 Note that the comparisons here are just for savings from ratepayer-funded efficiency programs. Substantial additional savings have been achieved nationally through federal equipment efficiency standards. States also produce savings through building codes and, in some cases, additional equipment efficiency standards. Over the past decade, there have also been significant efforts in a number of states (perhaps most notably in California) to increase savings from such regulatory mechanisms. However, the data necessary to provide state-by-state comparisons of savings from codes and standards are not readily available.

- the type of metrics being employed to measure efficiency program effectiveness;
- alternatives or additions to current utility-run approaches that are funded by system benefit charges; and
- other regulatory and non-regulatory policy changes.

Needless to say, that range of topics is enormous. Each one of them could be the sole subject of a substantial report, so this study does not purport to provide the "final word" on any of these issues. Rather, it provides a high-level assessment of what is possible and makes preliminary recommendations on some of the policy and program changes that may be necessary to realize another quantum leap in the levels of electric efficiency savings being achieved.

In section II, we summarize the approach we have taken to address the questions raised in this study. In section III, we discuss the current best practice and estimate the ten-year impact of simply continuing that practice. That analysis illustrates how much further we need to go to achieve 30 percent savings in ten years. In section IV, we consider what could be done—technologically and programmatically—to increase savings. In section V, we address what policymakers would need to do to enable those savings to be achieved. Our concluding section VI briefly summarizes key "takeaways" from the report. More detailed discussions of a range of issues raised in the main body of the report are provided in several technical appendices.

What Do We Mean By "30 Percent Savings In Ten Years"?

Savings targets can be defined in many ways, with significantly different economic and policy implications. The "30 percent savings in ten years" target considered in this study is defined as follows:

- Only savings in homes and businesses. We do not consider reductions in line losses, power plant heat rate improvements, or other changes on the utility's side of the meter.
- Just efficiency. We do not consider impacts of customer-sited renewables that generate rather than reduce consumption of electricity.
- Affecting electricity consumption ten years from now. Our focus is on savings that will be in effect at the end of a ten-year period. For example, savings from measures installed in 2016, but that last for only a few years, would not count. Thus, our target is expressed in the form of a much longer-term objective than the "first-year savings" goals currently used in most states.
- Relative to a "business as usual" baseline. We focus on incremental savings that would result from new policies or program interventions. We do not count, for example, savings from federal lighting efficiency standards that have already been promulgated. Nor do we count savings that are forecast to occur "naturally" as markets evolve. In the parlance of the efficiency industry, our focus is on "net savings."

II. Study Approach

It is important to make clear at the outset that this is not an efficiency potential study, at least not in the way that term is commonly used in the energy efficiency industry in North America. That is, we do not conduct a bottoms-up analysis of savings potential from hundreds of individual efficiency measures, assess which of those measures' savings potential is cost-effective based on today's estimates of costs and savings, and then forecast how many of each of those measures consumers would purchase and install under current efficiency program designs. Many such studies already exist. Moreover, while they can provide some useful insights, such traditional potential studies are inherently poor tools for assessing the limits of what is possible, typically grossly understating maximum achievable efficiency potential. (See Appendix A for a discussion of the limitations of traditional potential studies.)

Traditional potential studies are inherently poor tools for assessing the limits of what is possible.

Thus, we approach the question from a more "top down" perspective. As the ensuing discussion will demonstrate, this still involves substantial analysis. However, the analysis is focused more on macro-level trends, lessons learned from past attempts to push the envelope, and strategic or targeted analysis of selected new ideas that have the potential to have big impacts.

We started this project by trying to better understand what the states that are achieving two percent (or close to two percent) incremental annual savings are doing today. Based on both the high-level findings from that analysis and our own past experience (particularly in such leading states), we developed a list of both program and broader policy ideas for how savings levels in even the most aggressive states might be further increased. We then conducted interviews with nine national "thought leaders" from across the country,[11] to get their feedback on our initial ideas and to solicit any additional ideas that they might have. With that input, we conducted additional research into several promising ways to leverage additional savings. What follows is a synthesis of the results of that work.

11 Tom Eckman, Northwest Power and Conservation Council; Rafael Friedman, Pacific Gas and Electric; David Goldstein, Natural Resource Defense Council; Fred Gordon, Oregon Energy Trust; Marty Kushler, American Council for an Energy-Efficient Economy (ACEEE), Mike Messenger, Itron; Phil Mosenthal, Optimal Energy; Steve Nadel, ACEEE; and Steve Schiller, Schiller Consulting.

III. Current Best Practice

A. What Leading States Are Achieving

In 2014, the two states achieving the greatest level of electricity savings from ratepayer-funded programs were Massachusetts and Rhode Island. Massachusetts' investor-owned utilities achieved savings equal to nearly 2.8 percent of sales in 2014, 2.75 percent if one excludes a few small combined heat and power (CHP) projects.[12] National Grid in Rhode Island achieved savings equal to approximately 3.5 percent of sales in 2014.[13] However, roughly one-quarter of those savings were from a uniquely large CHP project, without which the annual savings would have been about 2.5 percent of sales.[14] With the exception of the major CHP project impacts in Rhode Island, these are not unpredicted, one-off results. Rather, they represent a continuation of a steady upward trajectory in savings over the past several years in both states. Moreover, both states are projecting slightly higher annual savings levels in the coming years.

It is important to note that the savings any jurisdiction will experience after ten years of running efficiency programs will be less than the sum of its annual savings over that period because every efficiency program portfolio includes measures that last less than ten years. Massachusetts and Rhode Island are no exception. If they were to replicate their 2014 savings every year for the next ten years, the result (excluding CHP impacts) would be annual savings at the end of the tenth year of about 23 percent in Massachusetts and 19 percent in Rhode Island, or an average of 21 percent.

There are undoubtedly many factors that have contributed to the success of both Massachusetts and Rhode Island in acquiring groundbreaking levels of electric energy savings. We have not investigated the issue in the depth required to comprehensively identify all of the factors. However, several jump out as particularly important. Perhaps the most basic and most important is that both states endeavor to treat efficiency as a resource that should be acquired whenever it is less expensive than supply alternatives. In other words, there are no arbitrary budget limits that prevent program administrators from maximizing the amount of efficiency being acquired as long as it is cost-effective. That mandate to pursue all cost-effective efficiency resulted in 2014 electric utility efficiency program spending of more than $500 million in Massachusetts and $80 million in Rhode Island.[15] That translates to between 6 percent and 7 percent of revenues in both states. Vermont (5.95 percent) was the only other state with comparable spending levels; no other state spent more than 4.3 percent of revenues on ratepayer-funded electric efficiency programs.[16]

Other key policy factors include the presence of sophisticated performance mechanisms to reward utility shareholders for meeting or exceeding goals,

12 Note that this is higher than the 2.5 percent reported in the *2015 ACEEE State Scorecard.* The difference is that the ACEEE uses total state sales in its denominator, including sales by municipal utilities who do not run programs.

13 Gilleo et al., 2015.

14 Narragansett Electric Company (d/b/a National Grid). (2015). *2014 Energy Efficiency Year End Report.* RI PUC Docket No. 4451.

15 The Massachusetts electric utilities are required, by policy, to fund efforts to improve the efficiency of oil and propane heated homes. We estimate that on the order of 15 percent of the total 2014 electric efficiency spending could be allocable to such efforts.

16 Gilleo et al., 2015.

cost-effectiveness screening frameworks that come close to fully valuing all of the benefits of efficiency, consideration of spillover effects as well as free rider effects, and a long history of working with non-utility stakeholders to explore new opportunities for savings and develop consensus plans and goals.

Programmatically, both states have very comprehensive and sophisticated program portfolios. The composition of those portfolios is summarized in Appendix B.

Energy efficiency measures aren't static. As opportunities for some measures decrease over time, opportunities for others increase.

B. The Effect of Product Efficiency Standards on Future Savings Potential

A significant portion of the savings that Massachusetts and Rhode Island achieved in 2014 was from measures that will be affected (in some cases effectively mandated) by new federal product efficiency standards. Because such standards apply to all consumer purchases,[17] whereas utility program participation is voluntary and therefore only affects a portion of the market, the standards will increase the level of savings actually experienced on the electric grid. However, in this study we are examining whether it is possible to achieve 30 percent savings in ten years relative to a baseline that includes the effects of laws, regulations, or other policy interventions that are already "on the books."[18] Thus, for the purposes of this study, we consider future savings from already adopted product efficiency standards to be part of the baseline. Put another way, a portion of Massachusetts' and Rhode Island's 2014 savings could not be replicated with the identical efficiency measures over the next ten years and still count as "new savings" relative to the ten-year savings goal that is the subject of this study.

Of course, one would never expect the mix of efficiency measures in a portfolio of programs to remain static year to year, let alone for ten years. As opportunities for some measures decrease over time, opportunities for others increase. The real question is whether the opportunities for new savings that become available over the study period will be greater than, equal to, or less than the savings that can no longer be claimed toward the goal due to the already adopted product efficiency standards. If new savings opportunities will not make up for the savings that can no longer count toward the goal, then a discounting of (i.e., a downward adjustment to) a ten-year extrapolation of the Massachusetts and Rhode Island 2014 results would be warranted.

On the one hand, it could be argued that the adoption of product efficiency standards has always been followed by the introduction by manufacturers of new products with efficiency levels that exceed the standards. Under this line of reasoning, an efficiency program administrator's pursuit of savings from the new products could be used to offset the "loss" of savings from the products which they used to promote and are now (or will soon be) mandated and therefore considered part of the baseline sales forecast. We believe that conclusion is appropriate, at least in aggregate, for most product standards. We reach a different conclusion with respect to changes to efficiency standards for residential light bulbs and linear fluorescent light fixtures, which account for most of the lighting in commercial buildings. This is both because these measures account for such a large portion of current efficiency program portfolios and because, especially in the case of residential lighting, the increment of efficiency improvement is so large that it could not be offset by the introduction of new, more efficient lighting products. Our analysis suggests that it is

17 This is virtually always the case for product efficiency standards. It is a little less clear for building codes, as there is often less than universal compliance with new requirements.

18 An alternative approach might have been to examine the achievability of a larger savings level (i.e., 35 percent or 40 percent), but include the effects of equipment efficiency standards that are already adopted but yet to go into effect in the assessment (i.e., measuring relative to a less efficient baseline). We have chosen to assess savings potential relative to a baseline that includes savings from laws or regulations than are already "on the books" for two reasons. First, that is the baseline against which most program administrators' efficiency program performance is typically measured. Second, it enables us to more clearly communicate that all of the savings we estimate to be achievable would be the result of new policies; we include in "new" the continuation of existing policies, such as utility energy efficiency resource standards (EERS).

appropriate to reduce the ten-year effect of continuing the Massachusetts and Rhode Island 2014 savings levels by about one-fifth, or to a total of about 17 percent persisting savings in ten years. This effect is discussed in some detail in Appendix C.

C. Transferability of Leading States' Results to the Rest of the Country

Massachusetts and Rhode Island are different from some other parts of the country in a number of ways that could affect electricity savings potential both positively and negatively. For example, both states have higher than average electric rates, higher than average avoided costs, colder than average climates, and longer than average histories of promoting electric efficiency. We are unaware of any analysis that could offer definitive insights into the extent to which these or other differences would affect the transferability of their savings levels to the rest of the country. Our qualitative assessment in Appendix D suggests that the net effect of all these factors is likely to be fairly small. The results of dozens of efficiency potential studies also suggest that achievable cost-effective savings potential does not vary considerably (if at all) from region to region (see Appendix A). Thus, our conclusion is that the principal reason Massachusetts and Rhode Island are achieving much greater levels of savings today than most of the rest of the country is that their policy commitment to pursuing cost-effective efficiency is considerably stronger.

IV. Going Beyond Current Best Practice

In this section we explore several ways in which savings levels in even the most aggressive states could be increased in the coming decade. This includes defining efficiency technology more broadly, promoting emerging or new technology, and improving current efficiency program designs in ways that can increase market penetration rates of efficiency measures.

A. Expanding the Definition of End-Use Efficiency Technology

Two "measures" that are not typically included in efficiency program portfolios—combined heat and power (CHP) and conservation voltage reduction (CVR)—could play important roles in providing additional savings and helping to bridge the gap between the 17 percent that current best practice efforts could achieve over the next decade and a more ambitious project target of 30 percent savings.

1. Combined Heat and Power

CHP systems simultaneously generate (1) electricity and (2) thermal energy that is used for process or space heating, water heating, space cooling, and other needs. There is an inherent energy trade-off with such systems. Specifically, they typically consume a little more gas (or other fuel) on-site than would be consumed by a boiler or furnace that only meets a building's or facility's thermal energy needs. In exchange, the building or facility can produce electricity, eliminating the need to purchase that electricity from the grid. Generally, the amount of electricity produced on-site is considerably more than the average central station power plant would produce with the amount of additional gas consumed on-site. As a result, the combined electric and thermal efficiency of CHP systems can reach or exceed 80 percent, which can be 50 percent greater than the combined efficiency of grid delivered electricity and a boiler operated to meet the building's thermal energy needs.[19]

Massachusetts and Rhode Island are achieving much greater levels of savings today than in most of the rest of the country not because of geographic, climatic or economic conditions, but because their policy commitment to pursuing cost-effective efficiency is considerably stronger.

One of the challenges in treating CHP as an electric efficiency measure is determining how much "savings credit" to assign to it. One could treat all of the electricity generation as "savings."[20] However, that ignores the reality that, unlike other efficiency measures, additional gas (or other fuel) must be consumed to produce those savings. One option for addressing this is used by the American Council for an Energy-Efficiency Economy (ACEEE) to calculate what it calls "effective electric savings." In this approach, the electricity output is "de-rated" by the amount of electricity that would have been produced on the grid had the extra gas been burned in a typical grid-connected power plant. There are other approaches to address this as well.[21] Under the ACEEE approach, we estimate that

19 York, D., Nadel, S., Rogers, E., Cluett, R., Kwatra, S., Sachs, H., Amann, J., & Kelly, M. (2015). *New Horizons for Energy Efficiency: Major Opportunities to Reach Higher Electricity Savings by 2030.* ACEEE Report Number U1507.

20 This is how Massachusetts and Rhode Island currently treat CHP generation when counting its contribution toward electric savings goals. However, the increase in gas consumption is considered an added cost when performing cost-effectiveness screening.

21 One additional alternative, which is currently in use in Illinois, is to "de-rate" the electricity output by the amount of electricity that would be produced on the grid with a carbon emissions allowance equal to the carbon emissions associated with the additional on-side gas consumption. Under that approach, the savings credit will decline as the marginal emissions rate on the grid improves. *Illinois Statewide Technical Reference Manual for Energy Efficiency.* Version 4.0. (2015). Prepared by the Illinois Energy Efficiency Stakeholder Advisory Group (SAG).

aggressive promotion of CHP systems, where cost-effective, could achieve effective electricity savings equal to 2 percent of national electricity sales in ten years.[22,23]

2. Conservation Voltage Reduction

In the US, regulations require that voltage be delivered to homes and businesses within 5 percent of the nominal 120 volts that electricity-consuming equipment is designed to use—i.e., between 114 and 126 volts. Because voltage levels drop along the length of distribution feeders, utilities often maintain higher voltage levels at the beginning of feeders in order to ensure that at least 114 volts will be delivered to the last home or business served by a feeder. The result is that many homes and businesses receive higher voltages than they need. Because many types of electricity-consuming devices use more electricity at higher voltages, better controlling voltage levels will provide end-use electricity savings. CVR is the term typically used to describe enhanced management of voltage levels by distribution utilities to enable such end-use energy savings, while still meeting minimum voltage standards and other utility operating requirements. Several studies suggest that deployment of CVR where it is most cost-effective could produce national savings of about 2.3 percent.[24]

It should be noted that some—including the authors of this report—have argued that savings from CVR should not be allowed to count towards utility efficiency savings targets; rather, distribution utilities should pursue CVR wherever it is cost-effective under their existing obligations as regulated monopolies to minimize costs to their customers. We still believe that is a reasonable argument under the existing design of typical efficiency resource standard requirements. If utilities are not being required to capture all cost-effective energy efficiency (e.g. because of insufficiently aggressive targets or spending caps), then it would be inappropriate to count efficiency improvements resulting from investments on their own distribution systems towards their savings targets. However, in the context of much more aggressive savings targets that are explicitly designed to encompass, support, and promote multiple ways of achieving more aggressive levels of electricity savings, CVR deployment can be viewed as a

"Low-Hanging Fruit" Grows Back

While it is true that the "low-hanging fruit" of linear fluorescent lighting upgrades—i.e., replacing very inefficient T12s with T8s or high performance T8s (HPT8s)—will disappear from ratepayer-funded efficiency programs because of recent and upcoming federal efficiency standards, new opportunities are emerging to take their place. LED troffers with integrated controls are already capable of nearly 70 percent savings relative to the new T8 baseline. They are also already cost-effective. Moreover, their efficiency is forecast to continue to improve while their costs are forecast to continue to decline. Put simply, they should become one of the next major reservoirs of electricity savings. Even if one assumes a baseline of an HPT8, they could potentially provide another 2.2 percent savings over the next decade. This new opportunity is discussed in greater detail in Appendix E.

22 This estimate is based on ACEEE's estimate of CHP savings potential (Hayes, S., Herndon, G., Barrett, J., Mauer, J., Molina, M., Neubauer, M., Trombley, D., & Ungar, L. (2014). *Change is in the Air: How States Can Harness Energy Efficiency to Strengthen the Economy and Reduce Pollution.* ACEEE Report E1401.), adjusted up by about 15 percent to account for the limitations of their analysis (e.g., only systems between 100 kW and 100 MW, no export to the grid, only gas-fired systems—no other fuels or waste-to-energy systems, no consideration of biogas, such as methane produced from waste water treatment systems, etc.). Savings were then divided by the US Energy Information Administration's "Annual Energy Outlook 2015" which forecasts 2025 sales of 4078 TWh. Available at: http://www.eia.gov/beta/aeo/#/?id=8-AEO2015).

23 As noted earlier, the 2014 savings levels presented for Massachusetts and Rhode Island excluded each state's CHP savings because the anomalously high level of CHP savings in Rhode Island that year—equal to about 1.0 percent of total state sales—is not likely to be representative of average annual CHP savings in the future. It is perhaps worth noting that though the Massachusetts CHP savings in 2014 were quite modest, from 2011 to 2013 the state's utilities averaged nearly 80,000 MWh of CHP savings annually, or close to the 0.2 percent of total electricity sales that we are assuming to be achievable on average each year for the next decade.

24 Schneider, K.P., Tuffner, F.K., Fuller, J.C., & Singh, R. (2010). *Evaluation of Conservation Voltage Reduction (CVR) on a National Level.* Prepared for the US Department of Energy under contract DE-AC05-76RL01830; and York et al., 2015.

complement to, rather than a substitute for, other demand-side efficiency improvements.

B. Promoting New Technologies

There are a variety of emerging technologies that offer new opportunities for additional electricity savings. In the residential sector, for example, heat pump water heaters, heat pump dryers, new generations of ultra-efficient and cold climate compatible ductless heat pumps for heating and cooling, and smart thermostats all offer substantial new savings potential. In the commercial and industrial sectors, substantial new savings can be achieved through LED alternatives to linear fluorescent fixtures, particularly when integrated with controls; advanced rooftop HVAC systems; and "smart" systems that use advanced sensors, controls, communications protocols and interconnectivity to optimize performance of a variety of building systems or manufacturing processes. All of these technologies are commercially available today (and in some cases, have been for several years), but generally with very low current levels of market penetration, even in leading states. A recent report by ACEEE that characterizes these and several other measures with currently very low levels of market penetration suggests that all such emerging technologies could collectively save between 18 percent and 19 percent of estimated electricity sales over the next 15 years.[25]

We can also say with virtual certainty that *additional* new efficiency technology advances that we cannot identify today will surface in the next decade. Others that are recognized today, but are now too expensive to be cost-effective, will likely see costs decline to the point where they become economically attractive. Technological advancements that had not been foreseen even a few years ahead of time have consistently made large contributions to reported savings. For example, nearly half of the achievable electric energy savings identified in the Northwest Power and Conservation Council's recently published Draft Seventh Power Plan are from efficiency measures not included in the Council's Sixth Plan produced just five years earlier.[26] Put simply, when assessing how much savings could be achieved in the future, we need to account in some way for the savings potential from new technology that we cannot specifically identify today.

Beyond new technology, there may be important new opportunities for efficiency that emerge as patterns of electricity use change. For example, as the market penetration of electric cars increases, there may be important new opportunities for promoting the purchase of the most efficient vehicles. Similarly, to the extent that there is increased electrification of electric space heating, either as a result of natural market forces or government policy designed to address concerns about climate change, opportunities for acquiring additional cost-effective electric heating savings will grow.

C. New Efficiency Program Approaches

There are also opportunities to achieve deeper levels of savings and greater market penetration of efficient technology—old and new—within the construct of electric ratepayer-funded efficiency programs. Several approaches that have shown great promise merit greater consideration:

- **Upstream product rebates:** Several program administrators, including Pacific Gas & Electric (California), Efficiency Vermont, and the Connecticut utilities have tested upstream program models—where incentives are aimed at distributors rather than end-use purchasers—for a variety of HVAC products. As Figure 2 illustrates, such programs have seen large, sometimes dramatic, participation increases compared to traditional downstream models. A more detailed description of these experiences is presented in Appendix F. The EPA is currently coordinating the launch of a national "mid-stream" program, with incentives provided to retailers for air purifiers, freezers, clothes dryers, and possibly other products.[27] Upstream approaches may not be the best approach for all efficient products, but they can significantly increase participation and savings for the products for

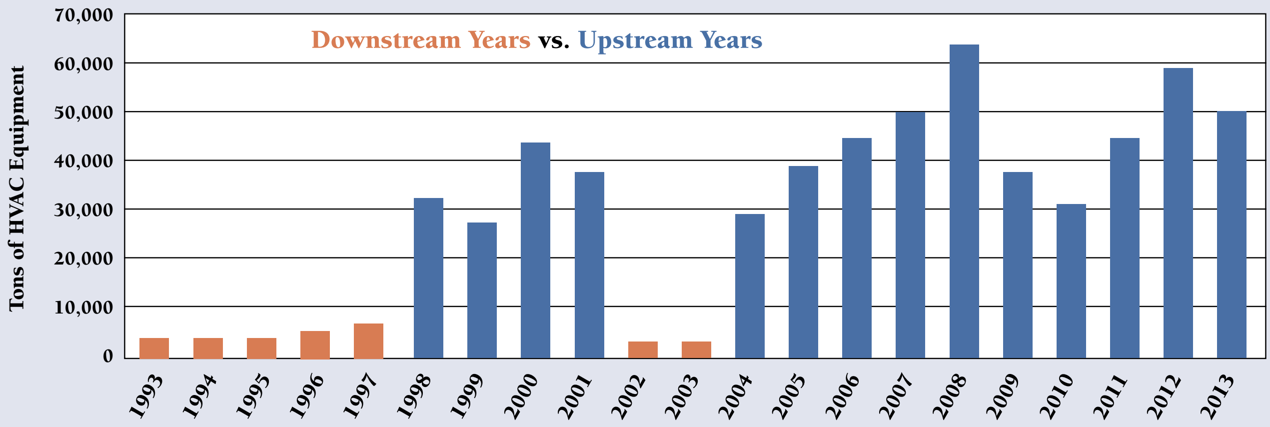
25 The report gives a mid-point savings estimate of 22 percent, including savings from CHP and CVR. The 18-19 percent figure referenced here excludes those two technologies, since we discuss them separately. York et al., 2015.

26 Data provided by Charlie Grist, Northwest Power and Conservation Council, October 14, 2015.

27 See Energy Star. (2015). Retail Products Platform. Available at: http://www.energystar.gov/sites/default/files/asset/document/ESRPP_1pager_10-07-15.pdf.

Figure 2

PG&E Commercial HVAC Program Participation Increases with Upstream Incentive[28]



which they are best suited.[29]

- **Strategic Energy Management (SEM):** SEM is aimed at improving operational efficiency in industrial, commercial, and institutional settings in a systematic and sustained manner, and is increasingly being supported by energy efficiency program administrators. ACEEE recently estimated that aggressive adoption of SEM in the industrial sector could lead to a 1.0 percent reduction in US electric consumption, and that adoption of SEM in the commercial/institutional sector could lead to an additional 0.1 percent-0.3 percent reduction.
- **Market-specific "deeper dives":** Many industries and market segments use energy in ways that are highly specific, and in some cases are even unique when compared with other energy users in their rate class. For instance, hospitals use energy differently than manufacturing facilities, and they are also likely to have very different decision-making processes when it comes to planning for energy efficiency improvements. Leading programs recognize that getting deep savings requires sustained engagement with large customers through "account management" approaches, and that specific intelligence about the business needs of different market sectors is critical to successful engagement. In several cases, industry-specific "deep dives" have identified ways to produce enormous savings. An illustrative case study of how Efficiency Vermont helped transform the market for "snow guns" sold to ski resorts to products that provide more than 95 percent electricity savings relative to standard products is provided in Appendix G. We offer this example not because savings potential from snow guns is substantial nationally (though it is in Vermont and some other states), but rather to illustrate that savings in many niche markets—which *collectively* could be very substantial on a national scale—are potentially much larger than one might imagine.

Just as we have not quantified the potential from all possible new technology, we have not attempted to quantify the savings potential from new or enhanced efficiency program approaches. Indeed, just as with new technology that has not yet emerged, the potential savings from some enhanced efficiency program strategies (e.g., industry-

28 Mosenthal, P. (2015). *Do Potential Studies Accurately Forecast What Is Possible in the Future? Are we Mislabeling and Misusing Them?* Presented at the ACEEE Efficiency as a Resource Conference, Little Rock, AR. Graphic provided to Mr. Mosenthal by Jim Hanna, Energy Solutions.

29 Upstream approaches appear to be most beneficial when either (1) the incremental cost or per unit savings of measures is small (making the transaction costs of the alternative of customer-specific rebates both comparatively expensive and challenging to implement, given the potentially limited value provided to retailers or other trade allies); or (2) when the current market share for a product is relatively low (mitigating potential net-to-gross concerns).

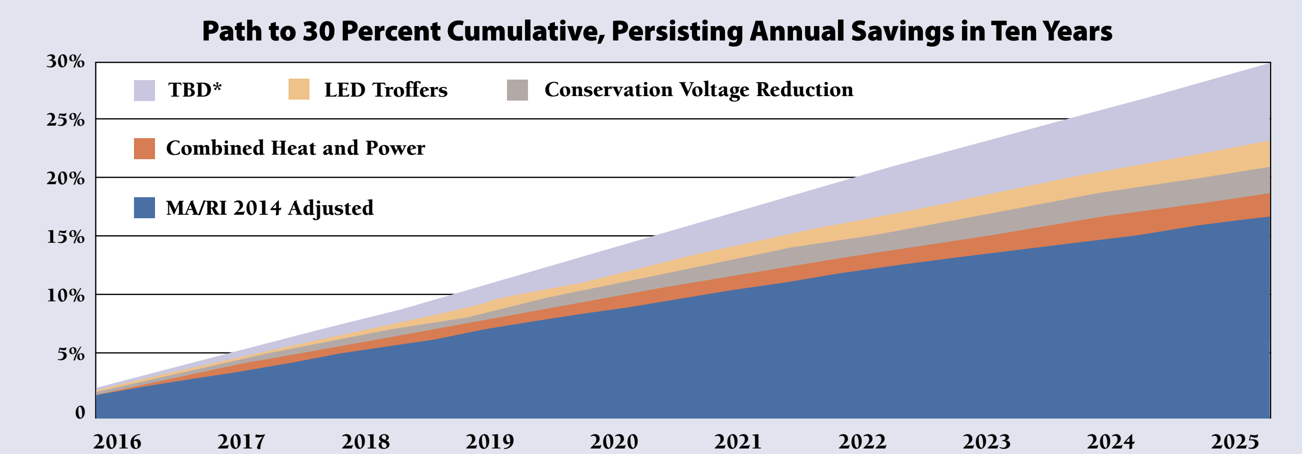
specific deeper dives) are challenging, at best, to forecast.

D. Bridging the Gap to 30 Percent Savings in Ten Years

We estimate that extending the Massachusetts and Rhode Island 2014 savings levels for the next ten years, after downward adjustments to remove anomalous CHP savings and to reduce lighting savings to account for the effect of new federal standards, would produce cumulative persisting annual savings of a little over 17 percent. In the discussion in this section of the report, we identify a number of potential sources of savings that could be tapped to go beyond the adjusted Massachusetts and Rhode Island 2014 savings levels. We have only quantified three of those opportunities—CHP, CVR, and LED alternatives to linear fluorescent lighting. As Figure 3 shows, adding those three opportunities to the adjusted current Massachusetts/Rhode Island savings levels could bring cumulative persisting annual savings levels to almost 24 percent over ten years. ACEEE has identified a number of other technologies with substantial additional potential. The combination of those technologies, others that will emerge in the coming years, and improved program strategies that we have discussed only qualitatively would need to be able to produce an additional 6 percent savings in order for the 30 percent savings target to be achieved.

Given the range of options for filling that gap, as well as historic experience with the emergence of new technology, new market approaches, and what happens when efforts to significantly ramp up savings are undertaken, we believe it is possible to cost-effectively achieve 30 percent cumulative savings over ten years.

Figure 3



**Gap to be addressed by other unquantified or unknown technologies and strategies*

V. Policy Needs and Considerations

Cost-effective electricity savings potential, with all of the enormous economic and other benefits it can provide, will only be fully realized if policies are carefully designed to encourage least-cost approaches to meeting long-term electricity demands. Specifically, significant changes will be necessary to address common policies and practices that:

- Artificially cap efficiency program spending;
- Inadequately address utility profitability concerns;
- Over-reward short-term savings;
- Limit investment in market transformation efforts;
- Under-value the diverse benefits of efficiency; and
- Discourage innovation and appropriate levels of risk-taking.

In this section, we discuss key policy changes that are either already clearly essential or warrant serious consideration as options for addressing these issues.

A. Increase Spending on Cost-Effective Efficiency Programs

As noted above, perhaps the most important factor underlying Massachusetts' and Rhode Island's recent success in achieving high levels of savings is that they operate under a mandate to pursue all cost-effective efficiency. They do not artificially constrain spending on efficiency; if it is cost-effective, it is funded. That perspective will be absolutely essential if savings goals are to grow beyond what has been achieved to date in these best practice states.

While a portion of additional savings could be achieved through other policy instruments (e.g., more stringent equipment efficiency standards or building codes—see discussion below), it is hard to imagine how a target of 30 percent savings in ten years could be met without greater savings from ratepayer-funded initiatives. As discussed below, the form of such ratepayer funding could be different than the mechanisms funded by system benefit charges that are common across the United States today. However, whatever the vehicle for collecting the funds, the *magnitude* of the funding will almost certainly have to grow.

That will require changes in jurisdictions in which efficiency program spending is currently capped at some level less than "all cost-effective." One reason for such caps is that ratepayer-funded efficiency programs are often viewed more as social programs than as vehicles to acquire resources that cost-effectively meet system needs. That perspective ignores the reality that cost-effective efficiency investments—by definition—reduce utility system costs (both operating costs and capital investments). The total resource cost (TRC) and societal cost test benefit-to-cost ratios for the 2014 Massachusetts and Rhode Island program portfolios demonstrate this, at approximately 3.5-to-1 and 2.7-to-1, respectively.[30] In other words, efficiency is an economic bargain.

A second related reason many states currently cap efficiency program spending is that they are concerned that it will increase electric rates too much or too fast. However, such concerns typically fail to adequately consider several important realities regarding efficiency programs:

- Many benefits of efficiency programs put downward pressure on rates. Examples include capacity savings, T&D system savings, environmental compliance cost savings, and price suppression effects. Depending on local circumstances, these downward pressures can be greater than the upward pressure caused by efficiency

30 For Massachusetts, see the electric statewide summary spreadsheet for 2014 at http://ma-eeac.org/results-reporting/; for Rhode Island, see Narragansett Electric Company (d/b/a National Grid). (2015).

program spending.[31]

- Efficiency programs reduce utility system risks, such as lowering exposure to fuel price volatility. This benefit has value to consumers.
- Bills matter more than rates. Even if rates go up as a result of efficiency program spending, consumers who participate in efficiency programs will be better off because their consumption will typically go down by a much greater amount.
- The best way to address impacts on non-participants is to expand efficiency programs so that more customers can participate and benefit.

One of the rare analyses of bill and rate impact trade-offs recently estimated that an aggressive efficiency strategy in Vermont would produce an average 7 percent reduction in electric bills (net of rate increases) for the more than 95 percent of residential customers who would be expected to participate in programs. The corresponding average increase in bills would be 4 percent to 5 percent for the fewer than 5 percent of customers who would not participate.[32] While policymakers in different states might reach different conclusions regarding whether that trade-off would be worth making, very few are ever able to make informed decisions because they do not see data in this way. That needs to change.

B. Make It Profitable to Pursue All Cost-Effective Efficiency

Policymakers have long recognized that greater energy efficiency can have adverse effects on the profitability of electric utilities due to reductions in sales volumes. That barrier must be addressed if we are to reach 30 percent cumulative savings over ten years. Regulators must implement critical policy changes such as providing utilities the opportunity to earn shareholder incentives for meeting savings targets, decoupling (i.e., removing) the link between utility profitability and increased electricity sales, or simply collecting funds from the utilities and giving the job of running efficiency programs to independent third parties.[33] Numerous reports on these topics provide more detail on the nature of the barriers and options for addressing them.[34]

C. Align Goals with Long-Term Objectives

Most utility system investment decisions are made with long-term economic, reliability, environmental, and other objectives in mind. If efficiency is to be treated as a resource comparable to supply-side alternatives, then policymakers should also focus not just on how much it can deliver in the next year or two, but for at least the next decade as well. Strategies to address climate change may demand consideration of even longer-term time horizons. However, energy efficiency goals are rarely—if ever—structured to consider impacts more than a few years into the future. Instead, they are often very short-term focused. Moreover, credit is commonly given only for savings that are easily "counted" at the individual measure (or building) level. As a result, most efficiency goals today reward and likely lead to efficiency investment decisions that are less (sometimes far less) than optimal. Several changes to the approach to typical efficiency goal-setting practices are warranted.

31 We found that to be the case in an unpublished 2014 analysis of Commonwealth Edison's (ComEd) efficiency programs in Illinois (primarily using Com Ed's own estimates of savings and avoided costs). The one additional factor that can put upward pressure on rates is lost revenue—i.e., the impact of spreading utility fixed costs across a smaller pool of consumption. However, allowing concerns about the impacts of lost revenues on rates to drive decisions on the level of ratepayer investment in efficiency is tantamount to saying that you would not want greater efficiency even if it could be acquired for free.

32 Analysis of "high case" in Woolf, T., Malone, E., & Kallay, J. (2014). *Rate and Bill Impacts of Vermont Energy Efficiency Programs (from Proposed Long-Term Energy Efficiency Scenarios 2014-2034)*. Snyapse Energy Economics. Prepared for the Vermont Department of Public Service.

33 Where the third party route is taken, part of the compensation for such third parties should be tied to their performance.

34 For example, see Hayes, S., Nadel, S., Kushler, M., & York, D. (2011). *Carrots for Utilities: Providing Financial Returns for Utility Investments in Energy Efficiency.* (ACEEE Report Number U111). Lazar, J., Shirley, W., & Weston, F. (2011). *Revenue Regulation and Decoupling: A Guide to Theory and Application.* Montpelier, VT: The Regulatory Assistance Project; Cappers, P., Goldman, C., Chait, M., Edgar, G., Schlegel, J., & Shirley, W. (2009). *Financial Analysis of Incentive Mechanisms to Promote Energy Efficiency: Case Study of a Prototypical Southwest Utility.* Berkeley, CA: Lawrence Berkeley National Laboratory (LBNL-1598E).

1. Increase Focus on Longer Measure Life

Today, most efficiency savings targets are defined in terms of annual savings—i.e., how much savings the measures installed will produce in their first year. Under this approach, annual savings from measures that have a one-year life, five-year life, ten-year life, or longer are treated as if they are all of equal value. The result has been, in part, an over-emphasis on efficiency measures and programs that produce shorter-lived savings because many shorter-lived measures have lower costs per first year kilowatt-hour (kWh) saved. There are a variety of ways to fix this problem.[35] Perhaps the easiest and most straightforward is to shift to a lifetime savings goal.

2. Focus on a Longer Time Horizon

In most states, program administrators' performance is measured annually, against annual savings goals. Thus, program administrators focus most of their attention on "this year" rather than on the medium or longer term. As a result, there is an inherent disincentive to make investments in efficiency technology or program strategies that will take several years or more to begin to bear fruit, even if the longer-term payoff could be very large. Several states—including Vermont, Illinois, and California—have attempted to address the problem by moving to three-year performance goals, though this may still not be long enough to adequately promote investments that will take longer to pay off. Three-year goals may also be insufficient to motivate program administrators to invest in potentially valuable long-term market transformation efforts.

3. Consider Goals Based on Actual Sales, Rather than Evaluation-Based Calculations

Policymakers should explore the possibility of establishing total electricity sales goals, or perhaps goals framed in terms of sales per unit of gross domestic product or other measure of energy intensity. The performance of program administrators could be assessed relative to such targets, rather than by summing up estimates of savings from thousands of efficiency measures as is currently done. Basing goals on actual sales levels would have a number of advantages, including elimination of discord over evaluation of gross savings;[36] elimination of debate over net-to-gross adjustments;[37] explicitly rewarding market transformation effects; and explicitly rewarding non-incentive programs, information or education efforts, and savings from both operational efficiency improvements and capital investments—provided they actually produce savings. To be sure, there would be challenges with this kind of shift. For example, regulators would need to establish mechanisms for weather-normalizing sales, adjusting for increased electrification of vehicles and buildings where deemed beneficial, and potentially adjusting for other factors, such as changes in demographics or economic activity relative to forecasts at the time sales goals were set. However, the potential benefits are large enough to warrant further exploration.

Is it time to start using the ultimate metric of efficiency program performance: electricity sales levels?

D. Recognize the Full Value of Energy Efficiency

Energy efficiency investments should only be pursued when they are cost-effective—that is, when they are less expensive than supply alternatives. That perspective is already widely-held across the US. However, in most jurisdictions, cost-effectiveness screening fails to fully value the benefits that efficiency provides. To begin with, most jurisdictions do not fully value the electric system benefits of efficiency because they do not fully account for avoided T&D costs, reductions in environmental compliance costs, the value of reduced risk, the value of price suppression effects, or the full magnitude of reductions in T&D line losses.[38] Also, most jurisdictions which use the societal test or the TRC test include the portion of efficiency measure

35 Optimal Energy and Energy Futures Group. (2013). *Final Report: Alternative Michigan Energy Savings Goals to Promote Longer Term Savings and Address Small Utility Challenges.* Lansing, MI: Michigan Public Service Commission.

36 Such evaluations would still have value, but for informing program design rather than for "bean counting."

37 Again, evaluation of free ridership and spillover would still have value, but only for informing program administrators on what is working and what is not.

38 Lazar, J., & Baldwin, X. (2011). *Valuing the Contribution of Energy Efficiency to Avoided Marginal Line Losses and Reserve Requirements.* Montpelier, VT: The Regulatory Assistance Project.

costs borne by program participants in screening but do not assign value to the often very large non-energy benefits that many efficiency measures provide to those participants. In addition, many jurisdictions inappropriately under-value future benefits of efficiency by using discount rates based on utilities' weighted average cost of capital—a measure of utility shareholders' time value of money—rather than lower discount rates that better reflect the time value of money to utility consumers or society as a whole.[39] As a number of recent papers and reports make clear,[40] the end result of these screening errors and omissions are cost-effectiveness results that are biased—often dramatically so—against efficiency investments. Such biases may not be critical when only a modest portion of cost-effective efficiency is being pursued. However, they become very important when the goal is to acquire all cost-effective efficiency. Thus, it is vital that states review the way they conduct cost-effectiveness screening of efficiency to ensure that the practices treat efficiency and supply alternatives in a balanced way.[41]

E. Recognize and Reward Market Transformation

Since the mid- to late-1990s, utility ratepayer-funded efficiency programs have been overwhelmingly focused on short-term resource acquisition. Achieving 30 percent savings in ten years will require significantly greater emphasis on longer-term market transformation, both because transformed markets produce greater levels of savings (e.g., everyone buys a more efficient product because doing so is the new status quo, rather than just those who voluntarily participate in a program) and because they create new platforms for the development of the next generation of efficient technologies and processes.

The biggest barrier to increased investment in market transformation is that efficiency program administrators are rarely given credit for market transformation effects of their efficiency programs. Instead, as Figure 4 shows, regulators and many stakeholder groups tend to narrowly focus on savings that are easily counted, which usually means savings for which financial incentives have been paid. Although such "resource acquisition" programs often still produce some market transforming effects, greater savings would be possible if the way savings are counted was better aligned with longer-term energy efficiency policy goals. There are at least three ways this could be done:

1. **Establish longer-term savings goals.** This point was discussed in subsection C above.
2. **Assign credit to success in advancing the adoption or increasing the enforcement[42] of more efficient building codes or equipment standards.** Several states—including California, Arizona, Massachusetts, and Rhode Island—have begun to at least partially address this opportunity.[43]
3. **Estimate and count market transformation effects of other programs.** Even short-term resource acquisition programs often have some long-term market transformation effects. The effect that many years of promotion of compact fluorescent light bulbs had on recent federal lighting efficiency standards exemplifies this. It is ironic that once an efficiency

39 For an excellent discussion of how to select an appropriate discount rate, see Chapter 5 of: Woolf, T. (2014). *Cost-Effectiveness Screening Principles and Guidelines: For Alignment with Policy Goals, Non-Energy Impacts, Discount Rates and Environmental Compliance Costs.* Lexington, MA: Northeast Energy Efficiency Partnerships.

40 For example, see Lazar, J., & Colburn, K. (2013). *Recognizing the Full Value of Energy Efficiency (What's Under the Feel-Good Frosting of the World's Most Valuable Layer Cake of Benefits).* Montpelier, VT: The Regulatory Assistance Project; and Neme, C., & Kushler, M. (2010). *Is it Time to Ditch the TRC? Examining Concerns with Current Practice in Benefit-Cost Analysis.* Proceedings of the 2010 ACEEE Summer Study on Energy Efficiency in Buildings, Volume 5.

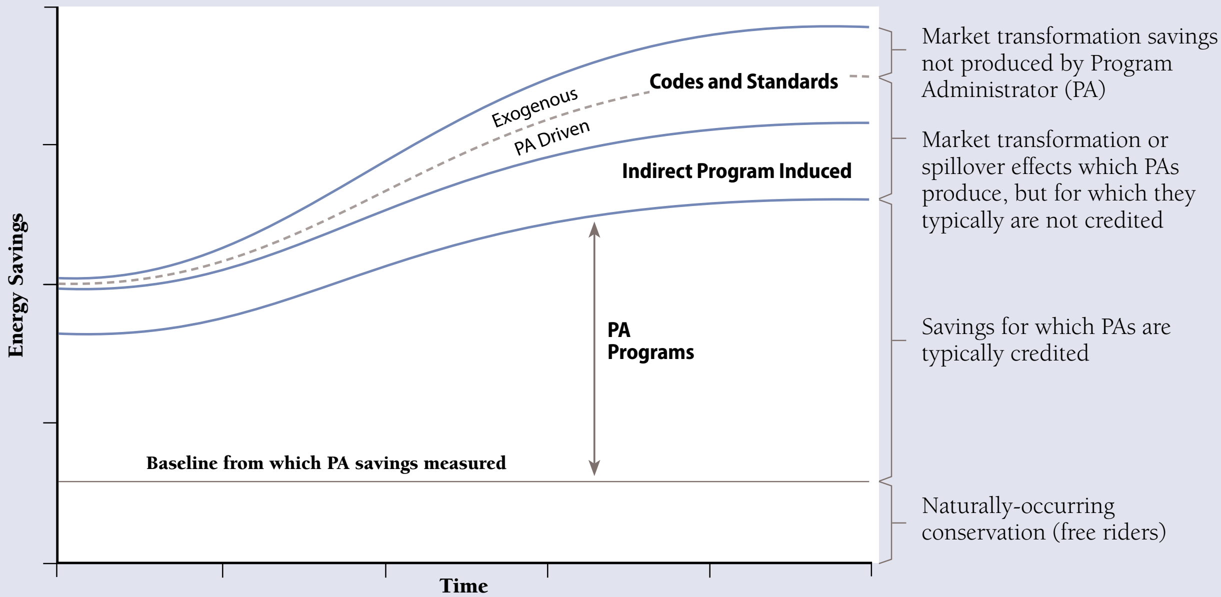
41 The Resource Value Framework recently developed by the National Screening Project offers a useful framework for such assessments. See Woolf, T., Neme, C., Stanton, P., LeBaron, R., Saul-Rinaldi, K., & Cowell, S. (2014). *The Resource Value Framework: Reforming Energy Efficiency Cost-Effectiveness Screening.* Prepared for the National Efficiency Screening Project.

42 The Institute for Market Transformation notes that there is "significant and widespread" lack of compliance with state building codes. In many places compliance is as low as 50 percent. It similarly reports that "every dollar spent on code compliance and enforcement returns $6 dollars in energy savings, an impressive 600-percent return on investment." See http://www.imt.org/codes/code-compliance.

43 For more information on this topic, see Lee, A., Groshans, D., Schaffer, P., Rekkas, A., Faesy, R., Hoefgen, L., & Mosenthal, P. (2013). *Attributing Building Energy Code Savings to Energy Efficiency Programs.* Prepared for Northeast Energy Efficiency Partnerships, Innovation Electricity Efficiency, and Institute for Market Transformation.

Figure 4

Common Divergence Between Savings Generated and Credit Given[44]



program accelerates the market adoption of an efficient technology, it is no longer able to claim credit for the resulting savings. Regulators typically require the program to treat the customers who are part of the increased baseline that the program produced as free riders. We are not suggesting that it is smart or prudent to continue to offer efficiency programs to promote efficiency measures for which the market has already changed, or where the cost per unit of additional savings that would be produced by additional program efforts is too high to justify. However, credit could be given for past program efforts for moving the market, at least for a certain period of time. Put simply, we need to create a set of rules that provides incentives for more intentional efforts to more effectively transform markets. Any concern about making goals easier to reach by changing "savings accounting practices" could be addressed by adjusting goals further upward so that they are just as hard to reach as today. To be sure, it is challenging to estimate these kinds of market effects. As a result, there will probably always be a tendency to be conservative in such estimates. However, that is better than ignoring them altogether and, by extension, not providing incentives for program administrators to try to produce them.

F. Reorient Regulatory Scrutiny to Focus More on the "Forest," Less on the "Trees"

The regulatory processes governing both efficiency program planning and approval of energy savings claims have become increasingly complex and rife with conflict. To some degree, that may reflect perceptions that increased scrutiny is necessary and commensurate with significant increases in both efficiency program spending and reliance on savings as an increasingly substantial portion of the electricity resource portfolio. However, one could argue that the result has been regulatory constructs and cultures that undermine our ability to maximize acquisition of cost-effective efficiency savings. Examples include:

- Not valuing savings from long-term market transformation (as discussed above);
- Placing greater emphasis on quantifying and adjusting for free rider effects than on quantifying spillover effects; and
- Discounting or ignoring altogether savings produced from changes in the way customers operate their buildings or production facilities (i.e., operational efficiency improvements).

44 Figure adapted from a graphic in Lee, A., & Faesy, R. (2011). *Supporting Energy Efficiency Codes and Standards through DSM/EE Programs*. Webinar. Montpelier, VT: The Regulatory Assistance Project.

These kinds of practices do not just result in giving less "credit" for current efficiency programs. They also effectively remove potentially valuable types of efficiency programs from consideration, provide false conclusions that other programs are not cost-effective, discourage community-based and other collaborative approaches to promoting efficiency, and discourage creativity and innovation in the design and delivery of programs. In other words, the focus on ensuring that efficiency program administrators do not "get away with something" or do not get to claim any savings that they did not create can produce an unintended effect of leading to far fewer savings than might otherwise be achieved. Ironically, because efficiency savings are typically so much less expensive to acquire than the alternative supply-side investments, reductions in "waste" by utility efficiency programs that result from some aspects of current regulatory constructs may simultaneously produce far more wasteful or unnecessary supply-side investment. This type of approach to regulation of efficiency investments will need to change if we are to reach 30 percent savings over ten years.

Some current regulatory approaches to ensuring utilities are not rewarded for "over-claiming" savings are likely to be causing significant unnecessary investment in supply resources.

G. Consider New Models for Acquiring Efficiency Resources

Today, electric efficiency resources are almost universally acquired through a combination of (1) government codes and standards; and (2) efficiency programs that are funded through surcharges on electric bills, delivered by utilities or alternative administrators chosen by regulators, and based on designs that are scrutinized and approved by regulators. In this section, we consider alternatives to the utility-centric nature of program design and delivery and direct regulation of efficiency programs. We also explore the concept of rewarding acquisition of non-electric energy savings.

1. Competitive Procurement

Several of the thought leaders interviewed at the outset of this project suggested that a key to achieving another "step function" increase in the level of electric efficiency is spurring innovation, and that one way to do so would be to promote greater competition to the identification and delivery of energy savings by potentially engaging a much wider array of market actors. Such competition could come in a variety of forms, including efficiency program bidding, new forms of the "standard offer" programs much more commonly offered across a number of jurisdictions in the 1990s, and efficiency feed-in-tariffs.

Experience with variations on some of these types of mechanisms suggests that they also pose a number of challenges.[45] For one thing, they have mostly ended up paying for standard forms of energy savings—and sometimes at a cost that was much greater than if those savings had been acquired through more traditional program administrator models. That is particularly true with mechanisms in which the same fixed price is offered for all savings (i.e., the most simple standard offer or efficiency feed-in-tariff approach).[46] Other challenges include increased administrative complexity, a likely need for greater investment in evaluation, measurement, and verification (EM&V),[47] and the potential for some market confusion. There are certainly ways to reduce any such adverse consequences.[48] However, it is not clear whether the benefits outweigh the costs of doing so. Thus, it may

45 Current examples include the Illinois Power Agency's annual procurement of energy savings for residential and small business customers through a competitive solicitation for new programs (not competing with existing utility programs), New Jersey's "Pay for Performance" programs, and both the New England and PJM capacity markets (which permit efficiency savings to compete with generation alternatives).

46 For example, Public Service Electric & Gas' standard offer program in New Jersey in the 1990s and early 2000s—arguably the largest such program of its kind to date (PSE&G spent over $1 billion on it)—got 83 percent of its savings from commercial lighting retrofits at a levelized cost of 3.9 cents per kWh. See Edgar, G., Kushler, M., & Schultz, D. (1998). *Evaluation of Public Service Electric and Gas Company's Standard Offer Program.* Prepared for PSE&G. That is roughly twice the cost at which similar types of savings were being captured through more standard utility program interventions.

47 One would need to verify the savings claims of a much larger range of savings delivery agents.

48 Neme, C., & Cowart, R. (2013). *Energy Efficiency Feed-in Tariffs: Key Policy and Design Considerations. Proceedings of the 2013 ECEEE Summer Study on Energy Efficiency in Buildings, Volume 2;* and Cowart, R., & Neme, C. (2013). Can Competition Accelerate Energy Savings? Options and Challenges for Efficiency Feed-in Tariffs. *Energy & Environment,* 24(1&2).

be prudent to explore the use of competitive mechanisms in more targeted ways—i.e., to address certain challenging efficiency opportunities or to solicit new ideas or market approaches that have not been tested.

2. New Regulatory Paradigms

There is growing interest across the country in exploring new approaches to regulating electric utilities in order to better respond to a number of emerging industry trends, such as: increasing deployment of rooftop photovoltaics and other forms of distributed generation; consumers' and utilities' growing ability to collect, analyze, and use data on energy usage patterns and costs to inform operations and investment decisions; and growing acknowledgement of the significant opportunities to better optimize investments in T&D infrastructure. The state of New York's "Reforming the Energy Vision" proceeding is perhaps the most prominent and far-reaching example. Among other things, it would aim to both make promotion of energy efficiency by distribution utilities a more integral and integrated part of the way they do business and endeavor to simultaneously "animate" the private market to help deliver cost-effective demand-side alternatives (including efficiency) to more traditional distribution system investments.

In our view, the key to making this work for efficiency—in other words, the key to capturing all the cost-effective efficiency potential—will be to (1) include explicit customer efficiency metrics against which utilities will be judged and upon which their financial rewards will be based; and (2) adopt specific values for such metrics that ensure utility profitability is maximized only when it has truly captured all cost-effective efficiency. Since the effectiveness of this new regulatory paradigm in promoting acquisition of all cost-effective efficiency has not yet been tested, it will be important to regularly review the effectiveness of the performance metrics in encouraging efficiency investment. It may also be prudent to simultaneously establish minimum efficiency savings requirements as a "failsafe," as part of a transition to a new and untested regulatory paradigm.

3. Counting Acquisition of Some Fossil Fuel Savings Towards Electric Savings Targets

Studies in both the United States and Europe suggest that substantial electrification of both building energy use (particularly space heating and water heating) and cars will likely be necessary if we are to affordably reduce greenhouse gas emissions by 80 percent by 2050, the level commonly seen as necessary to stabilize the global climate.[49] In this context, it is worth considering whether to allow improvements, for example, to the insulation levels and air tightness of buildings that are currently heated with natural gas or other fossil fuels to count towards electric savings targets (e.g., translating gas savings to kWh equivalents). From a long-term perspective, if buildings are going to ultimately have to become electrically heated, the savings will ultimately become electric savings anyway.

It is also worth noting that new generations of electric heat pumps can be more efficient, even after accounting for losses in generating and distributing electricity, than the most efficient gas furnace; similarly, electric cars can be inherently more efficient than combustion engine-driven vehicles. In such circumstances, one could argue that fuel-switching these end uses to electricity can increase energy efficiency. In that context, it may also be worth considering whether to allow energy savings that result from increases in efficient electrification to count toward electric savings targets as well. However, such allowance may also justify consideration of increasing savings goals because of the increase in savings opportunity.

These are obviously controversial ideas. However, they are consistent with a need that we see for a more holistic or integrated approach to thinking about energy efficiency (rather than narrowly focusing on the efficiency of just one fuel in isolation).

H. Additional and More Effective Codes and Standards

Achieving 30 percent savings in ten years may also require policy changes beyond the world of electric ratepayer-funded efficiency programs. Indeed, additional policy changes may be necessary to enhance the effectiveness of such programs. Among those that could be of significant value are:

- Adoption of more aggressive building codes for new construction;
- Adoption of building codes for existing buildings. For example, several jurisdictions[50] have adopted

49 For example, see European Climate Foundation. (2010). *Roadmap 2050: Practical Guide to a Prosperous, Low Carbon Europe*; and Energy and Environmental Economics, Lawrence Berkeley National Laboratory, & Pacific Northwest National Laboratory. (2014). *US 2050 Report: Pathways to Deep Decarbonization in the United States.*

50 Examples include Boulder, CO; San Francisco and Berkeley, CA; and Burlington, VT.

rental energy ordinances. Deepening the efficiency requirements (in some cases) and expanding them to other jurisdictions could both provide substantial cost-effective savings and create platforms for helping building owners to move to even higher levels of efficiency. A Boulder, Colorado ordinance appears to have had some success in that regard.[51]

- Mandatory building efficiency benchmarking, labeling, and disclosure requirements. Nearly 20 different cities[52] and two states (Washington and California) have adopted such requirements for at least some types of buildings.[53]
- Adoption of additional or more aggressive federal and state product efficiency standards.
- Adoption of the SAVE Act or other legislation that requires the efficiency of homes to be considered in mortgage underwriting, allowing buyers of more efficient homes to be eligible to purchase more expensive properties and possibly to be eligible for lower interest rates.[54] Such requirements could create greater market demand for more efficient buildings.

51 See Gichon, Y., Cuzzolino, M., Hutchings, L., and Neiger, D. (2012). *Cracking the Nut on Split-Incentives: Rental Housing Policy.* Proceedings of the 2012 ACEEE Summer Study on Energy Efficiency in Buildings, Volume 8, pp. 92-101; (2012). Lawrence Berkeley National Laboratory. (2012). *Boulder, Colorado's SmartRegs: Minimum Performance Standards for Residential Rental Housing.* Clean Energy Program Policy Brief.

52 Boston, Cambridge, New York, Philadelphia, Washington DC, Atlanta, Chicago, Minneapolis, Kansas City, Austin, Boulder, Seattle, Portland, San Francisco, and Berkeley.

53 See Institute for Market Transformation: http://www.buildingrating.org/graphic/us-benchmarking-policy-landscape.

54 See Institute for Market Transformation. The SAVE Act. Summary. Available at: http://www.imt.org/finance-and-real-estate/save-act; Cardwell, D. (2013). Bill Would Sweeten Loans for Energy-Efficient Homes. *The New York Times.* Available at: http://www.nytimes.com/2013/06/07/business/senate-bill-sweetens-loans-for-energy-efficient-homes.html?_r=0.

VI. Conclusions

This report addresses whether it is possible to achieve 30 percent electricity savings in ten years. That is a very ambitious target, requiring far greater savings than efficiency potential studies typically suggest is possible or than leading states are currently on the path to achieving. However, efficiency potential studies are inherently poor tools for assessing the boundaries of what is possible. And though the most aggressive states have dramatically increased savings in recent years, they are not yet fully addressing all currently known technological, programmatic, or policy-driven opportunities for capturing cost-effective savings, let alone new opportunities that we know with virtual certainty will surface over the next decade.

A high-level examination of additional opportunities, including consideration of historic patterns in emerging technology and new market interventions, suggests that it should be possible to achieve 30 percent savings in ten years. That said, it is abundantly clear that such an achievement will only be possible if fundamental enabling policies are put in place. Among these are:

- **Increasing efficiency program funding to whatever level is necessary to capture all cost-effective efficiency.** If efficiency is less expensive than supply alternatives, it should be pursued. That paradigm is an essential prerequisite for achieving 30 percent savings in ten years. Since efficiency program costs replace more expensive utility system options, it is also an essential prerequisite for minimizing total electricity costs.
- **Eliminating utilities' financial disincentives to support efficiency.** The utility business model needs to be aligned with the objective of pursuing all cost-effective efficiency. That includes, but is not limited to, decoupling profits from the volume of throughput on the system.
- **Fixing the way savings goals are structured.** The current emphasis on bottoms-up estimation of annual savings achieved from one to three years of program implementation runs counter to long-term objectives. At a minimum, goals should be expressed in terms of lifetime savings generated over a multi-year period and serious consideration should be given to more sweeping changes such as setting long-term electricity sales goals or electricity intensity goals instead.
- **Fully valuing all of the benefits of efficiency.** The manner in which cost-effectiveness screening of efficiency resources is conducted is fundamentally flawed because it compares only a portion of the benefits of efficiency to its full cost. This misapplication of common cost-effectiveness tests will significantly hinder efforts to cost-effectively achieve 30 percent savings in ten years.
- **Encouraging and rewarding market transformation efforts.** This will require changes in the way savings goals are structured and the way savings are counted. However, such changes are absolutely essential if market transformation efforts are to be undertaken at the scale necessary to reach savings targets on the order of 30 percent in ten years.
- **Striking a better balance in the regulation of utility efficiency programs.** In some states, regulators' approaches to ensuring utilities are not rewarded for "over-counting" savings are likely to be causing greater "waste" by reducing cost-effective efficiency investment, thereby increasing investment in more expensive supply resources. Of particular concern are failures to value market transformation effects, spillover effects, and savings from customer operational efficiency improvements—all of which can provide valuable contributions to meeting aggressive long-term savings targets.

- **Exploring new regulatory approaches to acquisition of efficiency resources.** Such efforts might include new competitive procurement processes or new forms of utility regulation and compensation. Such approaches should be tested in pilot forms or with "backstops" to ensure that the adverse effects of any unexpected failures are minimized.
- **Broadening, accelerating, and improving the effectiveness of efficiency codes and standards.** These tools have been shown to be very effective in capturing significant levels of savings. There are a variety of ways they could be expanded, including through disclosure and performance requirements for existing buildings and potentially for regulation of the efficiency of existing buildings (especially rental properties).

Appendix A:

The Limitations of Traditional Efficiency Potential Studies

Efficiency potential studies have become very detailed endeavors that build up estimates of future savings potential based on literally thousands of individual assumptions, including:

- The list of efficiency measures to be analyzed—typically hundreds if not a thousand or more measures or measure permutations;
- The savings, expected life, incremental cost, load shape, and other features of each measure;
- The size of the market for each measure for each year of the analysis horizon;
- The various components of utility avoided costs, forecast for 30 to 40 years into the future. Depending on the jurisdiction and how comprehensively it assesses benefits, these can include avoided energy costs, avoided transmission and distribution system costs, avoided generation costs, price suppression effects, avoided carbon emissions and other avoided environmental compliance costs, and line loss rates;
- Forecasts of the value of other benefits such as avoided gas or other fossil fuel costs (needed for measures that save multiple fuels), avoided water costs (needed for measures that save water as well as energy), and sometimes other non-energy benefits;
- Estimates of the portion of the technical or economic potential of each measure that is "achievable"—or the portion of their customers that efficiency program administrators could convince to invest in each measure through their efficiency programs. Such estimates are typically developed using models of "adoption curves" that are based on estimates of customers "willingness to pay" studies.

Much can be learned from these studies. They provide useful insights into which measures are cost-effective and which are not—at least at today's savings levels and prices, and today's estimates of avoided costs. They can also provide useful insights into the relative magnitude of savings potential of different measures—at least among measures that are known today. That, in turn, can shed light on the relative effectiveness or ineffectiveness of current programs.

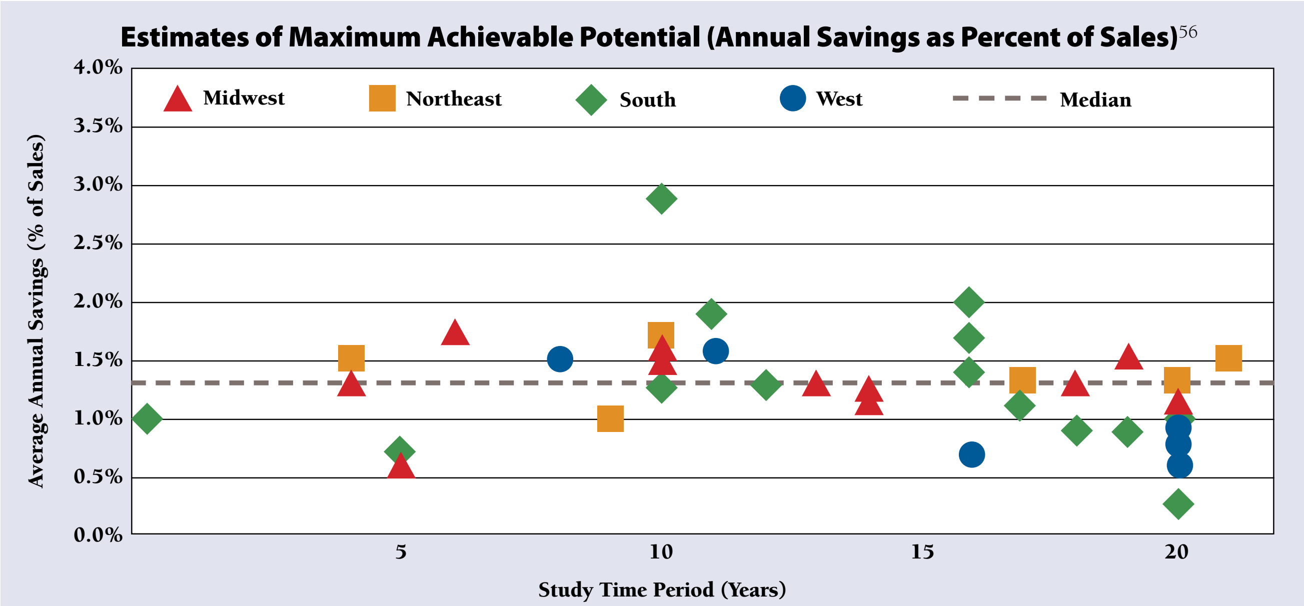
That said, efficiency potential studies have not proven to be very useful at providing insight into the bigger question that they are commonly undertaken to address: How much savings can be cost-effectively achieved over the next decade (or more)? Indeed, it has become clear that they routinely underestimate longer-term savings potential. As Figure A1 shows, the average "maximum achievable" annual savings estimated by nearly 40 different recent efficiency potential studies is about 1.3 percent of annual sales (black line). Interestingly, there do not appear to be any large regional differences in these estimates. Even for the Northeast, the region that has arguably been most aggressive in pursuing efficiency in recent years, the average across six different studies is only slightly higher—about 1.5 percent—with no study suggesting more than about 1.8 percent was possible.

In contrast, the Massachusetts utilities have ramped up to the point where they achieved 2.8 percent in 2014; National Grid in Rhode Island reached almost 3.5 percent in 2014.

A variety of papers and reports have documented many of the reasons that detailed, bottom-up potential studies appear to underestimate what is achievable, particularly in the long term.[55] We will not repeat all of the reasons here.

55 For example, see: Goldstein, D. (2008). *Extreme Efficiency: How Far Can We Go If We Really Need To?* 2008 ACEEE Summer Study on Energy Efficiency in Buildings. Volume 10, pp.44-56; and Kramer, C., & Reed, G. (2012). *Ten Pitfalls of Potential Studies.* Montpelier, VT: The Regulatory Assistance Project.

Figure A1



However, a few are worth highlighting:

- There is an almost universal focus on efficiency measures that are known and documentable today. Even when attempts are made to identify and quantify potential savings from emerging technologies, such efforts are limited to technologies that are known and for which some analysis of savings potential and cost already exists. We are unaware of a potential study that has attempted to account for the truly unknown and unknowable. That is a big omission, particularly as the time horizon for potential studies extends out a decade or more. For example, nearly half of the achievable electric energy savings identified in the Northwest Power and Conservation Council's recently published Draft Seventh Power Plan are from efficiency measures not included in the Council's Sixth Plan produced just five years earlier.[57]
- The potential savings from truly custom measures—particularly for industrial applications—are rarely (if ever) addressed comprehensively. This is a function of the fact that most potential studies build up savings at the measure level. It is impossible, almost by definition, to identify and characterize all possible custom measures.
- Studies rarely attempt to account for increasing savings (as some existing technologies evolve) or decreasing costs (driven economies of scale of production, product familiarity, and other factors) of some measures over time.
- Assessments of the portion of economic potential that are "achievable" are typically based on overly simplistic and inherently conservative assumptions about how customers react to cost vs. savings trade-offs (e.g., payback periods). When efforts are made to benchmark such assumptions, the benchmarking is typically against the "average program" or against other potential studies that approached the question in the same way. Program participation rate assumptions are rarely calibrated against actual experience of the leading or most aggressive programs.
- Studies rarely attempt to account for long-term market transformation effects.

The regulatory context in which potential studies are developed and considered is probably responsible for many of their inherent limitations. First, every one of the

56 Graphic courtesy of Phil Mosenthal of Optimal Energy. See his presentation—*Do Potential Studies Accurately Forecast What is Possible in the Future? Are We Mislabeling and Misusing Them?*—for the ACEEE Energy Efficiency as a Resource Conference in Little Rock, AR, September 21, 2015.

57 Data provided by Charlie Grist, Northwest Power and Conservation Council, October 14, 2015.

literally thousands of assumptions in these studies must be able to withstand intense regulatory scrutiny. Second, the contractors performing the studies must be able to develop and use the thousands of assumptions in a reasonably affordable way or they will not be competitive when bidding on such projects. The tendency is, therefore, to ensure that each assumption is defensible as "mainstream" based on data currently at hand, and can be used over and over again in multiple places without being continually re-examined and revised. That leads to the use of conservatisms whenever there are any potential questions.

It is not surprising that the compounding effect of conservatisms across thousands of assumptions significantly dampens projections of what can be achieved. While that might be acceptable for some types of analyses for some purposes, it is not helpful in exploring the boundaries of what is possible ten years (or more) into the future, especially—as is the case with this project—if such inquiry intentionally assumes no policy constraints and is designed to be a "best estimate" of what is possible (meaning the probability of overestimation and underestimation of savings potential is roughly equal).

Appendix B: Massachusetts and Rhode Island Utilities' 2014 Efficiency Program Savings

A. Massachusetts and Rhode Island 2014 Results by Program

Both Massachusetts' and Rhode Island's utilities have very comprehensive portfolios of efficiency programs that promote a wide range of efficiency measures to both residential and business customers. Significant efforts are made to serve low-income customers, so there are several programs focused solely on that group of customers. As Table B1 shows, roughly half of the savings come from business customers, both from new construction and equipment replacement projects and from retrofitting of existing buildings. An additional 15-20 percent of savings are produced by residential lighting programs, while an additional 10 percent (MA) to 19 percent (RI) are from residential behavior programs.

Table B1

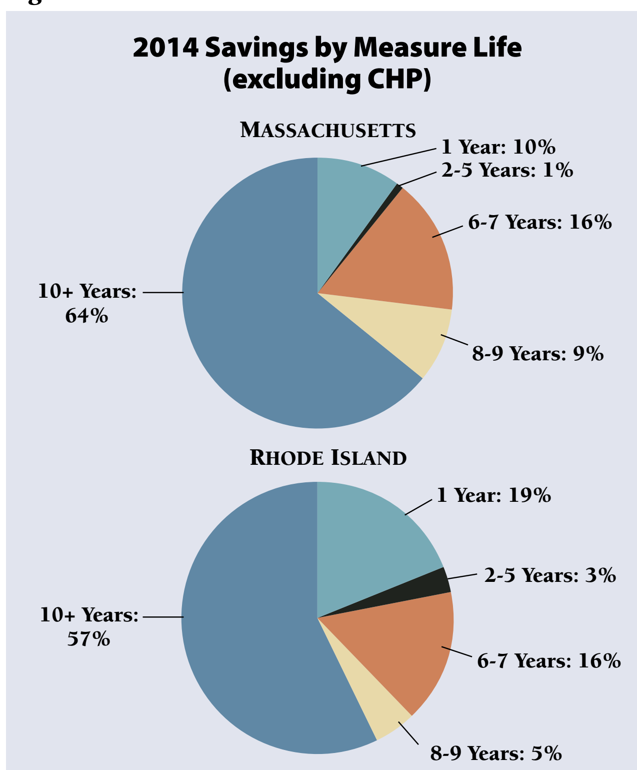
Massachusetts and Rhode Island Electric Savings by Program (excluding CHP)

Sector/Program	MA	RI
Residential New Construction	1%	0%
Residential ENERGY STAR HVAC	1%	1%
Residential Single Family Retrofits	6%	7%
Residential Multifamily Retrofits	2%	2%
Residential Behavioral	10%	19%
Residential ENERGY STAR Lighting	18%	16%
Residential ENERGY STAR Products	1%	3%
Low-Income New Construction	0%	0%
Low-Income Single Family Retrofit	1%	3%
Low-Income Multifamily Retrofit	2%	2%
C&I New Construction/Equip. Replacement	24%	18%
C&I Retrofit	26%	19%
C&I Direct Install	8%	10%

B. Massachusetts and Rhode Island 2014 Results by Measure Life

As Figure B1 shows, roughly 60 percent of the first year savings from both Massachusetts and Rhode Island's electric efficiency programs come from measures with estimated savings lives of ten years or more.[58] On the other hand,

Figure B1



58 Savings by measure life were estimated for Massachusetts by analyzing measure level data for both NSTAR and National Grid. (See Appendix 2 of filings by each utility with the Massachusetts Department of Public Utilities in

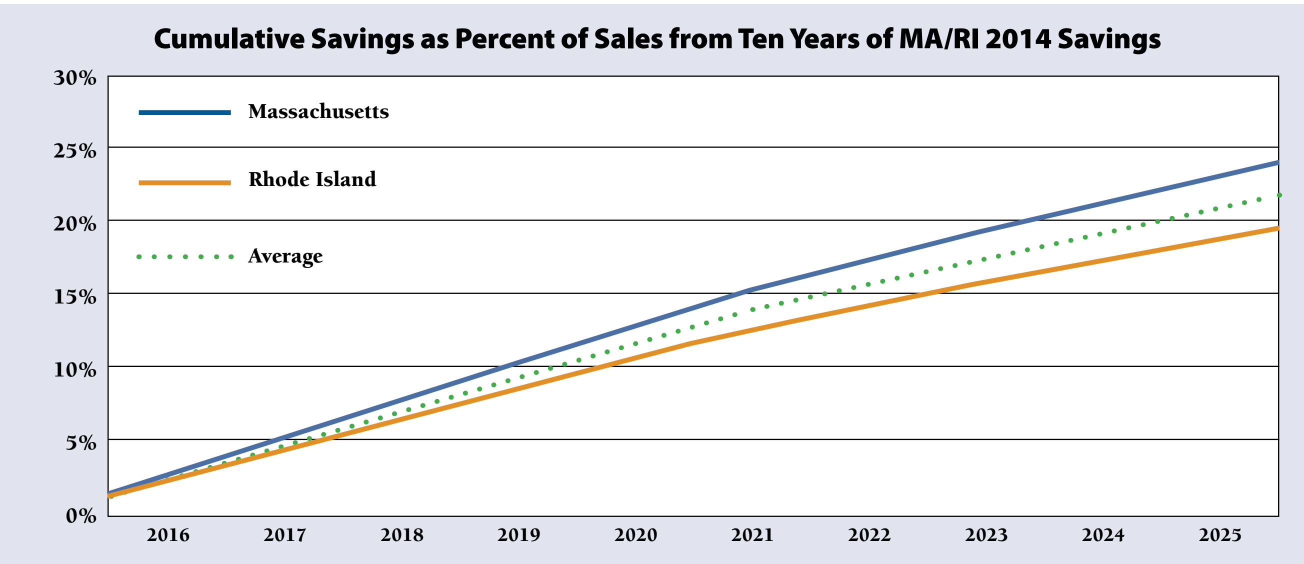
continued on next page

ten percent of the Massachusetts savings and 19 percent of the Rhode Island savings had a life of only one year; virtually all of those one-year savings are from their residential behavior programs.[59] Most of the rest of the shorter-lived savings—primarily from CFLs and a portion of commercial LED applications—have lives of six to eight years.

C. Ten-Year Implications of Massachusetts and Rhode Island 2014 Results

Figure B2 shows what the cumulative persisting savings would be if both the magnitude and the mix of savings lives in the Massachusetts and Rhode Island 2014 programs were repeated each year for ten years. As noted above, because some of the measures being installed each year have lives that are less than ten years, the cumulative persisting savings in ten years would be less than the annual savings multiplied by ten. Specifically, the cumulative persisting annual savings in year ten would be about 23 percent for Massachusetts and 19 percent for Rhode Island. The two-state average of about 21 percent serves as the foundation for the balance of our analysis of what would be required to achieve 30 percent savings in ten years.

Figure B2



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Docket 15-49.) NSTAR and National Grid are the two largest program administrators in Massachusetts. Together they accounted for nearly 90 percent of the state's reported 2014 electric savings. National Grid also serves virtually all of Rhode Island. Thus, the mix of measure lives within each type of program were assumed to be the same in Rhode Island as for National Grid in Massachusetts. Those program level mixes were then multiplied by the slightly different profile of savings by program in Rhode Island to produce a portfolio mix for that state.

59 There is evidence to suggest that savings from residential behavior programs would persist for more than a year—declining by only about 20 percent annually—if the programs were stopped. (Khawaja, S., & Stewart, J. (Winter 2014/2015). Long-Run Savings and Cost-Effectiveness of Home Energy Report Programs. Cadmus.) However, such programs are not designed to be one-off investments. Rather, utilities typically run them every year to both eliminate any erosion of savings and support marketing of their other programs. Thus, there are ongoing debates in several states regarding how to deal with measure life assumptions for such programs. If a life of longer than one year were to be adopted, the annual savings claimed each year would have to be reduced. That is probably the most accurate way to reflect the impact of such programs. However, it is a somewhat complicated approach to put in place because one needs to carefully tease out of each year's evaluated savings the portion that was attributable to the previous year's funding of the portion attributable to the current year's efforts. This distinction becomes less important in the context of the ten-year savings goal analyzed in this report (as all that matters is how much total savings the program can deliver after ten years).

Appendix C:

The Impact of Federal Lighting Efficiency Standards

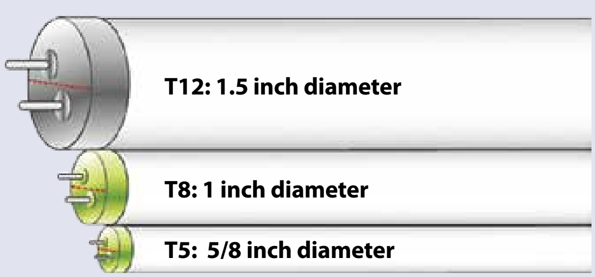
In 2012, new federal efficiency standards for general service fluorescent lamps effectively banned the sale of new T12s, as well as the first generation (known as 700 series) of T8 lamps.[60] The new minimum requirements are on the order of 25 percent more efficient than a typical T12.[61]

Utility efficiency programs that have claimed linear fluorescent lighting savings relative to a T12 baseline will be affected by the recent change in minimum efficiency standards. At a minimum, it would appear necessary to assume that any light fixtures that are replaced during a normal stock turnover cycle would have been at least as efficient as an 800 series T8; any new savings from more efficient products would be measured relative to that baseline. While one could theoretically argue that efficiency programs could still generate savings relative to a T12 baseline with retrofit programs that cause such existing inefficient fixtures to be replaced before they otherwise would have been (i.e., outside of the "normal stock turnover cycle" referenced earlier), it is likely a stretch to argue that such "early retirement" savings would still be persisting ten years from now (i.e., within the timeframe of interest to this project) as most such existing T12s would likely have been replaced during natural replacement cycles by then. Again, that does not mean that electric grids will not see substantial savings as a result of businesses replacing very inefficient T12s with T8s (or better). It only means that such savings would not "count" toward the savings target we are examining in this report.

The magnitude of the effect that the current linear fluorescent efficiency standard will have on utility program savings will ultimately depend primarily on the portion of the utility's current commercial and industrial (C&I) lighting savings that are based on an assumed T12 baseline. Public data on the magnitude of Massachusetts and Rhode Island business electricity savings that are derived from linear fluorescent lighting for which the baseline was assumed to be a T12 are not available. However, only about four percent of linear fluorescent light fixtures currently in use in Massachusetts businesses are T12s.[62,63] Similarly,

Fluorescent Lamp Comparisons

The T12, T8, and T5 designation for fluorescent lamps refers to how many eighths of an inch in diameter the light measures. For example, a T12 lamp is 1.5 or 12/8 of an inch in diameter.



The Retrofit Companies Blog (2013, March). When Are Your Fluorescent Lights Being Discontinued?

60 The 800 Series of T8s require significant quantities of several rare earth minerals that were recently subject to supply constraints. As a result, a number of manufacturers applied for and were granted two-year extensions for compliance, during which time they could continue to manufacture 700 Series T8s.

61 For further description of lighting fixtures, see The Retrofit Companies Blog (2013, March). When Are Your Fluorescent Lights Being Discontinued?

62 DNV-GL. (2015). Massachusetts Commercial and Industrial Customer On-Site Assessments: Interim Results Report. Prepared for the Massachusetts Program Administrators and Energy Efficiency Advisory Council Consultants.

63 It is also worth noting that, even for the likely rare cases in which T12s are retrofitted, both the Massachusetts and Rhode Island utilities stopped claiming savings relative to the full T12 wattage after 2012. By agreement with their respective state Advisory Councils, the baseline wattage of T12 retrofits is being "de-rated" by an increasing amount every year between 2013 and 2017, such that by 2017 it is effectively assumed that the baseline is equivalent to an 800 Series T8 (i.e., about 88 Watts for a four-foot, three-lamp fixture).

low levels of existing T12s have been documented in some of the other states with aggressive efficiency programs and/or standards.[64] Thus, it appears reasonable to assume that the impact of the most recent linear fluorescent fixture efficiency standards on the Massachusetts and Rhode Island utilities will be very small—too small to warrant adjusting our estimates of the impact of continuing 2014 levels of savings into the future.

Standards for linear fluorescent fixtures will be modified again in 2018, when the minimum efficiency requirements for T8s will be increased by about another four percent.[65] That will likely affect virtually every utility's estimates of commercial lighting savings because utilities today typically do not assume a baseline efficiency that is greater than an 800 series T8. The magnitude of the impact will depend on the portion of commercial lighting savings associated with linear fluorescents. It will also depend on the mix of linear fluorescent measures. The new standards will reduce savings associated with upgrades to high performance T8s by about 25 percent. It will have much smaller effects on savings associated with T5s (i.e., fluorescent lamps that are 5/8 of an inch in diameter), LED troffers (i.e., typically a trough-shaped reflective box fluorescent lamps), de-lamping, and controls. It is difficult to say precisely how much of an impact this increasing baseline would have on the Massachusetts and Rhode Island utilities because detailed data on the portion of their commercial lighting savings coming from linear fluorescent lighting measures—let alone the portion coming from different efficiency measures affecting linear fluorescent electricity consumption—are not publicly available. Based on limited data that are available, we estimated that the effect will be to reduce the Massachusetts and Rhode Island utilities' commercial lighting savings by between five percent and ten percent beginning in 2018.[66]

B. Impact of Residential Lighting Standards

Section 321 of the 2007 Energy Independence and Security Act (EISA) established minimum efficiency standards for general service lamps. The standards were intended to eliminate the then typical 40W, 60W, 75W, and 100W screw-based incandescent light bulbs.

EISA had two phases. In the first phase, starting in 2011 for 100W bulbs and concluding by 2013 for 40W bulbs, maximum wattages of light bulbs were required to go down by 25-30 percent (e.g. the lighting output of an old 75W incandescent would be required to be met with a maximum of 53W). One key impact of those requirements was that manufacturers shifted significant production to halogens that just met the new efficiency standards. Though more efficient than the old incandescent bulbs that they replaced, the new halogens are still much less efficient than compact fluorescent light bulbs (CFLs) or LEDs, but they are the same size and have very high color rendition which makes them attractive to some buyers. Utility programs that currently promote screw-based CFLs or LEDs—particularly for residential applications—typically already reflect the change in baseline, from incandescent to halogen, in the way savings were estimated or "counted" in 2014.

Under the second phase of EISA's general service screw-based lighting requirements in 2020, the US Department of Energy is to put in place a new standard requiring all general service lamps to produce at least 45 lumens per watt. That would have the effect of cutting the current (EISA phase 1) maximum wattage in half, or effectively mandating efficiency levels that begin to approach those of current CFLs. Thus, if this second phase of standards goes into effect as anticipated when the law was passed,[67] there would be substantial savings on the grid, but little room

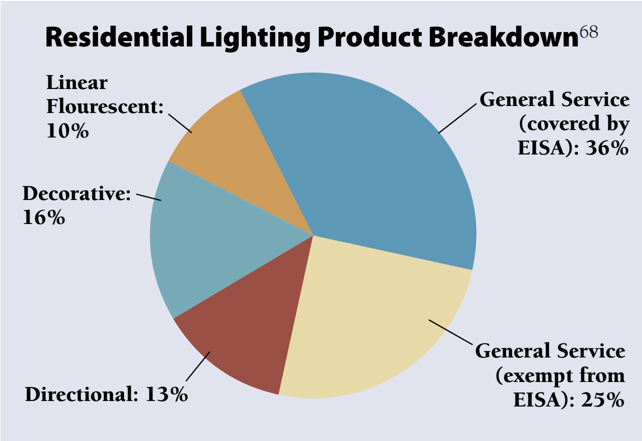
64 For example, see slide 18 in: Mellinger, D. (2015). State of the Commercial Lighting Market in Vermont. Presented at Efficiency Vermont's 2015 Better Buildings by Design conference.

65 For a summary description of recent and planned future changes in general service fluorescent lamp standards, see: http://www.appliance-standards.org/node/6802.

66 That is consistent with the following assumptions: 50 percent of C&I lighting savings are from measures affecting linear fluorescent electricity consumption; 50 percent of the linear fluorescent savings are from HPT8s; savings from HPT8s are 25 percent lower under the new 2018 standard than under the current standard; savings from other non-HPT8 measures affecting linear fluorescent lighting consumption (e.g., T5s, LED troffers, de-lamping, and control) are five percent lower under the new 2018 standard.

67 There has been significant political opposition to the lighting standards since they were enacted, including attempts to either weaken or completely repeal them. A federal bill with a rider that will prohibit the US Department of Energy from enforcing the 2020 standards has already become law, though it is unclear whether that will have any significant effect on the market as manufacturers may still be loath to violate the law and states and private parties could still sue to enforce the law through the courts. For the purposes of this project, we assume that the standards will go into effect as passed and that manufacturers will abide by their requirements.

Figure C1



for additional savings to be generated by utility ratepayer-funded efficiency programs.[69]

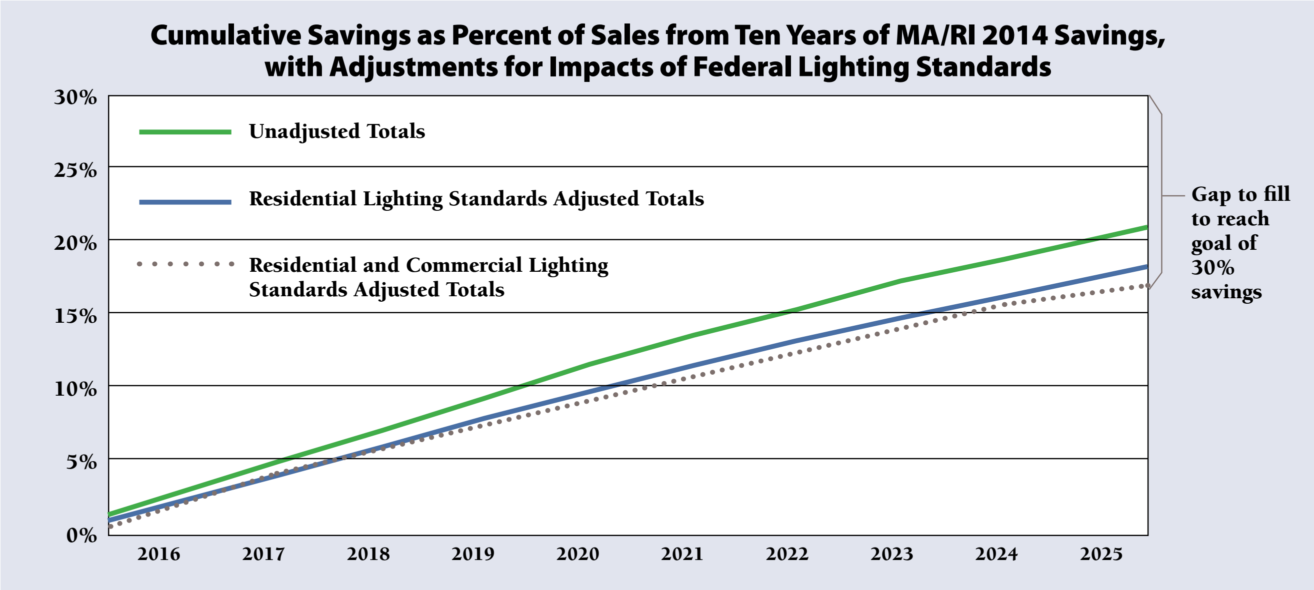
That said, as Figure C1 illustrates, the EISA standards only cover about one-third of products in residential light sockets. A number of general service lamp types—including three-way and incandescent bulbs with less than 40W or greater than 150W—are exempt from the standards. Also exempt are incandescent reflector (directional) lamps, "candelabra-based" (decorative) lamps, and a variety of others serving niche applications.

Current utility residential lighting programs are getting savings from both EISA-covered products and non-EISA products. We assume that about half of the residential lighting savings being produced by all of the Massachusetts and Rhode Island residential and low-income efficiency programs are associated with EISA-covered products. Put another way, we assume that about half of the Massachusetts and Rhode Island 2014 residential and low-income lighting savings should not be able to contribute to a 2025 cumulative persisting annual savings goal. That is a significant adjustment, not only because both states' residential lighting programs produce a significant portion of the total portfolio savings, but also because lighting savings are an important part of many of their other residential and low-income programs (particularly whole building retrofit programs).

C. Adjusting MA/RI 2014 Savings to Account for Future Impact of Lighting Standards

Figure C2 shows the cumulative persisting annual savings over the next ten years assuming that the average of the 2014 results for Massachusetts and Rhode Island were realized each year, but with downward adjustments

Figure C2



68 Miziolek, C., Wallace, P., & Lis, D. (2015). *The State of Our Sockets: A Regional Analysis of the Residential Lighting Market.* Northeast Energy Efficiency Partnerships.

69 Though LED technology may provide some additional savings potential, the increment will be relatively small compared to the change in wattage utility programs currently claim relative to an EISA phase 1 halogen baseline.

to account for the portion of residential and commercial lighting savings that will become part of the "baseline" condition as a result of federal efficiency standards discussed above. The dotted green line is the unadjusted average for the two states, ending at just under 21 percent in 2025. The dotted blue line is the savings if adjustments are made only to the account for the impacts of residential lighting efficiency standards. It ends at slightly under 18 percent in 2025. The solid dark blue line is the net impact of adjusting for both residential and commercial lighting standards. It ends at a little over 17 percent. That is the adjusted point from which the discussion in the rest of this paper builds.

Appendix D:

Representativeness of Massachusetts and Rhode Island

Massachusetts and Rhode Island are different from some other parts of the country in a number of ways. Since this report is meant to address electric efficiency potential across the United States, it is important to consider whether the differences between Massachusetts and Rhode Island and other parts of the country have implications for achievable cost-effective savings potential and, to the extent possible, either adjust for such differences or qualify our conclusions. To that end, we consider several factors that could theoretically affect electricity savings potential. Where possible, we analyze relevant data on each of these factors. However, in many cases our conclusions are necessarily qualitative as there has been relatively little (or no) empirical research on the relative importance of each of the factors.

A. Costs of Electricity

Average retail electricity prices in Massachusetts (14.5 cents/kWh) and Rhode Island (13.7 cents/kWh) were above the national average (10.1 cents/kWh) in 2013.[70] In theory, that could make customers in the region more willing to make investments in energy efficiency. However, we are unaware of empirical analysis that would support such a conclusion. While it is true that all four of the states that produced the greatest levels of electricity savings in 2014 had higher than average electric rates, it is also true that seven of the next 12 highest ranking states had average rates at or below the national average,[71] in some cases well below average.[72] Also, the two Northeastern states with the highest average electric rates—New York and Connecticut—had electricity savings levels in 2014 that were one-half to one-third the levels achieved in neighboring Massachusetts and Rhode Island. In short, it is not clear that there is a significant correlation between costs of electricity and achievable savings potential.

B. Magnitude of Avoided Costs

Anecdotally, it appears as if the avoided costs use for cost-effectiveness screening of efficiency measures and programs in New England are higher than those used in many other states. One might hypothesize that such differences could make more energy efficiency measures and programs cost-effective, leading to greater savings potential. However, while some such effect is possible, we do not believe it is substantial. One reason for differences in avoided costs between New England and many other regions of the country is that the New England states endeavor to more comprehensively assess avoided supply costs, particularly avoided transmission and distribution costs. Secondly, and perhaps more importantly, most of the electricity savings being acquired in Massachusetts and Rhode Island passes cost-effectiveness screening easily. In fact, the average TRC benefit-cost ratio for Massachusetts' 2014 programs was 3.49 to 1; only one non-low-income program,[73] which accounted for about one percent of portfolio savings,[74] had a benefit-to-cost ratio of less than 2 to 1. In other words, even if avoided costs were cut in half, it would have had a negligible impact on the level of savings pursued.

70 US Energy Information Administration. (2015). *Electric Power Annual*. Table 2.10.

71 For state rankings in delivery of electricity savings see Table 13 in Gilleo, A., Nowak, S., Kelly, M., Vaidyanathan, S., Shoemaker, M., Chittum, A., and Bailey, T. (2015, October). *The 2015 State Energy Efficiency Scorecard*. ACEEE Report U1509.

72 Iowa, Illinois, Oregon, and Washington all had average electric rates below 8.5 cents/kWh in 2013.

73 All the low-income programs had a benefit-to-cost ratio of at least 1.7 to 1.

74 The Residential HVAC equipment program had a benefit-to-cost ratio of 1.45 to 1.

C. Climate

The climate in southern New England is certainly different than in many other parts of the country. It is colder than many other places in the winter and, though peak cooling days can be quite hot, the cooling season is shorter and considerably less severe than in the South or the desert Southwest. One implication of those differences is that heating savings may be more likely to be cost-effective and cooling savings may be less likely to be cost-effective than in many other parts of the country.

That said, there is relatively little electric heat in New England, so—despite more heating hours—the magnitude of heating savings potential is quite low. Indeed, it is probably lower than in many milder climates. Though central cooling is almost ubiquitous in commercial buildings, it is not in residential homes, which rely on a mix of central and window air conditioning.

The upshot is that New England probably has a higher proportion of its electric savings potential in non-space conditioning end uses. It is difficult to say exactly what that might mean in terms of the ability to save large portions of baseline electricity use. It is possible that it makes it a little easier to achieve higher percentage savings, as the history of efficiency programs suggests that thermal envelop improvements (which are an important way to reduce heating and cooling loads) are among the most difficult of the efficiency measures to effectively promote.

D. History of Investment in Energy Efficiency

Massachusetts and Rhode Island have among the longest histories of aggressive state efforts to promote energy efficiency. On the one hand, one might argue that this experience will make it easier to achieve deep levels of savings because the states have helped build an extensive and increasingly sophisticated infrastructure of efficiency service providers and increased the awareness and sensitivity to efficiency opportunities among customers and the product supply chains that sell to them. On the other hand, one could also argue that their experience will make it more difficult to achieve deep levels of savings because they have already captured a lot of the easiest savings. Intuitively, both arguments have merit. It is not clear what the net effect of these two factors is.

E. Summary

We are unaware of any analysis that could offer definitive insights into the extent to which the success of leading states in acquiring electricity savings is transferable. Our qualitative assessment suggests that there are some factors that might suggest that savings percentages in the southern New England states of Massachusetts and Rhode Island would be expected to be a little larger than in some other parts of the country, and other factors which push in the opposite direction. Our professional judgment is that the net effect of all these factors is likely to be fairly small. As noted above, the results of dozens of efficiency potential studies also suggests that achievable cost-effective savings potential does not vary considerably (if at all) from region to region.

Appendix E:

LED Alternatives to Linear Fluorescent Lighting

Nationally, commercial customers currently account for approximately 36 percent of total electricity consumption. Between 35 percent and 40 percent of commercial electricity use is for lighting; the majority of that consumption is associated with various forms of linear fluorescent fixtures, particularly T12s and T8s. Linear fluorescent fixtures also play important, though less substantial, roles in residential and industrial lighting.

As discussed above, many program administrators have historically achieved substantial portions of their lighting savings by persuading business customers to install high performance T8s and other measures that reduce linear fluorescent lighting consumption (e.g., T5s, de-lamping, controls). Both because of the effects of new federal efficiency standards and, in some jurisdictions, success in helping a substantial portion of business customers to install more efficient linear fluorescent technology, it is sometimes argued that the "low-hanging fruit" of C&I lighting is or will soon be largely "picked." However, that argument ignores the evolution of technology. In particular, it ignores the emergence of LED alternatives to linear fluorescent fixtures, or what are often called LED troffers.

As Table E1 shows, high performance T8s currently save 11 percent to 22 percent relative to the current federal minimum efficiency standard for linear fluorescent lighting. In contrast, an LED troffer provides 45 percent savings on its own (or two to four times as much savings as an HPT8) and 66 percent if installed with integrated controls (or three to six times as much savings as an HPT8). These savings are already cost-effective ($0.06 to $0.11 per kWh saved, depending on the situation). Moreover, both because their performance is improving and their cost is declining, their cost-per-unit of savings is forecast to improve by 50-80 percent (down to $0.01 to $0.05 per kWh saved) by 2025. Put simply, LED alternatives to linear fluorescent lighting fixtures offer a massive reservoir of new and very cost-effective savings potential that most efficiency programs—even most efficiency potential studies—have not even considered tapping.

Because their savings potential is so substantial even compared to an HPT8 baseline, the emergence of LED troffers will permit utility programs to revisit and re-serve virtually every single business customer they have already treated with HPT8s. Moreover, because utility programs already have valuable data for those customers (e.g., numbers of existing light fixtures, typical run hours, etc.), they will be able to develop estimates of savings potential and strategies for reaching out to the customers before revisiting them, saving time and money while increasing marketing effectiveness. Indeed, even relative to an HPT8 baseline, we estimate that the conversion of 75 percent of linear fluorescent fixtures to LED troffers with integrated controls over the next ten years would produce savings equal to approximately 2.2 percent of national electricity sales in 2025.[75,76]

75 This is an estimate of just the lighting savings. We have not adjusted the estimate for additional cooling energy savings or heating energy penalties.

76 We are not suggesting that fixtures first get converted to HPT8s and then again (later) to LED troffers. It would obviously be ideal to just promote the most efficient technology. We are only suggesting that when assessing how much further beyond what Massachusetts and Rhode Island 2014 savings levels one can go, one needs to account for the fact that the 2014 Massachusetts and Rhode Island savings levels already account for the next major increment in linear fluorescent savings potential (i.e., to very high market penetrations of HPT8s) over the next decade.

77 Table E1 was developed by Dan Mellinger, Vermont Energy Investment Corporation Lighting Strategy Manager. It is an expanded and updated version of one he developed for a 2013 business lighting white paper: Mellinger, D. (2013, July 15). *A New Dawn in Efficient Lighting: The Future of Efficiency for Businesses.* Burlington, VT: Vermont Energy Investment Corporation.

Table E1

Comparison of LED Troffer Savings to HPT8 Savings[77]

	Lighting Technology[i]	Typical System Watts[v]	Savings		Estimated Upgrade Cost[vi]					
					Total Cost		Cost/Watt Saved		$/kWh Levelized	
			Watts Saved vs. 2014 Baseline	% Saved vs. 2014 Baseline	Time of Natural Replace-ment	Early Retirement Retrofit	Time of Natural Replace-ment	Early Retirement Retrofit	Time of Natural Replace-ment	Early Retirement Retrofit
2012 Baseline[ii]	3-lamp F32 T8 (89 lpW) w/ 0.88 Ballast	88	--	--	--	--	--	--	--	--
2014 Baseline[iii]	3-lamp F32 T8 (89 lpW) w/ 0.88 HE Ballast	84	--	--	--	--	--	--	--	--
2018 Baseline[iv]	3-lamp F32 T8 (92 lpW) w/ 0.88 HE Ballast	81	--	--	--	--	--	--	--	--
HPT8	3-lmap F32 T8 High Lumen w/ 0.77 HE Ballast	75	9	11%	$15	$100	$1.67	$11.11	$0.03	$0.23
	3-lamp F28 Reduced Watt w/ o.77 HE Ballast	66	18	21%	$15	$100	$0.83	$5.56	$0.02	$0.11
LED	2015 LED 2x4 Troffer, 5200 lumens[vii] 112 lpW[viii]	46	38	45%	$115	$200	$3.06	$5.32	$0.06	$0.11
	2020 LED 2x4 Troffer, 5200 lumens[vii] 131 lpW[ix]	40	44	53%	$62	$147	$1.40	$3.32	$0.03	$0.07
	2025 LED 2x4 Troffer, 5200 lumens[vii] 156 lpW[x]	33	51	60%	$30	$115	$0.60	$2.28	$0.01	$0.05
LED + Integrated Controls[xi]	2015 LED 2x4 Troffer, 5200 lumens[vii] 112 lpW[viii]	28	56	66%	$190	$275	$3.41	$4.94	$0.07	$0.10
	2020 LED 2x4 Troffer, 5200 lumens[vii] 131 lpW[ix]	24	60	71%	$114	$199	$1.91	$3.33	$0.04	$0.07
	2025 LED 2x4 Troffer, 5200 lumens[vii] 156 lpW[x]	20	64	76%	$69	$154	$1.09	$2.42	$0.02	$0.05

i A 3-lamp T8 configuration was selected based on Efficiency Vermont projects from 2000 — 2015 where the average number of lamps per fixture is 2.9

ii 2009 General Service Fluorescent Lamp DOE Rule (effective 2012) established 89 ipW efficacy standard for 4' T8 fluorescent lamps. http://www.appliance-standards.org/node/6802

iii 2011 Fluorescent Ballast DOE Rule (effective 2014) established efficiency standards fluorescent ballasts. http://www.appliance-standards.org/node/6811

iv 2015 General Service Fluorescent Lamp DOE Rule (effective 2018) establishes 92.4 ipW efficacy standard for 4' T8 fluorescent lamps. http://www.appliance-standards.org/node/6802

v Fluorescent wattages based on Xcel Energy Input Wattage Guide. http://www.xcelenergy.com/staticfiles/xe/Marketing/MN-Bus-Lightning-Input-Wattage-Guide.pdf

vi Equipment costs based on Efficiency Vermont past projects; labor costs assume ½ hour per fixture at $50/hour; future LED costs are based on 2014 DOE Energy Savings Forecast of Solid-State Lighting in General Illumination Applications. http://energy.gov/sites/prod/files/2015/05/f22/energysavingsforecast14.pdf

vii 5200 lumens is approximately equivalent to a 3-lamp "800 series" 89 ipW T8 (3 lamps x 2710 means lumens x 0.88 ballast factor x %72 fixture efficiency)

viii Average efficacy of DesignLights Consortium Premium Tier LED 2x4 Troffers as of Nov. 2015. http://www.designlights.org/qpl

ix 2020 efficacy forecast per 2014 DOE Energy Savings Forecast of Solid-State Lighting in General Illumination Applications. http://energy.gov/sites/prod/files/201505/f22/energysavingsforecast14.pdf

x 2025 efficacy forecast per 2014 DOE Energy Savings Forecast of Solid-State Lighting in General Illumination Applications. http://energy.gov/sites/prod/files/2015/05/f22/energysavingsforecast14.pdf

xi Wireless integrated controls (occupancy, daylight, task tuning) can save 39% of lighting energy per LBNL Wireless Advanced Lighting Controls Retrofit Demonstration. http://www.gsa.gov/portal/mediald/227615/fileName/Wireless_Advanced_Lighting_Controls_Retrofit_Demo_FINAL_508-0629

Appendix F:

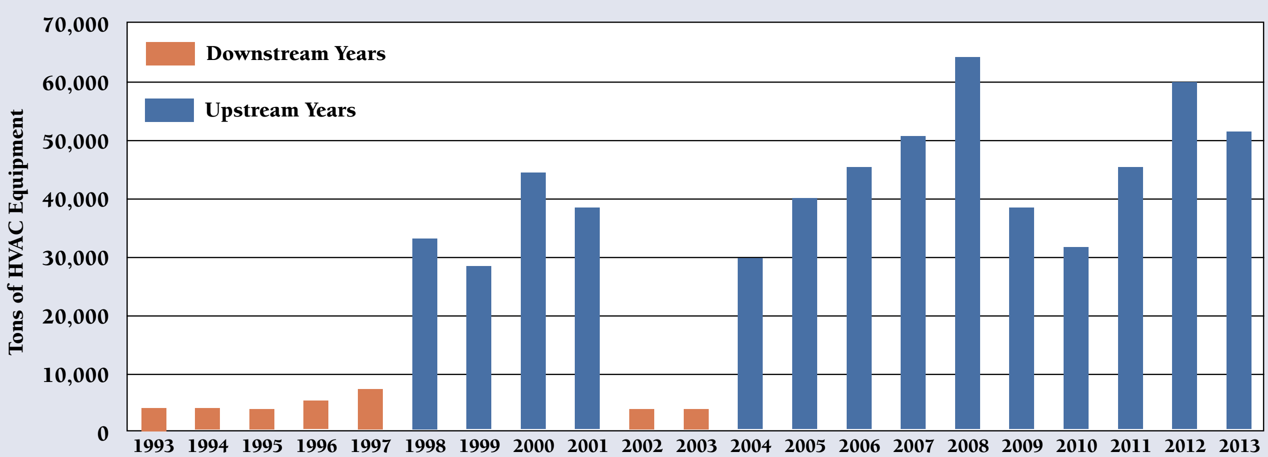
Expanding Consideration of Upstream Product Rebates

Upstream incentives—that is, incentives paid to manufacturers, distributors, contractors, and other key players in the supply chain rather than to the end use customers—can have several advantages. Most importantly, they typically lead to much higher market penetration rates for efficient equipment. That can be seen in Figure F1, which shows that a commercial cooling equipment upstream incentive program (blue bars) run by Pacific Gas and Electric in California achieved nine times the level of participation that its former downstream customer rebate program design (red bars) achieved. Notably, when the program design was changed back to a customer rebate after four years of the upstream model, participation plummeted again. After two years of that much lower participation rate, the upstream incentive approach was re-initiated and participation skyrocketed again. Very similar results have been achieved in California for commercial gas boilers and other products.[78]

Similarly, in September 2013 Efficiency Vermont launched an upstream incentive for high efficiency circulator pumps for boilers and saw the market share (from one of the leading HVAC wholesalers) for those products increase from two percent or less to about 50 percent in the span of just one year. It took about six months to get the program off the ground, but it has continued to grow steadily.[79] Today, the program is producing as many participants every 2.5 days as it did

Figure F1

Pacific Gas & Electric Commercial HVAC Program Participation Increases with Upstream Incentive[81]



78 Personal communication between Jim Hanna (Energy Solutions) and Jim Grevatt, July 2015.

79 Personal communication with Jake Marin, Efficiency Vermont, July 2015.

80 Personal communication with Howard Merson, Efficiency Vermont, August 27, 2015.

81 Mosenthal, P. (2015). Do Potential Studies Accurately Forecast What Is Possible in the Future? Are we Mislabeling and Misusing them? Presented at the ACEEE Efficiency as a Resource Conference, Little Rock, AR. Graphic provided to Mr. Mosenthal by Jim Hanna, Energy Solutions.

in an entire year before moving to an upstream strategy.[80] Moreover, it has had documentable market transformation effects. For example, when the upstream program was initially launched, Taco, the largest manufacturer of circulator pumps, did not have a product on the market that met Efficiency Vermont's program specifications. They subsequently modified their equipment to produce a new product that did. Moreover, they even appear to have named the product after the Vermont program: VT 2218.

The Connecticut utilities have also had notable recent success in moving residential HVAC and water heating equipment incentives upstream to distributors. That includes:

- Ten-fold increase in high efficiency gas water heater participation in the first year (and on track for 50 percent greater participation in the second year, or a nearly 15-fold increase over the last year of downstream rebates);
- Six- to seven-fold increase in electric heat pump water heater participation in the first year; and
- 70 percent increase in efficient gas boiler participation in the first year (on track for roughly another doubling in participation in the second year, or a roughly three-fold increase relative to the last year of downstream rebates).[82]

These types of increases in market penetration happen for several reasons. First, it is generally easier to inform and work with a relatively small number of strategic market actors who influence (through their own stocking and sales practices) the purchases of thousands of end use customers. Second, because the cost of products is typically marked up at every step in the supply chain, a financial incentive paid to a distributor will cover a higher fraction of the incremental cost of a product (making it easier to persuade the distributor to stock and promote it) than the same financial incentive paid to an end-use customer. Third, upstream incentives are easy to set up in ways that eliminate the need for filling out of rebate forms and other paperwork that downstream players often hate. To be sure, launching an upstream program requires effort to build relationships with distributors and to reach agreement with them on how the program will work. However, once the relationships are established and the program systems are in place, the program may also potentially enable reductions in marketing and administrative costs. Moreover, once an upstream program for one type of equipment is in place, it is much easier to launch similar initiatives for other products sold by the same distributors (or other upstream market actors).

These days, residential lighting programs are almost universally delivered as upstream programs. However, few jurisdictions have gone upstream in other markets. Some have done so with commercial lighting products with some success and, as noted above, a few leaders have done the same with HVAC and water heating equipment. The dramatic success of these efforts suggests that this type of approach ought to be at least considered for many more types of efficient equipment (e.g., residential appliances, commercial office equipment, food service equipment, and ventilation equipment).

82 Parsons, J., (2015). Dramatically Increase Residential HVAC Program Participation with an Upstream Approach. The United Illuminating Company. Presented at the 2015 ACEEE Efficiency as a Resource Conference.

Appendix G:

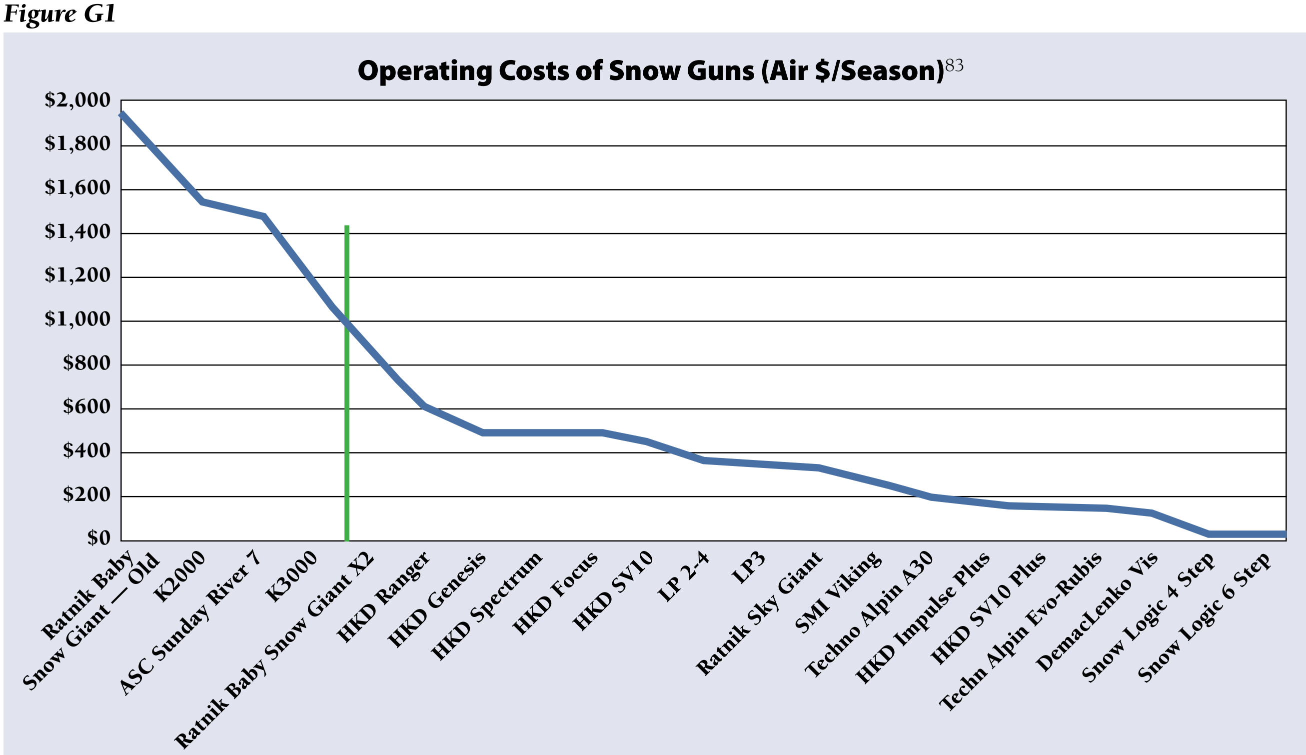
Vermont's Transformation of the Snowmaking Gun Market

Many of the thought leaders that we interviewed for this project suggested one of the defining characteristics of today's leading states is that they are more carefully segmenting their markets and tailoring their efficiency program or service offerings to the unique needs of different types of businesses—whether grocery stores, hospitals, automotive manufacturing, or any other type of customer for which needs and opportunities may be similar. These approaches are married with sophisticated "account management" models in which staff is dedicated to working with specific larger customers and industries.

Some of these leading jurisdictions have begun to advance this concept to another level in which they pursue what we will call industry "deep dives." That can include not only doing extensive assessments of energy savings opportunities at individual facilities, but also investing in efforts to understand the business needs to unearth either unknown barriers or new opportunities to leverage in promoting efficiency investments and, where potentially appropriate, working closely with the supply chains for those businesses to help better position and potentially even modify product offerings to maximize efficiency.

One notable example is Efficiency Vermont's recent work with the state's ski industry. Since its inception in 2000, Efficiency Vermont has worked fairly closely with ski areas

Figure G1



83 McMurry, J., & Lawrence, G. (2014). *Snow Gun Performance, Efficiency, and Operating Costs.* Presented at the Ski Areas Best Practices Exchange. Burlington, VT: Efficiency Vermont

in the state. It has also achieved significant savings from that work, both from the promotion of efficient snow guns and from work to help ski areas with both the design and construction of new and retrofitting of existing hotels, condos, and other buildings. However, a few years ago, it began to go a little deeper in its efforts to promote more efficient snow guns. First, it bought testing equipment and began investing considerable effort to test the efficiency and demonstrate the effectiveness of different snow guns at ski resorts and wherever else they could get an interested audience. From 2012 through 2014, Efficiency Vermont staff spent a day testing snow making equipment at each of the National Ski Areas Association's annual eastern region meetings. Each vendor's guns were lined up on the same trail, with the same test applied to each. The data collected were then presented at the conference the day after the testing—typically to a standing-room-only crowd. As Figure G1 illustrates, the tests clearly demonstrated that there were significant differences not only between the energy efficiency of old snow guns (those to the left of the green line) and new snow guns (those to the right of the green line), but also between the new guns themselves. In fact, the most efficient new guns (the Snow Logics) have operating costs that are more than 95 percent lower than the least efficient new gun on the market (the Ratnik Baby Snow Giant X2).

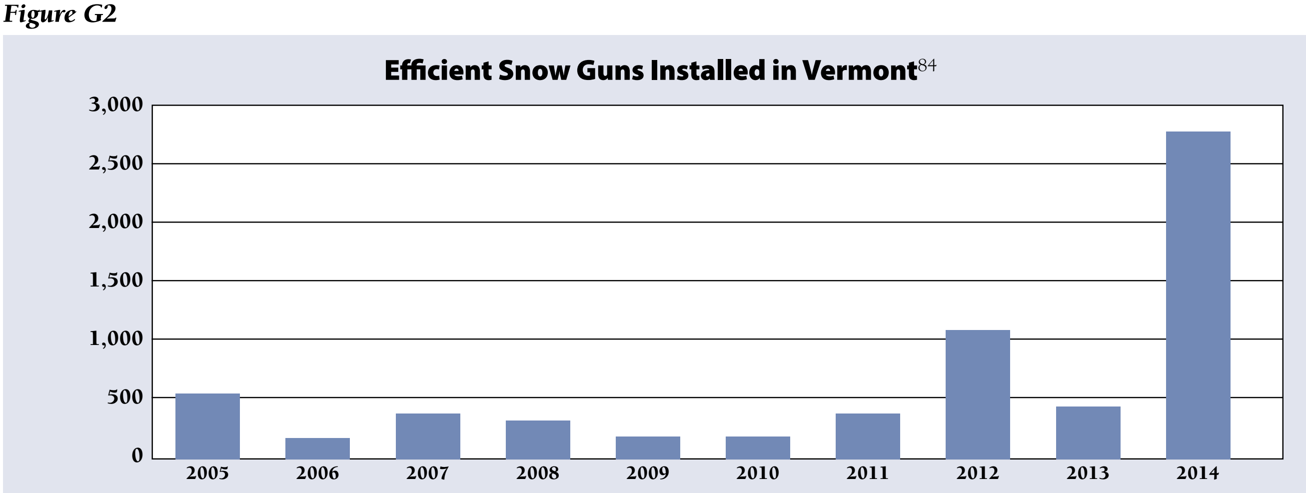
The testing also demonstrated that many of the more efficient guns also functioned at higher air and water temperatures (important for extending the ski season), made better snow, and were quieter than the alternatives.

Prior to Efficiency Vermont's testing, these differences in performance were not fully understood by the industry. Indeed, there was considerable skepticism among ski areas about snow gun efficiency claims. All that has changed.

To take advantage of the great interest in the testing results, Efficiency Vermont launched a major initiative in 2014 called the Great Snow Gun Round Up. It offered financial incentives of up to 75 percent of the cost of the most efficient guns. Ski areas would need to pick up the balance of the cost of the gun plus a variety of other related costs (including pipe repairs, air compressors, new hydrants, new tower mount, etc.). All told, the industry spent nearly $15 million, with a third of that coming from Efficiency Vermont. As Figure G2 shows, the result was more efficient snow guns rebated than in the previous six years combined. In addition, the ski areas donated for scrap four old snow guns for every five new ones that they purchased. Efficiency Vermont pledged to donate the proceeds from the scrap metal to a state program that promotes skiing and snowboarding, in part through massive ski pass discounts for all fifth graders in the state.

There is also anecdotal evidence of some market transformation effects from this effort. For example, some ski areas in competing states have reportedly complained that they are not getting comparable support for investments in better snow guns. Also, some manufacturers are changing product designs to be able to market their products in the highest efficiency tier.

Figure G2



84 Graphic provided by Alan Hebert, Efficiency Vermont, August 31, 2015.

One should not conclude that the Vermont snow gun example is illustrative of the percentage savings that would be possible from deeper dives into savings potential in other industry or business types. Indeed, it is highly unlikely that there are many other business end uses of electricity for which it will be possible to achieve savings on the order of 95 percent or more, even with intensive assessment of opportunities and assistance to the businesses and their supply chains. Rather, the example is meant to illustrate that some additional savings, beyond levels currently envisioned, is likely possible through such industry-specific “deeper dives.” The precise magnitude of such increases in savings will undoubtedly vary substantially—from industry to industry and from end use to end use—but cannot be known or even predicted until such efforts are undertaken.

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Recognizing the Full Value of Energy Efficiency

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Energy efficiency provides numerous benefits to utilities, to participants (including ratepayers), and to society as a whole. However, many of these benefits are frequently undervalued, or not valued at all, when energy efficiency measures are assessed. This paper seeks to comprehensively identify, characterize, and provide guidance regarding the quantification of the benefits provided by energy efficiency investments that save electricity. It focuses on the benefits of electric energy efficiency, but many of the same concepts are equally applicable to demand response, renewable energy, and water conservation measures. Similarly, they may also apply to efficiency investments associated with natural gas, fuel oil, or other end-user fuels. This report is meant to provide a comprehensive guide to consideration and valuation (where possible) of energy efficiency benefits. It provides a real-world example that has accounted for many, but not all, of the energy efficiency benefits analyzed herein. We also provide a list of recommendations for regulators to consider when evaluating energy efficiency programs.

Valuing the Contribution of Energy Efficiency to Avoided Marginal Line Losses and Reserve Requirements

Available at: http://www.raponline.org/document/download/id/4537

While utilities and their regulators are familiar with the energy savings that energy efficiency measures can provide, they may not be aware of how these same measures also provide very valuable peak capacity benefits in the form of marginal reductions to line losses that are often overlooked in the program design and measure screening. This paper is the first of two that the Regulatory Assistance Project is publishing on the relationship between energy efficiency and avoiding line losses.

US Experience with Efficiency as a Transmission and Distribution System Resource

Available at: http://www.raponline.org/document/download/id/4765

Transmission and distribution (T&D) investments by investor-owned utilities, which collectively account for approximately two-thirds of the electricity sales in the United States, have averaged about $26 billion annually over the past decade. This paper summarizes US experience to date of efforts to use geographically targeted efficiency programs to defer T&D system investments. It presents several case studies and summarizes lessons learned from those initiatives. Most importantly, it concludes that targeted efficiency programs—either alone or in combination with other demand resources—clearly can be a cost-effective alternative to T&D investments. However, their cost-effective potential as a T&D resource has been grossly under-utilized for a variety of policy and institutional reasons. The paper offers several policy recommendations to address those barriers.

Energy Efficiency Cost-Effectiveness Screening

Available at: http://www.raponline.org/document/download/id/6149

Energy efficiency is widely recognized as a low-cost, readily available resource that offers a variety of benefits to utility customers and to society as a whole. There is a great amount of variation across the states in the ways that energy efficiency programs are screened for cost-effectiveness. Many states apply methodologies and assumptions that do not capture the full value of efficiency resources, leading to under-investment in this low-cost resource, and thus higher costs to utility customers and society. This report addresses the major differences between tests, and is designed to help regulators recognize the important features of these broad cost-benefit tests that are frequently overlooked as the tests are applied. The authors address two elements of energy efficiency program screening that are frequently treated improperly or entirely overlooked—"other program impacts" (OPIs) and the costs of complying with environmental regulations.

Revenue Regulation and Decoupling: A Guide to Theory and Application

Available at: http://www.raponline.org/document/download/id/902

This guide was prepared to assist anyone who needs to understand both the mechanics of a regulatory tool known as decoupling and the policy issues associated with its use. This would include public utility commissioners and staff, utility management, advocates, and others with a stake in the regulated energy system. While this guide is somewhat technical at points, we have tried to make it accessible to a broad audience, to make comprehensible the underlying concepts and the implications of different design choices. This guide includes a detailed case study that demonstrates the impacts of decoupling using different pricing structures (rate designs) and usage patterns.
Other documents on energy efficiency and other topics are available on The Regulatory Assistance Project website at: www.raponline.org.

Energy Efficiency Collaboratives: Driving Ratepayer-Funded Efficiency through Regulatory Policies Working Group

Available at: http://www.raponline.org/document/download/id/7860

Collaboratives for energy efficiency have a long and successful history and are currently used, in some form, in more than half of the US states. Collaboratives can be useful to gather stakeholder input on changing program budgets and program changes in response to performance or market shifts, as well as to provide continuity while regulators come and go, identify additional energy efficiency opportunities and innovations, assess the role of energy efficiency in new regulatory contexts, and draw on lessons learned and best practices from a diverse group. This guide defines and examines four different types of collaboratives based on their origin, scope, decision-making method, membership, duration, available resources, and how they interact with and influence their respective commissions. The guide also highlights common elements and conclusions on the overall effectiveness of specific characteristics of different types of collaboratives. As comprehensive, sophisticated programs have evolved, so too have the purpose, usefulness, and focus of collaboratives. Increasingly, customers as a group are seen as a vital and strategic, demand-side power sector resource with distinct advantages over other resources. States with energy efficiency collaboratives are likely to find themselves better able to respond to these trends and utilize this resource. This guide provides valuable context for decision-makers as they design new or improve existing energy efficiency collaboratives.

Thermal Efficiency for Low Income Households in Vermont

Available at: http://www.raponline.org/document/download/id/7536

Thermal energy efficiency—improvements in the usable heating and cooling performance of buildings—directly lowers energy costs and creates indirect benefits for the household and broader community. These include improved energy affordability, improved work and school productivity, job creation, and reduced greenhouse gas emissions. An estimated 125,000 Vermonters are fuel-poor, a situation that forces them to make difficult decisions between household health and comfort and other basic services. This paper characterizes and quantifies the multitude of benefits associated with investments in thermal energy efficiency initiatives, especially as they relate to reducing the fuel burden on low-income households. The paper also reviews policies for capturing and delivering those benefits in Vermont. The recommendations include strengthening building codes and standards, utilizing integrated resource planning to advance thermal efficiency, establishing binding energy savings targets, enabling new markets for energy efficiency services, and expanding successful existing programs.

The Regulatory Assistance Project (RAP)® is a global, non-profit team of experts focused on the long-term economic and environmental sustainability of the power sector. We provide technical and policy assistance on regulatory and market policies that promote economic efficiency, environmental protection, system reliability, and the fair allocation of system benefits among consumers. We work extensively in the US, China, the European Union, and India. Visit our website at **www.raponline.org** to learn more about our work.

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MPSC Case No.: U-18419
Respondent: K. L. Bilyeu
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.24a
Page: 1 of 1

Question: Regarding the GDS potential study provided as Exhibit A-32:

a. The study defines "avoided costs" as "…the generation, transmission and distribution costs that can be avoided…" (p. 17 of 118). However, in defining the Utility Cost Test, it references only "avoided utility costs of energy and capacity"; there is no mention of avoided transmission and/or distribution (T&D) costs. Were avoided T&D costs included in the potential study? If so, what were they? If not, why not?

Answer: No. T&D avoided costs were not included in the benefit/cost analyses for the GDS Energy Efficiency Potential Study. T&D avoided costs were not included in the study since the Company does not have a forecast of T&D avoided costs.

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.24bi
Page: 1 of 1

Question: Regarding the GDS potential study provided as Exhibit A-32:

b. On pp. 23-24, the study report states that “annual kWh sales and electric system peak load for the DTE Energy are projected to stay fairly constant over the two decades” analyzed (2016 to 2035). This is based on a load forecast provided to GDS by DTE.

   i. Please provide a copy of the load forecast provided to GDS.

Answer: Please refer to the attachment “U-18419-MECNRDCSCDE-1.24bi-GDS Potential Study Load Forecast.xlsx”.

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.24bii
Page: 1 of 1

Question: Regarding the GDS potential study provided as Exhibit A-32:

b. On pp. 23-24, the study report states that "annual kWh sales and electric system peak load for the DTE Energy are projected to stay fairly constant over the two decades" analyzed (2016 to 2035). This is based on a load forecast provided to GDS by DTE.

   ii. Is the load forecast provided to GDS different than the load forecast used in the base case for DTE's IRP? If so, please summarize the nature and magnitude of the differences.

Answer: Yes. The load forecast provided to GDS was the most up-to-date forecast at the time of the potential study. Please refer to the attachment "U-18419-MECNRDCSCDE-1.24bi-GDS Potential Study Load Forecast.xlsx" for the magnitude of the differences.

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.24biii
Page: 1 of 1

Question: Regarding the GDS potential study provided as Exhibit A-32:

b. On pp. 23-24, the study report states that "annual kWh sales and electric system peak load for the DTE Energy are projected to stay fairly constant over the two decades" analyzed (2016 to 2035). This is based on a load forecast provided to GDS by DTE.

iii. Was the load forecast provided to GDS a forecast of what sales would be absence any efficiency programs? Or did it include – implicitly or explicitly – assumptions regarding efficiency programs continuing in 2016 and any subsequent years? If the latter, please explain what level of post-2015 efficiency program savings were included or embedded in the load forecast.

Answer: The initial load forecast provided to GDS included the impacts of future participants in the Company's energy efficiency programs. The Company then provided GDS with information on the future impacts of the Company's energy efficiency programs. GDS then worked with the Company to develop a load forecast that excluded the future impacts of the Company's programs.

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.24ci
Page: 1 of 1

Question: Regarding the GDS potential study provided as Exhibit A-32:

c. On p. 8 of 118, the report states that the potential study "evaluates three achievable potential scenarios". However, it then lists and describes only two scenarios: (1) one in which financial incentives were set equal to 50% of incremental measure cost and no budget cap is applied; and (2) a second in which an annual spending cap equal to 2% of revenues is applied.

  i. Was there a third achievable potential scenario analyzed but for which results were not included in the report? If so, please provide the results in a form comparable to that provided in tables in Chapters 1, 6, 7 and 8.

Answer: No. Only the two achievable potential scenarios described on page 8 were evaluated.

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.24cii
Page: 1 of 1

Question: Regarding the GDS potential study provided as Exhibit A-32:

c. On p. 8 of 118, the report states that the potential study "evaluates three achievable potential scenarios". However, it then lists and describes only two scenarios: (1) one in which financial incentives were set equal to 50% of incremental measure cost and no budget cap is applied; and (2) a second in which an annual spending cap equal to 2% of revenues is applied.

ii. If a third achievable potential scenario was contemplated, but ultimately not analyzed, what was the third scenario?

Answer: Only the two achievable potential scenarios described on page 8 were evaluated. A third achievable potential scenario was not contemplated.

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.24ciii
Page: 1 of 1

Question: Regarding the GDS potential study provided as Exhibit A-32:

c. On p. 8 of 118, the report states that the potential study "evaluates three achievable potential scenarios". However, it then lists and describes only two scenarios: (1) one in which financial incentives were set equal to 50% of incremental measure cost and no budget cap is applied; and (2) a second in which an annual spending cap equal to 2% of revenues is applied.

iii. Was a scenario assuming financial incentives up to the limit of UCT cost-effectiveness per measure (but no more than 100% of measure cost) ever contemplated or analyzed? If not, why not?

Answer: No. The Company did not examine this scenario because every measure could be cost-effective under this assumption if the utility cost was reduced to a penny and participants were responsible for paying the remainder of the measure cost. The Company does not believe this is a reasonable or prudent scenario.

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.24d
Page: 1 of 1

Question: Regarding the GDS potential study provided as Exhibit A-32:

d. Please provide the workpapers used by GDS to produce the summary results for the achievable potential (i.e. those shown in tables in chapters 1, 6, 7 and 8 of the report), disaggregated to the measure level, in an Excel workbook with all formulas intact.

Answer: Please refer to the following attachments

"U-18419-MECNRDCSCDE-1.24d-Residential GDS Potential Study Workpapers.xlsx".
"U-18419-MECNRDCSCDE-1.24d-Commerical GDS Potential Study Workpapers.xlsx".
"U-18419-MECNRDCSCDE-1.24d-Industrial GDS Potential Study Workpapers.xlsx".

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.24e
Page: 1 of 1

Question: Regarding the GDS potential study provided as Exhibit A-32:

e. If not provided in response to part “d” of this question, please provide the potential study results, disaggregated by measure, in an Excel file. Please include in the file for each measure for each year:

i. the per unit kWh;
ii. the per unit peak kW savings;
iii. the per unit measure cost;
iv. the per unit measure life;
v. the per unit rebate cost at a 50% incremental cost level;
vi. the number of units rebated/incented for each year of the analysis;
vii. the UCT benefit-cost ratio for each measure at a 50% incremental cost incentive level;
viii. the net-to-gross assumption for each measure at a 50% incremental cost incentive level;
ix. the total incremental annual technical potential MWh savings from each measure;
x. the total incremental annual economic potential MWh savings from each measure;
xi. the total net incremental annual achievable MWh savings each year from each measure at a 50% incremental cost incentive level (i.e. the produce of items “i”, “vi” and “viii”); and
xii. the total cumulative annual achievable MWh savings each year from each measure at the 50% incremental cost incentive level.

Answer: Please see response to question MECNRDCSCDE-1.24d.

MPSC Case No.:	U-18419
Respondent:	K. L. Bilyeu
Requestor:	MECNRDCSC
Question No.:	MECNRDCSCDE-1.24f
Page:	1 of 1

Question: Regarding the GDS potential study provided as Exhibit A-32:

f. On p. 47 of 118, the study report states that savings can be captured over time through two principal processes: (1) time-sensitive opportunities such as when equipment replacements are normally made in the market; and (2) at any time in the life of the equipment (commonly referred to as "retrofit" or "early replacement"). Please the savings potential and costs shown in tables 1-1, 1-2 and 1-3 broken down into these two sub- categories.

Answer: Please refer to the attachment "U-18419-MECNRDCSCDE-1.24f-Data Request.xlsx".

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.3bi
Page: 1 of 1

Question: On p. 23, lines 6-8 of her testimony, Ms. Dimitry states that the 1.5% annual energy efficiency savings level had “the greatest demand reduction while simultaneously being administered within a budget that is consistent with previous levels and it achieves the highest benefit to cost ratio.”

b. With respect to the benefit cost ratio of the 1.5% EE selected and 2.0% EE not selected:

i. Please provide the NPV of benefits, NPV of costs, NPV of net benefits and benefit-cost ratio for each.

Answer: Please refer to the attachments identified below:

“U-18419-MECNRDCSCDE-1.3bi-DSMore Analysis - Group=All 1.5 Percent.xlsx”
“U-18419-MECNRDCSCDE-1.3bi-DSMore Analysis - Group=All 2 Percent.xlsx”

Cost / Benefit Tests For Normal Weather

	Cost Based	Market-Based Minimum	Today	Alternate	Option	Maximum
Utility (PAC) Test	5.18	5.39	7.95	7.52	7.84	15.11
TRC Test	5.18	5.39	7.95	7.52	7.84	15.11
RIM Test	0.56	0.59	0.86	0.82	0.85	1.61
RIM (Net Fuel)	0.56	0.59	0.86	0.82	0.85	1.61
Societal Test	7.61	7.90	11.66	11.02	11.50	22.18
Participant Test	65535	65535	65535	65535	65535	65535

Cost of Conserved kWh, kW, and CCF

100% Allocation	Nominal	Levelized	% Allocation
Total Costs / kW Savings	$44.8403	$65.5660	100.00%
Total Cost / kWh Savings	$0.0072	$0.0105	100.00%
Total Costs / CCF Savings	$0.0000	$0.0000	100.00%
Allocated By Cost-Based Avoided Costs	$0.0000	$0.0000	
Allocated Costs / kW Savings	$9.2732	$13.5594	20.68%
Allocated Costs / kWh Savings	$0.0057	$0.0083	79.32%
Allocated Costs / CCF Savings	$0.0000	$0.0000	0.00%

Present Values (PVs) of Costs and Benefits Per Test

	Cost Based	Market-Based Minimum	Today	Alternate	Option	Maximum
Utility (PAC) Test						
Avoided Electric Production	$2,414,494,646.61	$2,307,183,930.21	$4,003,167,514.58	$3,700,879,965.16	$3,926,194,580.71	$8,873,496,286.90
Avoided Electric Production Adders	$0.00	$1,046,307,912.35	$1,815,436,467.86	$1,678,349,064.20	$1,780,529,242.35	$4,024,130,566.11
Avoided Electric Capacity	$629,515,793.61	$0.00	$0.00	$0.00	$0.00	$0.00
Avoided T&D Electric	$1,469,813,100.99	$1,469,813,100.99	$1,469,813,100.99	$1,469,813,100.99	$1,469,813,100.99	$1,469,813,100.99
Avoided Ancillary	$680,844,894.83	$581,679,740.34	$680,844,894.83	$680,844,894.83	$680,844,894.83	$769,497,145.69
Avoided Gas Production	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Avoided Gas Capacity	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$5,194,668,436.04	$5,404,984,683.89	$7,969,261,978.25	$7,529,887,025.17	$7,857,381,818.88	$15,136,937,099.69
Administration Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Implementation / Participation Costs	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58
Other / Miscellaneous Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Incentives	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58
Reduced Arrears	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Test Results	5.18	5.39	7.95	7.52	7.84	15.11
TRC Test						
Avoided Electric Production	$2,414,494,646.61	$2,307,183,930.21	$4,003,167,514.58	$3,700,879,965.16	$3,926,194,580.71	$8,873,496,286.90
Avoided Electric Production Adders	$0.00	$1,046,307,912.35	$1,815,436,467.86	$1,678,349,064.20	$1,780,529,242.35	$4,024,130,566.11
Avoided Electric Capacity	$629,515,793.61	$0.00	$0.00	$0.00	$0.00	$0.00
Avoided T&D Electric	$1,469,813,100.99	$1,469,813,100.99	$1,469,813,100.99	$1,469,813,100.99	$1,469,813,100.99	$1,469,813,100.99
Avoided Ancillary	$680,844,894.83	$581,679,740.34	$680,844,894.83	$680,844,894.83	$680,844,894.83	$769,497,145.69
Avoided Gas Production	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Avoided Gas Capacity	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$5,194,668,436.04	$5,404,984,683.89	$7,969,261,978.25	$7,529,887,025.17	$7,857,381,818.88	$15,136,937,099.69
Administration Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Implementation / Participation Costs	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58
Other / Miscellaneous Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58
Reduced Arrears	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Participant Costs (net)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Participant Tax Credits (net)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Environmental Benefits	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Other Benefits	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Test Results	5.18	5.39	7.95	7.52	7.84	15.11
RIM Test						
Avoided Electric Production	$2,414,494,646.61	$2,307,183,930.21	$4,003,167,514.58	$3,700,879,965.16	$3,926,194,580.71	$8,873,496,286.90
Avoided Electric Production Adders	$0.00	$1,046,307,912.35	$1,815,436,467.86	$1,678,349,064.20	$1,780,529,242.35	$4,024,130,566.11
Avoided Electric Capacity	$629,515,793.61	$0.00	$0.00	$0.00	$0.00	$0.00
Avoided T&D Electric	$1,469,813,100.99	$1,469,813,100.99	$1,469,813,100.99	$1,469,813,100.99	$1,469,813,100.99	$1,469,813,100.99
Avoided Ancillary	$680,844,894.83	$581,679,740.34	$680,844,894.83	$680,844,894.83	$680,844,894.83	$769,497,145.69
Avoided Gas Production	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Avoided Gas Capacity	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$5,194,668,436.04	$5,404,984,683.89	$7,969,261,978.25	$7,529,887,025.17	$7,857,381,818.88	$15,136,937,099.69
Administration Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Implementation / Participation Costs	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58
Other / Miscellaneous Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Incentives	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58	$1,001,882,535.58
Reduced Arrears	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Lost Revenue (Electric)	$8,229,505,546.70	$8,082,768,461.52	$8,229,505,546.70	$8,229,505,546.70	$8,229,505,546.70	$8,382,807,333.71
Lost Revenue (Gas)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$8,229,505,546.70	$8,082,768,461.52	$8,229,505,546.70	$8,229,505,546.70	$8,229,505,546.70	$8,382,807,333.71
Net Fuel Lost Revenue (Electric)	$8,229,505,546.69	$8,082,768,461.51	$8,229,505,546.69	$8,229,505,546.69	$8,229,505,546.69	$8,382,807,333.68
Net Fuel Lost Revenue (Gas)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$8,229,505,546.69	$8,082,768,461.51	$8,229,505,546.69	$8,229,505,546.69	$8,229,505,546.69	$8,382,807,333.68
Test Results	0.56	0.59	0.86	0.82	0.85	1.61
	0.56	0.59	0.86	0.82	0.85	1.61
Societal Test						
Avoided Electric Production	$4,776,931,909.47	$4,566,605,762.69	$7,915,304,976.33	$7,318,066,531.64	$7,762,923,167.24	$17,533,589,332.58
Avoided Electric Production Adders	$0.00	$2,070,955,713.38	$3,589,590,806.76	$3,318,743,172.10	$3,520,485,656.34	$7,951,482,762.33
Avoided Electric Capacity	$1,276,856,377.89	$0.00	$0.00	$0.00	$0.00	$0.00
Avoided T&D Electric	$2,875,334,992.68	$2,875,334,992.68	$2,875,334,992.68	$2,875,334,992.68	$2,875,334,992.68	$2,875,334,992.68
Avoided Ancillary	$1,303,002,644.23	$1,114,994,041.65	$1,303,002,644.23	$1,303,002,644.23	$1,303,002,644.23	$1,470,524,137.04
Avoided Gas Production	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Avoided Gas Capacity	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$10,232,125,924.27	$10,627,890,510.41	$15,683,233,420.00	$14,815,147,340.65	$15,461,746,460.49	$29,830,931,224.64
Administration Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Implementation / Participation Costs	$1,344,761,567.06	$1,344,761,567.06	$1,344,761,567.06	$1,344,761,567.06	$1,344,761,567.06	$1,344,761,567.06
Other / Miscellaneous Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$1,344,761,567.06	$1,344,761,567.06	$1,344,761,567.06	$1,344,761,567.06	$1,344,761,567.06	$1,344,761,567.06
Reduced Arrears	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Participant Costs (net)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Environmental Benefits	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Other Benefits	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Test Results	7.61	7.90	11.66	11.02	11.50	22.18
Participant Test						
Incentives	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Participant Costs (gross)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Participant Tax Credits (gross)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Participant Bill Savings (Electric) (gross)	$3,920,752,959.14	$3,852,182,389.78	$3,920,752,959.14	$3,920,752,959.14	$3,920,752,959.14	$3,992,814,197.90
Participant Bill Savings (Gas) (gross)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$3,920,752,959.14	$3,852,182,389.78	$3,920,752,959.14	$3,920,752,959.14	$3,920,752,959.14	$3,992,814,197.90
Test Results	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

	Cost Based	Market-Based Minimum	Today	Alternate	Option	Maximum
Utility (PAC/UTC) Test						
Net Benefits	$4,192,785,900.47	$4,403,102,148.32	$6,967,379,442.68	$6,528,004,489.60	$6,855,499,283.30	$14,135,054,564.11
Levelized Cost (kW)	$65.5660	$65.5660	$65.5660	$65.5660	$65.5660	$65.5660
Levelized Cost (kWh)	$0.0105	$0.0105	$0.0105	$0.0105	$0.0105	$0.0104
Levelized Cost (CCF)	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000
TRC Test						
Net Benefits	$4,192,785,900.47	$4,403,102,148.32	$6,967,379,442.68	$6,528,004,489.60	$6,855,499,283.30	$14,135,054,564.11
Levelized Cost (kW)	$65.5660	$65.5660	$65.5660	$65.5660	$65.5660	$65.5660
Levelized Cost (kWh)	$0.0105	$0.0105	$0.0105	$0.0105	$0.0105	$0.0104
Levelized Cost (CCF)	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000
RIM Test						
Net Benefits	-$4,036,719,646.23	-$3,679,666,313.20	-$1,262,126,104.02	-$1,701,501,057.10	-$1,374,006,263.39	$5,752,247,230.40
Net Benefits (Net Fuel)	-$4,036,719,646.22	-$3,679,666,313.20	-$1,262,126,104.01	-$1,701,501,057.09	-$1,374,006,263.39	$5,752,247,230.43
Societal Test						
Net Benefits	$8,887,364,357.21	$9,283,128,943.35	$14,338,471,852.94	$13,470,385,773.59	$14,116,984,893.43	$28,486,169,657.58
Levelized Cost (kW)	$88.0050	$88.0050	$88.0050	$88.0050	$88.0050	$88.0050
Levelized Cost (kWh)	$0.0140	$0.0141	$0.0140	$0.0140	$0.0140	$0.0139
Levelized Cost (CCF)	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000
Participant Test						
Net Benefits	$3,920,752,959.14	$3,852,182,389.78	$3,920,752,959.14	$3,920,752,959.14	$3,920,752,959.14	$3,992,814,197.90

Present Values (PVs) of Impacts

	Cost Based	Market-Based Minimum	Today	Alternate	Option	Maximum
kW (Discounted)	15280516.0893	15280516.0893	15280516.0893	15280516.0893	15280516.0893	15280516.0893
kWh (Discounted)	95810913917.6051	95260206948.3074	95810913917.6051	95810913917.6051	95810913917.6051	96714391871.7234
CCF (Discounted)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
kW (Undiscounted)	22343347.5893	22343347.5893	22343347.5893	22343347.5893	22343347.5893	22343347.5893
kWh (Undiscounted)	139474308622.9580	138671599749.7710	139474308622.9580	139474308622.9580	139474308622.9580	140788967798.6340
CCF (Undiscounted)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-11.11b
Page: 1 of 1

Question: On p. 16, lines 4-7 of his testimony, Mr. Bilyeu states that DTE's assumption that savings last 15 years is based on the Company's 2018-2019 energy efficiency plan and measure lifespan assumptions used by industry standards.

b. Please provide the lifetime MWh savings forecast for DTE's 2018 and 2019 plan years. Please provide the source for the values provided, including any calculations made in Excel.

Answer: Please refer to the document "U-18419-MECNRDCSCDE-11.11b - FirstYear and Lifetime Savings" supplied with the Company's response to MECNRDCSCDE-11.11a.

DTE Electric Company
2018 - 2019 Energy Waste Reduction Plan

Energy Waste Reduction Programs	2018 Lifetime MWh Savings	2018 First-Year MWh Savings	2019 Lifetime MWh Savings	2019 First-Year MWh Savings
Residential				
Residential ENERGY STAR Products	1,994,920	146,741	1,972,215	145,004
Appliance Recycling	235,703	29,463	234,412	29,302
Heating, Ventilation & Air Conditioning (HVAC)	130,981	12,053	137,221	12,653
Multifamily	30,417	2,144	30,253	2,132
Home Energy Consultation (HEC)	67,593	4,690	67,273	4,664
Audit and Weatherization	30,656	1,473	36,151	1,731
School Program	35,271	2,948	35,078	2,931
On-Line Energy Audit	42,044	3,082	41,794	3,065
Behavior Programs	65,354	65,354	64,996	64,996
Emerging Measures and Approaches	19,032	1,346	18,928	1,339
Low Income				
Low Income attributed to Energy Efficiency Assistance	80,980	5,621	80,536	5,590
Low Income attributed to Multifamily Units	30,065	2,216	29,914	2,204
Low Income attributed to Home Energy Consultation	97,638	6,766	97,105	6,729
Low Income attributed to Behavior	8,720	8,720	8,672	8,672
Commercial & Industrial (C&I)				
Prescriptive	2,003,334	143,995	1,990,479	143,206
Non-Prescriptive	2,395,693	161,493	2,382,573	160,609
Retro-Commissioning	7,021	7,021	6,983	6,983
Business Energy Consultation	48,214	5,269	47,946	5,241
Mid-Stream Lighting	236,974	15,809	235,676	15,722
Energy Star Retail Lighting	71,092	7,904	70,703	7,861
Multifamily Common Areas	37,193	2,635	36,955	2,620
Emerging Measures and Approaches	90,993	6,435	90,494	6,400
Self Direct	99,283	7,021	98,739	6,983
Other Programs and Costs				
Pilot Program	499,521	35,327	496,785	35,133
Education Program	299,712	21,196	298,071	21,080

U-18419 MECNRDCSCDE-11.11b - ProfitKey and Lifetime Savings.xlsx 2018 Measure Savings

Electric Portfolio Lifetime Savings: 7,008,860,397
Electric Portfolio WAML: 14.14

Measure Code	[illegible]	Program Code	Fuel Type	Measure Life	Units	kWh Savings/Unit	Gross kWh Savings	[illegible]	[illegible]	[illegible]	Lifetime Savings	Portfolio Weight	Portfolio Measure Life
N-RE-AP-010112-E-XX-XX-XX-01	ENERGY STAR Dehumidifier	ES	E	12	1,975	169	333,183	0.94	0.92	1.00	3,457,635	0	0
N-RE-AP-010169-C-XX-XX-XX-01	Clothes Washer ENERGY STAR, Gas water heater, Gas dryer	ES	E	11	63	17	1,063	1.00	0.92	1.00	10,753	0	0
N-RE-AP-010168-C-XX-XX-XX-01	Clothes Washer ENERGY STAR, Gas water heater, Electric dryer	ES	E	11	1,580	108	170,640	1.00	0.92	1.00	1,726,877	0	0
N-RE-AP-010170-C-XX-XX-XX-01	Clothes Washer ENERGY STAR, Electric water heater, Gas Dryer	ES	E	11	593	84	49,770	1.00	0.92	1.00	503,672	0	0
N-RE-AP-010171-C-XX-XX-XX-01	Clothes Washer ENERGY STAR, Electric water heater, Electric Dryer	ES	E	11	790	175	138,250	1.00	0.92	1.00	1,399,090	0	0
N-RE-CE-010158-E-XX-XX-XX-01	ENERGY STAR + 10% Display	ES	E	5	10,468	19	203,070	1.00	0.92	1.00	934,120	0	0
N-RE-CE-010157-E-XX-XX-XX-01	ENERGY STAR + 30% Display	ES	E	5	691	30	20,599	1.00	0.92	1.00	94,757	0	0
N-RE-CE-010156-E-XX-XX-XX-01	ENERGY STAR + 50 % Display	ES	E	5	889	40	35,726	1.00	0.92	1.00	164,348	0	0
N-RE-CE-010159-E-XX-XX-XX-01	ENERGY STAR PC	ES	E	4	9,875	77	760,375	1.00	0.92	1.00	2,798,180	0	0
N-RE-CE-010160-E-XX-XX-XX-01	ENERGY STAR 7.0 TV + 20% (21-39")	ES	E	6	9,875	79	780,125	1.00	0.92	1.00	4,306,290	0	0
N-RE-CE-010161-E-XX-XX-XX-01	ENERGY STAR 7.0 TV + 20% (21-40")	ES	E	6	3,950	137	540,755	1.00	0.92	1.00	2,984,968	0	0
N-RE-CE-010162-E-XX-XX-XX-01	ENERGY STAR 7.0 TV + 20% (41-50")	ES	E	6	3,950	209	827,130	1.00	0.92	1.00	4,565,758	0	0
N-RE-CE-010163-E-XX-XX-XX-01	ENERGY STAR 7.0 TV + 20% (51-60")	ES	E	6	10,863	296	3,213,128	1.00	0.92	1.00	17,736,464	0	0
N-RE-CE-010164-E-XX-XX-XX-01	ENERGY STAR 7.0 TV + 20% (over 60")	ES	E	6	8,888	412	3,661,650	1.00	0.92	1.00	20,212,308	0	0
N-RE-CE-010165-E-XX-XX-XX-01	ENERGY STAR 7.0 TV + 35% (21-39")	ES	E	6	3,950	80	316,000	1.00	0.92	1.00	1,744,320	0	0
N-RE-CE-010166-E-XX-XX-XX-01	ENERGY STAR 7.0 TV + 35% (21-40")	ES	E	6	39,500	138	5,451,000	1.00	0.92	1.00	30,089,520	0	0
N-RE-CE-010167-E-XX-XX-XX-01	ENERGY STAR 7.0 TV + 35% (41-50")	ES	E	6	13,825	211	2,910,163	1.00	0.92	1.00	16,064,097	0	0
N-RE-CE-010168-E-XX-XX-XX-01	ENERGY STAR 7.0 TV + 35% (51-60")	ES	E	6	13,825	297	4,104,643	1.00	0.92	1.00	22,657,627	0	0
N-RE-CE-010169-E-XX-XX-XX-01	ENERGY STAR 7.0 TV + 35% (over 60")	ES	E	6	395	413	163,175	1.00	0.92	1.00	900,723	0	0
N-RE-HV-010077-E-XX-XX-XX-02	ENERGY STAR Room AC	ES	E	10	3	42	135	1.00	0.92	1.00	2,139	0	0
N-RE-LI-010013-E-XX-XX-XX-02	LED indoor - outdoor lamp (3 watt)	ES	E	12	988	27	26,693	0.87	0.92	1.00	256,088	0	0
N-RE-LI-010017-E-XX-XX-XX-03	LED Replacing A-line 29W	ES	E	15	369,325	19	7,127,973	0.81	0.92	1.00	79,676,477	0	0
N-RE-LI-010018-E-XX-XX-XX-03	LED Replacing A-line 43W	ES	E	15	2,202,125	29	62,780,563	0.81	0.92	1.00	701,537,568	0	1
N-RE-LI-010019-E-XX-XX-XX-03	LED Replacing A-line 53W halogen	ES	E	15	75,050	34	2,521,680	0.81	0.92	1.00	28,187,339	0	0
N-RE-LI-010020-E-XX-XX-XX-03	LED Replacing A-line 100W (72W Halogen)	ES	E	15	98,750	46	4,562,250	0.81	0.92	1.00	50,996,831	0	0
N-RE-LI-010021-E-XX-XX-XX-03	LED Flood PAR (average values)	ES	E	15	1,441,750	54	77,854,500	0.87	0.92	1.00	934,721,327	0	2
N-RE-LI-010022-E-XX-XX-XX-03	LED Globe	ES	E	15	59,250	27	1,599,750	0.87	0.92	1.00	19,206,599	0	0
N-RE-LI-010006-E-XX-XX-XX-02	CFL Bulbs 3-Way	ES	E	6	5,925	78	462,150	0.81	0.92	1.00	3,492,208	0	0
N-RE-LI-010161-E-XX-XX-XX-02	LED Candelabra	ES	E	15	98,750	24	2,340,375	0.87	0.92	1.00	28,098,542	0	0
Averaged	Programmable Thermostats Tier 2	ES	E	10	75	123	9,194	1.00	1.00	0.37	91,938	0	0
W-SF-HV-200158-C-WR-WR-WR-WR-01	Programmable Thermostats Tier 3	ES	E	10	8,153	200	1,631,195	1.00	1.00	0.54	16,311,952	0	0
N-RE-AP-010109-E-XX-XX-XX-03	Refrigerator recycling	AR	E	8	29,380	1,135	33,346,300	0.67	0.92	1.00	213,523,028	0	0
N-RE-AP-010110-E-XX-XX-XX-03	Freezer recycling	AR	E	8	3,710	844	3,050,148	0.85	0.92	1.00	21,809,436	0	0
N-RE-AP-010111-E-XX-XX-XX-01	Room AC recycling	AR	E	8	131	113	14,747	0.67	0.92	1.00	94,425	0	0
N-RE-AP-010113-E-XX-XX-XX-01	Dehumidifier recycling	AR	E	8	198	138	27,487	0.67	0.92	1.00	176,006	0	0
N-RE-HV-010078-E-XX-XX-XX-02	ECM Furnace	HVAC	E	10	13,618	730	9,941,045	1.00	0.92	1.00	91,457,615	0	0
W-SF-HV-200020-E-WR-WR-WR-WR-03	FurnaceAC - SEER 14	HVAC	E	15	2,108	178	374,130	1.02	0.92	1.00	5,266,284	0	0
W-SF-HV-200024-E-WR-WR-WR-WR-03	FurnaceAC - SEER 15	HVAC	E	15	2,835	234	662,295	1.02	0.92	1.00	9,321,218	0	0
W-SF-HV-200028-E-WR-WR-WR-WR-03	FurnaceAC - SEER 16	HVAC	E	15	1,814	392	711,349	1.02	0.92	1.00	10,011,541	0	0
W-SF-HV-200030-E-WR-WR-WR-WR-03	FurnaceAC - SEER 17	HVAC	E	15	464	506	234,843	1.02	0.92	1.00	3,302,838	0	0
W-SF-HV-200064-C-WR-WR-WR-WR-01	O&M Tuneup	HVAC	E	5	315	126	39,620	0.97	0.92	4.60	176,784	0	0
W-SF-HV-200095-E-WR-WR-WR-WR-03	FurnaceAC - SEER 18	HVAC	E	15	299	612	183,159	1.02	0.92	4.20	2,578,151	0	0
W-SF-HV-200096-E-WR-WR-WR-WR-03	FurnaceAC - SEER 19	HVAC	E	15	209	792	165,523	1.02	0.92	4.70	2,667,723	0	0
	Programmable Thermostats Tier 2	HVAC	E	9	324	99	32,222	0.74	0.92	0.30	197,629	0	0
	Programmable Thermostats Tier 1	HVAC	Combo	9	87	99	8,626	0.74	0.92	0.30	52,850	0	0
W-SF-HV-200072-C-WR-WR-WR-WR-01	Setback thermostat - moderate setback	HVAC	E	9	4,436	99	440,682	0.74	0.92	0.30	2,701,372	0	0
W-SF-HV-200072-C-WR-WR-WR-WR-01	Setback thermostat - moderate setback	HVAC	Combo	9	1,378	99	136,974	0.74	0.92	0.30	839,268	0	0
W-SF-HV-200158-C-WR-WR-WR-WR-01	Programmable Thermostats Tier 3	HVAC	E	10	1,179	167	196,571	1.00	1.00	0.40	1,965,706	0	0
W-SF-HV-200158-C-WR-WR-WR-WR-01	Programmable Thermostats Tier 3	HVAC	Combo	10	265	167	44,237	1.00	1.00	0.41	442,367	0	0
W-SF-HV-200100-E-WR-WR-WR-WR-03	FurnaceAC - SEER 20	HVAC	E	15	-	595	-	1.02	0.92	0.50	-	-	-
W-SF-HV-200104-E-WR-WR-WR-WR-03	FurnaceAC - SEER 21	HVAC	E	15	-	648	-	1.02	0.92	0.50	-	-	-
N-MF-WH-020128-E-XX-XX-XX-02	Low Flow Showerheads 1.5 gpm electric water heater	MFR	E	10	834	326	271,884	0.76	0.92	1.00	1,901,013	0	0
N-MF-WH-020132-E-XX-XX-XX-02	Low Flow Kitchen Faucet Aerators - 1.5 gpm electric water heater	MFR	E	10	834	202	168,468	0.83	0.92	1.00	1,286,422	0	0
N-MF-WH-020134-E-XX-XX-XX-02	Low Flow Bathroom Faucet Aerators - 1.5 gpm electric water heater	MFR	E	10	834	41	34,194	0.83	0.92	1.00	261,105	0	0
N-RE-LI-010018-E-XX-XX-XX-03	LED Replacing A-line 43W	MFR	E	15	84,790	29	2,458,910	0.68	0.92	1.00	22,676,577	0	0
N-RE-WH-010047-E-XX-XX-XX-03	Pipe Wrap R3 - electric water heater	MFR	E	15	904	51	46,078	1.00	0.92	1.00	635,883	0	0
N-RE-LI-010021-E-XX-XX-XX-03	LED Flood PAR (average values)	MFR	E	15	1,390	54	75,060	0.68	0.92	1.00	704,363	0	0
N-RE-LI-010022-E-XX-XX-XX-03	LED Globe	MFR	E	15	10,064	27	271,717	0.68	0.92	1.00	2,549,793	0	0
N-RE-LI-010161-E-XX-XX-XX-02	LED Candelabra	MFR	E	15	1,807	24	42,825	0.68	0.92	1.00	401,878	0	0
N-RE-LI-010013-E-XX-XX-XX-02	LED Night Light	HEC	E	12	16,995	22	373,890	0.76	0.92	1.00	3,137,087	0	0
N-RE-LI-010018-E-XX-XX-XX-03	LED Replacing A-line 43W	HEC	E	15	90,640	29	2,583,240	0.97	0.92	1.00	34,579,251	0	0
N-RE-LI-010019-E-XX-XX-XX-03	LED Replacing A-line 53W halogen	HEC	E	15	2,264	34	76,138	0.97	0.92	1.00	1,019,178	0	0
N-RE-LI-010020-E-XX-XX-XX-03	LED Replacing A-line 100W (72W Halogen)	HEC	E	15	1,133	46	52,345	0.97	0.92	1.00	700,685	0	0
N-RE-LI-010021-E-XX-XX-XX-03	LED Flood PAR (average values)	HEC	E	15	18,128	54	978,912	0.97	0.92	1.00	13,103,716	0	0
N-RE-LI-010022-E-XX-XX-XX-03	LED Globe	HEC	E	15	18,128	27	489,456	0.97	0.92	1.00	6,551,858	0	0
N-RE-LI-010161-E-XX-XX-XX-02	LED Candelabra	HEC	E	15	13,390	24	317,343	0.97	0.92	1.00	4,247,953	0	0
N-RE-WH-010047-E-XX-XX-XX-03	Pipe Wrap R3 - electric water heater	HEC	E	15	1,067	51	54,417	0.72	0.92	1.00	540,687	0	0
N-RE-WH-010055-E-XX-XX-XX-02	Low Flow Showerheads 1.5 gpm electric water heater	HEC	E	10	397	334	132,448	1.00	0.92	1.00	1,218,519	0	0
N-RE-WH-010055-E-XX-XX-XX-02	Low Flow Handheld Showerheads 1.5 gpm electric water heater	HEC	E	10	304	334	101,477	1.00	0.92	1.00	933,588	0	0
N-RE-WH-010061-E-XX-XX-XX-02	Low Flow Kitchen Faucet Aerators - 1.5 gpm electric water heater	HEC	E	10	283	279	79,037	0.89	0.92	1.00	647,071	0	0
N-RE-WH-010063-E-XX-XX-XX-02	Low Flow Bathroom Faucet Aerators - 1.5 gpm electric water heater	HEC	E	10	373	40	14,938	0.89	0.92	1.00	122,312	0	0
W-SF-HV-200158-C-WR-WR-WR-WR-01	Programmable Thermostats Tier 3	HEC	Combo	10	850	40	33,990	1.00	1.00	0.35	339,900	0	0
W-SF-HV-200072-C-WR-WR-WR-WR-01	Setback thermostat - moderate setback	HEC	Combo	9	2,891	23	66,484	0.82	0.92	0.15	451,398	0	0
W-SF-BE-200006-C-WR-WR-WR-WR-01	Basement Wall Insulation	IWMN	Elec	25	10	401	3,929	1.00	0.92	0.25	90,374	0	0
W-SF-BE-200006-C-WR-WR-WR-WR-01	Basement Wall Insulation	IWMN	Combo	25	-	401	-	1.00	0.92	0.25	-	-	-
W-SF-BE-200012-C-WR-WR-WR-WR-01	Crawlspace Wall Insulation	IWMN	Elec	25	7	236	1,652	1.00	0.92	0.60	38,001	0	0
W-SF-BE-200012-C-WR-WR-WR-WR-01	Crawlspace Wall Insulation	IWMN	Combo	25	-	236	-	1.00	0.92	0.60	-	-	-
W-SF-BE-200031-C-WR-WR-WR-WR-01	Floor Insulation	IWMN	Elec	25	8	283	2,378	1.00	0.92	0.45	54,651	0	0
W-SF-BE-200031-C-WR-WR-WR-WR-01	Floor Insulation	IWMN	Combo	25	-	283	-	1.00	0.92	0.45	-	-	-
N-RE-HV-010078-E-XX-XX-XX-02	ECM Furnace	HP	Elec	10	11	730	7,665	1.00	0.92	1.00	70,518	0	0
W-SF-BE-200052-C-WR-WR-WR-WR-01	Infiltration reduction - 10%	HP	Elec	13	245	113	27,713	1.00	0.92	0.35	331,423	0	0
W-SF-BE-200054-C-WR-WR-WR-WR-01	Infiltration reduction - 20%	HP	Elec	13	245	237	136,897	1.00	0.92	0.35	1,641,612	0	0
W-SF-BE-200055-C-WR-WR-WR-WR-01	Infiltration reduction - 30%	HP	Elec	13	245	354	86,772	1.00	0.92	0.35	1,037,789	0	0
W-SF-BE-200056-C-WR-WR-WR-WR-01	Infiltration reduction - 40%	HP	Elec	13	245	472	115,531	1.00	0.92	0.65	1,381,752	0	0
W-SF-BE-200057-C-WR-WR-WR-WR-01	Infiltration reduction - 50%	HP	Elec	13	53	589	30,919	1.00	0.92	1.00	369,796	0	0
	CEA Bonus	HP	Combo		1,000	-	-	0.00	1.00	0.00	-	-	-
W-SF-HV-200158-C-WR-WR-WR-WR-01	Programmable Thermostats Tier 3	HP	Elec	10	24	341	8,195	1.00	1.00	0.60	81,952	0	0
W-SF-HV-200158-C-WR-WR-WR-WR-01	Programmable Thermostats Tier 3	HP	Combo	10	18	341	6,224	1.00	1.00	0.60	62,242	0	0
W-SF-BE-200118-C-WR-WR-WR-WR-01	R-49 Roof Insulation	IWMN	Elec	20	95	417	39,437	1.00	0.92	0.15	725,641	0	0
W-SF-BE-200118-C-WR-WR-WR-WR-01	R-49 Roof Insulation	IWMN	Combo	20	95	417	39,437	1.00	0.92	0.15	725,641	0	0
W-SF-BE-200121-C-WR-WR-WR-WR-02	R6 to R19 kneewalls	IWMN	Elec	20	14	761	10,656	1.00	0.92	0.06	196,075	0	0
W-SF-BE-200121-C-WR-WR-WR-WR-02	R6 to R19 kneewalls	IWMN	Combo	20	14	761	10,656	1.00	0.92	0.06	196,075	0	0
W-SF-BE-200069-C-WR-WR-WR-WR-01	Rim Joist Insulation	IWMN	Elec	25	833	205	170,391	1.00	0.92	0.40	3,918,985	0	0
W-SF-BE-200069-C-WR-WR-WR-WR-01	Rim Joist Insulation	IWMN	Combo	25	833	205	170,391	1.00	0.92	0.40	3,918,985	0	0
W-SF-BE-200119-C-WR-WR-WR-WR-01	R-60 Roof Insulation	IWMN	Elec	20	188	471	88,737	1.00	0.92	0.21	1,632,760	0	0
W-SF-BE-200119-C-WR-WR-WR-WR-01	R-60 Roof Insulation	IWMN	Combo	20	188	471	88,737	1.00	0.92	0.21	1,632,760	0	0
W-SF-HV-200072-C-WR-WR-WR-WR-01	Setback thermostat - moderate setback	HP	Elec	9	30	306	9,161	1.00	0.92	0.60	75,850	0	0
W-SF-HV-200072-C-WR-WR-WR-WR-01	Setback thermostat - moderate setback	HP	Combo	9	30	306	9,161	1.00	0.92	0.60	75,850	0	0
W-SF-BE-200074-C-WR-WR-WR-WR-01	Wall Insulation	IWMN	Elec	25	58	362	21,030	1.00	0.92	0.23	483,679	0	0
W-SF-BE-200074-C-WR-WR-WR-WR-01	Wall Insulation	IWMN	Combo	25	58	362	21,030	1.00	0.92	0.23	483,679	0	0
W-SF-BE-200077-C-WR-WR-WR-WR-01	Window Replacement	IWMN	Elec	25	487	398	193,841	1.00	0.92	0.47	4,460,953	0	0
W-SF-BE-200077-C-WR-WR-WR-WR-01	Window Replacement	IWMN	Combo	25	772	398	307,263	1.00	0.92	0.47	7,069,109	0	0
N-RE-LI-010013-E-XX-XX-XX-02	LED Night Light	SCH	E	12	4,230	22	93,060	0.78	0.92	1.00	801,356	0	0
N-RE-WH-010191-E-XX-XX-XX-02	Low Flow Showerheads - School Ed. Program 1.5 gpm electric water heater	SCH	E	10	4,230	491	2,076,930	0.30	0.92	1.00	5,732,327	0	0
N-RE-WH-010061-E-XX-XX-XX-02	Low Flow Kitchen Faucet Aerators - 1.5 gpm electric water heater	SCH	E	10	4,230	279	1,180,170	0.30	0.92	1.00	3,257,269	0	0
N-RE-WH-010200-E-XX-XX-XX-02	Low Flow Bathroom Faucet Aerators - School Ed. Program 1.5 gpm electric water heater	SCH	E	10	8,460	64	538,448	0.24	0.92	1.00	1,188,892	0	0
N-RE-LI-010018-E-XX-XX-XX-03	LED Replacing A-line 43W	SCH	E	15	8,460	29	241,110	0.53	0.92	1.00	1,763,479	0	0
N-RE-LI-010013-E-XX-XX-XX-02	LED Night Light (Combo & Lamp Only)	SCH	E	12	76,712	22	1,687,670	0.78	0.92	1.00	14,532,867	0	0
N-RE-LI-010018-E-XX-XX-XX-03	LED Replacing A-line 43W (Combo & Lamp Only)	SCH	E	15	38,356	29	1,093,150	0.53	0.92	1.00	7,995,300	0	0
MINIGRANT-CE1	Level 1 Mini Grant - Combo - Elec DTE Schools 17	SCH	E	0	260	-	-	0.00	1.00	1.00	-	-	-
MINIGRANT-EO1	Level 1 Mini Grant - Elec Only DTE Schools 17	SCH	E	0	114	-	-	0.00	1.00	1.00	-	-	-
MINIGRANT-CE2	Level 2 Mini Grant - Combo - Elec DTE Schools 17	SCH	E	0	35	-	-	0.00	1.00	1.00	-	-	-
MINIGRANT-EO2	Level 2 Mini Grant - Elec Only DTE Schools 17	SCH	E	0	15	-	-	0.00	1.00	1.00	-	-	-
MINIGRANT-CE3	Level 3 Mini Grant - Combo - Elec DTE Schools 17	SCH	E	0	18	-	-	0.00	1.00	1.00	-	-	-
MINIGRANT-EO3	Level 3 Mini Grant - Elec Only DTE Schools 17	SCH	E	0	8	-	-	0.00	1.00	1.00	-	-	-
N-RE-LI-010013-E-XX-XX-XX-02	LED Night Light	OEA	E	12	2,850	22	62,700	0.85	0.92	1.00	588,377	0	0
N-RE-WH-010047-E-XX-XX-XX-03	Pipe Wrap R3 - electric water heater	OEA	E	15	8,550	45	384,750	0.36	0.92	1.00	1,911,438	0	0
N-RE-WH-010055-E-XX-XX-XX-02	Low Flow Showerheads 1.5 gpm electric water heater	OEA	E	10	1,425	334	475,950	0.32	0.92	1.00	1,401,197	0	0
N-RE-WH-010061-E-XX-XX-XX-02	Low Flow Kitchen Faucet Aerators - 1.5 gpm electric water heater	OEA	E	10	1,425	279	397,575	0.83	0.92	1.00	3,035,883	0	0
N-RE-WH-010063-E-XX-XX-XX-02	Low Flow Bathroom Faucet Aerators - 1.5 gpm electric water heater	OEA	E	10	1,425	40	57,000	0.24	0.92	1.00	125,856	0	0
N-RE-LI-010018-E-XX-XX-XX-03	LED Replacing A-line 43W	OEA	E	15	7,125	29	203,063	0.77	0.92	1.00	2,157,742	0	0
Custom	Remaining Cost of kit (Misc Items) - E w/ EWH	OEA	E	-	1,425	-	-	0.00	1.00	1.00	-	-	-
N-RE-LI-010013-E-XX-XX-XX-02	LED Night Light (Combo & Lamp Only)	OEA	E	12	34,038	22	748,835	0.85	0.92	1.00	7,027,071	0	0
N-RE-LI-010018-E-XX-XX-XX-03	LED Replacing A-line 43W (Combo & Lamp Only)	OEA	E	15	85,095	29	2,425,205	0.77	0.92	1.00	25,770,232	0	0
Custom	Remaining Cost of kit (Misc Items)	OEA	E	-	17,019	-	-	0.00	1.00	1.00	-	-	-
Custom	Behavior Modification: Home Energy Reports 2017 - HER E	HER	E	1	########	1	50,890,398	1.00	1.00	1.00	50,890,398	0	0
Custom	Whole Home EP E	DTEIS	E	1	########	1	14,463,587	1.00	1.00	1.00	14,463,587	0	0
N-MF-WH-020128-E-XX-XX-XX-02	Low Flow Showerheads 1.5 gpm electric water heater	LI	E	10	1025	326	334,150	0.76	1.00	1.00	2539540	0	0
N-MF-WH-020128-E-XX-XX-XX-02	Low Flow Showerheads 1.5 gpm electric water heater (Handheld)	LI	E	10	1025	326	334,150	0.76	1.00	1.00	2539540	0	0
N-MF-WH-020132-E-XX-XX-XX-02	Low Flow Kitchen Faucet Aerators - 1.5 gpm electric water heater	LI	E	10	615	202	124,230	0.83	1.00	1.00	1031109	0	0
N-MF-WH-020134-E-XX-XX-XX-02	Low Flow Bathroom Faucet Aerators - 1.5 gpm electric water heater	LI	E	10	615	41	25,215	0.83	1.00	1.00	209285	0	0
N-RE-LI-010018-E-XX-XX-XX-03	LED Replacing A-line 43W	LI	E	15	61500	29	1,752,750	0.68	1.00	1.00	17878050	0	0
N-RE-WH-010047-E-XX-XX-XX-03	Pipe Wrap R3 - electric water heater	LI	E	15	718	51	36,593	1.00	1.00	1.00	548888	0	0
N-RE-LI-010021-E-XX-XX-XX-03	LED Flood PAR (average values)	LI	E	15	5,125	54	276,750	0.68	1.00	1.00	2,822,850	0	0
N-RE-LI-010022-E-XX-XX-XX-03	LED Globe	LI	E	15	5125	27	138,375	0.68	1.00	1.00	1411425	0	0
N-RE-LI-010161-E-XX-XX-XX-02	LED Candelabra	LI	E	15	4486	24	106,316	0.68	1.00	1.00	1084425	0	0
N-RE-LI-010013-E-XX-XX-XX-02	LED Night Light	LI	E	12	21870	22	481,140	0.76	1.00	1.00	4387997	0	0
N-RE-LI-010018-E-XX-XX-XX-03	LED Replacing A-line 43W	LI	E	15	116640	29	3,324,240	0.97	1.00	1.00	48367692	0	0
N-RE-LI-010019-E-XX-XX-XX-03	LED Replacing A-line 53W halogen	LI	E	15	2768	34	93,013	0.97	1.00	1.00	1353338	0	0
N-RE-LI-010020-E-XX-XX-XX-03	LED Replacing A-line 100W (72W Halogen)	LI	E	15	1458	46	67,360	0.97	1.00	1.00	980082	0	0
N-RE-LI-010021-E-XX-XX-XX-03	LED Flood PAR (average values)	LI	E	15	23328	54	1,259,712	0.97	1.00	1.00	18328810	0	0
N-RE-LI-010022-E-XX-XX-XX-03	LED Globe	LI	E	15	23328	27	629,856	0.97	1.00	1.00	9164405	0	0
N-RE-LI-010161-E-XX-XX-XX-02	LED Candelabra	LI	E	15	26973	24	639,260	0.97	1.00	1.00	9301234	0	0
N-RE-WH-010047-E-XX-XX-XX-03	Pipe Wrap R3 - electric water heater	LI	E	15	729	51	37,179	0.72	1.00	1.00	401533	0	0
N-RE-WH-010055-E-XX-XX-XX-02	Low Flow Showerheads 1.5 gpm electric water heater	LI	E	10	729	334	243,486	1.00	1.00	1.00	2434860	0	0
N-RE-WH-010055-E-XX-XX-XX-02	Low Flow Handheld Showerheads 1.5 gpm electric water heater	LI	E	10	510	334	170,440	1.00	1.00	1.00	1704402	0	0
N-RE-WH-010061-E-XX-XX-XX-02	Low Flow Kitchen Faucet Aerators - 1.5 gpm electric water heater	LI	E	10	365	279	101,696	0.89	1.00	1.00	905090	0	0
N-RE-WH-010063-E-XX-XX-XX-02	Low Flow Bathroom Faucet Aerators - 1.5 gpm electric water heater	LI	E	10	510	40	20,412	0.89	1.00	1.00	181667	0	0
W-SF-HV-200158-C-WR-WR-WR-WR-01	Programmable Thermostats Tier 3	LI	Combo	10	43	130	5,617	1.00	1.00	0.35	56174	0	0
W-SF-HV-200072-C-WR-WR-WR-WR-01	Setback thermostat - moderate setback	LI	Combo	9	193	50	9,580	0.82	1.00	0.15	70703	0	0
N-RE-LI-010018-E-XX-XX-XX-03	LED Replacing A-line 43W	EEAP	E	15	74000	29	2,109,000	0.77	1.00	1.00	24358950	0	0
N-RE-LI-010018-E-XX-XX-XX-03	LED Replacing A-line 43W DI	EEAP	E	15	37000	29	1,054,500	0.77	1.00	1.00	12179475	0	0
N-RE-WH-010055-E-XX-XX-XX-02	Low Flow Showerheads 1.5 gpm electric water heater	EEAP	E	10	185	334	61,790	1.00	1.00	1.00	617900	0	0
N-RE-WH-010061-E-XX-XX-XX-02	Low Flow Kitchen Faucet Aerators - 1.5 gpm electric water heater	EEAP	E	10	185	279	51,615	1.00	1.00	1.00	516150	0	0
N-RE-WH-010063-E-XX-XX-XX-02	Low Flow Bathroom Faucet Aerators - 1.5 gpm electric water heater	EEAP	E	10	0	40	-	1.00	1.00	1.00	0	0	0
N-RE-WH-010040-E-XX-XX-XX-02	Electric Water Heater EF 0.93+	EEAP	E	15	2	-	-	1.00	1.00	1.00	0	0	0
N-RE-HV-010078-E-XX-XX-XX-02	ECM Furnace - HIGHER INCENTIVE	EEAP	E	10	93	730	67,525	0.92	1.00	1.00	621230	0	0
N-RE-HV-010078-E-XX-XX-XX-02	ECM Furnace - LOWER INCENTIVE	EEAP	E	10	93	730	67,525	0.92	1.00	1.00	621230	0	0
W-SF-HV-200158-C-WR-WR-WR-WR-01	Programmable Thermostats Tier 3	EEAP	E	10	1046	341	356,411	1.00	1.00	1.41	3564106	0	0
W-SF-HV-200072-C-WR-WR-WR-WR-01	Setback thermostat - moderate setback	EEAP	E	9	2606	306	796,794	0.62	1.00	1.41	4446110	0	0
W-SF-BE-200116-C-WR-WR-WR-WR-01	R-30 Roof Insulation	EEAP	E	20	96	241	22,983	1.00	1.00	1.03	459660	0	0
W-SF-BE-200117-C-WR-WR-WR-WR-01	R-38 Roof Insulation	EEAP	E	20	20	335	6,678	1.00	1.00	1.08	133559	0	0
W-SF-BE-200118-C-WR-WR-WR-WR-01	R-49 Roof Insulation	EEAP	E	20	42	417	17,335	1.00	1.00	1.12	346705	0	0
W-SF-BE-200119-C-WR-WR-WR-WR-01	R-60 Roof Insulation	EEAP	E	20	21	471	9,782	1.00	1.00	1.12	195644	0	0
W-SF-BE-200030-C-WR-WR-WR-WR-01	Energy Star Door	EEAP	E	20	21	164	3,393	1.00	1.00	1.12	67858	0	0
W-SF-BE-200077-C-WR-WR-WR-WR-01	Window Replacement	EEAP	E	25	19	398	7,429	1.00	1.00	1.01	185718	0	0
W-SF-BE-200074-C-WR-WR-WR-WR-01	Wall Insulation	EEAP	E	25	83	362	30,003	1.00	1.00	1.12	750074	0	0
W-SF-BE-200114-C-WR-WR-WR-WR-01	R-38 "scuttle hole" Attic hatch	EEAP	E	20	53	77	4,072	1.00	1.00	1.14	81438	0	0
W-SF-BE-200115-C-WR-WR-WR-WR-01	R-38 pull-down stairs Attic hatch	EEAP	E	20	8	159	1,316	1.00	1.00	0.45	26312	0	0
W-SF-BE-200069-C-WR-WR-WR-WR-01	Rim Joist Insulation	EEAP	E	25	7	205	1,458	1.00	1.00	0.77	36446	0	0
W-SF-BE-200006-C-WR-WR-WR-WR-01	Basement Wall Insulation	EEAP	E	25	18	401	7,208	1.00	1.00	0.39	180188	0	0
W-SF-BE-200012-C-WR-WR-WR-WR-01	Crawlspace Wall Insulation	EEAP	E	25	12	236	2,843	1.00	1.00	1.30	71087	0	0
W-SF-HV-200024-C-WR-WR-WR-WR-01	Duct Insulation	EEAP	E	20	6	149	944	1.00	1.00	0.68	18879	0	0
W-SF-BE-200031-C-WR-WR-WR-WR-01	Floor Insulation	EEAP	E	25	14	283	3,843	1.00	1.00	1.22	96074	0	0
W-SF-BE-200113-C-WR-WR-WR-WR-02	R0 to R19 kneewalls	EEAP	E	20	6	2,820	17,490	1.00	1.00	1.12	349796	0	0
W-SF-BE-200121-C-WR-WR-WR-WR-02	R6 to R19 kneewalls	EEAP	E	20	6	761	4,726	1.00	1.00	1.12	94515	0	0
W-SF-BE-200052-C-WR-WR-WR-WR-01	Infiltration reduction - 10%	EEAP	E	13	40	113	4,508	1.00	1.00	1.80	58603	0	0
W-SF-BE-200054-C-WR-WR-WR-WR-01	Infiltration reduction - 20%	EEAP	E	13	69	237	16,429	1.00	1.00	1.71	213571	0	0
W-SF-BE-200056-C-WR-WR-WR-WR-01	Infiltration reduction - 40%	EEAP	E	13	76	472	35,699	1.00	1.00	1.64	464087	0	0
€ 105,393.00	Regrigerator Replacement - Bottom Mounted	EEAP	E	16	176	552	97,179	1.00	1.00	1.00	1554865	0	0
€ 105,390.00	Regrigerator Replacement - Top Mounted	EEAP	E	16	2035	769	1,564,915	1.00	1.00	1.00	25038640	0	0
€ 105,391.00	Regrigerator Replacement - Side by Side	EEAP	E	16	185	585	108,225	1.00	1.00	1.00	1731600	0	0
W-SF-HV-200048-C-WR-WR-WR-WR-03	High efficiency 95 AFUE furnace with ECM - SF	EEAP	E	15	5197	6	31,169	0.92	1.00	70.02	430129	0	0
W-SF-HV-200080-C-WR-WR-WR-WR-03	High efficiency 96 AFUE furnace with ECM	EEAP	E	15	13661	6	88,695	0.92	1.00	73.84	1223985	0	0
W-MH-HV-400040-C-WR-WR-WR-WR-03	High efficiency 95 AFUE furnace with ECM - MH	EEAP	E	15	4609	4	17,804	0.92	1.00	124.20	245701	0	0
Custom	Behavior Modification: Home Energy Reports 2017 - HER E	LI	E	1	8720065	1	8,720,065	1.00	1.00	1.00	8720065	0	0
N-CO-AP-000315-E-XX-XX-XX-01	Smart Strip plug outlet	PRE	E	5	74.95	16.97	85	0.97	0.92	1.00	5,675.44	0.00	€ 0.00
N-CO-CL-000316-E-XX-XX-XX-02	PC Network Energy Management Controls replacing no central control	PRE	E	4	1,157.28	135.00	540	0.97	0.92	1.00	557,687.74	0.00	€ 0.00
N-CO-HV-000202-E-XX-XX-XX-02	ENERGY STAR Room AC less than 14,000 Btu hr	PRE	E	15	12.31	52.00	780	0.97	0.92	1.00	8,565.65	0.00	€ 0.00
N-CO-HV-000203-E-XX-XX-XX-02	ENERGY STAR Room AC greater than 14,000 Btu hr	PRE	E	15	63.77	113.00	1,695	0.97	0.92	1.00	96,453.45	0.00	€ 0.00
N-CO-HV-000210-E-XX-XX-XX-01	ECM motors on furnaces	PRE	E	20	13.42	1,348.00	26,960	0.97	0.92	1.00	322,979.04	0.00	€ 0.00
N-CO-HV-000339-E-XX-XX-XX-01	Guest Room Energy Management, Electric Heating and Cooling	PRE	E	8	1,157.28	1,114.00	8,912	0.97	0.92	1.00	9,203,913.15	0.00	€ 0.01
N-CO-HV-000340-C-XX-XX-XX-01	Guest Room Energy Management, Gas Heating Electric Cooling	PRE	E	8	411.68	237.00	1,896	0.97	0.92	1.00	696,561.32	0.00	€ 0.00
N-CO-KR-000317-E-XX-XX-XX-01	Vending Equipment Controller	PRE	E	10	32.44	800.00	8,000	0.97	0.92	1.00	231,612.07	0.00	€ 0.00
N-CO-KR-000320-E-XX-XX-XX-02	ENERGY STAR Commercial Solid Door Refrigerators less than 15ft3	PRE	E	12	3,190.53	453.00	5,436	0.97	0.92	1.00	15,477,548.33	0.00	€ 0.02
N-CO-KR-000321-E-XX-XX-XX-02	ENERGY STAR Commercial Solid Door Refrigerators 15 to 30 ft3	PRE	E	12	127.53	628.00	7,536	0.97	0.92	1.00	857,667.48	0.00	€ 0.00
N-CO-KR-000322-E-XX-XX-XX-02	ENERGY STAR Commercial Solid Door Refrigerators 30 to 50ft3	PRE	E	12	38.04	982.00	11,784	0.97	0.92	1.00	399,986.06	0.00	€ 0.00
N-CO-KR-000323-E-XX-XX-XX-02	ENERGY STAR Commercial Solid Door Refrigerators more than 50ft3	PRE	E	12	6.71	1,486.00	17,832	0.97	0.92	1.00	106,813.10	0.00	€ 0.00
N-CO-KR-000324-E-XX-XX-XX-02	ENERGY STAR Commercial Solid Door Freezers less than 15ft3	PRE	E	12	38.04	485.00	5,820	0.97	0.92	1.00	197,549.12	0.00	€ 0.00
N-CO-KR-000325-E-XX-XX-XX-02	ENERGY STAR Commercial Solid Door Freezers 15 to 30 ft3	PRE	E	12	7.83	1,343.00	16,116	0.97	0.92	1.00	112,623.36	0.00	€ 0.00
N-CO-KR-000326-E-XX-XX-XX-02	ENERGY STAR Commercial Solid Door Freezers 30 to 50ft3	PRE	E	12	33.10	2,402.00	28,824	0.97	0.92	1.00	851,356.83	0.00	€ 0.00
N-CO-KR-000327-E-XX-XX-XX-02	ENERGY STAR Commercial Solid Door Freezers more than 50ft3	PRE	E	12	2.28	4,183.00	50,196	0.97	0.92	1.00	102,248.86	0.00	€ 0.00
N-CO-KR-000329-E-XX-XX-XX-01	ENERGY STAR Ice Machines less than 500 lbs	PRE	E	9	19.02	501.00	4,259	0.97	0.92	1.00	72,273.45	0.00	€ 0.00
N-CO-KR-000330-E-XX-XX-XX-01	ENERGY STAR Ice Machines 500 to 1000 lbs	PRE	E	9	31.32	1,188.00	10,098	0.97	0.92	1.00	282,271.22	0.00	€ 0.00
N-CO-KR-000331-E-XX-XX-XX-01	ENERGY STAR Ice Machines more than 1000 lbs	PRE	E	9	19.02	1,525.00	12,963	0.97	0.92	1.00	219,994.03	0.00	€ 0.00
N-CO-KR-000368-E-XX-XX-XX-02	Strip Curtains - Cooler	PRE	E	4	2,171.40	85.00	340	0.97	0.92	1.00	658,836.50	0.00	€ 0.00
N-CO-KR-000369-E-XX-XX-XX-02	Strip Curtains - Freezer	PRE	E	4	964.40	454.00	1,816	0.97	0.92	1.00	1,562,902.67	0.00	€ 0.00
N-CO-KR-000372-E-XX-XX-XX-02	ECM Case Motors	PRE	E	15	548.16	824.00	12,360	0.97	0.92	1.00	6,046,272.97	0.00	€ 0.01
N-CO-KR-000375-E-XX-XX-XX-02	ECM Cooler and Freezer Motors - replacing all types	PRE	E	15	1,339.89	1,365.00	20,475	0.97	0.92	1.00	24,482,253.26	0.00	€ 0.05
N-CO-KR-000377-E-XX-XX-XX-02	Evaporator Fan Motor Controls on PSC motors	PRE	E	5	9.13	796.00	3,980	0.97	0.92	1.00	32,428.92	0.00	€ 0.00
N-CO-KR-000378-E-XX-XX-XX-02	Evaporator Fan Motor Controls on ECM motors	PRE	E	5	12.31	330.00	1,650	0.97	0.92	1.00	18,119.65	0.00	€ 0.00
N-CO-KR-000379-E-XX-XX-XX-01	Door Gaskets - Cooler and Freezer	PRE	E	4	10,611.81	98.00	392	0.97	0.92	1.00	3,712,230.95	0.00	€ 0.00
N-CO-KR-000380-E-XX-XX-XX-02	Reach-in Refrigerated display case door retrofit for Medium Temp	PRE	E	12	265.37	574.00	6,888	0.97	0.92	1.00	1,631,173.92	0.00	€ 0.00
N-CO-KR-000381-E-XX-XX-XX-02	Reach-in Refrigerated display case door retrofit for Low Temp	PRE	E	12	154.38	1,454.00	17,448	0.97	0.92	1.00	2,403,797.83	0.00	€ 0.00
N-CO-LI-000075-E-XX-XX-XX-03	Occupancy Sensors under 500 W	PRE	E	10	8,399.49	288.25	2,883	0.97	0.92	1.00	21,606,377.79	0.00	€ 0.03
N-CO-LI-000076-E-XX-XX-XX-03	Occupancy Sensors over 500 W	PRE	E	10	1,212.67	720.60	7,206	0.97	0.92	1.00	7,798,242.56	0.00	€ 0.01
N-CO-LI-000078-E-XX-XX-XX-03	Central Lighting Control	PRE	E	12	343.08	8,340.63	100,088	0.97	0.92	1.00	30,643,139.66	0.00	€ 0.05
N-CO-LI-000079-E-XX-XX-XX-03	Switching Controls for Multilevel Lighting	PRE	E	12	6.71	6,000.00	72,000	0.97	0.92	1.00	431,277.64	0.00	€ 0.00
N-CO-LI-000081-E-XX-XX-XX-03	Daylight Sensor controls	PRE	E	12	19.40	8,810.00	105,720	0.97	0.92	1.00	1,830,481.97	0.00	€ 0.00
N-CO-LI-000096-E-XX-XX-XX-01	LED High Bay (per kW saved base)	PRE	E	16	9,573.83	4,160.00	66,560	0.97	0.92	1.00	568,668,006.20	0.07	€ 1.19
N-CO-LI-000106-E-XX-XX-XX-02	Exterior HID replacement to 175W HID retrofit	PRE	E	12	8,178.56	301.50	3,618	0.97	0.92	1.00	26,406,129.28	0.00	€ 0.04
N-CO-LI-000107-E-XX-XX-XX-02	Exterior HID replacement above 175W to 250W HID retrofit	PRE	E	12	7,658.62	461.30	5,536	0.97	0.92	1.00	37,833,349.74	0.00	€ 0.06
N-CO-LI-000108-E-XX-XX-XX-01	Exterior HID replacement above 250W to 400W HID retrofit	PRE	E	12	14,424.52	795.60	9,547	0.97	0.92	1.00	122,895,756.16	0.02	€ 0.19
N-CO-LI-000114-E-XX-XX-XX-01	Garage HID replacement to 175W HID retrofit	PRE	E	12	2,232.93	611.00	7,332	0.97	0.92	1.00	14,610,201.07	0.00	€ 0.02
N-CO-LI-000115-E-XX-XX-XX-01	Garage HID replacement above 175W to 250W HID retrofit	PRE	E	12	108.51	936.00	11,232	0.97	0.92	1.00	1,087,682.22	0.00	€ 0.00
N-CO-LI-000116-E-XX-XX-XX-01	Garage HID replacement above 250W to 400W HID retrofit	PRE	E	12	95.09	1,614.00	19,368	0.97	0.92	1.00	1,643,527.22	0.00	€ 0.00
N-CO-LI-000117-E-XX-XX-XX-02	Exterior Lighting BiLevel Control w Override, 150 to 1000 HID	PRE	E	10	69.36	743.80	7,438	0.97	0.92	1.00	460,384.89	0.00	€ 0.00
N-CO-LI-000137-E-XX-XX-XX-03	LED Downlight	PRE	E	15	25,899.52	141.50	2,123	0.97	0.92	1.00	49,056,774.63	0.01	€ 0.10
N-CO-LI-000145-E-XX-XX-XX-01	LED Exit Signs Electronic Fixtures (Retrofit Only)	PRE	E	15	2,296.69	201.00	3,015	0.97	0.92	1.00	6,179,444.92	0.00	€ 0.01
N-CO-LI-000149-E-XX-XX-XX-02	LED Refrigerator Case Lighting	PRE	E	16	9,446.30	460.00	7,360	0.97	0.92	1.00	62,043,921.35	0.01	€ 0.13
N-CO-LI-000150-E-XX-XX-XX-01	Occupancy Sensors for LED Refrigerator Lighting	PRE	E	16	24.61	195.00	3,120	0.97	0.92	1.00	68,525.23	0.00	€ 0.00
N-CO-LI-000156-E-XX-XX-XX-01	Stairwell Bi-Level Control	PRE	E	9	12.55	4,809.00	43,281	0.97	0.92	1.00	484,896.84	0.00	€ 0.00
N-CO-LI-000490-E-XX-XX-XX-02	Occupancy and Daylight Sensor under 500W	PRE	E	10	2,586.43	365.10	3,651	0.97	0.92	1.00	8,426,997.45	0.00	€ 0.01
N-CO-LI-000491-E-XX-XX-XX-02	Occupancy and Daylight Sensor over 500W	PRE	E	10	1.12	912.80	9,128	0.97	0.92	1.00	9,112.74	0.00	€ 0.00
N-CO-LI-000495-E-XX-XX-XX-01	Exterior Multi-Step Dim Time Clock	PRE	E	8	64,536.68	0.91	7	0.97	0.92	1.00	420,425.52	0.00	€ 0.00
N-CO-LI-000580-E-XX-XX-XX-01	Exterior LED BiLevel Controls 0-810W LED	PRE	E	11	1,955.49	492.40	5,416	0.97	0.92	1.00	9,452,035.79	0.00	€ 0.01
N-CO-LI-000583-E-XX-XX-XX-01	Garage LED BiLevel Controls	PRE	E	11	1,397.26	408.82	4,497	0.97	0.92	1.00	5,607,362.05	0.00	€ 0.01
N-CO-LI-000584-E-XX-XX-XX-01	Garage LED BiLevel Controls with Photocell	PRE	E	11	1,769.78	923.43	10,158	0.97	0.92	1.00	16,042,609.82	0.00	€ 0.02
N-CO-MP-000251-E-XX-XX-XX-01	Pumps HP 7.5	PRE	E	15	19.02	201.47	3,022	0.97	0.92	1.00	51,288.10	0.00	€ 0.00
N-CO-MP-000253-E-XX-XX-XX-01	Pumps HP 15	PRE	E	15	152.14	201.40	3,021	0.97	0.92	1.00	410,169.00	0.00	€ 0.00
N-CO-MP-000254-E-XX-XX-XX-01	Pumps HP 20	PRE	E	15	100.68	201.40	3,021	0.97	0.92	1.00	271,435.37	0.00	€ 0.00
N-CO-MP-000256-E-XX-XX-XX-01	VFD HP 2 Process Pumping	PRE	E	15	1.14	1,082.15	16,232	0.97	0.92	1.00	16,532.55	0.00	€ 0.00
N-CO-MP-000258-E-XX-XX-XX-01	VFD HP 5 Process Pumping	PRE	E	15	6.85	1,082.15	16,232	0.97	0.92	1.00	99,195.33	0.00	€ 0.00
N-CO-MP-000259-E-XX-XX-XX-01	VFD HP 7.5 Process Pumping	PRE	E	15	19.40	1,082.15	16,232	0.97	0.92	1.00	281,053.43	0.00	€ 0.00
N-CO-MP-000262-E-XX-XX-XX-01	VFD HP 20 Process Pumping	PRE	E	15	77.61	1,082.15	16,232	0.97	0.92	1.00	1,124,213.74	0.00	€ 0.00
N-CO-MP-000266-E-XX-XX-XX-01	VFD HP 50 Process Pumping	PRE	E	15	1,432.33	1,082.17	16,233	0.97	0.92	1.00	20,748,622.32	0.00	€ 0.04
N-CO-MP-000271-E-XX-XX-XX-02	VFD for Process Fans under 50 Hp	PRE	E	15	650.54	532.00	7,980	0.97	0.92	1.00	4,632,731.45	0.00	€ 0.01
N-CO-MS-000212-E-XX-XX-XX-01	Electrically Commutated Plug Fans in data centers under Cabinet	PRE	E	15	8.95	1,819.00	27,285	0.97	0.92	1.00	217,915.01	0.00	€ 0.00
N-CO-MS-000215-E-XX-XX-XX-01	High Efficiency CRAC unit greater than 240 MBH	PRE	E	15	12,714.03	176.00	2,640	0.97	0.92	1.00	29,953,430.38	0.00	€ 0.06
N-CO-MS-000407-E-XX-XX-XX-01	VSD Air Compressors	PRE	E	15	8,414.80	1,390.00	20,850	0.97	0.92	1.00	156,570,403.96	0.02	€ 0.31
N-CO-MS-000408-E-XX-XX-XX-01	Cycling Compressed Air Dryer replacing non-cycling - thermal mass	PRE	E	10	12,720.74	5.24	52	0.97	0.92	1.00	595,071.12	0.00	€ 0.00
N-CO-MS-000409-E-XX-XX-XX-01	Cycling Compressed Air Dryer replacing non-cycling - VSD	PRE	E	10	974.67	17.04	170	0.97	0.92	1.00	148,169.70	0.00	€ 0.00
N-CO-MS-000410-E-XX-XX-XX-01	Cycling Compressed Air Dryer replacing non-cycling - Digital Scroll	PRE	E	10	6,638.37	16.16	162	0.97	0.92	1.00	957,449.43	0.00	€ 0.00
N-CO-MS-000411-E-XX-XX-XX-01	Compressed Air Audits & Leak Repair	PRE	E	1	2,604.45	624.00	624	0.97	0.92	1.00	1,450,305.88	0.00	€ 0.00
N-CO-MS-000413-E-XX-XX-XX-01	Compressed Air Pressure Flow Controller replacing no flow controller	PRE	E	10	731.14	73.94	739	0.97	0.92	1.00	482,434.91	0.00	€ 0.00
N-CO-MS-000414-E-XX-XX-XX-01	Desiccant to Refrigerated Air Dryers	PRE	E	10	458.67	53.40	534	0.97	0.92	1.00	218,573.91	0.00	€ 0.00

U-18419-MECNRDCSCDE-11.11b - FirstYear and Lifetime Savings.xlsx 2018 Measure Savings

N-CO-MS-000417-E-XX-XX-XX-XX-01	No-Loss Condensate Drains	PRE	E		5	92.45	2,097.00	10,485	0.97	0.92	1.00	864,993.48	0.00	€	0.00
N-CO-MS-000444-E-XX-XX-XX-XX-01	3-phase High Frequency Battery Charger - 2 shifts	PRE	E		20	36.52	2,688.00	53,760	0.97	0.92	1.00	1,752,139.25	0.00	€	0.00
N-CO-MS-000458-E-XX-XX-XX-XX-01	Refrigeration Savings due to Lighting Savings -20F to 0F	PRE	E		12	30,944.36	1.79	21	0.97	0.92	1.00	593,164.78	0.00	€	0.00
N-CO-MS-000459-E-XX-XX-XX-XX-01	Refrigeration Savings due to Lighting Savings 0F to 20F	PRE	E		12	75,728.16	1.16	14	0.97	0.92	1.00	940,710.94	0.00	€	0.00
N-CO-MS-000460-E-XX-XX-XX-XX-01	Refrigeration Savings due to Lighting Savings 20F to 40F	PRE	E		12	########	0.76	9	0.97	0.92	1.00	1,712,685.47	0.00	€	0.00
N-CO-MS-000479-E-XX-XX-XX-XX-01	Computer Room Air Conditioner Economizer less than 65 MBH	PRE	E		15	698.07	331.00	4,965	0.97	0.92	1.00	3,092,979.50	0.00	€	0.01
N-CO-MS-000534-E-XX-XX-XX-XX-01	Compressed Air Storage Tank	PRE	E		25	1,908.50	422.76	10,569	0.97	0.92	1.00	18,000,404.81	0.00	€	0.06
N-CO-MS-000637-E-XX-XX-XX-XX-01	Injection Molding Machine - Full Electric (Servo Electric)	PRE	E		20	178.99	237.00	4,740	0.97	0.92	1.00	757,131.86	0.00	€	0.00
W-CO-BE-111580-E-DE-HS-VA-XX-01	Cool roof	PRE	E		20	1,210.43	41.76	835	0.97	0.92	1.00	902,175.33	0.00	€	0.00
W-CO-BE-112819-E-DE-LO-VA-XX-01	High Performance Glazing	PRE	E		20	28.53	531.90	10,638	0.97	0.92	1.00	270,867.36	0.00	€	0.00
W-CO-BE-117019-C-DE-HS-VW-XX-01	Window Film	PRE	E		10	51.46	57.64	576	0.97	0.92	1.00	26,472.27	0.00	€	0.00
W-CO-HV-110015-E-DE-FF-CG-XX-02	AC <65k SEER 14 - 1 Ph	PRE	E		15	320.71	269.15	4,037	0.97	0.92	1.00	1,155,464.49	0.00	€	0.00
W-CO-HV-110550-E-DE-LO-VA-XX-01	Air-Cooled Screw Chiller COP = 2.8, IPLV = 3.46	PRE	E		20	76.07	102.03	2,041	0.97	0.92	1.00	138,529.67	0.00	€	0.00
W-CO-HV-110556-E-DE-LO-EA-XX-01	Air-Cooled Screw Chiller COP = 2.8, IPLV = 3.64	PRE	E		20	255.06	140.65	2,813	0.97	0.92	1.00	640,275.45	0.00	€	0.00
W-CO-HV-110568-E-DE-LO-VA-XX-01	Air-Cooled Screw Chiller COP = 2.8, IPLV = 3.64	PRE	E		20	2,170.28	124.80	2,496	0.97	0.92	1.00	4,834,249.05	0.00	€	0.01
W-CO-HV-110586-E-DE-LO-VA-XX-01	Air-Cooled Screw Chiller COP = 2.8, IPLV = 4.75	PRE	E		20	892.50	280.10	5,602	0.97	0.92	1.00	4,461,835.76	0.00	€	0.01
W-CO-HV-110604-E-DE-LO-VA-XX-01	Air-Cooled Screw Chiller COP = 3.08, IPLV = 3.36	PRE	E		20	253.94	135.94	2,719	0.97	0.92	1.00	616,138.58	0.00	€	0.00
W-CO-HV-110640-E-DE-LO-VA-XX-01	Air-Cooled Screw Chiller COP = 3.08, IPLV = 4.00	PRE	E		20	828.96	249.56	4,991	0.97	0.92	1.00	3,692,220.94	0.00	€	0.01
W-CO-HV-110712-E-DE-LO-VA-XX-01	Air-Cooled Screw Chiller COP = 3.36, IPLV = 4.42	PRE	E		20	1,402.85	354.82	7,096	0.97	0.92	1.00	8,883,890.05	0.00	€	0.02
W-CO-HV-111182-E-DE-LO-NA-XX-01	Chiller Tuneup	PRE	E		5	385.76	200.89	1,004	0.97	0.92	1.00	345,786.52	0.00	€	0.00
W-CO-HV-111185-E-DE-LO-EW-XX-01	Chiller Tuneup	PRE	E		5	14,184.00	97.38	487	0.97	0.92	1.00	6,162,790.94	0.00	€	0.00
W-CO-HV-111301-E-DE-LO-VW-XX-01	CHW reset 5 deg	PRE	E		5	964.40	30.01	150	0.97	0.92	1.00	129,130.58	0.00	€	0.00
W-CO-HV-111301-E-DE-LO-VW-XX-01	CHW reset 5 deg	PRE	E		5	1,417.39	30.01	150	0.97	0.92	1.00	189,785.42	0.00	€	0.00
W-CO-HV-112054-E-DE-FS-CG-XX-01	Economizer	PRE	E		15	446.36	17.83	267	0.97	0.92	1.00	106,514.73	0.00	€	0.00
W-CO-HV-112089-E-DE-SO-CG-XX-01	Economizer	PRE	E		15	5.71	172.74	2,591	0.97	0.92	1.00	13,195.01	0.00	€	0.00
W-CO-HV-112123-E-DE-LO-EW-XX-01	Efficient Chilled Water Pump	PRE	E		15	1,543.04	829.17	12,438	0.97	0.92	1.00	17,126,643.87	0.00	€	0.03
W-CO-HV-112157-E-DE-LO-EA-XX-01	Efficient Hot Water Pump	PRE	E		15	196.89	517.39	7,761	0.97	0.92	1.00	1,363,633.02	0.00	€	0.00
W-CO-HV-113132-E-DE-AS-AS-XX-02	ASHP 65k - 135k EER 11.3 COP 3.4	PRE	E		15	8.61	71.94	1,079	0.97	0.92	1.00	8,294.59	0.00	€	0.00
W-CO-HV-113160-E-DE-PS-AS-XX-02	ASHP 65k - 135k EER 11.3 COP 3.4	PRE	E		15	19.02	63.94	959	0.97	0.92	1.00	16,277.61	0.00	€	0.00
W-CO-HV-113198-C-DE-LO-VW-XX-01	HVAC Occ Sensor	PRE	E		15	275.20	92.70	1,390	0.97	0.92	1.00	341,472.82	0.00	€	0.00
W-CO-HV-113901-E-DE-PS-GH-XX-01	PTAC	PRE	E		15	637.66	13.47	202	0.97	0.92	1.00	114,964.30	0.00	€	0.00
W-CO-HV-113950-E-DE-SO-GH-XX-01	PTAC-HP	PRE	E		15	382.60	62.07	931	0.97	0.92	1.00	317,882.15	0.00	€	0.00
W-CO-HV-113985-E-DE-AS-CG-XX-01	Refrigerant charging correction	PRE	E		2	378.12	96.60	193	0.97	0.92	1.00	65,192.74	0.00	€	0.00
W-CO-HV-114650-C-DE-LN-CG-XX-02	Setback/Setup	PRE	E		9	1,084.02	75.21	677	1.00	1.00	1.00	733,717.38	0.00	€	0.00
W-CO-HV-114664-C-DE-SO-CG-XX-02	Setback/Setup	PRE	E		9	1,085.24	-	-	1.00	1.00	1.00	-	-	€	-
W-CO-HV-114834-E-DE-LO-VW-XX-01	VFD Fan	PRE	E		10	336.68	1,183.13	11,831	0.97	0.92	1.00	3,554,778.13	0.00	€	0.00
W-CO-HV-114847-E-DE-HS-VA-XX-01	VFD Fan	PRE	E		10	14.54	628.80	6,288	0.97	0.92	1.00	81,606.93	0.00	€	0.00
W-CO-HV-114848-E-DE-HS-VW-XX-01	VFD Fan	PRE	E		10	3,417.63	605.09	6,051	0.97	0.92	1.00	18,454,511.78	0.00	€	0.02
W-CO-HV-114864-E-DE-LO-VA-XX-01	VFD Pump	PRE	E		10	95.87	3,799.05	37,991	0.97	0.92	1.00	3,250,229.18	0.00	€	0.00
W-CO-HV-114890-E-DE-HS-VA-XX-01	VFD Pump	PRE	E		10	1,157.28	1,509.99	15,100	0.97	0.92	1.00	15,594,491.27	0.00	€	0.02
W-CO-HV-115171-E-DE-LO-EW-XX-01	Water-Cooled cent Chiller > 300 ton 0.58 kW/ton with 0.35 kW/ton IPLV	PRE	E		20	605.22	155.79	3,116	0.97	0.92	1.00	1,682,874.55	0.00	€	0.00
W-CO-HV-115172-E-DE-LO-VW-XX-01	Water-Cooled cent Chiller > 300 ton 0.58 kW/ton with 0.35 kW/ton IPLV	PRE	E		20	3,646.45	135.65	2,713	0.97	0.92	1.00	8,828,391.39	0.00	€	0.02
W-CO-HV-115193-E-DE-LO-VW-XX-01	Water-Cooled cent Chiller > 300 ton 0.58 kW/ton with 0.41 kW/ton IPLV	PRE	E		20	1,403.97	98.25	1,965	0.97	0.92	1.00	2,462,004.96	0.00	€	0.01
W-CO-HV-115466-E-DE-LO-VW-XX-01	Water-Cooled cent Chiller 150 - 300 ton 0.63 kW/ton with 0.38 kW/ton IPLV	PRE	E		20	500.86	143.63	2,873	0.97	0.92	1.00	1,283,995.28	0.00	€	0.00
W-CO-HV-118468-E-DE-AS-CG-XX-01	DX Condenser Coil Cleaning	PRE	E		3	472.09	20.30	61	0.97	0.92	1.00	25,656.83	0.00	€	0.00
W-CO-HV-118644-E-DE-PS-AS-XX-02	ASHP <65k SEER 15 HSPF 8.5 - 1 Ph	PRE	E		15	89.50	253.35	3,800	0.97	0.92	1.00	303,511.60	0.00	€	0.00
W-CO-KR-110733-E-DE-GR-XX-XX-01	Anti Sweat Heater Control	PRE	E		12	4,340.36	1,858.44	22,301	0.97	0.92	1.00	86,380,473.53	0.01	€	0.14
W-CO-KR-110734-E-LA-GR-XX-XX-01	Anti Sweat Heater Control	PRE	E		12	66.20	1,770.77	21,249	0.97	0.92	1.00	1,255,252.03	0.00	€	0.00
W-CO-KR-110736-E-SA-GR-XX-XX-01	Anti Sweat Heater Control	PRE	E		12	23.97	1,827.67	21,932	0.97	0.92	1.00	469,091.58	0.00	€	0.00
W-CO-KR-112145-E-DE-GR-XX-XX-01	Efficient Condenser	PRE	E		15	248.35	1,260.53	18,908	0.97	0.92	1.00	4,190,537.67	0.00	€	0.01
W-CO-KR-112411-E-DE-GR-XX-XX-01	Floating Head Pressure Control	PRE	E		16	336.68	1,705.83	27,293	0.97	0.92	1.00	8,200,446.66	0.00	€	0.02
W-CO-KR-113608-E-DE-GR-XX-XX-01	Night Covers	PRE	E		5	12,343.74	15.63	78	0.97	0.92	1.00	861,104.21	0.00	€	0.00
W-CO-KR-113611-E-SA-GR-XX-XX-01	Night Covers	PRE	E		5	1,420.75	16.18	81	0.97	0.92	1.00	102,541.33	0.00	€	0.00
W-CO-HV-100001-E-WR-WR-WR-WR-03	AC <65k SEER 14 - 3 Ph	PRE	E		15	216.85	236.02	3,540	0.97	0.92	1.00	685,098.50	0.00	€	0.00
W-CO-HV-100273-E-WR-WR-WR-WR-02	AC >760k EER 10.2	PRE	E		15	617.52	21.90	328	0.97	0.92	1.00	181,005.60	0.00	€	0.00
W-CO-HV-100003-E-WR-WR-WR-WR-03	AC 135k - 240k EER 12	PRE	E		15	674.58	31.33	470	0.97	0.92	1.00	282,940.55	0.00	€	0.00
W-CO-HV-100004-E-WR-WR-WR-WR-03	AC 240k - 760k EER 10.3	PRE	E		15	666.75	16.57	248	0.97	0.92	1.00	147,843.88	0.00	€	0.00
W-CO-HV-100005-E-WR-WR-WR-WR-03	AC 65k - 135k EER 12	PRE	E		15	1,148.90	31.16	467	0.97	0.92	1.00	479,154.96	0.00	€	0.00
W-CO-HV-100231-C-WR-WR-WR-WR-01	Web enabled EMS with Electric Heat	PRE	E		15	2,893.20	7,323.43	109,851	0.97	0.92	1.00	283,624,138.23	0.04	€	0.56
N-CO-KR-000345-E-XX-XX-XX-XX-01	Steam Cookers (6 Pan, Electric)	PRE	E		12	1.12	15,170.00	182,040	0.97	0.92	1.00	181,735.61	0.00	€	0.00
N-CO-KR-000347-E-XX-XX-XX-XX-01	ENERGY STAR® Hot Holding Cabinets (Half Size)	PRE	E		12	12.31	1,788.00	21,456	0.97	0.92	1.00	235,621.35	0.00	€	0.00
N-CO-KR-000349-E-XX-XX-XX-XX-01	ENERGY STAR® Hot Holding Cabinets (Full Size)	PRE	E		12	1.12	5,278.00	63,336	0.97	0.92	1.00	63,230.09	0.00	€	0.00
N-CO-LI-000096-E-XX-XX-XX-XX-01	LED High Bay (per kW saved base) (2)	PRE	E		16	1,928.80	4,160.00	66,560	0.97	0.92	1.00	114,566,961.95	0.01	€	0.24
N-CO-LI-000106-E-XX-XX-XX-XX-02	Exterior HID replacement to 175W HID retrofit (2)	PRE	E		12	1,928.80	301.50	3,618	0.97	0.92	1.00	6,227,513.05	0.00	€	0.01
N-CO-LI-000107-E-XX-XX-XX-XX-02	Exterior HID replacement above 175W to 250W HID retrofit (2)	PRE	E		12	1,446.03	461.30	5,536	0.97	0.92	1.00	7,143,329.68	0.00	€	0.01
N-CO-LI-000108-E-XX-XX-XX-XX-01	Exterior HID replacement above 250W to 400W HID retrofit (2)	PRE	E		12	4,823.13	795.60	9,547	0.97	0.92	1.00	41,092,720.30	0.01	€	0.06
N-CO-LI-000114-E-XX-XX-XX-XX-01	Garage HID replacement to 175W HID retrofit (2)	PRE	E		12	964.40	611.00	7,332	0.97	0.92	1.00	6,310,133.45	0.00	€	0.01
N-CO-LI-000115-E-XX-XX-XX-XX-01	Garage HID replacement above 175W to 250W HID retrofit (2)	PRE	E		12	31.96	936.00	11,232	0.97	0.92	1.00	320,312.96	0.00	€	0.00
N-CO-LI-000116-E-XX-XX-XX-XX-01	Garage HID replacement above 250W to 400W HID retrofit (2)	PRE	E		12	31.96	1,614.00	19,368	0.97	0.92	1.00	552,334.52	0.00	€	0.00
N-CO-LI-000149-E-XX-XX-XX-XX-02	LED Refrigerator Case Lighting (2)	PRE	E		16	1,928.80	460.00	7,360	0.97	0.92	1.00	12,668,462.14	0.00	€	0.03
N-CO-MP-000264-E-XX-XX-XX-XX-01	VFD HP 30 Process Pumping	PRE	E		15	77.61	1,082.15	16,232	0.97	0.92	1.00	1,124,213.74	0.00	€	0.00

Electric Portfolio Lifetime Savings: 7,613,918,132
Electric Portfolio WAML: 14.14

[illegible]													
Custom	Whole Home EP E	DTEIS	E	1	14,384,373	1	14,463,587	1.00	1.00	1.00	14,384,373	0	0
N-MF-WH-020128-E-XX-XX-XX-XX-02	Low Flow Showerheads 1.5 gpm electric water heater	LI	E	10	1,015	326	334,150	0.76	1.00	1.00	2,514,764	0	0
N-MF-WH-020128-E-XX-XX-XX-XX-02	Low Flow Showerheads 1.5 gpm electric water heater (Handheld)	LI	E	10	1,015	326	334,150	0.76	1.00	1.00	2,514,764	0	0
N-MF-WH-020132-E-XX-XX-XX-XX-02	Low Flow Kitchen Faucet Aerators - 1.5 gpm electric water heater	LI	E	10	609	202	124,230	0.83	1.00	1.00	1,021,049	0	0
N-MF-WH-020134-E-XX-XX-XX-XX-02	Low Flow Bathroom Faucet Aerators - 1.5 gpm electric water heater	LI	E	10	609	41	25,215	0.83	1.00	1.00	207,243	0	0
N-RE-LI-010018-E-XX-XX-XX-XX-03	LED Replacing A-line 43W	LI	E	15	60,900	29	1,752,750	0.68	1.00	1.00	17,703,630	0	0
N-RE-WH-010047-E-XX-XX-XX-XX-03	Pipe Wrap R3 - electric water heater	LI	E	15	711	51	36,593	1.00	1.00	1.00	543,533	0	0
N-RE-LI-010021-E-XX-XX-XX-XX-03	LED Flood PAR (average values)	LI	E	15	5,075	54	276,750	0.68	1.00	1.00	2,795,310	0	0
N-RE-LI-010022-E-XX-XX-XX-XX-03	LED Globe	LI	E	15	5,075	27	138,375	0.68	1.00	1.00	1,397,655	0	0
N-RE-LI-010161-E-XX-XX-XX-XX-02	LED Candelabra	LI	E	15	5,030	24	106,316	0.68	1.00	1.00	1,216,025	0	0
N-RE-LI-010013-E-XX-XX-XX-XX-02	LED Night Light	LI	E	12	21,735	22	481,140	0.76	1.00	1.00	4,360,910	0	0
N-RE-LI-010018-E-XX-XX-XX-XX-03	LED Replacing A-line 43W	LI	E	15	115,920	29	3,324,240	0.97	1.00	1.00	48,069,126	0	0
N-RE-LI-010019-E-XX-XX-XX-XX-03	LED Replacing A-line 53W halogen	LI	E	15	2,890	34	93,013	0.97	1.00	1.00	1,412,844	0	0
N-RE-LI-010020-E-XX-XX-XX-XX-03	LED Replacing A-line 100W (72W Halogen)	LI	E	15	1,449	46	67,360	0.97	1.00	1.00	974,032	0	0
N-RE-LI-010021-E-XX-XX-XX-XX-03	LED Flood PAR (average values)	LI	E	15	23,184	54	1,259,712	0.97	1.00	1.00	18,215,669	0	0
N-RE-LI-010022-E-XX-XX-XX-XX-03	LED Globe	LI	E	15	23,184	27	629,856	0.97	1.00	1.00	9,107,834	0	0
N-RE-LI-010161-E-XX-XX-XX-XX-02	LED Candelabra	LI	E	15	26,807	24	639,260	0.97	1.00	1.00	9,243,819	0	0
N-RE-WH-010047-E-XX-XX-XX-XX-03	Pipe Wrap R3 - electric water heater	LI	E	15	725	51	37,179	0.72	1.00	1.00	399,055	0	0
N-RE-WH-010055-E-XX-XX-XX-XX-02	Low Flow Showerheads 1.5 gpm electric water heater	LI	E	10	725	334	243,486	1.00	1.00	1.00	2,419,830	0	0
N-RE-WH-010055-E-XX-XX-XX-XX-02	Low Flow Handheld Showerheads 1.5 gpm electric water heater	LI	E	10	507	334	170,440	1.00	1.00	1.00	1,693,881	0	0
N-RE-WH-010061-E-XX-XX-XX-XX-02	Low Flow Kitchen Faucet Aerators - 1.5 gpm electric water heater	LI	E	10	362	279	101,696	0.89	1.00	1.00	899,503	0	0
N-RE-WH-010063-E-XX-XX-XX-XX-02	Low Flow Bathroom Faucet Aerators - 1.5 gpm electric water heater	LI	E	10	507	40	20,412	0.89	1.00	1.00	180,545	0	0
W-SF-HV-200158-C-WR-WR-WR-WR-01	Programmable Thermostats Tier 3	LI	Combo	10	44	130	5,617	1.00	1.00	0.35	57,652	0	0
W-SF-HV-200072-C-WR-WR-WR-WR-01	Setback thermostat - moderate setback	LI	Combo	9	192	50	9,580	0.82	1.00	0.15	70,267	0	0
N-RE-LI-010018-E-XX-XX-XX-XX-03	LED Replacing A-line 43W	EEAP	E	15	73,600	29	2,109,000	0.77	1.00	1.00	24,227,280	0	0
N-RE-LI-010018-E-XX-XX-XX-XX-03	LED Replacing A-line 43W DI	EEAP	E	15	36,800	29	1,054,500	0.77	1.00	1.00	12,113,640	0	0
N-RE-WH-010055-E-XX-XX-XX-XX-02	Low Flow Showerheads 1.5 gpm electric water heater	EEAP	E	10	184	334	61,790	1.00	1.00	1.00	614,560	0	0
N-RE-WH-010061-E-XX-XX-XX-XX-02	Low Flow Kitchen Faucet Aerators - 1.5 gpm electric water heater	EEAP	E	10	184	279	51,615	1.00	1.00	1.00	513,360	0	0
N-RE-WH-010063-E-XX-XX-XX-XX-02	Low Flow Bathroom Faucet Aerators - 1.5 gpm electric water heater	EEAP	E	10	-	40	-	1.00	1.00	1.00	-	-	-
N-RE-WH-010040-E-XX-XX-XX-XX-02	Electric Water Heater EF 0.93+	EEAP	E	15	2	-	-	1.00	1.00	1.00	-	-	-
N-RE-HV-010078-E-XX-XX-XX-XX-02	ECM Furnace - HIGHER INCENTIVE	EEAP	E	10	92	730	67,525	0.92	1.00	1.00	617,872	0	0
N-RE-HV-010078-E-XX-XX-XX-XX-02	ECM Furnace - LOWER INCENTIVE	EEAP	E	10	92	730	67,525	0.92	1.00	1.00	617,872	0	0
W-SF-HV-200158-C-WR-WR-WR-WR-01	Programmable Thermostats Tier 3	EEAP	E	10	1,041	341	356,411	1.00	1.00	1.41	3,544,841	0	0
W-SF-HV-200072-C-WR-WR-WR-WR-01	Setback thermostat - moderate setback	EEAP	E	9	2,592	306	796,794	0.62	1.00	1.41	4,422,077	0	0
W-SF-BE-200116-C-WR-WR-WR-WR-01	R-30 Roof Insulation	EEAP	E	20	95	241	22,983	1.00	1.00	1.03	457,175	0	0
W-SF-BE-200117-C-WR-WR-WR-WR-01	R-38 Roof Insulation	EEAP	E	20	20	335	6,678	1.00	1.00	1.08	132,837	0	0
W-SF-BE-200118-C-WR-WR-WR-WR-01	R-49 Roof Insulation	EEAP	E	20	41	417	17,335	1.00	1.00	1.12	344,831	0	0
W-SF-BE-200119-C-WR-WR-WR-WR-01	R-60 Roof Insulation	EEAP	E	20	21	471	9,782	1.00	1.00	1.12	194,587	0	0
W-SF-BE-200030-C-WR-WR-WR-WR-01	Energy Star Door	EEAP	E	20	21	164	3,393	1.00	1.00	1.12	67,491	0	0
W-SF-BE-200077-C-WR-WR-WR-WR-01	Window Replacement	EEAP	E	25	19	398	7,429	1.00	1.00	1.01	184,714	0	0
W-SF-BE-200074-C-WR-WR-WR-WR-01	Wall Insulation	EEAP	E	25	82	362	30,003	1.00	1.00	1.12	746,019	0	0
W-SF-BE-200114-C-WR-WR-WR-WR-01	R-38 "scuttle hole" Attic hatch	EEAP	E	20	52	77	4,072	1.00	1.00	1.14	80,998	0	0
W-SF-BE-200115-C-WR-WR-WR-WR-01	R-38 pull-down stairs Attic hatch	EEAP	E	20	8	159	1,316	1.00	1.00	0.45	26,170	0	0
W-SF-BE-200069-C-WR-WR-WR-WR-01	Rim Joist Insulation	EEAP	E	25	7	205	1,458	1.00	1.00	0.77	36,249	0	0
W-SF-BE-200006-C-WR-WR-WR-WR-01	Basement Wall Insulation	EEAP	E	25	18	401	7,208	1.00	1.00	0.39	179,214	0	0
W-SF-BE-200012-C-WR-WR-WR-WR-01	Crawlspace Wall Insulation	EEAP	E	25	12	236	2,843	1.00	1.00	1.30	70,703	0	0
W-SF-HV-200024-C-WR-WR-WR-WR-01	Duct Insulation	EEAP	E	20	6	149	944	1.00	1.00	0.68	18,776	0	0
W-SF-BE-200031-C-WR-WR-WR-WR-01	Floor Insulation	EEAP	E	25	14	283	3,843	1.00	1.00	1.22	95,555	0	0
W-SF-BE-200113-C-WR-WR-WR-WR-02	R0 to R19 kneewalls	EEAP	E	20	6	2,820	17,490	1.00	1.00	1.12	347,905	0	0
W-SF-BE-200121-C-WR-WR-WR-WR-02	R6 to R19 kneewalls	EEAP	E	20	6	761	4,726	1.00	1.00	1.12	94,004	0	0
W-SF-BE-200052-C-WR-WR-WR-WR-01	Infiltration reduction - 10%	EEAP	E	13	40	113	4,508	1.00	1.00	1.80	58,286	0	0
W-SF-BE-200054-C-WR-WR-WR-WR-01	Infiltration reduction - 20%	EEAP	E	13	69	237	16,429	1.00	1.00	1.71	212,416	0	0
W-SF-BE-200056-C-WR-WR-WR-WR-01	Infiltration reduction - 40%	EEAP	E	13	75	472	35,699	1.00	1.00	1.64	461,579	0	0
€ 105,393.00	Regrigerator Replacement - Bottom Mounted	EEAP	E	16	174	552	97,179	1.00	1.00	1.00	1,540,043	0	0
€ 105,390.00	Regrigerator Replacement - Top Mounted	EEAP	E	16	2,024	769	1,564,915	1.00	1.00	1.00	24,903,296	0	0
€ 105,391.00	Regrigerator Replacement - Side by Side	EEAP	E	16	184	585	108,225	1.00	1.00	1.00	1,722,240	0	0
W-SF-HV-200048-C-WR-WR-WR-WR-03	High efficiency 95 AFUE furnace with ECM - SF	EEAP	E	15	5,169	6	31,169	0.92	1.00	70.02	427,804	0	0
W-SF-HV-200080-C-WR-WR-WR-WR-03	High efficiency 96 AFUE furnace with ECM	EEAP	E	15	13,587	6	88,695	0.92	1.00	73.84	1,217,369	0	0
W-MH-HV-400040-C-WR-WR-WR-WR-03	High efficiency 95 AFUE furnace with ECM - MH	EEAP	E	15	4,584	4	17,804	0.92	1.00	124.20	244,373	0	0
Custom	Behavior Modification: Home Energy Reports 2017 - HER E	LI	E	1	8,672,307	1	8,720,065	1.00	1.00	1.00	8,672,307	0	0
N-CO-AP-000315-E-XX-XX-XX-XX-01	Smart Strip plug outlet	PRE	E	5	74.29	16.97	85	0.97	0.92	1.00	5,625.22	0.00	0.00
N-CO-CL-000316-E-XX-XX-XX-XX-02	PC Network Energy Management Controls replacing no central control	PRE	E	4	1,147.04	135.00	540	0.97	0.92	1.00	552,752.45	0.00	0.00
N-CO-HV-000202-E-XX-XX-XX-XX-02	ENERGY STAR Room AC less than 14,000 Btu hr	PRE	E	15	12.20	52.00	780	0.97	0.92	1.00	8,489.85	0.00	0.00
N-CO-HV-000203-E-XX-XX-XX-XX-02	ENERGY STAR Room AC greater than 14,000 Btu hr	PRE	E	15	63.20	113.00	1,695	0.97	0.92	1.00	95,599.88	0.00	0.00
N-CO-HV-000210-E-XX-XX-XX-XX-01	ECM motors on furnaces	PRE	E	20	13.31	1,348.00	26,960	0.97	0.92	1.00	320,120.81	0.00	0.00
N-CO-HV-000339-E-XX-XX-XX-XX-01	Guest Room Energy Management, Electric Heating and Cooling	PRE	E	8	1,147.04	1,114.00	8,912	0.97	0.92	1.00	9,122,462.59	0.00	0.01
N-CO-HV-000340-C-XX-XX-XX-XX-01	Guest Room Energy Management, Gas Heating Electric Cooling	PRE	E	8	408.04	237.00	1,896	0.97	0.92	1.00	690,397.06	0.00	0.00
N-CO-KR-000317-E-XX-XX-XX-XX-01	Vending Equipment Controller	PRE	E	10	32.16	800.00	8,000	0.97	0.92	1.00	229,562.40	0.00	0.00
N-CO-KR-000320-E-XX-XX-XX-XX-02	ENERGY STAR Commercial Solid Door Refrigerators less than 15ft3	PRE	E	12	3,162.30	453.00	5,436	0.97	0.92	1.00	15,340,578.88	0.00	0.02
N-CO-KR-000321-E-XX-XX-XX-XX-02	ENERGY STAR Commercial Solid Door Refrigerators 15 to 30 ft3	PRE	E	12	126.40	628.00	7,536	0.97	0.92	1.00	850,077.50	0.00	0.00
N-CO-KR-000322-E-XX-XX-XX-XX-02	ENERGY STAR Commercial Solid Door Refrigerators 30 to 50ft3	PRE	E	12	37.70	982.00	11,784	0.97	0.92	1.00	396,446.36	0.00	0.00
N-CO-KR-000323-E-XX-XX-XX-XX-02	ENERGY STAR Commercial Solid Door Refrigerators more than 50ft3	PRE	E	12	6.65	1,486.00	17,832	0.97	0.92	1.00	105,867.85	0.00	0.00
N-CO-KR-000324-E-XX-XX-XX-XX-02	ENERGY STAR Commercial Solid Door Freezers less than 15ft3	PRE	E	12	37.70	485.00	5,820	0.97	0.92	1.00	195,800.90	0.00	0.00
N-CO-KR-000325-E-XX-XX-XX-XX-02	ENERGY STAR Commercial Solid Door Freezers 15 to 30 ft3	PRE	E	12	7.76	1,343.00	16,116	0.97	0.92	1.00	111,626.70	0.00	0.00
N-CO-KR-000326-E-XX-XX-XX-XX-02	ENERGY STAR Commercial Solid Door Freezers 30 to 50ft3	PRE	E	12	32.80	2,402.00	28,824	0.97	0.92	1.00	843,822.70	0.00	0.00
N-CO-KR-000327-E-XX-XX-XX-XX-02	ENERGY STAR Commercial Solid Door Freezers more than 50ft3	PRE	E	12	2.26	4,183.00	50,196	0.97	0.92	1.00	101,344.01	0.00	0.00
N-CO-KR-000329-E-XX-XX-XX-XX-01	ENERGY STAR Ice Machines less than 500 lbs	PRE	E	9	18.85	501.00	4,259	0.97	0.92	1.00	71,633.86	0.00	0.00
N-CO-KR-000330-E-XX-XX-XX-XX-01	ENERGY STAR Ice Machines 500 to 1000 lbs	PRE	E	9	31.05	1,188.00	10,098	0.97	0.92	1.00	279,773.24	0.00	0.00
N-CO-KR-000331-E-XX-XX-XX-XX-01	ENERGY STAR Ice Machines more than 1000 lbs	PRE	E	9	18.85	1,525.00	12,963	0.97	0.92	1.00	218,047.18	0.00	0.00
N-CO-KR-000368-E-XX-XX-XX-XX-02	Strip Curtains - Cooler	PRE	E	4	2,152.18	85.00	340	0.97	0.92	1.00	653,006.09	0.00	0.00
N-CO-KR-000369-E-XX-XX-XX-XX-02	Strip Curtains - Freezer	PRE	E	4	955.86	454.00	1,816	0.97	0.92	1.00	1,549,071.67	0.00	0.00
N-CO-KR-000372-E-XX-XX-XX-XX-02	ECM Case Motors	PRE	E	15	543.31	824.00	12,360	0.97	0.92	1.00	5,992,766.13	0.00	0.01
N-CO-KR-000375-E-XX-XX-XX-XX-02	ECM Cooler and Freezer Motors - replacing all types	PRE	E	15	1,328.03	1,365.00	20,475	0.97	0.92	1.00	24,265,596.15	0.00	0.05
N-CO-KR-000377-E-XX-XX-XX-XX-02	Evaporator Fan Motor Controls on PSC motors	PRE	E	5	9.05	796.00	3,980	0.97	0.92	1.00	32,141.93	0.00	0.00
N-CO-KR-000378-E-XX-XX-XX-XX-02	Evaporator Fan Motor Controls on ECM motors	PRE	E	5	12.20	330.00	1,650	0.97	0.92	1.00	17,959.30	0.00	0.00
N-CO-KR-000379-E-XX-XX-XX-XX-01	Door Gaskets - Cooler and Freezer	PRE	E	4	10,517.90	98.00	392	0.97	0.92	1.00	3,679,379.35	0.00	0.00
N-CO-KR-000380-E-XX-XX-XX-XX-02	Reach-in Refrigerated display case door retrofit for Medium Temp	PRE	E	12	268.42	574.00	6,888	0.97	0.92	1.00	1,649,923.05	0.00	0.00
N-CO-KR-000381-E-XX-XX-XX-XX-02	Reach-in Refrigerated display case door retrofit for Low Temp	PRE	E	12	153.01	1,454.00	17,448	0.97	0.92	1.00	2,382,525.28	0.00	0.00
N-CO-LI-000075-E-XX-XX-XX-XX-03	Occupancy Sensors under 500 W	PRE	E	10	10,194.18	288.25	2,883	0.97	0.92	1.00	26,222,932.91	0.00	0.03
N-CO-LI-000076-E-XX-XX-XX-XX-03	Occupancy Sensors over 500 W	PRE	E	10	1,201.94	720.60	7,206	0.97	0.92	1.00	7,729,231.57	0.00	0.01
N-CO-LI-000078-E-XX-XX-XX-XX-03	Central Lighting Control	PRE	E	12	340.04	8,340.63	100,088	0.97	0.92	1.00	30,371,961.43	0.00	0.05
N-CO-LI-000079-E-XX-XX-XX-XX-03	Switching Controls for Multilevel Lighting	PRE	E	12	6.65	6,000.00	72,000	0.97	0.92	1.00	427,461.03	0.00	0.00
N-CO-LI-000081-E-XX-XX-XX-XX-03	Daylight Sensor controls	PRE	E	12	19.23	8,810.00	105,720	0.97	0.92	1.00	1,814,283.01	0.00	0.00
N-CO-LI-000096-E-XX-XX-XX-XX-01	LED High Bay (per kW saved base)	PRE	E	16	9,489.11	4,160.00	66,560	0.97	0.92	1.00	563,635,545.97	0.07	1.18
N-CO-LI-000106-E-XX-XX-XX-XX-02	Exterior HID replacement to 175W HID retrofit	PRE	E	12	8,106.18	301.50	3,618	0.97	0.92	1.00	26,172,446.72	0.00	0.04
N-CO-LI-000107-E-XX-XX-XX-XX-02	Exterior HID replacement above 175W to 250W HID retrofit	PRE	E	12	7,590.84	461.30	5,536	0.97	0.92	1.00	37,498,541.34	0.00	0.06
N-CO-LI-000108-E-XX-XX-XX-XX-01	Exterior HID replacement above 250W to 400W HID retrofit	PRE	E	12	14,296.87	795.60	9,547	0.97	0.92	1.00	121,808,183.09	0.02	0.19
[illegible]													

N-CO-MS-000417-E-XX-XX-XX-XX-01	No-Loss Condensate Drains	PRE	E	5	91.63	2,097.00	10,485	0.97	0.92	1.00	857,338.67	0.00	0.00
N-CO-MS-000444-E-XX-XX-XX-XX-01	3-phase High Frequency Battery Charger - 2 shifts	PRE	E	20	36.20	2,688.00	53,760	0.97	0.92	1.00	1,736,633.59	0.00	0.00
N-CO-MS-000458-E-XX-XX-XX-XX-01	Refrigeration Savings due to Lighting Savings -20F to 0F	PRE	E	12	30,670.52	1.79	21	0.97	0.92	1.00	587,915.53	0.00	0.00
N-CO-MS-000459-E-XX-XX-XX-XX-01	Refrigeration Savings due to Lighting Savings 0F to 20F	PRE	E	12	75,058.00	1.16	14	0.97	0.92	1.00	932,386.07	0.00	0.00
N-CO-MS-000460-E-XX-XX-XX-XX-01	Refrigeration Savings due to Lighting Savings 20F to 40F	PRE	E	12	208,575.26	0.76	9	0.97	0.92	1.00	1,697,528.96	0.00	0.00
N-CO-MS-000479-E-XX-XX-XX-XX-01	Computer Room Air Conditioner Economizer less than 65 MBH	PRE	E	15	691.89	331.00	4,965	0.97	0.92	1.00	3,065,608.00	0.00	0.01
N-CO-MS-000534-E-XX-XX-XX-XX-01	Compressed Air Storage Tank	PRE	E	25	1,891.61	422.76	10,569	0.97	0.92	1.00	17,841,109.19	0.00	0.06
N-CO-MS-000637-E-XX-XX-XX-XX-01	Injection Molding Machine - Full Electric (Servo Electric)	PRE	E	20	177.41	237.00	4,740	0.97	0.92	1.00	750,431.58	0.00	0.00
W-CO-BE-111580-E-DE-HS-VA-XX-01	Cool roof	PRE	E	20	1,199.72	41.76	835	0.97	0.92	1.00	894,191.48	0.00	0.00
W-CO-BE-112819-E-DE-LO-VA-XX-01	High Performance Glazing	PRE	E	20	28.28	531.90	10,638	0.97	0.92	1.00	268,470.30	0.00	0.00
W-CO-BE-117019-C-DE-HS-VW-XX-01	Window Film	PRE	E	10	51.00	57.64	576	0.97	0.92	1.00	26,238.01	0.00	0.00
W-CO-HV-110015-E-DE-FF-CG-XX-02	AC <65k SEER 14 - 1 Ph	PRE	E	15	317.87	269.15	4,037	0.97	0.92	1.00	1,145,239.14	0.00	0.00
W-CO-HV-110550-E-DE-LO-VA-XX-01	Air-Cooled Screw Chiller COP = 2.8, IPLV = 3.46	PRE	E	20	75.40	102.03	2,041	0.97	0.92	1.00	137,303.75	0.00	0.00
W-CO-HV-110556-E-DE-LO-EA-XX-01	Air-Cooled Screw Chiller COP = 2.8, IPLV = 3.64	PRE	E	20	252.81	140.65	2,813	0.97	0.92	1.00	634,609.29	0.00	0.00
W-CO-HV-110568-E-DE-LO-VA-XX-01	Air-Cooled Screw Chiller COP = 2.8, IPLV = 3.64	PRE	E	20	2,151.07	124.80	2,496	0.97	0.92	1.00	4,791,468.09	0.00	0.01
W-CO-HV-110586-E-DE-LO-VA-XX-01	Air-Cooled Screw Chiller COP = 2.8, IPLV = 4.75	PRE	E	20	884.60	280.10	5,602	0.97	0.92	1.00	4,422,350.48	0.00	0.01
W-CO-HV-110604-E-DE-LO-VA-XX-01	Air-Cooled Screw Chiller COP = 3.08, IPLV = 3.36	PRE	E	20	251.70	135.94	2,719	0.97	0.92	1.00	610,686.03	0.00	0.00
W-CO-HV-110640-E-DE-LO-VA-XX-01	Air-Cooled Screw Chiller COP = 3.08, IPLV = 4.00	PRE	E	20	821.62	249.56	4,991	0.97	0.92	1.00	3,659,546.42	0.00	0.01
W-CO-HV-110712-E-DE-LO-VA-XX-01	Air-Cooled Screw Chiller COP = 3.36, IPLV = 4.42	PRE	E	20	1,390.44	354.82	7,096	0.97	0.92	1.00	8,805,271.55	0.00	0.02
W-CO-HV-111182-E-DE-LO-NA-XX-01	Chiller Tuneup	PRE	E	5	382.35	200.89	1,004	0.97	0.92	1.00	342,726.46	0.00	0.00
W-CO-HV-111185-E-DE-LO-EW-XX-01	Chiller Tuneup	PRE	E	5	14,058.48	97.38	487	0.97	0.92	1.00	6,108,252.96	0.00	0.00
W-CO-HV-111301-E-DE-LO-VW-XX-01	CHW reset 5 deg	PRE	E	5	955.86	30.01	150	0.97	0.92	1.00	127,987.83	0.00	0.00
W-CO-HV-111301-E-DE-LO-VW-XX-01	CHW reset 5 deg	PRE	E	5	1,404.85	30.01	150	0.97	0.92	1.00	188,105.90	0.00	0.00
W-CO-HV-112054-E-DE-FS-CG-XX-01	Economizer	PRE	E	15	442.41	17.83	267	0.97	0.92	1.00	105,572.12	0.00	0.00
W-CO-HV-112089-E-DE-SO-CG-XX-01	Economizer	PRE	E	15	5.66	172.74	2,591	0.97	0.92	1.00	13,078.24	0.00	0.00
W-CO-HV-112123-E-DE-LO-EW-XX-01	Efficient Chilled Water Pump	PRE	E	15	1,529.38	829.17	12,438	0.97	0.92	1.00	16,975,080.65	0.00	0.03
W-CO-HV-112157-E-DE-LO-EA-XX-01	Efficient Hot Water Pump	PRE	E	15	195.15	517.39	7,761	0.97	0.92	1.00	1,351,565.47	0.00	0.00
W-CO-HV-113132-E-DE-AS-AS-XX-02	ASHP 65k - 135k EER 11.3 COP 3.4	PRE	E	15	8.71	71.94	1,079	0.97	0.92	1.00	8,389.93	0.00	0.00
W-CO-HV-113160-E-DE-PS-AS-XX-02	ASHP 65k - 135k EER 11.3 COP 3.4	PRE	E	15	18.85	63.94	959	0.97	0.92	1.00	16,133.56	0.00	0.00
W-CO-HV-113198-C-DE-LO-VW-XX-01	HVAC Occ Sensor	PRE	E	15	272.76	92.70	1,390	0.97	0.92	1.00	338,450.93	0.00	0.00
W-CO-HV-113901-E-DE-PS-GH-XX-01	PTAC	PRE	E	15	632.02	13.47	202	0.97	0.92	1.00	113,946.92	0.00	0.00
W-CO-HV-113950-E-DE-SO-GH-XX-01	PTAC-HP	PRE	E	15	379.21	62.07	931	0.97	0.92	1.00	315,069.03	0.00	0.00
W-CO-HV-113985-E-DE-AS-CG-XX-01	Refrigerant charging correction	PRE	E	2	374.77	96.60	193	0.97	0.92	1.00	64,615.82	0.00	0.00
W-CO-HV-114650-C-DE-LN-CG-XX-02	Setback/Setup	PRE	E	9	1,074.43	75.21	677	1.00	1.00	1.00	727,224.31	0.00	0.00
W-CO-HV-114664-C-DE-SO-CG-XX-02	Setback/Setup	PRE	E	9	1,097.71	-	-	1.00	1.00	1.00	-	-	-
W-CO-HV-114834-E-DE-LO-VW-XX-01	VFD Fan	PRE	E	10	333.70	1,183.13	11,831	0.97	0.92	1.00	3,523,319.92	0.00	0.00
W-CO-HV-114847-E-DE-HS-VA-XX-01	VFD Fan	PRE	E	10	14.41	628.80	6,288	0.97	0.92	1.00	80,884.74	0.00	0.00
W-CO-HV-114848-E-DE-HS-VW-XX-01	VFD Fan	PRE	E	10	3,387.38	605.09	6,051	0.97	0.92	1.00	18,291,197.51	0.00	0.02
W-CO-HV-114864-E-DE-LO-VA-XX-01	VFD Pump	PRE	E	10	95.02	3,799.05	37,991	0.97	0.92	1.00	3,221,466.09	0.00	0.00
W-CO-HV-114890-E-DE-HS-VA-XX-01	VFD Pump	PRE	E	10	1,147.04	1,509.99	15,100	0.97	0.92	1.00	15,456,486.93	0.00	0.02
W-CO-HV-115171-E-DE-LO-EW-XX-01	Water-Cooled cent Chiller > 300 ton 0.58 kW/ton with 0.35 kW/ton IPLV	PRE	E	20	599.86	155.79	3,116	0.97	0.92	1.00	1,667,981.86	0.00	0.00
W-CO-HV-115172-E-DE-LO-VW-XX-01	Water-Cooled cent Chiller > 300 ton 0.58 kW/ton with 0.35 kW/ton IPLV	PRE	E	20	3,614.18	135.65	2,713	0.97	0.92	1.00	8,750,264.03	0.00	0.02
W-CO-HV-115193-E-DE-LO-VW-XX-01	Water-Cooled cent Chiller > 300 ton 0.58 kW/ton with 0.41 kW/ton IPLV	PRE	E	20	1,391.54	98.25	1,965	0.97	0.92	1.00	2,440,217.31	0.00	0.01
W-CO-HV-115466-E-DE-LO-VW-XX-01	Water-Cooled cent Chiller 150 - 300 ton 0.63 kW/ton with 0.38 kW/ton IPLV	PRE	E	20	506.62	143.63	2,873	0.97	0.92	1.00	1,298,753.85	0.00	0.00
W-CO-HV-118468-E-DE-AS-CG-XX-01	DX Condenser Coil Cleaning	PRE	E	3	467.91	20.30	61	0.97	0.92	1.00	25,429.78	0.00	0.00
W-CO-HV-118644-E-DE-PS-AS-XX-02	ASHP <65k SEER 15 HSPF 8.5 - 1 Ph	PRE	E	15	88.70	253.35	3,800	0.97	0.92	1.00	300,825.65	0.00	0.00
W-CO-KR-110733-E-DE-GR-XX-XX-01	Anti Sweat Heater Control	PRE	E	12	4,301.95	1,858.44	22,301	0.97	0.92	1.00	85,616,044.56	0.01	0.13
W-CO-KR-110734-E-LA-GR-XX-XX-01	Anti Sweat Heater Control	PRE	E	12	65.61	1,770.77	21,249	0.97	0.92	1.00	1,244,143.60	0.00	0.00
W-CO-KR-110736-E-SA-GR-XX-XX-01	Anti Sweat Heater Control	PRE	E	12	23.76	1,827.67	21,932	0.97	0.92	1.00	464,940.33	0.00	0.00
W-CO-KR-112145-E-DE-GR-XX-XX-01	Efficient Condenser	PRE	E	15	246.15	1,260.53	18,908	0.97	0.92	1.00	4,153,453.26	0.00	0.01
W-CO-KR-112411-E-DE-GR-XX-XX-01	Floating Head Pressure Control	PRE	E	16	333.70	1,705.83	27,293	0.97	0.92	1.00	8,127,876.33	0.00	0.02
W-CO-KR-113608-E-DE-GR-XX-XX-01	Night Covers	PRE	E	5	12,234.50	15.63	78	0.97	0.92	1.00	853,483.81	0.00	0.00
W-CO-KR-113611-E-SA-GR-XX-XX-01	Night Covers	PRE	E	5	1,408.18	16.18	81	0.97	0.92	1.00	101,633.88	0.00	0.00
W-CO-HV-100001-E-WR-WR-WR-WR-03	AC <65k SEER 14 - 3 Ph	PRE	E	15	214.93	236.02	3,540	0.97	0.92	1.00	679,035.68	0.00	0.00
W-CO-HV-100273-E-WR-WR-WR-WR-02	AC >760k EER 10.2	PRE	E	15	612.06	21.90	328	0.97	0.92	1.00	179,403.78	0.00	0.00
W-CO-HV-100003-E-WR-WR-WR-WR-03	AC 135k - 240k EER 12	PRE	E	15	668.61	31.33	470	0.97	0.92	1.00	280,436.65	0.00	0.00
W-CO-HV-100004-E-WR-WR-WR-WR-03	AC 240k - 760k EER 10.3	PRE	E	15	660.84	16.57	248	0.97	0.92	1.00	146,535.53	0.00	0.00
W-CO-HV-100005-E-WR-WR-WR-WR-03	AC 65k - 135k EER 12	PRE	E	15	1,138.74	31.16	467	0.97	0.92	1.00	474,914.65	0.00	0.00
W-CO-HV-100231-C-WR-WR-WR-WR-01	Web enabled EMS with Electric Heat	PRE	E	15	2,867.59	7,323.43	109,851	0.97	0.92	1.00	281,114,190.10	0.04	0.55
N-CO-KR-000345-E-XX-XX-XX-XX-01	Steam Cookers (6 Pan, Electric)	PRE	E	12	1.11	15,170.00	182,040	0.97	0.92	1.00	180,127.33	0.00	0.00
N-CO-KR-000347-E-XX-XX-XX-XX-01	ENERGY STAR® Hot Holding Cabinets (Half Size)	PRE	E	12	12.20	1,788.00	21,456	0.97	0.92	1.00	233,536.21	0.00	0.00
N-CO-KR-000349-E-XX-XX-XX-XX-01	ENERGY STAR® Hot Holding Cabinets (Full Size)	PRE	E	12	1.11	5,278.00	63,336	0.97	0.92	1.00	62,670.54	0.00	0.00
N-CO-LI-000096-E-XX-XX-XX-XX-01	LED High Bay (per kW saved base) (2)	PRE	E	16	1,911.73	4,160.00	66,560	0.97	0.92	1.00	113,553,095.03	0.01	0.24
N-CO-LI-000106-E-XX-XX-XX-XX-02	Exterior HID replacement to 175W HID retrofit (2)	PRE	E	12	1,911.73	301.50	3,618	0.97	0.92	1.00	6,172,402.31	0.00	0.01
N-CO-LI-000107-E-XX-XX-XX-XX-02	Exterior HID replacement above 175W to 250W HID retrofit (2)	PRE	E	12	1,433.23	461.30	5,536	0.97	0.92	1.00	7,080,114.38	0.00	0.01
N-CO-LI-000108-E-XX-XX-XX-XX-01	Exterior HID replacement above 250W to 400W HID retrofit (2)	PRE	E	12	4,780.45	795.60	9,547	0.97	0.92	1.00	40,729,067.91	0.01	0.06
N-CO-LI-000114-E-XX-XX-XX-XX-01	Garage HID replacement to 175W HID retrofit (2)	PRE	E	12	955.86	611.00	7,332	0.97	0.92	1.00	6,254,291.56	0.00	0.01
N-CO-LI-000115-E-XX-XX-XX-XX-01	Garage HID replacement above 175W to 250W HID retrofit (2)	PRE	E	12	31.67	936.00	11,232	0.97	0.92	1.00	317,478.33	0.00	0.00
N-CO-LI-000116-E-XX-XX-XX-XX-01	Garage HID replacement above 250W to 400W HID retrofit (2)	PRE	E	12	31.67	1,614.00	19,368	0.97	0.92	1.00	547,446.60	0.00	0.00
N-CO-LI-000149-E-XX-XX-XX-XX-02	LED Refrigerator Case Lighting (2)	PRE	E	16	1,911.73	460.00	7,360	0.97	0.92	1.00	12,556,351.85	0.00	0.03
N-CO-MP-000264-E-XX-XX-XX-XX-01	VFD HP 30 Process Pumping	PRE	E	15	76.92	1,082.15	16,232	0.97	0.92	1.00	1,114,264.94	0.00	0.00
N-CO-MS-000214-E-XX-XX-XX-XX-01	High Efficiency CRAC unit 65 MBH - 240 MBH	PRE	E	15	1,852.91	159.00	2,385	0.97	0.92	1.00	3,943,676.10	0.00	0.01
N-CO-MS-000419-E-XX-XX-XX-XX-01	Variable Displacement AC	PRE	E	13	126.40	442.00	5,746	0.97	0.92	1.00	648,161.53	0.00	0.00
N-CO-MS-000442-E-XX-XX-XX-XX-01	High Efficiency Welders	PRE	E	20	22.18	761.00	15,220	0.97	0.92	1.00	301,201.71	0.00	0.00
N-CO-MS-000445-E-XX-XX-XX-XX-01	3 Phase HP Battery Charger - 3 Shifts	PRE	E	20	3.33	3,638.00	72,760	0.97	0.92	1.00	215,986.56	0.00	0.00
W-CO-HV-110658-E-DE-LO-VA-XX-01	Air-Cooled Screw Chiller COP = 3.08, IPLV = 5.22	PRE	E	20	192.93	390.94	7,819	0.97	0.92	1.00	1,346,160.70	0.00	0.00
W-CO-HV-100053-E-WR-WR-WR-WR-03	HP >240,000 Btuh (20 tons)	PRE	E	15	302.70	19.24	289	0.97	0.92	1.00	77,971.60	0.00	0.00
W-CO-HV-115464-E-DE-LO-NW-XX-01	Water-Cooled cent Chiller 150 - 300 ton 0.63 kW/ton with 0.38 kW/ton IPLV (2)	PRE	E	20	290.51	228.78	4,576	0.97	0.92	1.00	1,186,192.16	0.00	0.00
W-CO-HV-100161-E-WR-WR-WR-WR-01	WLHP <=17,000 Btuh (1.4 tons)	PRE	E	15	3.33	31.66	475	0.97	0.92	1.00	1,409.84	0.00	0.00
W-CO-HV-100162-E-WR-WR-WR-WR-01	WLHP 17,001 Btuh (1.4 tons) -65,000 Btuh (5.4 tons)	PRE	E	15	41.03	26.81	402	0.97	0.92	1.00	14,725.48	0.00	0.00
W-CO-HV-100163-E-WR-WR-WR-WR-01	WLHP 65,001 Btuh (5.4 tons) - 135,000 Btuh (11.3 tons)	PRE	E	15	6.65	26.81	402	0.97	0.92	1.00	2,387.92	0.00	0.00
	NP Custom - Electric CUSTOM E	NONPRE	E	$ 15.00	151,756,212.6	1.1	16	1.00	0.92	1.00	2,276,343,189.0	0.3	4.5
	NP RFP - Electric General E	NONPRE	E	$ 12.00	8,852,445.7	1.1	13	1.00	0.92	1.00	106,229,348.8	0.0	0.2
	Retro Commissioning	EMER	E	$ 1.00	6,982,985.1	1.1	1	1.00	0.92	1.00	6,982,985.1	0.0	0.0
	A-Line <19W	EMER	E	$ 15.00	23,038.44	58.05	871	1.00	0.92	1.00	18,455,863.90	0.00	0.04
	A-Line >19W	EMER	E	$ 15.00	-	85.40	1,281	1.00	0.92	1.00	-	-	-
	LED Candelabra	EMER	E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	LED Globe	EMER	E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	LED MR16	EMER	E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	BR30	EMER	E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	BR40	EMER	E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	LED Retrofit kit, less than 20W	EMER	E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	LED Retrofit kit, greater than 25W	EMER	E	$ 15.00	5,696.33	141.50	2,123	1.00	0.92	1.00	11,123,223.59	0.00	0.02
	PAR20	EMER	E	$ 15.00	15,894.58	145.50	2,183	1.00	0.92	1.00	31,914,727.18	0.00	0.06
	PAR30	EMER	E	$ 15.00	2,579.79	145.50	2,183	1.00	0.92	1.00	5,179,960.34	0.00	0.01
	PAR38	EMER	E	$ 15.00	5,448.86	145.50	2,183	1.00	0.92	1.00	10,940,765.99	0.00	0.02
	R20	EMER	E	$ 15.00	928.86	78.75	1,181	1.00	0.92	1.00	1,009,438.61	0.00	0.00
	R30	EMER	E	$ 15.00	-	78.75	1,181	1.00	0.92	1.00	-	-	-
	R40	EMER	E	$ 15.00	-	78.75	1,181	1.00	0.92	1.00	-	-	-
	LED T8, 2ft	EMER	E	$ 15.00	1,353.74	23.00	345	1.00	0.92	1.00	429,677.08	0.00	0.00
	LED T8, 4ft	EMER	E	$ 15.00	118,622.88	33.40	501	1.00	0.92	1.00	54,675,657.85	0.01	0.11
	Wall Mounted Floods - 175W Equiv	EMER	E	$ 15.00	181.93	461.30	6,920	1.00	0.92	1.00	1,158,155.46	0.00	0.00
	Wall Mounted Floods - 250W Equiv	EMER	E	$ 15.00	103.96	795.60	11,934	1.00	0.92	1.00	1,141,405.95	0.00	0.00
	Wall Mounted Floods - 400W Equiv	EMER	E	$ 15.00	180.80	795.60	11,934	1.00	0.92	1.00	1,985,053.82	0.00	0.00
	Exterior Wall Packs - 175W Equiv	EMER	E	$ 15.00	838.46	461.30	6,920	1.00	0.92	1.00	5,337,586.05	0.00	0.01
	Exterior Wall Packs - 250W Equiv	EMER	E	$ 15.00	528.84	795.60	11,934	1.00	0.92	1.00	5,806,282.44	0.00	0.01
	Exterior Wall Packs - 400W Equiv	EMER	E	$ 15.00	25.99	795.60	11,934	1.00	0.92	1.00	285,351.49	0.00	0.00
	Ceiling Mount Occupancy Sensor	EMER	E	$ 15.00	1,970.72	720.60	10,809	1.00	0.92	1.00	19,597,391.48	0.00	0.04
	Wall Mount Occupancy Sensor	EMER	E	$ 15.00	1,137.91	288.25	4,324	1.00	0.92	1.00	4,526,435.29	0.00	0.01
N-CO-LI-000140-E-XX-XX-XX-XX-03	LED Candelabra	EMER	E	$ 9.00	10,796.26	75.40	679	0.75	0.92	1.00	5,055,174.69	0.00	0.01
N-CO-LI-000145-E-XX-XX-XX-XX-01	LED Exit Signs Electronic Fixtures (Retrofit Only)	EMER	E	$ 15.00	730.21	201.00	3,015	0.75	0.92	1.00	1,519,094.04	0.00	0.00
N-CO-LI-000139-E-XX-XX-XX-XX-03	LED lamp PAR	EMER	E	$ 9.00	5,788.88	145.50	1,310	0.75	0.92	1.00	5,230,573.19	0.00	0.01
N-CO-LI-000142-E-XX-XX-XX-XX-03	LED Replacing A-line 50-80W (60W Equivalent)	EMER	E	$ 9.00	16,696.78	98.80	889	0.75	0.92	1.00	10,244,277.75	0.00	0.01
N-CO-LI-000142-E-XX-XX-XX-XX-03	LED Replacing A-line 50-80W (75W Equivalent)	EMER	E	$ 9.00	5,370.37	98.80	889	0.75	0.92	1.00	3,294,981.95	0.00	0.00
N-CO-LI-000144-E-XX-XX-XX-XX-03	LED Replacing Reflectors (average values)	EMER	E	$ 9.00	14,162.17	145.50	1,310	0.75	0.92	1.00	12,796,296.71	0.00	0.02
N-CO-WH-000171-E-XX-XX-XX-XX-02	Low Flow Faucet Aerator - Private Restroom - 1.0 gpm	EMER	E	$ 10.00	146.34	165.18	1,652	0.57	0.92	1.00	126,763.48	0.00	0.00
N-CO-WH-000170-E-XX-XX-XX-XX-02	Low Flow Faucet Aerator - Public Restroom - 1.0 gpm	EMER	E	$ 10.00	156.90	1,238.85	12,388	0.57	0.92	1.00	1,019,335.22	0.00	0.00
N-CO-LI-000143-E-XX-XX-XX-XX-03	LED Replacing A-line 80-100W	EMER	E	$ 9.00	7,082.87	160.10	1,441	0.75	0.92	1.00	7,041,933.39	0.00	0.01
N-CO-LI-000141-E-XX-XX-XX-XX-03	LED Globe	EMER	E	$ 9.00	1,854.19	85.70	771	0.75	0.92	1.00	986,795.58	0.00	0.00
N-CO-LI-000075-E-XX-XX-XX-XX-03	Occupancy Sensors under 500 W	EMER	E	$ 10.00	887.12	288.25	2,883	0.21	0.92	1.00	494,033.79	0.00	0.00
N-CO-WH-000199-E-XX-XX-XX-XX-01	Pipe Wrap - DWH 140F - Unconditioned - elec water heater	EMER	E	$ 20.00	316.83	90.39	1,808	0.21	0.92	1.00	110,657.20	0.00	0.00
N-CO-KR-000362-E-XX-XX-XX-XX-01	Pre Rinse Sprayers	EMER	E	$ 5.00	19.67	1,396.00	6,980	0.21	0.92	1.00	26,525.03	0.00	0.00
W-CO-HV-100064-C-WR-WR-WR-WR-02	Setback/Setup	EMER	E	$ 9.00	-	-	-	1.00	1.00	1.00	-	-	-
Custom	Labor - Electric	EMER	E	$ -	885.00	-	-	0.00	0.00	1.00	-	-	-
N-CO-LI-000126-E-XX-XX-XX-XX-03	CFL Screw in - 9W	ES	E	$ 2.00	-	53.40	107	0.91	0.82	1.00	-	-	-
N-CO-LI-000127-E-XX-XX-XX-XX-03	CFL Screw in - 14W	ES	E	$ 2.00	-	76.10	152	0.91	0.82	1.00	-	-	-
N-CO-LI-000128-E-XX-XX-XX-XX-03	CFL Screw in - 20W	ES	E	$ 2.00	-	88.10	176	0.91	0.82	1.00	-	-	-
N-CO-LI-000129-E-XX-XX-XX-XX-03	CFL Screw in - 26W	ES	E	$ 2.00	-	121.40	243	0.91	0.82	1.00	-	-	-
N-CO-LI-000497-E-XX-XX-XX-XX-02	LED Replacing A-line 40W Equivalent	ES	E	$ 9.00	14,870.18	8.00	72	0.81	0.92	1.00	797,850.51	0.00	0.00
N-CO-LI-000142-E-XX-XX-XX-XX-03	LED Replacing A-line 50-80W	ES	E	$ 9.00	100,652.07	98.80	889	0.81	0.92	1.00	66,695,269.53	0.01	0.08
N-CO-LI-000143-E-XX-XX-XX-XX-03	LED Replacing A-line 80-100W	ES	E	$ 9.00	2,989.13	160.10	1,441	0.81	0.92	1.00	3,209,604.55	0.00	0.00
	Self Direct	SD	E	$ 1.00	6,982,985.14	1.00	1	1.00	1.00	1.00	6,982,985.14	0.00	0.00
N-MF-LI-020001-E-XX-XX-XX-XX-02	CFL Screw in	MFR	E	$ 2.00	744.00	148.00	296	1.00	0.92	1.00	202,606.08	0.00	0.00
N-MF-LI-020006-E-XX-XX-XX-XX-03	LED Candelabra - 12/7	MFR	E	$ 9.00	558.00	124.00	1,116	1.00	0.92	1.00	572,909.76	0.00	0.00
N-CO-LI-000112-E-XX-XX-XX-XX-01	Exterior HID replacement LED/Induction	MFR	E	$ 16.00	307,644.00	4.32	69	1.00	0.92	1.00	19,558,676.50	0.00	0.04
N-CO-LI-000573-E-XX-XX-XX-XX-01	Interior Non Highbay/Lowbay LED Fixtures	MFR	E	$ 18.00	223,200.00	2.67	48	1.00	0.92	1.00	9,865,136.45	0.00	0.02
N-CO-LI-000145-E-XX-XX-XX-XX-01	LED Exit Signs Electronic Fixtures (Retrofit Only)	MFR	E	$ 15.00	117.80	201.00	3,015	1.00	0.92	1.00	326,753.64	0.00	0.00
N-CO-LI-000142-E-XX-XX-XX-XX-03	LED Replacing A-line 50-80W	MFR	E	$ 9.00	768.80	98.80	889	1.00	0.92	1.00	628,927.60	0.00	0.00
N-CO-LI-000143-E-XX-XX-XX-XX-03	LED Replacing A-line 80-100W	MFR	E	$ 9.00	396.80	160.10	1,441	1.00	0.92	1.00	526,009.19	0.00	0.00
N-CO-LI-000139-E-XX-XX-XX-XX-03	LED lamp PAR	MFR	E	$ 9.00	1,309.14	145.50	1,310	1.00	0.92	1.00	1,577,176.82	0.00	0.00
N-MF-LI-020152-E-XX-XX-XX-XX-01	LED A-Style Exterior-DTE MFCA 17	MFR	E	$ 11.00	1,178.00	165.30	1,818	1.00	0.92	1.00	1,970,600.81	0.00	0.00
N-CO-LI-000498-E-XX-XX-XX-XX-02	LED Replacing A-line 14W CFL-DTE MFCA 17	MFR	E	$ 9.00	421.60	12.00	108	1.00	0.92	1.00	41,890.18	0.00	0.00
N-CO-LI-000138-E-XX-XX-XX-XX-03	LED Lamp MR16-DTE MFCA 17	MFR	E	$ 9.00	496.00	38.10	343	1.00	0.92	1.00	156,472.13	0.00	0.00
	Custom Electric	MFR	E	$ 9.00	148,800.00	1.00	9	1.00	0.92	1.00	1,232,064.00	0.00	0.00
W-MF-HV-300089-E-WR-WR-WR-WR-01	PTHP - In Unit	MFR	E	$ 15.00	59.52	360.60	5,409	1.00	0.92	1.00	296,186.89	0.00	0.00

MPSC Case No.: U-18419
Respondent: K. L. Bilyeu
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-1.3bi
Page: 1 of 1

Question: On p. 23, lines 6-8 of her testimony, Ms. Dimitry states that the 1.5% annual energy efficiency savings level had "the greatest demand reduction while simultaneously being administered within a budget that is consistent with previous levels and it achieves the highest benefit to cost ratio."

b. With respect to the benefit cost ratio of the 1.5% EE selected and 2.0% EE not selected:

   i. Please provide the NPV of benefits, NPV of costs, NPV of net benefits and benefit-cost ratio for each.

Answer: Please refer to the attachments identified below:

"U-18419-MECNRDCSCDE-1.3bi-DSMore Analysis - Group=All 1.5 Percent.xlsx"
"U-18419-MECNRDCSCDE-1.3bi-DSMore Analysis - Group=All 2 Percent.xlsx"

Cost / Benefit Tests For Normal Weather

	Cost Based	Market-Based Minimum	Market-Based Today	Market-Based Alternate	Market-Based Option	Market-Based Maximum
Utility (PAC) Test	5.30	5.51	8.13	7.68	8.02	15.46
TRC Test	5.30	5.51	8.13	7.68	8.02	15.46
RIM Test	0.56	0.59	0.86	0.81	0.85	1.61
RIM (Net Fuel)	0.56	0.59	0.86	0.81	0.85	1.61
Societal Test	7.57	7.86	11.61	10.97	11.45	22.11
Participant Test	65535	65535	65535	65535	65535	65535

Cost of Conserved kWh, kW, and CCF

100% Allocation	Nominal	Levelized	% Allocation
Total Costs / kW Savings	$42.2966	$63.1284	100.00%
Total Cost / kWh Savings	$0.0068	$0.0101	100.00%
Total Costs / CCF Savings	$0.0000	$0.0000	100.00%
Allocated By Cost-Based Avoided Costs	$0.0000	$0.0000	
Allocated Costs / kW Savings	$8.7860	$13.1132	20.77%
Allocated Costs / kWh Savings	$0.0054	$0.0080	79.23%
Allocated Costs / CCF Savings	$0.0000	$0.0000	0.00%

Present Values (PVs) of Costs and Benefits Per Test

	Cost Based	Market-Based Minimum	Market-Based Today	Market-Based Alternate	Market-Based Option	Market-Based Maximum
Utility (PAC) Test						
Avoided Electric Production	$2,332,795,072.95	$2,228,994,160.93	$3,867,930,230.53	$3,575,822,610.38	$3,793,526,890.71	$8,574,214,518.87
Avoided Electric Production Adders	$0.00	$1,010,848,851.98	$1,754,106,359.54	$1,621,635,553.81	$1,720,364,444.94	$3,888,406,284.31
Avoided Electric Capacity	$611,625,178.02	$0.00	$0.00	$0.00	$0.00	$0.00
Avoided T&D Electric	$1,410,636,080.03	$1,410,636,080.03	$1,410,636,080.03	$1,410,636,080.03	$1,410,636,080.03	$1,410,636,080.03
Avoided Ancillary	$651,340,380.03	$556,503,936.56	$651,340,380.03	$651,340,380.03	$651,340,380.03	$736,311,848.76
Avoided Gas Production	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Avoided Gas Capacity	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$5,006,396,711.03	$5,206,983,029.50	$7,684,013,050.14	$7,259,434,624.25	$7,575,867,795.71	$14,609,568,731.97
Administration Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Implementation / Participation Costs	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75
Other / Miscellaneous Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Incentives	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75
Reduced Arrears	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Test Results	5.30	5.51	8.13	7.68	8.02	15.46
TRC Test						
Avoided Electric Production	$2,332,795,072.95	$2,228,994,160.93	$3,867,930,230.53	$3,575,822,610.38	$3,793,526,890.71	$8,574,214,518.87
Avoided Electric Production Adders	$0.00	$1,010,848,851.98	$1,754,106,359.54	$1,621,635,553.81	$1,720,364,444.94	$3,888,406,284.31
Avoided Electric Capacity	$611,625,178.02	$0.00	$0.00	$0.00	$0.00	$0.00
Avoided T&D Electric	$1,410,636,080.03	$1,410,636,080.03	$1,410,636,080.03	$1,410,636,080.03	$1,410,636,080.03	$1,410,636,080.03
Avoided Ancillary	$651,340,380.03	$556,503,936.56	$651,340,380.03	$651,340,380.03	$651,340,380.03	$736,311,848.76
Avoided Gas Production	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Avoided Gas Capacity	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$5,006,396,711.03	$5,206,983,029.50	$7,684,013,050.14	$7,259,434,624.25	$7,575,867,795.71	$14,609,568,731.97
Administration Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Implementation / Participation Costs	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75
Other / Miscellaneous Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75
Reduced Arrears	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Participant Costs (net)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Participant Tax Credits (net)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Environmental Benefits	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Other Benefits	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Test Results	5.30	5.51	8.13	7.68	8.02	15.46
RIM Test						
Avoided Electric Production	$2,332,795,072.95	$2,228,994,160.93	$3,867,930,230.53	$3,575,822,610.38	$3,793,526,890.71	$8,574,214,518.87
Avoided Electric Production Adders	$0.00	$1,010,848,851.98	$1,754,106,359.54	$1,621,635,553.81	$1,720,364,444.94	$3,888,406,284.31
Avoided Electric Capacity	$611,625,178.02	$0.00	$0.00	$0.00	$0.00	$0.00
Avoided T&D Electric	$1,410,636,080.03	$1,410,636,080.03	$1,410,636,080.03	$1,410,636,080.03	$1,410,636,080.03	$1,410,636,080.03
Avoided Ancillary	$651,340,380.03	$556,503,936.56	$651,340,380.03	$651,340,380.03	$651,340,380.03	$736,311,848.76
Avoided Gas Production	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Avoided Gas Capacity	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$5,006,396,711.03	$5,206,983,029.50	$7,684,013,050.14	$7,259,434,624.25	$7,575,867,795.71	$14,609,568,731.97
Administration Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Implementation / Participation Costs	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75
Other / Miscellaneous Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Incentives	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75	$945,046,779.75
Reduced Arrears	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Lost Revenue (Electric)	$7,963,286,609.71	$7,821,574,432.80	$7,963,286,609.71	$7,963,286,609.71	$7,963,286,609.71	$8,111,769,546.06
Lost Revenue (Gas)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$7,963,286,609.71	$7,821,574,432.80	$7,963,286,609.71	$7,963,286,609.71	$7,963,286,609.71	$8,111,769,546.06
Net Fuel Lost Revenue (Electric)	$7,963,286,609.71	$7,821,574,432.79	$7,963,286,609.71	$7,963,286,609.71	$7,963,286,609.71	$8,111,769,546.03
Net Fuel Lost Revenue (Gas)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$7,963,286,609.71	$7,821,574,432.79	$7,963,286,609.71	$7,963,286,609.71	$7,963,286,609.71	$8,111,769,546.03
Test Results	0.56	0.59	0.86	0.81	0.85	1.61
Societal Test	0.56	0.59	0.86	0.81	0.85	1.61
Avoided Electric Production	$4,785,869,527.28	$4,575,249,819.77	$7,929,899,215.20	$7,331,585,428.94	$7,777,244,492.43	$17,565,417,959.75
Avoided Electric Production Adders	$0.00	$2,074,875,793.26	$3,596,209,294.10	$3,324,873,992.03	$3,526,980,377.32	$7,965,917,044.75
Avoided Electric Capacity	$1,285,690,944.21	$0.00	$0.00	$0.00	$0.00	$0.00
Avoided T&D Electric	$2,861,629,468.06	$2,861,629,468.06	$2,861,629,468.06	$2,861,629,468.06	$2,861,629,468.06	$2,861,629,468.06
Avoided Ancillary	$1,292,143,214.48	$1,105,727,212.60	$1,292,143,214.48	$1,292,143,214.48	$1,292,143,214.48	$1,458,308,626.25
Avoided Gas Production	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Avoided Gas Capacity	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$10,225,333,154.03	$10,617,482,293.69	$15,679,881,191.84	$14,810,232,103.51	$15,457,997,552.28	$29,851,273,098.80
Administration Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Implementation / Participation Costs	$1,350,327,596.78	$1,350,327,596.78	$1,350,327,596.78	$1,350,327,596.78	$1,350,327,596.78	$1,350,327,596.78
Other / Miscellaneous Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$1,350,327,596.78	$1,350,327,596.78	$1,350,327,596.78	$1,350,327,596.78	$1,350,327,596.78	$1,350,327,596.78
Reduced Arrears	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Participant Costs (net)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Environmental Benefits	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Other Benefits	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Test Results	7.57	7.86	11.61	10.97	11.45	22.11
Participant Test						
Incentives	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Participant Costs (gross)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Participant Tax Credits (gross)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Participant Bill Savings (Electric) (gross)	$3,649,169,168.94	$3,585,921,041.81	$3,649,169,168.94	$3,649,169,168.94	$3,649,169,168.94	$3,716,263,314.16
Participant Bill Savings (Gas) (gross)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$3,649,169,168.94	$3,585,921,041.81	$3,649,169,168.94	$3,649,169,168.94	$3,649,169,168.94	$3,716,263,314.16
Test Results	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

	Cost Based	Market-Based Minimum	Market-Based Today	Market-Based Alternate	Market-Based Option	Market-Based Maximum
Utility (PAC/UTC) Test						
Net Benefits	$4,061,349,931.28	$4,261,936,249.75	$6,738,966,270.39	$6,314,387,844.50	$6,630,821,015.96	$13,664,521,952.22
Levelized Cost (kW)	$63.1284	$63.1284	$63.1284	$63.1284	$63.1284	$63.1284
Levelized Cost (kWh)	$0.0101	$0.0101	$0.0101	$0.0101	$0.0101	$0.0100
Levelized Cost (CCF)	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000
TRC Test						
Net Benefits	$4,061,349,931.28	$4,261,936,249.75	$6,738,966,270.39	$6,314,387,844.50	$6,630,821,015.96	$13,664,521,952.22
Levelized Cost (kW)	$63.1284	$63.1284	$63.1284	$63.1284	$63.1284	$63.1284
Levelized Cost (kWh)	$0.0101	$0.0101	$0.0101	$0.0101	$0.0101	$0.0100
Levelized Cost (CCF)	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000
RIM Test						
Net Benefits	-$3,901,936,678.43	-$3,559,638,183.04	-$1,224,320,339.33	-$1,648,898,765.21	-$1,332,465,593.76	$5,552,752,406.16
Net Benefits (Net Fuel)	-$3,901,936,678.43	-$3,559,638,183.04	-$1,224,320,339.32	-$1,648,898,765.21	-$1,332,465,593.75	$5,552,752,406.19
Societal Test						
Net Benefits	$8,875,005,557.25	$9,267,154,696.91	$14,329,553,595.05	$13,459,904,506.72	$14,107,669,955.50	$28,500,945,502.02
Levelized Cost (kW)	$90.2008	$90.2008	$90.2008	$90.2008	$90.2008	$90.2008
Levelized Cost (kWh)	$0.0144	$0.0145	$0.0144	$0.0144	$0.0144	$0.0143
Levelized Cost (CCF)	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000
Participant Test						
Net Benefits	$3,649,169,168.94	$3,585,921,041.81	$3,649,169,168.94	$3,649,169,168.94	$3,649,169,168.94	$3,716,263,314.16

Present Values (PVs) of Impacts

	Cost Based	Market-Based Minimum	Market-Based Today	Market-Based Alternate	Market-Based Option	Market-Based Maximum
kW (Discounted)	14970243.1459	14970243.1459	14970243.1459	14970243.1459	14970243.1459	14970243.1459
kWh (Discounted)	93839366022.4855	93298410087.2594	93839366022.4855	93839366022.4855	93839366022.4855	94727119454.1154
CCF (Discounted)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
kW (Undiscounted)	22343347.5893	22343347.5893	22343347.5893	22343347.5893	22343347.5893	22343347.5893
kWh (Undiscounted)	139474308622.9580	138671599749.7710	139474308622.9580	139474308622.9580	139474308622.9580	140788967798.6340
CCF (Undiscounted)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-7.7ai-aiii
Page: 1 of 1

Question: Refer to your response to MECNRDCSCDE-4.9ci to ciii which ask about the "manual adjustments" DTE made to develop its load forecasts.

a. State whether DTE retained any forecast that did not incorporate the final set of manual adjustments it made. If so:

   i. Produce those forecasts.
   ii. Identify each of the specific manual adjustments made to those forecasts to achieve the final forecast used.
   iii. Explain the basis for the manual adjustments made to those forecasts to achieve the final forecast used.

Answer: DTE did not retain any intermediate steps in the forecasting process, only final models inclusive of all model changes. Therefore, individual changes made to the forecast, whether manual or otherwise, are not available.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-7.7bi-iii
Page: 1 of 1

Question: Refer to your response to MECNRDCSCDE-4.9ci to ciii which ask about the "manual adjustments" DTE made to develop its load forecasts.

b. With regards to each of the High Load Sensitivity, Low Load Sensitivity, and 2017 Reference Case, and for each of the Residential, Commercial & Industrial, and Other sectors:

   i. Identify each of the manual adjustments made to those forecasts to develop the final forecast, and the size in GWhs of each such adjustment.
   ii. Explain the basis for each such manual adjustment.
   iii. Identify and produce any analysis supporting each such manual adjustment.

Answer: With regards to the High Load Sensitivity, Low Load Sensitivity and 2017 Reference Case, DTE did not retain any intermediate steps in the forecasting process, only final models inclusive of all model changes. Therefore, individual changes made to the forecast, whether manual or otherwise, are not available.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-7.7ci
Page: 1 of 1

Question: Refer to your response to MECNRDCSCDE-4.9ci to ciii which ask about the "manual adjustments" DTE made to develop its load forecasts.

c. With respect to DTE's commercial and industrial regression-based forecasts for the Reference Scenario:

i. Please identify all of the variables analyzed or used in the regression analysis.

Answer: The variables used in the regression analysis are:

- Detroit Vehicle Production
- Auto Energy Efficiency
- U.S. Vehicle Production less Transplant Production
- Michigan Manufacturing Employment
- Michigan Gross Product Chemical
- Chemical Plant Closings
- Michigan Gross Product Rubber & Plastics
- Rubber & Plastics Plant Closings
- Total Michigan Index of Industrial Production
- Population
- Population 45 & Up
- Education & Health Employment
- Elementary & Secondary Employment
- Government Employment

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-7.7cii-iv
Page: 1 of 1

Question: Refer to your response to MECNRDCSCDE-4.9ci to ciii which ask about the "manual adjustments" DTE made to develop its load forecasts.

c. With respect to DTE's commercial and industrial regression-based forecasts for the Reference Scenario:

ii. Please describe how the Company determined that manual adjustments were needed.
iii. Please explain the nature of the adjustments that were made.
iv. Was any analysis conducted to support any manual adjustments made? If so, please provide such analyses with an explanation of what they represent and how they were conducted.

Answer: DTE did not retain any intermediate steps in the forecasting process, only final models inclusive of all model changes. Therefore, individual changes made to the forecast, whether manual or otherwise, are not available.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-7.7di-iv
Page: 1 of 1

Question: Refer to your response to MECNRDCSCDE-4.9ci to ciii which ask about the "manual adjustments" DTE made to develop its load forecasts.

d. With respect to DTE's residential end use forecast for the Reference Scenario:

i. Were manual adjustments made to the end use forecast to produce the final forecast used in the reference scenario?
ii. Please describe how the Company determined that manual adjustments were needed.
iii. Please explain the nature of the adjustments that were made.
iv. Was any analysis conducted to support any manual adjustments made? If so, please provide such analyses with an explanation of what they represent and how they were conducted.

Answer: DTE did not retain any intermediate steps in the forecasting process, only final models inclusive of all model changes. Therefore, individual changes made to the forecast, whether manual or otherwise, are not available.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-11.5a-e
Page: 1 of 1

Question: In MECNRDCSCDE-7.10a, DTE states that certain "hard-wired reference values" used in the residential end-use forecast for this case were developed in or for previous forecasts and that documentation of the sources for those assumptions is not available.

a. For what previous forecasts were those assumptions developed?
b. Who developed them?
c. When were they developed?
d. Why is documentation of the sources of those assumptions not available?
e. If the sources of those assumptions are not available, why does DTE have confidence that its residential end-use forecast is accurate? What is the basis for that confidence?

Answer: a. The "hard-wired reference values" referenced above are from forecasts completed prior to the CON filing. To the best of my knowledge, these values were developed when the original residential end-use model was developed.
b. The end-use model was developed by the previous manager of Corporate Energy Forecasting, who retired in 2010. The Residential end-use forecast continues to be refined and adjusted on an ongoing basis.
c. I do not know the exact date of when the end-use residential model was developed, however forecasts dating back to 1994 did utilize an "end-use" approach to forecasting residential sales.
d. I cannot speak to why this documentation was not retained as I was not an employee of Detroit Edison at that time.
e. The Corporate Energy Forecasting team measures the accuracy of the forecast on an annual basis and benchmarks those results against a peer group of utilities. DTE has outperformed the benchmark peer group in residential forecast accuracy on average since 2010. Based on this performance, we maintain a high degree of confidence in our forecast methodology.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-7.10ai
Page: 1 of 1

Question: In response to MECNRDCSCDE-4.10c, DTE provided the Excel file "U-18419 MECNRDCSCDE-4.10c Residential Efficiency Standard Calculations.xlsx".

a. For several of the measures, the calculation of the effect of efficiency standards referenced a set of "hard-wired" numbers. For most measures (e.g. Room AC, CentAC, Dryer, clothes washer, dishwasher, freezer, heat pumps, microwave, and water heater), the hard-wired referenced values are in column B. For other measures, it is in different columns (e.g. column H for dehumidifiers, column E for furnace fans, columns F and G for refrig and column K for computers).

   i. Please explain what those hard-wired reference values represent. Please use central air conditioners as an example in providing this explanation (i.e. what does the 1499 kWh in 2020 represent?).

Answer: The referenced values represent estimates of annual per-appliance energy consumption.

MPSC Case No.:	U-18419
Respondent:	M. B. Leuker
Requestor:	MECNRDCSC
Question No.:	MECNRDCSCDE-7.10aii
Page:	1 of 1

Question: In response to MECNRDCSCDE-4.10c, DTE provided the Excel file "U-18419 MECNRDCSCDE-4.10c Residential Efficiency Standard Calculations.xlsx".

a. For several of the measures, the calculation of the effect of efficiency standards referenced a set of "hard-wired" numbers. For most measures (e.g. Room AC, CentAC, Dryer, clothes washer, dishwasher, freezer, heat pumps, microwave, and water heater), the hard-wired referenced values are in column B. For other measures, it is in different columns (e.g. column H for dehumidifiers, column E for furnace fans, columns F and G for refrig and column K for computers).

ii. Please explain how those hard-wired reference values were developed for each end use (e.g. why did the 1511 kWh value for central air conditioners in 2019 decline to 1499 in 2020, then to 1486 in 2021, etc.).

Answer: The hard-wired reference values are from the forecast that was conducted prior to the inclusion of the federal energy efficiency standard.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-7.10aiii
Page: 1 of 1

Question: In response to MECNRDCSCDE-4.10c, DTE provided the Excel file "U-18419 MECNRDCSCDE-4.10c Residential Efficiency Standard Calculations.xlsx".

a. For several of the measures, the calculation of the effect of efficiency standards referenced a set of "hard-wired" numbers. For most measures (e.g. Room AC, CentAC, Dryer, clothes washer, dishwasher, freezer, heat pumps, microwave, and water heater), the hard-wired referenced values are in column B. For other measures, it is in different columns (e.g. column H for dehumidifiers, column E for furnace fans, columns F and G for refrig and column K for computers).

iii. Please provide all assumptions and calculations underlying the derivation of those hard-wired reference values.

Answer: Please see the response to MECNRDCSCCE-7.10aii. In previous versions of the forecast, documentation of sources is not available.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-7.10b
Page: 1 of 1

Question: In response to MECNRDCSCDE-4.10c, DTE provided the Excel file "U-18419 MECNRDCSCDE-4.10c Residential Efficiency Standard Calculations.xlsx".

b. The effects of the efficiency standards appear to be spread across an assumed average appliance life. For example, the central air conditioner impacts are estimated assuming an average appliance life of 26 years (cell H38). Please provide the basis for each of those assumptions.

Answer: Bases of appliance lives are as follow:

- Room Air Conditioner: 2013 Residential Customer Appliance Saturation Survey
- Central Air Conditioner: 2013 Residential Customer Appliance Saturation Survey
- Dryer: 2013 Residential Customer Appliance Saturation Survey
- Clothes Washer: 2013 Residential Customer Appliance Saturation Survey
- Dehumidifier: Department of Energy's priority-setting activities for fiscal year 2003
- Dishwasher: 2013 Residential Customer Appliance Saturation Survey
- Freezer: 2013 Residential Customer Appliance Saturation Survey
- Heat Pump: 2013 Residential Customer Appliance Saturation Survey
- Microwave: 2013 Residential Customer Appliance Saturation Survey
- Water Heater: 2013 Residential Customer Appliance Saturation Survey
- Furnace Fan: Final rule, Department of Energy 2014 standard, effective March 2019
- Refrigerator: 2001 Residential Customer Appliance Saturation Survey
- Computer: Full adoption of energy efficient computers assumed over 15-year time horizon.
- Lighting: The lighting forecast is based on EIAs 2013 forecast for lighting efficiency measures through 2035.

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-7.10ci
Page: 1 of 2

Question: In response to MECNRDCSCDE-4.10c, DTE provided the Excel file "U-18419 MECNRDCSCDE-4.10c Residential Efficiency Standard Calculations.xlsx".

c. For lighting, DTE provides an explanation of its forecast, stating that it is based on an acceleration of EIA's 2013 forecast for lighting efficiency measures.

i. Please provide that EIA forecast.

Answer: The Energy Information Administration's lighting usage from Annual Energy Outlook of 2013 is shown below.

YEAR	USAGE (kWh)
2005	1,995
2006	1,921
2007	1,850
2008	1,786
2009	1,729
2010	1,692
2011	1,632
2012	1,607
2013	1,384
2014	1,293
2015	1,246
2016	1,217
2017	1,194
2018	1,179
2019	1,168
2020	1,058
2021	999
2022	962
2023	936
2024	912
2025	891
2026	870
2027	852
2028	835
2029	819

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-7.10ci
Page: 2 of 2

YEAR	USAGE (kWh)
2030	802
2031	790
2032	780
2033	772
2034	765
2035	759

MPSC Case No.: U-18419
Respondent: M. B. Leuker
Requestor: MECNRDCSC
Question No.: MECNRDCSCDE-7.10cii
Page: 1 of 1

Question: In response to MECNRDCSCDE-4.10c, DTE provided the Excel file "U-18419 MECNRDCSCDE-4.10c Residential Efficiency Standard Calculations.xlsx".

c. For lighting, DTE provides an explanation of its forecast, stating that it is based on an acceleration of EIA's 2013 forecast for lighting efficiency measures.

ii. What is the basis for the 290 kWh of consumption that is assumed for 2025 and all years thereafter? Does this assumption assume that all screw-based lighting just meet the minimum Energy Independence and Security Act efficiency standards for 2020? Or does it assume all residential lighting is provided by LEDs? Or does it assume a mix of efficiency assumptions? Please explain.

Answer: The forecast assumes that residential customers will seek energy efficient lighting without regard to the particular technology used to achieve that efficiency and, therefore, that diverse lighting technologies contribute to 290 kWh of consumption in 2025 and years thereafter.

STATE OF MICHIGAN

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

In the matter of the Application of **DTE ELECTRIC COMPANY** for approval of Certificates of Necessity pursuant to MCL 460.6s, as amended, in connection with the addition of a natural gas combined cycle generating facility to it generation fleet and for related accounting and ratemaking authorizations	U-18419 ALJ Suzanne D. Sonneborn

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PROOF OF SERVICE

On the date below, an electronic copy of **the Direct Testimony of Chris Neme with Exhibits MEC-17 through MEC-39 on behalf of Michigan Environmental Council, Natural Resources Defense Council, and Sierra Club** was served on the following:

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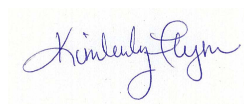
The statements above are true to the best of my knowledge, information and belief.

OLSON, BZDOK & HOWARD, P.C.
Counsel for MEC-NRDC-SC

Date: January 12, 2018



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