ENVIRONMENTAL LAW & POLICY CENTER
Protecting the Midwest's Environment and Natural Heritage

January 18, 2022

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

RE: MPSC Case No. U-20763

Dear Ms. Felice:

The following is attached for paperless electronic filing:

Revised Testimony of Peter Erickson on Behalf of the Environmental Law and Policy Center and Michigan Climate Action Network

Proof of Service

Sincerely,

Margrethe Kearney
Environmental Law & Policy Center
mkearney@elpc.org

cc: Service List, Case No. U-20763

STATE OF MICHIGAN
MICHIGAN PUBLIC SERVICE COMMISSION

In the matter of **ENBRIDGE ENERGY, LIMITED PARTNERSHIP** application for the Authority to Replace and Relocate the Segment of Line 5 Crossing the Straits of Mackinac into a Tunnel Beneath the Straits of Mackinac, if Approval is Required Pursuant to 1929 PA 16; MCL 483.1 et seq. and Rule 447 of the Michigan Public Service Commission's Rules of Practice and Procedure, R 792.10447, or the Grant of other Appropriate Relief	)	Case No. U-20763

REVISED DIRECT TESTIMONY OF PETER A. ERICKSON

ON BEHALF OF

THE ENVIRONMENTAL LAW & POLICY CENTER AND THE MICHIGAN CLIMATE ACTION NETWORK

January 18, 2022
~~**September 14, 2021**~~

I. BACKGROUND AND QUALIFICATIONS

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

A: My name is Peter A. Erickson. I am a Senior Scientist and the Climate Policy Program Director at Stockholm Environment Institute—U.S., a 501(c)(3) organization affiliated with Tufts University and based at 11 Curtis Avenue, Somerville, Massachusetts 02144. I work out of the Seattle office at 1402 Third Avenue, Suite 925, Seattle, Washington 98101.

Q: What is your educational background?

A: I received a Bachelor of Arts from Carleton College in 1998. My major field of study was Geology; I also studied mathematics extensively. In 2007, I took courses in intermediate microeconomics and macroeconomics at the University of Washington.

Q: Can you briefly describe your professional background and expertise?

A: I have worked in environmental research and consulting for over 20 years. During the last thirteen years, my professional focus has been on greenhouse gas (GHG) emissions accounting and the role of policy mechanisms in reducing GHG emissions. Specifically, I have conducted and led research projects on these topics on behalf of numerous partners and clients, including international institutions (e.g., the United Nations Framework Convention on Climate Change, the World Bank), the U.S. government (U.S. Environmental Protection Agency), state governments (e.g., State of Washington, State of Oregon), and local governments (e.g., City of Seattle). I have authored numerous peer-reviewed studies on how policies, actions, or infrastructure projects increase or decrease greenhouse gas emissions. These include studies about the GHG emissions implications of the proposed Keystone XL pipeline,[1] of the United States government's fossil fuel leasing

[1] Erickson, P., & Lazarus, M. (2014). Impact of the Keystone XL pipeline on global oil markets and greenhouse gas emissions. *Nature Climate Change*, 4(9), 778–781. https://doi.org/10.1038/nclimate2335

practices,[2] and of federal and state-level subsidies to US oil and gas production.[3] These and other projects are documented in my Curriculum Vitae, attached as Exhibit ELP-1 (PAE-1). In addition, I am an invited reviewer to the GHG emission reduction chapters in Working Group III of the Intergovernmental Panel on Climate Change's (IPCC) upcoming *Sixth Assessment Report.*

Q: Have you ever testified in front of the Michigan Public Service Commission?

A: No. Case No. U-20763 is my first time testifying in front of the Michigan Public Service Commission.

Q: Have you testified in other jurisdictions?

A: Yes. I have testified in front of the United States House Committee on Oversight and Reform, Subcommittee on Environment, on the topic of greenhouse gas emissions. I have also testified in front of the Pollution Control Hearings Board for The State of Washington on that topic.[4] I have submitted expert testimony to the United States District Court, District of Oregon,[5] and to the Shoreline Hearings Board for the State of Washington[6] regarding estimates of greenhouse gas emissions. I submitted an expert letter to the District Court of the Hague, Netherlands, regarding methods of estimating greenhouse gas emissions.[7] My

[2] Erickson, P., & Lazarus, M. (2018). Would constraining US fossil fuel production affect global CO2 emissions? A case study of US leasing policy. *Climatic Change*, 150, 29–42. https://doi.org/10.1007/s10584-018-2152-z

[3] Achakulwisut, P., Erickson, P., & Koplow, D. (2021). Effect of subsidies and regulatory exemptions on 2020-2030 oil and gas production and profits in the United States. *Environmental Research Letters*.

[4] Advocates for a Cleaner Tacoma *et al. v.* Puget Sound Clean Air Agency, Puget Sound Energy. Pollution Control Hearings Board for the State of Washington. PCHB No. P19-087c.

[5] *Juliana et al. v. United States*, United States District Court, District of Oregon. Case No. 6:15-cv-01517-TC.

[6] Columbia Riverkeeper *et al. v.* Cowlitz County *et al.* Shoreline Hearings Board for the State of Washington. SHB No. 17-010c.

[7] At the request of the plaintiffs, I submitted a letter to the District Court of the Hague in *Vereniging Milieudefensie et al. v. Royal Dutch Shell* (Case Number C/09/571932 / HA ZA 19-379) regarding methods of estimating greenhouse gas emissions associated with oil production. The letter is available at: https://www.sei.org/publications/climate-case-shell-sei-letter-court/

work on estimating greenhouse gas emissions has been directly cited by the United States Court of Appeals for the Ninth Circuit[8] and by the United States District Court of Alaska.[9]

Q: On whose behalf are you submitting this testimony?

A: I am submitting this testimony on behalf of the Environmental Law & Policy Center and the Michigan Climate Action Network.

Q: Are you sponsoring any exhibits?

A: Yes. I am sponsoring the following exhibits:

- ELP-1 (PAE-1) – Curriculum Vitae of Peter A. Erickson
- ELP-2 (PAE-2) – IPCC (2021), Summary for Policymakers. *In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*
- ELP-3 (PAE-3) – Angel, J. R., et al (2018). *Chapter 21: Midwest. Impacts, Risks, and Adaptation in the United States: The Fourth National Climate Assessment, Volume II*. U.S. Global Change Research Program
- ELP-4 (PAE-4) – Burger and Wentz (2019), "*Evaluating the Effects of Fossil Fuel Supply Projects on Greenhouse Gas Emissions and Climate Change under NEPA*"
- ELP-5 (PAE-5) –Heyes et al (2018), "*The Economics of Canadian Oil Sands*"
- ELP-6 (PAE-6) – Erickson et al (2014), "*Impact of the Keystone XL pipeline on global oil markets and greenhouse gas emissions*"

[8] *Ctr. for Biological Diversity v. Bernhardt*, 982 F.3d 723, 738 (9th Cir. 2020).
[9] Sovereign Inupiat for a Living Arctic v. Bureau of Land Mgmt., No. 3:20-CV-00290-SLG, 2021 WL 3667986, at *20 n. 201 (D. Alaska Aug. 18, 2021)).

- ELP-7 (PAE-7) –Achakulwisut, Erickson, and Koplow (2021), "Effect of subsidies and regulatory exemptions on 2020–2030 oil and gas production and profits in the United States"

Q: What materials did you review in preparing this testimony?

A: I reviewed relevant portions of Enbridge's application and testimony, Enbridge and Commission reports and websites, discovery responses from Enbridge, and other party responses to requests for discovery from Enbridge. I also reviewed and relied upon a variety of scientific and economic journal articles, reports, and other literature, and publicly available data and analysis in forming my opinions. Where I explicitly rely upon a source in forming my opinion, I cite to it in my testimony.

II. OVERVIEW OF TESTIMONY

Q: What is the purpose of your testimony?

A: The purpose of my testimony is to estimate, quantify, and explain the level of greenhouse gas emissions associated with Enbridge's Proposed Project. This will include both the greenhouse gas emissions resulting from the construction and operation of the Proposed Project, as well as the greenhouse gases contained in or associated with the oil and natural gas liquids ("NGL") fuel carried by the pipeline. I will also estimate the change in global greenhouse gas emissions that would arise as a consequence of the Proposed Project, as measured relative to a no-action scenario, where Enbridge discontinues use of the existing pipeline in the Straits of Mackinac, but does not construct the Proposed Project. This latter approach evaluates likely differences in global oil supply and consumption when comparing the no-action scenario to the Proposed Project being built.

Q: Please describe the project for which Enbridge seeks approval.

A: Enbridge Energy, Limited Partnership ("Enbridge") currently operates an oil pipeline called Line 5, which transports oil and Natural Gas Liquids ("NGL") from western Canada to eastern Canada. A portion of Line 5 currently consists of two 20-inch diameter pipelines that run through the Straits of Mackinac in Michigan. In this case, Enbridge is seeking approval to build an underground tunnel, and to replace and relocate into that tunnel the portion of the Line 5 petroleum pipeline that currently sits on the bottom of the Straits (the "Proposed Project").

Q: What methods did you use to estimate the greenhouse gas emissions associated with the Proposed Project?

A: I use standard greenhouse gas emissions accounting practices, consistent with those laid out in guidance by the Greenhouse Gas Protocol initiative,[10] and report my results in standard units of millions of metric tons of carbon-dioxide equivalent (CO_2e). In brief, with respect to the construction of the Proposed Project, these methods involve estimating what activities occur in association with the Proposed Project (for example, the use of a machine to bore the tunnel under the Straits of Mackinac), how much energy is used by each activity (for example, how much electricity is used by the tunnel-boring machine), and how much greenhouse gas emissions are associated with each unit of energy (for example, how much carbon dioxide is released by the power plants that make the electricity for the tunnel-boring machine). I use similar methods to estimate the greenhouse gas emissions associated with the operation of the Proposed Project, and also when estimating the greenhouse gas

[10] For example, the GHG Protocol's *Corporate Accounting and Reporting Standard,* their *Project Accounting* standard, and their *Policy and Action Standard* lay out methods for estimating GHG emissions associated with specific projects, including procedures for assessing emissions relative to a counterfactual, no-action baseline.

emissions associated with the oil and NGL that will be transported through the Proposed Project after completion.

Q: Are these methods commonly used by experts when estimating greenhouse gas emissions from oil pipelines?

A: Yes. My methods are consistent with those used in other greenhouse gas assessments of oil pipelines, such as the Keystone XL pipeline, and indeed I check my work against those other estimates, as well as against the peer-reviewed, scientific literature and against standards for life-cycle assessment (LCA) and oil market analysis. All data sources I rely upon directly are cited here in this document.

Q: Can you summarize your conclusions?

A: I reach three main conclusions that I describe in my testimony.

- First, I estimate that the Proposed Project is associated with about 87 million metric tons carbon-dioxide equivalent (CO_2e) annually.
- Second, I conclude that, when compared to a scenario in which the existing Line 5 pipeline no longer operates, construction and operation of the Proposed Project would lead to an *increase* of about 27 million metric tons CO_2e annually in global greenhouse gas emissions from the production and combustion of oil.
- ~~Third, by enabling the continued, long-term production and combustion of oil, construction of the project would work against, and therefore be inconsistent with, the goals of the global Paris Agreement and Michigan's Healthy Climate Plan.~~

Q: Does your analysis include an estimate of the greenhouse gas emissions from the existing dual pipelines Enbridge operates in the Straits of Mackinac?

A: No. I am aware that the Governor of Michigan and the Director of the Michigan Department of Natural Resources notified Enbridge on November 13, 2020, that the state revoked and terminated the 1953 Easement which allows Line 5 to operate in the Straits. My understanding is that this revocation and termination would require Line 5 to discontinue operation. However, I also discuss below why it is appropriate to consider a "no-action" scenario even in the absence of the Governor's actions. As a result, my analysis includes a scenario where I assume that if the Proposed Project is not completed, Line 5 will no longer operate.

III. OVERVIEW OF CLIMATE CHANGE AND THE NEED FOR GREENHOUSE GAS EMISSIONS CUTS

Q: How does the current understanding about the effects of climate change inform your discussion of GHG emissions and Enbridge's Proposed Project?

A: To provide some context, here I first provide some basic information about the state of climate science and the need for rapid and steep cuts in GHG emissions over the coming decades. Around the world, with just 1.1 degree Celsius (C) of warming experienced to date, we are already seeing serious harms that include increasing flooding, wildfires, droughts, heat waves, expanded impacts of pests and pathogens, and other effects. As addressed in more detail by other testifying experts in this case, these types of events are all plausibly linked to climate change.[11] For example, three "five-hundred year" floods occurred in Houston, Texas in just three years, with one storm – Hurricane Harvey –

[11] For an additional summary of these effects, see: Holdren, J. P. (2018, September). The Science & Policy of Climate Change: An Update on the Challenge and the Opportunity. Presented at the Low-emissions Solutions Conference, San Francisco, CA. (https://lowemissions.solutions/static/uploads/180911_GCAS_Holdren.pdf)

producing rainfall that "likely exceeded that of any known historical storm in the continental United States."[12] In many areas of the world and the country, increasing summer temperatures are already making working outdoors dangerous. A scientific review of the effects of climate change on health has concluded, "[t]he life of every child born today will be profoundly affected by climate change. Without accelerated intervention, this new era will come to define the health of people at every stage of their lives."[13] In the new, most recent assessment of the science behind climate change, the Intergovernmental Panel on Climate Change described the observed rate of climate change as both "unprecedented" and "unequivocally" caused by human activities.[14]

Q: Are there similar impacts as a result of climate change in the Midwest region or Michigan in particular?

A: In the Midwest of the United States, climate change will lead to increased temperatures and precipitation that will reduce agricultural productivity, erode soils, and lead to pest outbreaks, while also leading to poor air quality, substantial loss of life, and worsening economic conditions for people.[15]

[12] Hayhoe, K., Wuebbles, D. J., Easterling, D. R., Fahey, D. W., Doherty, S., Kossin, J. P., … Wehner, M. F. (2018). Chapter 2: Our Changing Climate. *Impacts, Risks, and Adaptation in the United States: The Fourth National Climate Assessment, Volume II*.

[13] Watts, N., Amann, M., Arnell, N., Ayeb-Karlsson, S., Belesova, K., Boykoff, M., … Montgomery, H. (2019). The 2019 report of The Lancet Countdown on health and climate change: Ensuring that the health of a child born today is not defined by a changing climate. *The Lancet*. https://doi.org/10.1016/S0140-6736(19)32596-6

[14] IPCC. (2021). Summary for Policymakers, attached as Exhibit ELP-2 (PAE-2). *In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.

[15] Angel, J. R., Swanson, C., Boustead, B. M., Conlon, K., Hall, K. R., Jorns, J. L., Kunkel, K. E., Lemos, M. C., Lofgren, B. M., Ontl, T., Posey, J., Stone, K., Takle, E., & Todey, D. (2018). Chapter 21: Midwest. Impacts, Risks, and Adaptation in the United States: *The Fourth National Climate Assessment, Volume II.* U.S. Global Change Research Program, attached as Exhibit ELP-3 (PAE-3). https://doi.org/10.7930/NCA4.2018.CH21

Q: Do GHG emissions need to be reduced to limit the impacts of climate change?

A: Yes. GHG emissions need to be substantially reduced to limit the impacts of climate change. For example, the U.S. Government's *Fourth National Climate Assessment* describes, consistent with the findings of the international scientific community, that climate risks can only be adequately addressed with "substantial and sustained reductions in global greenhouse gas emissions."[16] As the report notes, "[f]uture risks from climate change depend primarily on decisions made today."[17]

More broadly, guidance on how quickly GHG emissions need to be reduced can be found in international agreements such as the United Nations Framework Convention on Climate Change (UNFCCC), through which nations have been working collectively to address the risks of climate change throughout the world. The most recent landmark agreement of countries that are party to the UNFCCC, including the United States, is the Paris Agreement of 2015. The Paris Agreement commits countries to "holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels." In adopting the Paris Agreement, countries also asked the Intergovernmental Panel on Climate Change (IPCC) to produce a report on what emissions levels would be needed to achieve the 1.5 °C limit.[18]

[16] Reidmiller, D. R., Avery, C. W., Easterling, D. R., Kunkel, K. E., Lewis, K. L. M., Maycock, T. K., & Stewart, B. C. (2018). *Impacts, Risks, and Adaptation in the United States: The Fourth National Climate Assessment, Volume II.* U.S. Global Change Research Program. https://doi.org/10.7930/NCA4.2018. Page 25.
[17] *Ibid*, page 26.
[18] UNFCCC. (2015). Decision 1/CP.21: Adoption of the Paris Agreement. Retrieved from United Nations Framework Convention on Climate Change website: http://unfccc.int/resource/docs/2015/cop21/eng/10a01.pdf

Q: What level of reductions did the IPCC conclude would be necessary to achieve the 1.5 °C limit?

A: The IPCC, in its special report, *Global Warming of 1.5 °C,* describes that net global carbon dioxide (CO_2) emissions must reach zero to halt warming, and specifically that emissions levels must reach zero by about the year 2050 in order to meet the 1.5 °C with no or "limited" overshoot (exceedance) of the temperature limit. Even *if* other means of removing CO_2 are developed and applied at large scale, the IPCC found that, between 2020 and 2050, gross global CO_2 emissions from fossil fuel combustion and industry would need to decline by about 70%.[19] These findings were broadly re-affirmed by the IPCC in its recent report *Climate Change 2021: The Physical Science Basis*, even as their new report on GHG emission reduction scenarios is not due until early 2022.[20]

Q: How must fossil-fuel based energy systems change to meet the 1.5 °C limit?

A: Use and production of all three major fossil fuels – coal, gas, and oil – must decline dramatically to meet the 1.5 °C limit. Over the next three decades (through 2050), the IPCC finds that, to attain the 1.5 °C limit with no or limited temperature overshoot, coal use must decline by an average of 6% annually (for a total of 82% between 2020 and 2050), gas use by an average of 2% annually (for a total of 43%), and oil use by an average of 3% annually (for a total of 65%).[21] Further, one of the longstanding principles of the international negotiations, termed "common but differentiated responsibilities," is that reductions in the U.S. and other highly developed countries must proceed faster than these global averages,

[19] Rogelj, J., Shindell, D., Jiang, K., Fifita, S., Forster, P., Ginzburg, V., … Vilariño, M. V. (2018). *Mitigation pathways compatible with 1.5°C in the context of sustainable development. In Special Report on the impacts of global warming of 1.5 °C.* Retrieved from http://www.ipcc.ch/report/sr15/ Figure 2.6, page 117 and Table 2.4, page 119.

[20] IPCC. (2021). *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge University Press.

[21] Rogelj et al 2018, Table 2.6, page 132.

on account of our historic responsibility for climate change and our relatively high capacity to financially support solutions.

IV. GREENHOUSE GAS EMISSIONS ASSOCIATED WITH THE PROPOSED PROJECT

Q: Are there GHG emissions associated with the Proposed Project?

A: Yes. For the Proposed Project, Enbridge would build a tunnel and replace and relocate into that tunnel the portion of the Line 5 petroleum pipeline that currently sits on the bottom of the Straits of Mackinac. There are two main ways in which the Proposed Project will result in GHG emissions. First, GHG emissions will be released by the equipment used to build and operate the tunnel. Second, the Proposed Project will handle and transport petroleum that, once combusted, releases even greater quantities of GHG emissions than from Project construction or operation.

Q: Let's take those two sources of GHG emissions in turn. First, what is your estimate of the GHG emissions associated with the construction and operation of the pipeline for this Proposed Project?

A: I estimate the GHG emissions associated with construction of the pipeline to be about 87,000 metric tons carbon dioxide equivalent (CO_2e). I estimate that operation of the pipeline will result in about 520 metric tons CO_2e annually.

Q: What is CO_2e?

A: Emissions from different greenhouse gases, each of which causes different amounts of warming, are often combined into a single metric of CO_2 *equivalent* by using the concept of global warming potential (GWP). For example, a ton of methane causes many times more warming than a ton of carbon dioxide, and this ratio is called the GWP of methane. In the IPCC's latest *Sixth Assessment Report*, the GWP of fossil methane is reported as

29.8 over a 100-year timeframe. One metric ton of methane is therefore 29.8 metric tons CO_2e over 100 years according to the IPCC. Throughout my testimony, I focus my own calculations mainly on CO_2; in making these calculations, I include other, non-CO_2 GHGs like methane (CH_4) indirectly and only to the extent that they were calculated by primary sources, such as by the US EPA's eGrid tool (on a CO_2e basis, and inheriting any GWP assumptions made by each primary source). Further, any time I refer to a ton, I mean a metric ton unless stated otherwise, and which I may occasionally abbreviate as just the letter *t*.

Q: How did you arrive at 87,000 metric tons CO_2e as an estimate of the GHG emissions from construction of the Proposed Project?

A: I used standard GHG accounting practices to arrive at this estimate, using information provided by Enbridge and basic facts about the Proposed Project, and by relying on other published information about how much energy is used to carry out the proposed activities.

First, descriptions of the main activities and materials needed to construct the pipeline are readily available in project documents, e.g. the *Tunnel Design and Construction Report* dated December 23, 2020 (Exhibit A-13) and other documents provided by Enbridge. These activities include the use of a tunnel-boring machine, operation of other construction equipment, and the making and installation of key construction materials, including steel and concrete.

Second, I used published estimates about similar equipment, machinery, and materials to estimate how much energy is used for each activity.

Third, to complete the picture, I gathered basic data about how much GHG emissions are released from each unit of activity or energy.

Q: Is this typical of the methodology employed by experts in your field?

A: Yes. Together, these three steps – and their underlying data and assumptions – are, in my opinion, reasonable and consistent with assumptions in major government GHG inventories and assessments, such as the U.S. EPA's national GHG inventory and the US State Department's assessment of the Keystone XL pipeline.

Q: Can you summarize your estimates?

A: Yes. My estimates of the GHG emissions from the activities and materials needed to construct the Proposed Project are shown in Table 1 below. As shown, I estimate the total GHG emissions associated with construction to be about 87,000 metric tons carbon dioxide equivalent (CO_2e).

TABLE 1. EMISSIONS ASSOCIATED WITH CONSTRUCTION OF THE PROJECT

Source of construction-related emissions	Emissions (metric tons CO_2e)[22]	Method notes and assumptions
Equipment: tunnel boring machine (TBM) and related tunneling equipment (using electricity)	56,000	Based on electricity consumption during construction estimated by Enbridge for south side of the Straits
Equipment: other (electricity)	2,300	Based on electricity consumption during construction estimated by Enbridge for north side of the Straits
Equipment: other vehicles (diesel)	5,100	Includes excavators, grading equipment, loaders, dump trucks, and other vehicles
Materials: concrete for tunnel liner and roadway	19,000	Based on estimated cement content of Enbridge's estimated concrete usage
Materials: steel for pipeline	3,300	Based on 0.625-inch thick steel, 30-inch outer diameter pipeline, and average CO_2-intensity of US steel
Land-clearing	570	Estimated by Enbridge[23]
Estimated total construction emissions	**87,000**	(Individual figures may not add to total due to rounding)[22]

The estimate in Table 1 includes what I see as the major sources of emissions associated with project construction, but does not include several much-smaller sources of emissions associated with constructing the tunnel, such as for making the steel for electrical conduit

[22] All estimates here are rounded to two significant digits. As a result, the individual figures may not add to the total due to rounding.
[23] Enbridge Response to Michigan Public Service Commission Staff Discovery Request 6(8).

or rebar, or for making the grout that will occupy the annular space surrounding the concrete tunnel liner. Accordingly, I believe my estimate is conservative.

Q: Table 1 lists detailed assumptions about each major source of construction-related emissions. Can you describe these assumptions for the equipment used to construct the tunnel?

A: Yes. First, I assume that the tunnel excavator will, like other tunnel-boring machines, be operated using electricity. Enbridge has estimated the electricity usage during construction at the south terminus of the tunnel, where the tunnel boring machine (TBM) will be based, to be 66,184 megawatt-hours (MWh), and so I use this figure for the electricity used by the TBM and other, minor uses based at the south terminus. I then estimate the GHG emissions associated with each unit of electricity, using data specific to the Straits of Mackinac region from the US EPA, to be 0.851 metric tons of CO_2e per MWh of non-baseload electricity consumed; that figure is for electricity from the RFC Michigan eGrid regions, as derived from the US EPA's eGrid tool.[24]

Q: What assumptions did you use for the other equipment?

A: For equipment other than the tunnel-boring machine, such as other electric equipment at the north side of the Straits, and for loaders and dump trucks, my approach is similar. For electricity usage, I use estimates provided by Enbridge. For vehicles, I use published estimates about how much energy (here, diesel) was used for this kind of equipment from another, similar project, and then use data from the U.S. EPA about how much GHG emissions are released by combusting each unit of diesel.

[24] https://www.epa.gov/egrid/summary-data. A metric ton is 1,000 kilograms.

Q: What specific assumptions and calculations did you make about this other equipment?

A: I use an electricity estimate from Enbridge[25] for the north side to characterize other electrical equipment. For off- and on-road vehicles, such as loaders and grading equipment, used to excavate and grade material, I use an estimate of energy consumption of 0.25 million btu per cubic meter (mmbtu / m^3) for such equipment, based on another recent tunnel boring project (Parsons Brinckerhoff, 2011)[26] and apply that estimate to the 272,000 cubic meters of material I anticipate will be excavated for the Proposed Project (a 24.5-foot diameter bore for 20,350 feet, based on Enbridge's tunnel design documents[27]). I assume that energy for these vehicles is mostly diesel, with resulting CO_2 emissions of 74 kg CO_2 / mmbtu per Annex 2 of US EPA's national inventory (U.S. EPA, 2021).[28]

Q: Table 1 also lists detailed assumptions about the materials used to construct the tunnel. Can you describe these?

A: Yes. The two major materials used to construct the Proposed Project are concrete (for the tunnel lining and interior roadway) and steel (for the pipeline itself). Each of these materials is GHG-emissions-intensive to manufacture.

Q: How does the production and use of concrete result in GHG emissions?

A: For concrete, the main source of GHG emissions is CO_2 from making cement, which is the binding agent in concrete. Making cement relies on a substantial amount of heat, usually

[25] Enbridge Response to Michigan Public Service Commission Staff Discovery Request 6(9).
[26] Parsons Brinckerhoff. (2011). *Alaskan Way Viaduct Replacement Project: Final Environmental Impact Statement*. https://data.wsdot.wa.gov/publications/Viaduct/
[27] The 24.5 foot diameter bore assumes an inside tunnel diameter of 21 feet, a tunnel wall thickness of 15 inches, and an extra 6 inches of bore space around the outside, all of which were published in Enbridge's *Tunnel Design and Construction Report for the Straits Line 5 Replacement Segment*. December 23, 2020, Exhibit A-13.
[28] US EPA (2021). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019. U.S. Environmental Protection Agency. https://www.epa.gov/ghgemissions/).

from burning coal or natural gas, and also relies on a chemical reaction, involving lime, which releases CO_2 directly. I use information provided by Enbridge to estimate how much cement is needed, and then information from an industry group – the Global Cement and Concrete Association – to estimate that making each ton of US-made cement releases 0.75 tons CO_2.

Q: What specific assumptions and calculations did you make about concrete used in the Proposed Project?

A: Enbridge's report "Tunnel Design and Construction Report for the Straits Line 5 Replacement Segment," dated December 23, 2020 (Exhibit A-13), reports the tunnel length at 20,350 feet, the tunnel inside diameter of 21 feet, and the tunnel wall thickness of 15 inches. This information implies a volume of concrete of about 66,000 cubic yards. This is very similar to the value reported by Enbridge[29] that 65,330 tons of reinforced concrete will be needed. Because the numbers are so close, I rely here on the 65,330 tons reported by Enbridge. Further, additional project specifications report an average cement content of about 800 pounds of cementitious materials per cubic yard of concrete.[30] Together, this implies the need for about 24,000 tons of cement for the tunnel walls. Additional cement would be needed for the roadway inside the tunnel; I calculate that separately.

Q: How does the production and use of steel result in GHG emissions?

A: For steel, similarly, emissions are released both from making heat (e.g., from burning coal or other fossil fuels) and from chemical reactions inherent in the steel-making process.

[29] Enbridge Response to Environmental Law & Policy Center and Michigan Climate Action Network Discovery Request 1.

[30] "Cementitious" materials are primarily cement, but may include amounts of cement alternatives, such as fly ash. I calculated the 800 figure as the average of minimum 611 and maximum 1000 pounds of cementitious material per cubic yard, per page 317416 – 17 of the precast concrete tunnel specs in the following document: https://www.michigan.gov/documents/mdot/Enbridge_Submittal_-_Jointly_Developed_Project_Specs_715739_7.pdf).

Similar to my methodology for cement, I estimate the quantity and type of steel needed to make the pipeline that is part of the Project based on information provided by Enbridge and the GHG emissions associated with each unit of US-made steel provided by a research study.

Q: What specific assumptions and calculations did you make about steel used in the Proposed Project?

A: Information provided by Enbridge (Exhibit A-14), provides specifications for the steel pipeline, including the outside diameter of 30 inches and the wall thickness of 0.625. From this and the 20,350 ft length, I estimated the need for about 14 million cubic inches of steel. API 5L steel has a density of about 0.28 pounds per cubic inch (calculated from Table 4 of the American Petroleum Institute's *Specification for Line Pipe*),[31] implying the need for about 2,000 short tons of steel, or 1,800 metric tons. The average CO_2-intensity of blast-furnace steel in the U.S. is 1.83 t CO_2 / t of crude steel.[32] I use the GHG-emissions intensity of blast-furnace steel, not electric-arc steel, because the quantity of steel made by electric arc furnaces is constrained by how much scrap steel is available, so it is more plausible that the marginal source of steel is instead from blast furnaces.

Q: Are there also GHG emissions associated with the operation of the Proposed Project?

A: Yes. After the Proposed Project is constructed, there are GHG emissions associated with operating the tunnel, such as electricity to operate lighting and ventilation systems, and the electric service vehicles that would travel inside the tunnel. I estimate that GHG emissions associated with operating the tunnel itself would be approximately 520 metric tons CO_2e

[31] Available at https://law.resource.org/pub/us/cfr/ibr/002/api.5l.2004.pdf.
[32] See Figure 16 of Hasanbeigi, A., & Springer, C. (2019). How Clean is the US Steel Industry? An International Benchmarking of Energy and CO_2 intensities. Global Efficiency Intelligence.

annually. This does not include any emissions associated with operating the existing Line 5 Mackinaw City Pump Station.

Q: Can you explain how you arrived at the 520 metric tons CO2e annually associated with the operation of the Proposed Project?

A: Ongoing operation of the Proposed Project will involve energy and associated greenhouse gas emissions for the tunnel's ventilation fans, for the sump pump inside the tunnel, for the tunnel service vehicle that operates inside the tunnel, and for lighting, all for many years into the future. Based on electricity usage for these items at other similar tunnels, I estimate that GHG emissions associated with operating the tunnel would be approximately 520 metric tons CO_2e annually. More specifically, I estimate the tunnel itself would use about 600 megawatt-hours (MWh) of electricity per year, [33] which is a conservative estimate compared to confidential information provided by Enbridge in discovery and not cited here. At the US EPA's reported GHG-intensity of electricity in the Straits of Mackinac region of 0.87 tons CO_2e/MWh,[34] 600 MWh of electricity consumption translates into about 520 t CO_2e.

Q: Now that you have discussed estimated GHG emissions from construction and operation of the project, let's turn to the second source of GHG emissions you referenced above. Are there GHG emissions associated with the oil and NGL products that will be shipped through the Proposed Project?

[33] Based on average annual electricity consumption of 193 kWh/m for TBM tunnel types (Peeling, J., Wayman, M., Mocanu, I., Nitsche, P., Rands, J., & Potter, J. (2016). Energy Efficient Tunnel Solutions. Transportation Research Procedia, 14, 1472–1481. https://doi.org/10.1016/j.trpro.2016.05.221), discounted by 50% for lighting electricity since the Proposed Project would not normally be lit.

[34] This is the average GHG intensity for electricity consumed from the RFC Michigan and RFC West regions, which each border the Straits, in EPA's eGrid tool.

A: Yes, there are GHG emissions associated with the oil and NGL that will be transported using the pipeline contained in Enbridge's Proposed Project. I estimate that the GHG emissions associated with the crude oil and NGLs handled by the Proposed Project will be 87,000,000 metric tons CO_2e annually.

Q: Please explain how you arrived at 87,000,000 metric tons CO_2e annually.

A: The Proposed Project will also be associated with greenhouse gas emissions from the petroleum (oil and NGL) handled by the project. The Proposed Project is expected to handle 540,000 barrels per day (b/d) of liquid, comprising about 450,000 b/d of crude oil, and 90,000 b/d of natural gas liquids,[35] chiefly propane and butane,[36] again all for many years into the future. GHG emissions are released at each stage of producing, processing, and combusting petroleum, and so I estimate the total emissions by splitting the "life cycle" of a barrel of crude oil or NGL into stages, which are typically referred to in this type of analysis as the "upstream" and "downstream" stages.

Q: What are the upstream stages?

A: Here, I use the term *upstream* to refer to all stages that happen before, or upstream, of final combustion. So, *upstream* refers to the initial extraction and processing of petroleum, such as the operation of oil wells and any other equipment needed to process or handle the oil, as well as for oil refining (oil refining is sometimes considered *midstream*, but for my purposes here I will include it under upstream).

[35] Liquid volumes carried by the pipeline are taken from page 2-2 of Dynamic Risk Assessment Systems. (2017). *Alternatives Analysis for the Straits Pipelines*.

[36] I estimate the propane and butane fractions based on Muse Stancil. (2019). Review of the Report "Assessment of Alternative Methods of Supplying Propane to Michigan in the Absence of Line 5" for Enbridge, provided by Enbridge in response to Michigan Environmental Council, Grand Traverse Band of Ottawa and Chippewa Indians, Tip of the Mitt Watershed Council, and National Wildlife Federation Discovery Request 21.

Q: How do you estimate GHG emissions from the upstream stages?

A: For the upstream stages, I rely on research that estimated how much emissions are released for production and processing of petroleum from Western Canada and the Bakken formation in North Dakota and Montana in the United States, since these regions would be the source of the petroleum carried by the pipeline.

Q: What do you conclude about GHG emissions from upstream stages based on your review of available literature?

A: According to research by Stanford University and colleagues for the Oil-Climate Index, producing light oil from these formations in Western Canada and North Dakota releases about 55 kg CO_2e per barrel. Refining them releases an additional 18 kg CO_2e per barrel. I calculate these numbers as the average of the flare and no-flare case for the US Bakken formation in the Oil-Climate Index (Oil Climate Index, 2016).[37]

Q: **What is the downstream stage?**

A: By downstream, I mean combustion at point of end use.

Q: How do you estimate emissions from the downstream stage?

A: For the downstream stage I estimate emissions based on how much carbon is contained in a barrel of crude oil. According to the United States Environmental Protection Agency, a barrel of crude oil (or its derivatives) releases an average of 432 kg CO_2 once combusted.[38] A barrel of propane and butane releases 236 and 282 kg CO_2, respectively. These figures are derived from combining energy content (mmbtu/barrel) from Tables A-39 and A-41

[37] Oil Climate Index Webtool—Phase II. Carnegie Endowment for International Peace. http://oci.carnegieendowment.org/#total-emissions).

[38] This value of 432 kg CO_2 per barrel from the US EPA is nearly identical to the value of 429 kg CO_2e produced by the Oil-Climate index for Bakken oil. I use the EPA value since the EPA also provides values for propane and butane, and so I can use a consistent source for the largest (combustion) source of emissions across all three liquids.

and carbon contents (t C / mmbtu) from Table A-29 of Annex 2 of the US EPA's national GHG inventory (U.S. EPA, 2021).[39]

Q: What do you do next?

A: The last step in quantifying the emissions associated with petroleum handled by the Project is to estimate what, if any, of the petroleum handled would not ultimately be combusted or otherwise oxidized to CO_2, and for which the emission factors above would therefore not apply. I estimate that 8% of the petroleum handled would ultimately not be combusted or otherwise be oxidized, since it would end up underground as long-term storage, e.g. as plastics buried in landfills that no longer release CO_2. Accordingly, I reduce the per-barrel emissions estimates listed above for the "downstream" stage by 8%.

Q: What do you base that assumed reduction on?

A: I base it on a peer-reviewed study that is the most detailed assessment I am aware of that investigates what fraction of North American oil production is not ultimately combusted.[40] That article evaluates what fraction of oil is used for non-energy uses such as petrochemicals, lubricants, and other industrial uses, as well as what fraction of these otherwise "non-energy uses" are indeed ultimately combusted, such as when plastics are burned at waste-to-energy plants or tires are burned at cement kilns, and concludes that 8.02% of petroleum liquids end up as net carbon storage.

Q: What is the end result of this process?

[39] U.S. EPA. (2021). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019. U.S. Environmental Protection Agency. https://www.epa.gov/ghgemissions/).

[40] Heede, R. Tracing anthropogenic carbon dioxide and methane emissions to fossil fuel and cement producers, 1854–2010. *Climatic Change* **122,** 229–241 (2014). https://doi.org/10.1007/s10584-013-0986-y

A: In total, using the individual assumptions above, I estimate that the GHG emissions associated with the crude oil and NGLs handled by the Proposed Project will be 87,000,000 metric tons of CO_2e annually.

Q: Based on your analysis in this testimony, do you have any observations about the GHG emissions associated with the construction and operation of the Proposed Project as compared to the GHG emissions linked to the crude oil and NGL?

A: Yes. These emissions associated with the crude oil and NGLs handled by the Proposed Project are much larger than emissions associated with constructing and operating the Proposed Project itself. The following table compares all emissions using a common unit of time: one year. To do this, I amortize the emissions associated with construction over the planned 99-year life of the pipeline. I chose a 99-year amortization period because Enbridge refers to a design life of "no less than 99 years" for the tunnel (*Tunnel Design and Construction Report,* page 5).

TABLE 2. SUMMARY OF GREENHOUSE GAS EMISSIONS ASSOCIATED WITH THE PROPOSED PROJECT

GHG emissions category	Average annual emissions (metric tons CO_2e)	Notes
Tunnel construction	870	Amortized over 99 year lifetime
Tunnel operation	520	
Liquids (crude oil and NGL) handled	87,000,000	

V. INCREMENTAL GREENHOUSE GAS (GHG) EMISSIONS CAUSED BY THE PROPOSED PROJECT

Q: Have you estimated the GHG emissions associated with the Proposed Project in any other way?

A: Yes. I also estimated the incremental GHG emissions associated with the Project relative to a no-action scenario.

Q: What is a "no-action" scenario?

A: A no-action scenario is a scenario in which the Proposed Project does not go forward. In light of the Governor's actions, described above, if the Proposed Project does not go forward, Line 5 will no longer operate.

Q: Does your analysis depend on the Governor's actions being upheld in the courts?

A: No. Even if the Governor had not revoked the 1953 Easement, it still would make sense to consider a "no-action" scenario. Enbridge's stated purpose for the Proposed Project is to remove an environmental threat to the Straits of Mackinac caused by the location of the existing pipeline. Irrespective of the Governor's actions, it would be appropriate to consider whether Enbridge could achieve its stated purpose by shutting down the existing pipeline without constructing the Proposed Project.

Q: What are "incremental" GHG emissions, and how are they different from your analysis above?

A: My estimates of GHG emissions above included the major, "gross" sources of GHG emissions reasonably *attributable* to the Proposed Project. A different way of looking at the GHG emissions is instead to estimate what emissions are caused by, or a consequence of, the Project – what could be termed the "net" or "incremental" emissions. This type of estimate relies on assessing how GHG emissions would change with the Proposed Project,

compared to a no-action scenario where the Project does not go forward. This *consequential* view can therefore be useful for decision-makers interested in how any given project, such as the Proposed Project, will incrementally increase GHG emissions.

Q: Why are consequential emissions different from those attributable to the Proposed Project?

A: Because if the Proposed Project were not built, some of the GHG emissions I estimated above would still occur. Some of the oil and NGL products that would have been transported through the Proposed Project would still be transported by other methods, and still consumed. However, for the reasons I explain below, fewer oil and NGL products would be transported and consumed if the Proposed Project were not built, resulting in lower overall GHG emissions.

Q: Is this a common approach in the field of estimating greenhouse gas emissions?

A: Yes. Estimating incremental GHG emissions is a common feature of many GHG emissions estimation methods, including those discussed in the GHG Protocol's *Policy and Action Standard* and those reviewed in Burger and Wentz (2020), "Evaluating the Effects of Fossil Fuel Supply Projects on Greenhouse Gas Emissions and Climate Change under NEPA". The approach here is sometimes termed a *consequential* life-cycle assessment, whereas the approach in the prior section is sometimes termed an *attributional* life-cycle assessment. These terms and approaches are a common methodology used in the field of life cycle assessment, and are discussed in peer-reviewed papers often relied upon in my field, such as Brander, M., & Ascui, F. (2015).[41]

[41] The Attributional-Consequential Distinction and Its Applicability to Corporate Carbon Accounting. In *Corporate Carbon and Climate Accounting* (pp. 99–120). Springer, Cham. https://doi.org/10.1007/978-3-319-27718-9_5

Q: What do you estimate incremental GHG emissions to be?

A: Below I estimate the incremental GHG emissions associated with the Project to be about 27,000,000 metric tons CO_2e annually. This is lower than my estimate of all emissions associated with the Project of 87,000,000 metric tons CO_2e annually because, in my estimation, some of those emissions would occur even if the Proposed Project does not proceed.

Q: How did you estimate incremental GHG emissions associated with the Proposed Project?

A: To quantify the incremental GHG emissions of an energy project or action, one must first describe how that project or action will change the energy market. In the case of the Proposed Project, the availability of oil pipelines, including Line 5, affects global GHG emissions because pipelines help increase the supply of oil. Evaluation of these dynamics is a typical methodology for analyzing incremental GHG emissions of an energy infrastructure project. An overview of such approaches can be found in Section IV of the peer-reviewed paper by Burger and Wentz (2020), "Evaluating the Effects of Fossil Fuel Supply Projects on Greenhouse Gas Emissions and Climate Change under NEPA," attached as Exhibit ELP-4 (PAE-4).[42] The oil market is well-connected globally, and there is a straight-forward connection between oil supply and oil consumption. The more oil is available (and at lower cost), the lower the global price of oil, and the more oil is consumed. And, the more oil is consumed, the higher are GHG emissions from producing and burning oil.

[42] Burger, M., & Wentz, J. (2020). Evaluating the Effects of Fossil Fuel Supply Projects on Greenhouse Gas Emissions and Climate Change under NEPA. *William & Mary Environmental Law and Policy Review*, 44(2), 423–530.

Q: How do pipelines impact global markets for oil?

A: Pipelines increase the supply of oil by providing transport of oil to market when other options do not exist or are higher cost. This is widely understood, and is nicely summarized for Canadian oil in the peer-reviewed article, Heyes et al (2018), "The Economics of Canadian Oil Sands" – attached as Exhibit ELP-5 (PAE-5).[43] That article focuses on oil sands, but with principles that also apply to light oil. Further, when oil supply is greater, prices are lower, an effect which is summarized in my own peer-reviewed work: Erickson, P., & Lazarus, M. (2014), attached here as Exhibit ELP-6 (PAE-6). Impact of the Keystone XL pipeline on global oil markets and greenhouse gas emissions. *Nature Climate Change,* 4(9), 778–781.[44] As these peer-reviewed articles demonstrate, the effects of shifts in oil supply can be quantified using economic principles and models, which is what I do here.

Q: Why do you compare the Proposed Project to a "no-action" scenario?

A: Estimating the effect of the Proposed Project on oil supply requires clearly articulating what would happen in a "no-action" scenario, so that the effect of the Proposed Project can be compared to that, and the incremental effect of the Proposed Project can be quantified. Given that the State of Michigan is revoking and terminating the 1953 Easement that allows Line 5 to operate under the Straits, it is reasonable to consider the no-action scenario to be one in which the Line 5 pipeline is not operational. Even if the 1953 Easement remained valid, it would be appropriate to consider a no-action scenario in which Enbridge shuts down the existing Line 5 and does not replace it with a new segment of pipeline. Enbridge's stated purpose for the project is to "alleviate an environmental concern to the Great Lakes

[43] Heyes, A., Leach, A., & Mason, C. F. (2018). The economics of Canadian oil sands. *Review of Environmental Economics and Policy*, 12(2), 242–263. https://doi.org/10.1093/reep/rey006
[44] Also available at https://doi.org/10.1038/nclimate2335

raised by the State of Michigan relating to the approximate four miles of Enbridge's Line 5 that currently crosses the Straits of Mackinac."[45] One way to achieve that purpose would be to remove Line 5 from the Straits and decommission the pipeline.

Q: What would happen if the existing dual pipelines in the Straits of Mackinac were shut down, and the Proposed Project was not built?

A: In such a case, where the Line 5 pipeline through the Straits of Mackinac is not replaced, more of the oil from Montana, North Dakota, and Western Canada would likely be transported by rail, which is generally more expensive than pipelines for transporting petroleum. The key difference of the scenario *with* the Proposed Project and the scenario *without* the Project is therefore the cost of transporting oil out of these regions of North America. I will refer to these regions as the greater Williston Basin, which includes both the Bakken and Duvernay formations. This is what I analyze in more detail below.

Q: What are the main differences between moving oil by rail as compared to pipeline that affect the incremental GHG emissions associated with the Proposed Project?

A: Studies have found that the added cost for moving light crude oil by rail, as compared to by pipeline, is about USD $6 per barrel more expensive than pipelines. Different studies have found values somewhat above or below this value, but in my opinion, $6 per barrel is a reasonable, midrange estimate. However, I will discuss how my results could be lower or higher if the actual cost premium were different.

[45] Application at ¶2.

Q: Did you do an independent analysis of what the various alternatives to transporting oil and NGL via Line 5 would be?

A: No. I understand that a number of alternative analyses have been undertaken by various experts and groups. However, such a detailed analysis is not necessary for purposes of my analysis of GHG emissions. Rather, I rely on a regional average estimate of how constraints on pipeline capacity can increase the costs for moving oil, based on review of a number of sources.

Q: What sources did you consult to estimate the range of increase in costs for transporting oil from the greater Williston Basin by rail instead of by pipeline?

A: I consulted several sources. One was a statistical analysis of actual pipeline and rail crude oil tariffs, conducted by researchers at the University of Waterloo in Canada.[46] An analysis by university economists, Heyes *et al*. (2018), cited previously, report a range between $3 per barrel (which they attribute to the US State Department) and $9 per barrel (which they attribute to the TransCanada corporation).[47] A banking and financial services company, Scotiabank, also estimated that insufficient pipeline capacity would lead to an increase in costs of oil from Alberta about $6 per barrel.[48] Lastly, Alternative 3 of the Dynamic Risk report *Alternatives Analysis for the Straits Pipeline*, though it was addressing a specific rail path from Superior, Wisconsin to Sarnia, Michigan (and not the system-wide average cost

[46] Morrison, A., Bachmann, C., & Saccomanno, F. (2018). Developing an Empirical Pipeline and Rail Crude Oil Mode Split and Route Assignment Model. *Transportation Research Record,* 2672(9), 261–272. Available at https://doi.org/10.1177/0361198118801350.

[47] Heyes, A., Leach, A., & Mason, C. F. (2018). The economics of Canadian oil sands. *Review of Environmental Economics and Policy*, 12(2), 242–263. https://doi.org/10.1093/reep/rey006

[48] Based on the difference between the MSW (light crude) discounts in the "healthy pipeline" ($3/bbl discount) versus "base case" case ($9/bbl discount) in Chart 1 of Scotiabank (2018). Shut in? Assessing the merits of government supply intervention in the Alberta oil industry. Available at https://www.scotiabank.com/content/dam/scotiabank/sub-brands/scotiabank-economics/english/documents/commodity-note/shut-in-government-intervention-assessment_2018-11-21.pdf.

premium of moving oil by rail from the Greater Williston Basin, which is my focus here), also found a rail cost premium of about $6 per barrel. The key point for my analysis is that the added cost of alternative transport can make it more costly to supply oil and therefore decrease oil consumption, as I describe in more detail below.

Q: Are there greenhouse gas emissions from alternative methods of transporting oil?

A: Yes. The other factor that relates to GHG emissions is that the GHG emissions associated with moving oil by rail are, like cost, also slightly higher. The increase is small, about 6 kg CO_2e per barrel transported by rail instead of by pipeline, which is just 1% of the total GHG emissions associated with a barrel of oil.[49] However, this difference must also be accounted for, as I do below.

Q: Have you quantified how oil supply from the greater Williston Basin would be affected in the no-action scenario, where the existing line stops operating and the Proposed Project is not built?

A: Yes. In the absence of the Line 5 pipeline, some oil fields in the greater Williston Basin may not be able to afford an added cost of $6 per barrel for transporting their oil by rail, since that extra charge would erase any profit that would be expected by oil-field developers. In such a case, prospective new oil fields may not be developed, and so less oil would be supplied to the global oil market compared to the scenario where the Proposed Project is constructed.

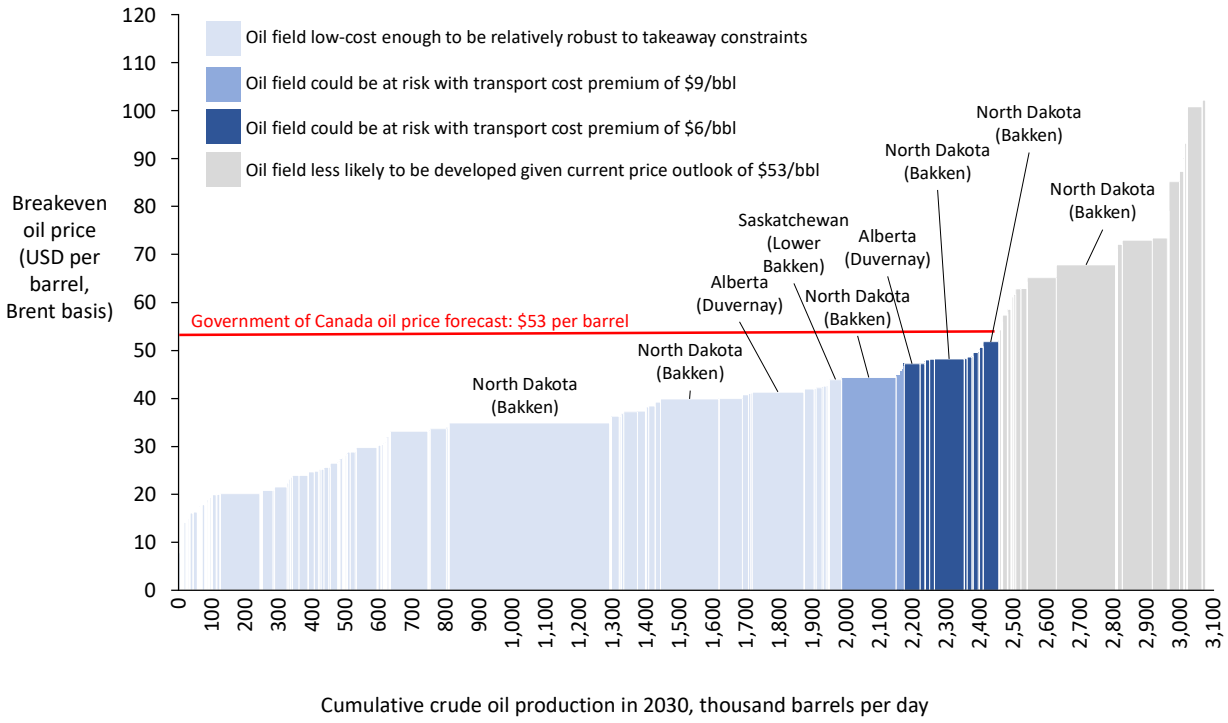
Indeed, the economics of oil in the greater Williston Basin may be challenging in the years ahead. The Government of Canada currently foresees crude oil prices to gradually

[49] Source: Nimana, B., Verma, A., Di Lullo, G., Rahman, Md. M., Canter, C. E., Olateju, B., Zhang, H., & Kumar, A. (2017). Life Cycle Analysis of Bitumen Transportation to Refineries by Rail and Pipeline. *Environmental Science & Technology*, 51(1), 680–691. https://doi.org/10.1021/acs.est.6b02889.

drift downwards towards $53 per barrel by the end of this decade (2030).[50] Oil fields that are only profitable ("break even") at prices just below this level – namely, between $53 per barrel and $47 per barrel ($53 minus the $6 extra for rail transportation) – would therefore not be able to afford an added $6 cost per barrel of transporting their oil to markets. A substantial number of oil projects in the greater Williston Basin are expected to break even in this range of $47 to $53 per barrel, and would therefore be put at risk by the added $6 per barrel in transportation costs. Figure 1, below, shows the sources of light crude oil production in the Canadian provinces of Alberta, British Columbia, Manitoba, and Saskatchewan, and US States of Montana and North Dakota that could potentially feed into the Enbridge mainline pipeline system, including Line 5. The oil fields colored in dark blue are the ones that would be put at risk by a transport cost premium of $6 per barrel. These are new oil fields, for example, in the Bakken formation of North Dakota and the Duvernay formation in Alberta. In total, the quantity of oil that would be put at risk, and ultimately stranded (not developed) by an added $6 per barrel in transportation costs (and assuming an oil price outlook of $53 per barrel) is 290,000 barrels per day. For reference, this is equivalent to about 64% of Line 5's expected crude oil throughput of 450,000 barrels per day.

[50] Canada Energy Regulator. (2021). *Energy Futures 2021: Consultation on Preliminary Results*.

FIGURE 1. CRUDE OIL COST CURVE FOR GREATER WILLISTON BASIN LIGHT CRUDE[51]



Therefore, were the Proposed Project not constructed and Line 5 not to be re-started, I estimate that about 290,000 barrels per day of greater Williston Basin light crude oil production would not be developed, due to the resulting increase in system-wide transportation costs. Note, however, that the actual amount of oil production at risk could actually be larger.

Q: In the no-action scenario, where the existing line stops operating and the Proposed Project is not built, could more than 290,000 barrels per day of oil supply be stranded?

A: My estimate of 290,000 barrels per day put at risk in the no-action scenario assumes that sufficient rail capacity exists to transport the oil carried by Line 5, and that it costs $6 per

[51] Source of cost curve: Rystad Energy. (2021). Cube Browser, Version 2.2. https://www.rystadenergy.com/Products/EnP-Solutions/UCube

barrel more than transporting oil by pipeline. However, when the capacity to move oil from oil fields to markets (whether by rail or pipeline) is constrained, firms that operate pipelines or rail lines can (and do) exert market power and increase their transportation charges or tariffs to capture additional profit. When they have done this in the recent past, the added cost of crude transportation compared to normal, average pipeline costs grows beyond the $6 per barrel difference in costs assumed here, to between roughly $9 per barrel and, in rare circumstances, as much as $27 per barrel on a temporary basis.[52]

Takeaway capacity for crude oil from the greater Williston Basin has been constrained in the past, and likely will be constrained in the coming years. Recent draft forecasts by the Canadian Energy Regulator, a government body, show that, even *with* the Line 5 pipeline (450,000 bpd crude capacity) *and* Line 3 pipeline (full capacity: 760,000 bpd, expanded from current capacity of 390,000 bpd), Western Canada will have only about 100,000 bpd of spare capacity in the system by 2030.[53] However, if *either* of those pipelines is not operational (and assuming continued delays in the Trans Mountain Pipeline expansion project to Vancouver, B.C.) oil transportation capacity would be insufficient. In that case, it is reasonable to expect that the no-action scenario could lead to added transportation charges of around $9 per barrel on a long-term basis.

An added charge of $9 per barrel for rail transport, instead of $6 per barrel, would have an even greater effect on oil supply. As shown in Figure 1, at a transport cost premium

[52] The low end of this is taken from the following source: Heyes, A., Leach, A., & Mason, C. F. (2018). The economics of Canadian oil sands. Review of Environmental Economics and Policy, 12(2), 242–263. https://doi.org/10.1093/reep/rey006. The authors describe a discount for diluted bitumen, a heavier grade of oil, of $9 per barrel at the Hardisty hub, but that the difference between rail and pipeline shipping costs for bitumen is *less* than for other grades of oil, e.g. light crude, that do not require diluent. Therefore, a $9 per barrel up-charge is likely on the low end. Alternatively, the high end is calculated as the difference between the "healthy pipeline" and "persistent distressed discounts" case for MSW (light crude) in Chart 1 of Scotiabank (2018).

[53] Takeaway capacity from western Canada is described on slide 10 of: Canada Energy Regulator. (2021). Energy Futures 2021: Consultation on Preliminary Results.

of $9, and again assuming an oil price outlook of about $53 per barrel, much more oil is at risk (the added oil that becomes at-risk at $9 per barrel, as compared to $6 per barrel, is shown in a medium blue): about 450,000 bpd of crude oil production. In other words, it is conceivable that the full crude oil capacity of the Line 5 pipeline, 450,000 bpd, could be left undeveloped if Line 5 is not re-started.

Q: In the no-action scenario, where the existing line stops operating and the Proposed Project is not built, could fewer than 290,000 barrels per day of oil supply be stranded?

A: Yes, as I explain above, my central estimate is that 290,000 barrels per day will be stranded, but the figure could also be lower. One way that less oil could be stranded is if the long-term price of oil was expected to be much higher than the $53 per barrel figure I used here. I used that estimate, because, in my opinion, the Government of Canada's recent analysis of oil prices is the most up-to-date and relevant for the greater Williston Basin. A forecast of $53 per barrel is also similar to the outlook of oil consultancy Rystad Energy, which foresees the oil price at about $50 per barrel in the latter half of this decade. However, if the long-term outlook for the price of oil was to increase dramatically, e.g. to $100 per barrel, then differences of about $6 per barrel in transportation costs may not matter as much to how much oil is supplied in Figure 1, and so much less oil could be stranded. Or, if the no-action scenario were to lead to much less than a $6 per barrel increase in transportation cost, the amount of oil stranded could also be less.

Note, however, that less-extreme increases in the outlook for oil prices may not have much effect on my estimate of how much oil would be at risk. For example, the U.S.

Energy Information Administration has forecast oil prices to be about $73 per barrel, [54] which is higher than the $53 forecast from the Canada Energy Regulator. But while a price outlook of $73 would shift *which* exact oil fields are at risk (shifting up the cost curve in Figure 1), the same *number* of barrels – about 290,000 barrels – would be at risk.

Q: Are your estimates of additional rail costs the same as what Michigan oil producers would expect to see if they were no longer able to use Line 5 to get their oil to market?

A: No. These estimates of rail costs reflect the cost of transporting crude oil from the greater Williston Basin to markets. I have no reason to believe they would reflect the additional cost to Michigan producers who would no longer be able to use Line 5 and instead used rail transport to get their product to market, since that is a much smaller quantity of oil in a much more localized transportation market.

Q: How much would the added cost of oil from the greater Williston Basin affect global GHG emissions?

A: Put simply, shutting down the existing dual pipelines in the Straits and not building the Proposed Project would lead to less, and more costly, oil supplied from the greater Williston Basin over the long term. This outcome would affect global oil markets and consumption levels, because the long-term global price of oil is directly affected by how much it costs to develop the oil fields that will provide the added, or marginal, sources of supply at a given level of expected demand.[55] Since new sources of oil would be more costly than previously anticipated, the long-term oil price would rise, and oil consumers

[54] Brent crude oil price forecast in real dollars for 2030 from US EIA. (2021). *Annual Energy Outlook 2021*. U.S. Energy Information Administration. http://www.eia.gov/forecasts/aeo/

[55] For a discussion of these dynamics, see page 7 of Fattouh, B., Poudineh, R., & West, R. (2019). Energy transition, uncertainty, and the implications of change in the risk preferences of fossil fuels investors. The Oxford Institute for Energy Studies, or Erickson, P., van Asselt, H., Koplow, D., Lazarus, M., Newell, P., Oreskes, N., & Supran, G. (2020). Why fossil fuel producer subsidies matter. *Nature*, 578(7793), E1–E4. https://doi.org/10.1038/s41586-019-1920-x

would respond to the higher expected price by using less oil, such as by switching to other forms of lower-carbon transportation or by using more efficient vehicles. The effect of reductions in oil supply on oil price and consumption is well-established, even as it is also the subject of ongoing research and debate, as discussed in Hamilton (2009) and Caldara et al (2019).[56]

Q: Why are the costs of oil from the greater Williston Basin so important?

A: The costs of oil from the greater Williston Basin are especially important because this region is expected to be one of the major sources of the new, added supplies of oil in the years to come. In particular, the crude oil from these regions is expected to comprise at least 7% of the marginal, new sources of oil, based on my analysis of the costs and volumes of world oil supply in Rystad Energy's Ucube database.[57] An increase in the cost of oil from the greater Williston Basin would therefore have a proportional effect on the global marginal cost of supplying oil: namely, a $6 per barrel increase in the cost of oil from this region could increase the average *global* marginal cost of supplying oil by about $0.40 per barrel. (An increase of $6 per barrel in 7% of the marginal cost translates, via simple multiplication, to an average increase of $0.40 per barrel). That, in turn, would translate into an increase in global oil prices of about $0.29 per barrel.

Q: Will that increase in oil prices have a significant impact on customers in Michigan?

A: I have not conducted that analysis here, but it in my opinion it is unlikely that the effects of the price increase would be locally significant. Rather, the impacts of the per barrel price

[56] Hamilton, J. D. (2009). Understanding crude oil prices. *The Energy Journal*, 30(2), 179–206. https://doi.org/10.5547/ISSN0195-6574-EJ-Vol30-No2-9; Caldara, D., Cavallo, M., & Iacoviello, M. (2019). Oil price elasticities and oil price fluctuations. *Journal of Monetary Economics*, 103, 1–20. https://doi.org/10.1016/j.jmoneco.2018.08.004

[57] Rystad Energy. (2021). Cube Browser, Version 2.2. https://www.rystadenergy.com/Products/EnP-Solutions/UCube

increase would have global impacts. Even though the increase is small on the individual level ($0.29 per barrel of oil is less than 1 cent per gallon), that added cost would add up to globally significant effects on consumer behavior and oil consumption around the world, since it would lead to changes in how (and how many) people and goods are transported using oil.

Q: If the Proposed Project were built, what is your overall estimate of the incremental GHG emissions compared to the no-action alternative?

A: In total, assuming a $6 per barrel increase in transportation costs associated with rail transport of petroleum, I estimate that, compared to the no-action scenario, where the existing line stops operating and the Proposed Project is not built, building the Proposed Project would lead to a net, incremental increase in annual global oil consumption of about 150,000 bpd, equivalent to 27,000,000 metric tons CO_2e per year from burning and producing that oil. Nearly all of this increase in oil consumption and GHG emissions would occur outside Michigan.

Q: How did you calculate this estimate?

A: This change in global oil price and oil consumption is calculated using a simple oil market model, parameterized by elasticities (long-run elasticity of crude oil supply of 0.6, long-run elasticity of crude oil demand of -0.3), a model that is described in more detail in my peer-reviewed, scientific work, including, most recently: Achakulwisut, P., Erickson, P., & Koplow, D. (2021). Effect of subsidies and regulatory exemptions on 2020–2030 oil and gas production and profits in the United States. *Environmental Research Letters*, 16(8), 084023, which is attached here as Exhibit ELP-7 (PAE-7).[58] I convert this change in oil

[58] Available at https://doi.org/10.1088/1748-9326/ac0a10 .

consumption to a change in GHG emissions from burning oil by assuming a global, reference GHG-intensity of crude oil of 502 kg CO_2e per barrel, while also assuming that any oil now carried by rail instead of pipeline does so at an added GHG-intensity of 6 kg CO_2e per barrel.

"Long-run" elasticities are intended to gauge effects over a period of time in which producers and consumers have time to make changes in their equipment or investment decisions, such as the decision of what kind of car to buy or whether or not to drill a new oil field. Over this time period – the next several years – the flexibility of decisions is greater than in the "short run," and hence the effects of a change in price are greater. The long-run elasticities of supply (0.6) and demand (-0.3) that I use here are the same as in my most recent peer-reviewed research. An elasticity of supply of 0.6 is consistent with a fairly "flat" oil supply curve characteristic of the current oil price outlook. (Were oil price outlooks to be much higher, e.g. over $100, the supply curve would be steeper, and the elasticity of supply lower.)

A long-run elasticity of demand, -0.3, is higher (in absolute value) than some prior reviews: Hamilton (2009) reported a range of -0.2 to -0.3. A higher value like -0.3, is commonly believed to be more consistent with the greater current availability of electric vehicles, and is still lower than an alternative, commonly used value of -0.5 as reported by Raimi (2019).[59]

Q: What is the source of your assumption about the elasticity of supply and demand?

A: My source for the elasticity of supply estimate of 0.6 is taken directly from the slope of the oil supply curve, as assembled by oil industry consultancy Rystad Energy, for prices in the

[59] Raimi, D. (2019). The Greenhouse Gas Impacts of Increased US Oil and Gas Production [Working Paper 19-03]. http://www.rff.org

$50 per barrel to $70 per barrel range, as described in Erickson *et al.* 2020. My source for the elasticity of demand is taken from Hamilton (2009).

Q: Why did you choose these specific values and not others in the literature?

A: The values I am using represent my expert judgment as to most reasonable values for the present situation, given current oil price outlooks and the expanding alternatives to oil in the transport sector, which is by far the largest sector using oil. These values are also well within the ranges used in other studies, and therefore represent mid-range values that should yield reasonable results for decision-makers. It would also be possible to use different values to get a sense of how the results could change.

Q: Did you calculate the results using different values?

A: Yes. I did a sensitivity analysis in which I varied elasticities of supply and demand to see how the results could vary. In the table below, I display how very different assumptions about elasticities of supply and demand could make my estimate of 27 million metric tons CO_2e higher or lower. While I present this to show a wide range of potential outcomes, I find the lower elasticity of supply value of 0.1 to be extraordinarily unlikely, as that implies a very steep supply curve in which oil producers are very insensitive to price, a situation that only arises if long-term oil forecasts are very high, e.g. over $100 per barrel. In the more likely scenario – with higher elasticity of supply -- the incremental GHG emissions remain over 20 million metric tons CO_2e even where assumptions regarding the elasticity of demand change.

TABLE 3. INCREMENTAL GLOBAL GHG EMISSIONS (MILLION TONS CO_2E) RESULTING FROM THE PROPOSED PROJECT, USING DIFFERENT ELASTICITIES OF SUPPLY AND DEMAND

		Long-run elasticity of global crude oil supply		
		0.1	**0.6** (best estimate)	1
Long-run elasticity of global crude oil demand	-0.2	4.2 million t CO_2e	20 million t CO_2e	27 million t CO_2e
	-0.3 (best estimate)	4.8 million t CO_2e	**27 million t CO_2e**	38 million t CO_2e
	-0.5	5.4 million t CO_2e	37 million t CO_2e	55 million t CO_2e

Values in **bold** are best estimates used in this testimony

Q: Does this mean that your estimate of incremental GHG emissions could be lower?

A: Yes, of course. As indicated in Table 3 above, my estimate of incremental emissions could be much lower if the elasticity of supply of oil was much lower, a situation that could arise if oil demand were to outpace oil supply in the years ahead and oil prices were to rise substantially, e.g. to well over $100 per barrel. I consider this outcome unlikely and, also, not very consistent with global goals to decarbonize the economy, the attainment of which would instead yield greatly reduced oil demand and, in turn, lower oil prices. As explained in my testimony above, my estimate could also be somewhat lower if the absence of Line 5 had less of an effect on oil transportation costs than in my central estimate.

Q: Are there any other ways your estimate of incremental GHG emissions could be lower?

A: Yes. Another way my estimate could be affected is if consumers, in response to slightly lower oil prices resulting from the Proposed Project (compared to the no-action scenario), were to increase their oil consumption at the expense of other fossil-based sources of energy, such as coal or gas-based electricity. I have not evaluated those effects, termed

"cross-price" or substitution effects in the economic literature, because they involve different fuels than what would be handled by the Proposed Project and so are secondary considerations. These effects could reduce my incremental estimate of 27 million metric tons CO_2e somewhat; however, as the global energy transition accelerates, the marginal source of the main substitute for oil – electricity – is no longer mainly fossil fuels, but instead primarily very low-carbon renewable power. This strong trend towards renewable power suggests that any shift away from electricity would have relatively minor effects on my incremental GHG emissions estimate.

Q: How could your estimate of incremental GHG emissions be higher?

A: My estimate of incremental GHG emissions could be somewhat greater if consumers were even more sensitive to oil prices in the future than they have been in the past (i.e., an elasticity of demand of -0.5 or more, as in Table 3) or if, as described above, the rail and pipeline takeaway capacity from the greater Williston Basin is even more constrained than I assume here (e.g., if either the Line 3 or Trans Mountain pipeline projects currently underway are not completed).

Q: If the estimate could change, why should it be relied upon here?

A: I believe my central estimate of 27,000,000 metric tons CO_2e is a reasonable approximation of the incremental effect of the Proposed Project on global GHG emissions based on available information regarding supply and demand elasticities. The methods used above use standard GHG emissions accounting principles, and my specific approaches regarding pipelines and oil markets have been successfully scrutinized by the scientific peer review process several times for other projects. Furthermore, I have considered several possible uncertainties. Finally, in other contexts involving estimations of GHG emissions, courts

have concluded that the inherent uncertainties in these types of estimations is no justification for failing to quantify these effects.[60]

Q: What about the possibility that, if the Proposed Project is not built, the "no action" scenario is not the closing of Line 5, but instead that the existing, dual pipelines continue to operate for some limited amount of time?

A: In such a case, then the concept of incremental emissions described above still applies, but the effect is essentially postponed by however many years the existing dual pipelines could continue to operate.

Q: Have you estimated how this decrease in the quantity of oil consumed would impact customers in Michigan?

A: No. My focus is on the global GHG emissions effect of the Line 5 pipeline. Michigan represents only about one-half of 1% of global oil consumption, so the GHG emissions effects inside Michigan are a small part of the overall GHG emissions effects of the Line 5 pipeline. Of course, the impact on Michigan's natural resources, as the result of all global GHG emissions, is significant, as discussed by other expert witnesses in this case.

Q: Have you estimated changes in price, consumption, or incremental GHG emissions associated with the propane or butane handled by the Proposed Project?

A: No. In contrast to the incremental emissions from increased consumption of crude oil that would result from constructing the Proposed Project (relative to the no-action scenario), which are driven by effects global markets, any incremental emissions from changes in propane and ethane markets would likely be more local, due to propane and ethane markets in the Eastern U.S. and Canada, including in Michigan.

[60] *See Ctr. for Biological Diversity v. Bernhardt*, 982 F.3d 723, 739–40 (9th Cir. 2020).

These effects are likely much smaller than for crude oil for three reasons: (1) the quantity of these NGLs handled by the pipeline is only 20% the volume of crude; (2) NGLs contain at least 35% less carbon per barrel than crude; and (3) the propensity for end-markets to increase their consumption of NGLs (relative to the no-action scenario) may be less than for crude oil, as consumers do not make as frequent decisions regarding home heating (a key source of propane use) as they do about how often and what kind of vehicle to drive.

For these reasons, I do not estimate the changes to price, consumption, or incremental GHG emissions associated with NGLs. I do note that the same fundamental market principles would apply as for oil: proceeding with the Proposed Project would, relative to the no-action scenario, would mean lower costs of producing NGLs from the greater Williston Basin, lower prices for these liquids, and therefore a (proportionally smaller) increase (again, relative to the no-action scenario) in their consumption.[61]

Q: Have you estimated how the incremental GHG emissions caused by the Proposed Project would affect climate change, including in Michigan?

A: No. Consistent with section III of this testimony ("Overview of climate change and the need for greenhouse gas emissions cuts"), the intent of global climate change policy is that substantial emission reductions are needed in all regions of the world and in all sectors. Accordingly, the change in warming or climate impacts that would result from actions in Michigan should be viewed in that context and not as isolated (and proportionally smaller) effects on global temperature.

[61] Lower-carbon alternatives to propane (e.g. for heating or for industrial equipment) and butane (e.g. for petrochemicals and plastic manufacturing) are becoming available.

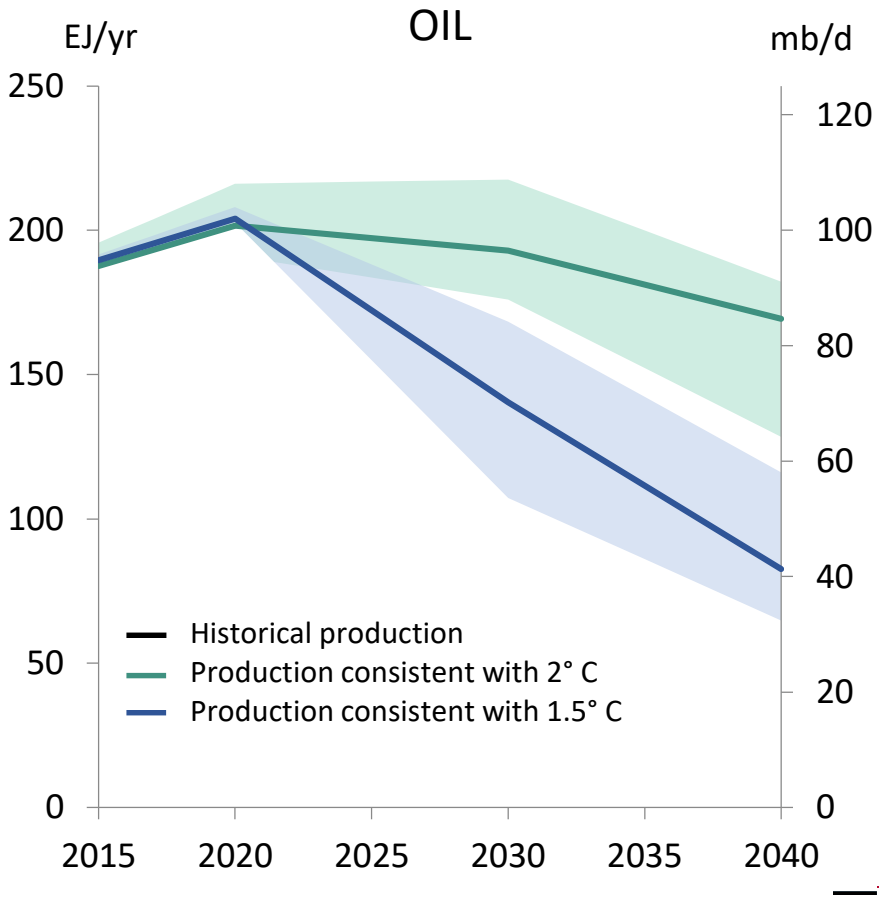
~~VI. INCONSISTENCY OF THE PROPOSED PROJECT WITH INTERNATIONALLY AGREED CLIMATE LIMITS~~

~~**Q: Is Enbridge's Proposed Project generally consistent with international, national and state climate goals?**~~

~~A: No. Michigan's Governor Gretchen Whitmer has initiated the MI Healthy Climate Plan aimed at protecting public health and the environment, and helping to develop new clean energy jobs, by putting Michigan on a path towards becoming carbon-neutral, meaning net zero greenhouse gas emissions, by 2050. Further, the Governor has committed the State of Michigan to advance the goals of the Paris Agreement. As described in section III of this testimony, one of the goals of the Paris Agreement is "pursuing efforts" to limit global warming to 1.5°C above pre-industrial levels. To meet that goal with no or "limited" overshoot (exceedance) of the temperature limit, the Intergovernmental Panel on Climate Change (IPCC) has found that global emissions must reach zero by about the year 2050. Further, the IPCC has found that oil production and use must fall by an average of about 3% annually (for a total of 65%) between 2020 and 2050.~~

~~Analysis by international research organizations of the IPCC's emission-reduction pathways, published in partnership with the United Nations' Environment Program, has found that oil production needs to decline under both the 1.5 °C and 2 °C limits, as shown in Figure 2.~~

FIGURE 2. OIL PRODUCTION AND USE CONSISTENT WITH 1.5 °C AND 2 °C LIMITS[62]



By contrast, maintaining oil production at recent levels for the next several decades is not consistent with meeting the warming goals of the Paris Agreement. Constructing long-lived oil infrastructure, such as pipelines, that helps lower the cost and investment risk of oil production – increasing oil use and emissions (as demonstrated in Section V of this testimony) is therefore at odds with the temperature and emissions goals of the Paris Agreement.

[62] Figure adapted from SEI, IISD, ODI, E3G, & UNEP. (2020). The Production Gap: Special Report 2020. http://productiongap.org/2020report. Green and blue bands show inter-quartile ranges across all scenarios analyzed by the Production Gap Report authors.

~~**Q: Besides the IPCC and the UN Environment Program, are there any other major international institutions that have pointed out the disconnect between further oil-related development and climate goals?**~~

~~A: Yes, the International Energy Agency (IEA), an intergovernmental organization, has similarly found that expanding oil production is inconsistent with reaching zero emissions by mid-century and limiting warming to 1.5°C. In its recent *Net Zero by 2050* report, the IEA found that there is "no need for investment in new fossil fuel supply" in their net-zero pathway.[63] More specifically, the IEA stated that "no new oil and natural gas fields are needed," which helps lead to a "contraction of oil and natural gas production."[64]~~

~~Constructing the Proposed Project and re-starting Line 5 would provide added certainty and low-cost takeaway capacity for new oil fields in the Bakken and Duvernay formations in Alberta, British Columbia, and Saskatchewan provinces of Canada, and in the states of North Dakota and Montana in the U.S. (*See* Figure 1). Developing new oil fields in these regions would be inconsistent with both the IPCC scenarios and the IEA's road map for reaching net zero by 2050, and would thus also be inconsistent with Michigan Governor Whitmer's commitment to align the state's policies with the Paris Agreement and with net zero emissions by 2050.~~

SUMMARY OF TESTIMONY/CONCLUSIONS

Q: Please summarize your conclusions.

A: My testimony has three main conclusions.

~~[63] Source: page 21 of IEA. (2021). *Net Zero by 2050: A Roadmap for the Global Energy Sector*. International Energy Agency. https://www.iea.org/reports/net-zero-by-2050~~

~~[64] Source: page 23 of IEA (2021).~~

First, as described in section IV of this testimony, the Proposed Project is associated with about 87 million metric tons carbon-dioxide equivalent (CO_2e) annually, the overwhelming majority of which are from the use, or combustion, of the oil and natural gas liquids transported by the Line 5 pipeline.

Second, as described in section V, compared to a no-action scenario, where the Line 5 pipeline no longer operates in the Straits, the Proposed Project would lead to an *increase* of about 27 million metric tons CO_2e in global greenhouse gas emissions from the production and combustion of oil.

~~Third, as described in section VI, by enabling the continued, long-term production and combustion of oil, construction of the project would work against, and therefore be inconsistent with, the goals of the global Paris Agreement and Michigan's Healthy Climate Plan.~~

Q: Does this conclude your testimony?

A: Yes.

STATE OF MICHIGAN
MICHIGAN PUBLIC SERVICE COMMISSION

In the matter of **Enbridge Energy, Limited Partnership's** declaratory request that it has the requisite authority needed from the Commission for the proposed Line 5 pipeline Project.	)))))	Case No. U-20763

PROOF OF SERVICE

I hereby certify that a true copy of the foregoing **Revised Testimony of Peter Erickson on Behalf of the Environmental Law and Policy Center and Michigan Climate Action Network** was served by electronic mail upon the following Parties of Record, this 18th day of January, 2022.

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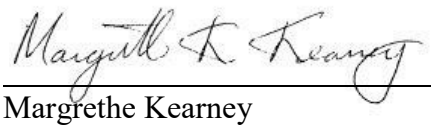

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