



**ENVIRONMENTAL LAW
& POLICY CENTER**



**MICHIGAN
CLIMATE ACTION
NETWORK**

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Delivered Via Electronic Submission at <https://www.line5tunneleis.com/> & Electronic Mail

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RE: Comments of Environmental Law & Policy Center and Michigan Climate Action Network to the United States Army Corps of Engineers, Detroit District on the Draft Environmental Impact Statement for the Enbridge Line 5 Tunnel Project

Dear Detroit District:

Thank you for the opportunity to submit written comments on the Draft Environmental Impact Statement for the Enbridge Line 5 Tunnel Project (“DEIS”) published by the United States Army Corps of Engineers, Detroit District (“Corps” or “USACE”) on May 30, 2025. This is in response to the Notice of Availability issued by the Corps and included in the *Federal Register* at 90 Fed. Reg. 23050 (May 30, 2025). These comments are submitted on behalf of two 501(c)(3) nongovernmental organizations: (1) the Michigan Climate Action Network (MiCAN), which is dedicated to confronting the climate crisis in Michigan and to advancing equitable climate solutions with the urgency science demands for the environment and all that live in it; and (2) the Environmental Law & Policy Center (ELPC), which advocates, innovates, and litigates to protect the Midwest’s environment from the Great Lakes to the Great Plains.

The Corps prepared the DEIS pursuant to the National Environmental Policy Act (“NEPA”)¹ during its evaluation of Enbridge Energy, Limited Partnership’s (“Enbridge”) application for a permit pursuant to Section 404 of the Clean Water Act (“CWA”),² and Section 10 of the River and Harbors Act (“RHA”).³ Enbridge seeks to construct a four-mile tunnel beneath the lakebed of the Straits of Mackinac (“the Straits”) to house a new segment of its Line 5 pipeline that will transport oil and natural gas liquids across the juncture of Lake Huron and Lake Michigan for 99 years (the “Tunnel Project”). The Tunnel Project would replace two existing, 72-year-old

¹ 42 U.S.C. § 4321, *et seq.*

² 33 U.S.C. § 1344.

³ 33 U.S.C. § 403.

pipelines that cross the Straits fully exposed along the lakebed (the “Dual Pipelines”), through which Enbridge transports 540,000 barrels per day (bpd) of oil and natural gas liquids to refineries and fractionators, primarily in Sarnia, Canada.⁴ On May 23, 2017, Enbridge entered into a Consent Decree with the United States Environmental Protection Agency (“EPA”) arising from multiple massive oil spills on Enbridge’s pipeline system, in which Enbridge committed to undertake numerous maintenance and monitoring efforts, including for the Dual Pipelines crossing the Straits, to reduce risks of future additional oil spills,⁵ and pursuant to which Enbridge was required to pay civil penalties totaling \$62 million for Clean Water Act violations.⁶ Subsequently, the State of Michigan and Enbridge engaged regarding the risk of an oil spill from the Dual Pipelines in the Straits, including from vessel anchor strikes.⁷ Universities and experts published comprehensive studies and models of an oil spill from the Dual Pipelines in the Straits and the enormous environmental harms and economic damages that would result.⁸ Citing “the inherent risks of pipeline operations, and the foreseeable, catastrophic effects if an oil spill occurs at the Straits,” on November 13, 2020, the State of Michigan, through Governor Gretchen Whitmer and the Department of Natural Resources, “provide[d] formal notice to Enbridge that the State is revoking and terminating the 1953 Easement” for the Dual Pipelines.⁹

Faced with emerging awareness of, and concern over, oil spills on Enbridge’s pipeline system and the risk of a spill from the Dual Pipelines on the lakebed crossing the Straits, and with the revocation of the easement for the Dual Pipelines, Enbridge has been pursuing the Tunnel Project as a means to avoid the Dual Pipelines’ ceasing operation and as a justification to continue transporting oil and natural gas liquids across the Straits for another 99 years. The DEIS states that the Tunnel Project’s purpose is to “minimiz[e] environmental risks”—i.e., the risk of oil spills resulting from vessel anchor strikes—so that the Line 5 pipeline can continue “transportation of light crude oil, like synthetic crude oil, light sweet crude oil, and NGLs [natural gas liquids]”

⁴ See, e.g., DEIS at pages 1-14, 4-182.

⁵ See Consent Decree entered in *United States of America v. Enbridge Energy, Limited Partnership, et al.*, Civil Action No. 1-16-cv-914 (W.D. Mich. May 23, 2017), available at https://www.epa.gov/system/files/documents/2025-04/enbridge_consent_decree.pdf.

⁶ U.S. EPA, “Enbridge Clean Water Act Settlement,” available at <https://www.epa.gov/enforcement/enbridge-clean-water-act-settlement>.

⁷ See DEIS at page 1-13.

⁸ See, e.g., “Statistical Analysis of Straits of Mackinac Line 5: Worst Case Spill Scenarios” (University of Michigan, March 2016), available at <https://graham.umich.edu/media/pubs/Mackinac-Line-5-Worst-Case-Spill-Scenarios.pdf>; “Oil Spill Economics: Estimates of the Economic Damages of an Oil Spill in the Straits of Mackinac in Michigan” (Michigan State University, May 2018), available at https://flowforwater.org/wp-content/uploads/2018/05/FLOW_Report_Line-5_Final-release-1.pdf; see also <https://graham.umich.edu/project/mackinac-oil-spill> (presenting additional related sources and materials);

⁹ November 13, 2020 Notice of Revocation and Termination of Easement, available at https://content.govdelivery.com/attachments/MIEOG/2020/11/13/file_attachments/1600920/Notice%20of%20Revocation%20and%20Termination%20of%20Easement%202811.13.2029.pdf; see also “Governor Whitmer Takes Action to Shut Down the Line 5 Dual Pipelines through the Straits of Mackinac After a Reasonable Transition Period to Protect the State’s Energy Needs,” available at <https://www.michigan.gov/whitmer/news/press-releases/2020/11/13/governor-whitmer-takes-action-to-shut-down-the-line-5-dual-pipelines-through-the-straits-of-mackina>.

across the Straits at the “existing capacity” of 540,000 barrels per day.¹⁰ The DEIS states that “[a]ll deliveries of Line 5 products” “feed fractionators and refineries” that already existing and that “are located south of the Straits crossing,” primarily in Sarnia, Ontario, and “none [of these deliveries] could be achieved absent the Straits crossing.”¹¹ In other words, the Tunnel Project bears upon the destination of Line 5 products, and the use of those products at refineries and fractionators in Sarnia is directly connected to and dependent upon the Project. The Corps’ permitting decision also is directly related to the continuing transport of oil and natural gas liquids through the Straits and to Sarnia.

The Tunnel Project, if constructed, would significantly affect the quality of the human environment.¹² Despite this, the DEIS fails to comply with NEPA in several important respects. The DEIS fails to adequately analyze the reasonably foreseeable environmental effects, including, in particular, reasonably foreseeable adverse environmental effects from greenhouse gas emissions (sometimes referred to as “GHG emissions”) and climate impacts that cannot be avoided should the Tunnel Project be implemented.¹³ The DEIS, for example, does not make use of reliable data and resources regarding greenhouse gas emissions and climate impacts, nor does it undertake scientific or technical analysis of these effects.¹⁴ Moreover, the DEIS fails to analyze a reasonable range of alternatives to the Tunnel Project, including a proper no-action alternative where the permit request is denied and the existing Dual Pipelines cease operation.¹⁵ In addition to failing to comply with the requirements of NEPA, the DEIS also fails to comply with the requirements of the public interest review that the Corps must conduct.¹⁶

In the pages that follow, MiCAN and ELPC provide comments identifying and explaining numerous fundamental flaws of the DEIS. These comments focus, in particular, on the DEIS’ complete failure to consider, analyze, and disclose to the public the greenhouse gas emissions and climate impacts of the Tunnel Project. But the DEIS’ flaws span numerous other areas as well, which other commentators have addressed in more detail and which MiCAN and ELPC incorporate rather than covering the same ground. Accordingly, MiCAN and ELPC incorporate by reference, as if fully stated within these comments, the complete submissions of comments, supporting materials, and expert reports of the following stakeholders: (1) Bay Mills Indian Community; (2) the Great Lakes Business Network and the National Wildlife Federation; and (3) FLOW Water Advocates and the Sierra Club.

As discussed below, and in the comments of other stakeholders incorporated herein, the DEIS is fundamentally flawed and fails to comply with the requirements of NEPA and the Corps’ public interest review. The DEIS defines the Tunnel Project’s purpose and need too narrowly for

¹⁰ DEIS at page 1-16; *see also id.* at page 2-3, footnote 5.

¹¹ *Id.* at page 1-14; *see also id.* at pages 3-143, 3-145.

¹² *See* 42 U.S.C. § 4332(2)(C).

¹³ *See d.* at §§ 4332(2)(C)(i) – (ii).

¹⁴ *See id.* at §§ 4332(2)(D) – (F); *id.* at §§ 4336(b)(3)(A), (B)

¹⁵ *See id.* at § 4332(2)(C)(iii).

¹⁶ *See* 33 CFR § 320.4(a).

a true hard look at the Project's effects or consideration of real alternatives, including those that do not permanently destroy wetlands, alter lakebed geology, and denigrate important cultural sites. While the DEIS does identify some of the Tunnel Project's impacts, the Corps' analysis still misses crucial aspects that reveal that the impacts will be considerably worse, including the perpetuation of oil spill risks throughout the Great Lakes watershed, the climate impacts from building a massive new fossil fuel infrastructure project, and the disproportionate impacts on Tribal Nations. These adverse environmental effects will be born by the public, whereas the benefit flows to Enbridge, allowing it to continue transporting oil and natural gas liquids across the Straits for decades to come despite the public's concerns and policymakers' decisions that fossil fuel products should not flow in the Great Lakes. The DEIS elevates Enbridge's corporate interests over the public interest, undermining protection of the Great Lakes for all who depend on them.

Finally, MiCAN and ELPC object to the Corps' use of "special emergency permitting procedures" to substantially compress the public's opportunity to review the DEIS and provide comments. In fact, between December 2022 and April 2025, the Corps' website consistently presented a "NEPA Timeline" calling for a comment period of 60 days following publication of the DEIS, but in May 2025 the Corps surreptitiously revised the timeline to cut in half the comment period from 60 to 30 days.¹⁷ As shown in the comments of Bay Mills Indian Community, which MiCAN and ELPC incorporate, the Corps' fast-tracking of the permitting process and invocation of special emergency procedures are unsubstantiated and unlawful. The Corps has not given the public sufficient time to review and comment on the DEIS; nor, apparently, will the Corps devote sufficient time to fully considering comments. Far from informed deliberation and decision-making, this "emergency" process predetermines a permit approval outcome.

For the reasons discussed below, and in the incorporated comments, MiCAN and ELPC respectfully submit that the Corps should deny the permit or, at the very least, revise, supplement, and issue for public review and comment a new environmental impact statement that addresses the DEIS' numerous fundamental flaws identified by commentators, including addressing greenhouse gas emissions and climate impacts. Whichever course the Corps takes, MiCAN and ELPC will continue to participate in this process and request a full and fair opportunity to do so.

I. The DEIS Fails to Analyze Reasonably Foreseeable Effects of GHG Emissions.

The DEIS does not comply with legal requirements to analyze reasonably foreseeable environmental effects of the Tunnel Project, including any adverse environmental effects which cannot be avoided should the project be implemented, because the Corps failed to consider, evaluate, quantify, and compare with alternatives the Tunnel Project's direct and indirect effects on greenhouse gas emissions and associated climate impacts. Throughout this process, the Corps has solicited and received substantial input and statements of concern from the public and stakeholders regarding the Tunnel Project's effects on "climate change, including greenhouse gas

¹⁷ The Internet Archive's "Wayback Machine" reveals the timing of this revision of the timeline. Compare <https://web.archive.org/web/20221203193709/https://www.line5tunneleis.com/nepa-timeline/> ("NEPA Timeline" webpage captures from December 2022 to April 2025 showing a 60-day comment period) with <https://web.archive.org/web/20250503162438/https://www.line5tunneleis.com/nepa-timeline-deis/> (revised "NEPA Timeline" webpage captures in May 2025 showing a 30-day comment period).

emissions and the social cost of greenhouse gases.”¹⁸ Yet, the DEIS does not include *any* analysis whatsoever of these effects. In fact, the DEIS’s treatment of “Greenhouse Gas Emissions and Climate Change” amounts, in its entirety, to a bare conclusion on page 1-6 that these effects are “Not Applicable,” supported by a single footnote 1, in which the Corps simply states:

USACE has removed this topic from consideration within the EIS consistent with Executive Order (EO) 14154, Unleashing American Energy, and due to the rescission of EO 14096, Revitalizing Our Nation’s Commitment to Environmental Justice for All, EO 12898, Environmental Justice, EO 13990, Protecting Public Health and the Environment and Restoring Science To Tackle the Climate Crisis, EO 14007, President’s Council of Advisors on Science and Technology, and EO 14008, Tackling the Climate Crisis at Home and Abroad.

NEPA, decades of judicial precedents interpreting and applying NEPA’s statutory requirements, and the regulations mandating a public interest review all establish the legal requirement that the DEIS consider, analyze, and disclose to the public the reasonably foreseeable effects of greenhouse gas emissions and climate impacts associated with the Tunnel Project. A broad scientific consensus shows that climate impacts due to greenhouse gas emissions significantly affect the quality of the human environment. MiCAN and ELPC have provided the Corps with ample expert analysis of the reasonably foreseeable effects of greenhouse gas emissions and climate impacts associated with the Tunnel Project. The DEIS fails to address this relevant environmental information, fails consider and analyze reliable data and resources regarding greenhouse gas emissions and climate impacts, and fails to undertake necessary scientific or technical analysis. The DEIS needs to be revised and supplemented to fully address this information, and perform and present the Corps’ analysis of greenhouse gas emissions and climate impacts of the Tunnel Project.

A. NEPA Requires Analysis of Environmental Effects of GHG Emissions.

Congress declared that NEPA’s purpose is to enact a “national policy” to “promote efforts which will prevent or eliminate damage to the environment and biosphere,”¹⁹ to “fulfill the responsibilities of each generation as trustee of the environment for succeeding generations,” to “attain the widest range of beneficial uses of the environment without degradation, risk to health

¹⁸ See Notice of Intent To Prepare a Draft Environmental Impact Statement for the Line 5 Tunnel Project, Mackinac and Emmet Counties, Michigan, 87 Fed. Reg. 50074, 50076 (Aug. 15, 2022); *see also* ELPC/MiCAN Line 5 Scoping Comments, at pages 9-12 (October 14, 2022), available at <https://www.line5tunneleis.com/wp-content/uploads/2022/10/Line-5-Corps-scoping-comment-2022.10.14-FINAL-e8755c5ed22df3e88163857507103312.pdf>; Bay Mills Indian Community’s Comments on the Scope of the Environmental Impact Statement for the Enbridge Line 5 Tunnel Project, Detroit District, at pages 35-42, (October 14, 2022), available at https://www.baymills.org/files/ugd/869f65_89226c222b4342918e4443a34ce1efd8.pdf; For Love of Water Scoping Comments, at pages 10-11, (October 14, 2022), available at <https://forloveofwater-wp-uploads.s3.us-east-2.amazonaws.com/wp-content/uploads/2022/10/FLOW-EIS-Scoping-Comments-to-US-Army-Corps-10-14-2022.pdf>; DEIS, Volume 2, Appendix B, at pages 54-59.

¹⁹ 42 U.S.C. § 4321.

or safety, or other undesirable and unintended consequences,”²⁰ and to give “*presently unquantified* environmental amenities and values . . . appropriate consideration,”²¹ among other objectives. The Corps’ decision to exclude entirely any consideration of greenhouse gas emissions and climate impacts from the Tunnel Project is troubling and inconsistent with the purpose and language of NEPA. It is imperative that the Corps reevaluate this decision, change course, and properly analyze the reasonably foreseeable environmental effects of greenhouse gas emissions and climate impacts associated with the Tunnel Project. Absent a course correction, the DEIS fails to comply with NEPA.

When Congress enacted NEPA, it established that “restoring and maintaining environmental quality to the overall welfare and development of man” is of “critical importance.”²² Congress made it the continuing responsibility of the Federal Government to “use all practicable means” to “fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.”²³ To that end, when a major federal action has the potential to significantly affect environmental quality, as the Tunnel Project does here, federal agencies are required by statute to draft detailed statements that analyze the proposed action’s reasonably foreseeable environmental effects.²⁴ Specifically, NEPA requires that such environmental impact statements must contain a detailed discussion and analysis of the “reasonably foreseeable environmental effects of the proposed agency action”; “any reasonably foreseeable adverse environmental effects which cannot be avoided should the proposal be implemented”; and “a reasonable range of alternatives to the proposed agency action, including an analysis of any negative environmental impacts of not implementing the proposed agency action in the case of a no action alternative, that are technically and economically feasible, and meet the purpose and need of the proposal.”²⁵ An environmental impact statement “serves as an environmental full disclosure tool by providing information to the public about the environmental costs involved in a particular project.”²⁶

The Corps’ omission of climate change considerations in the DEIS fails to satisfy the obligations placed on the agency by Congress. NEPA requires agencies like the Corps to take a “hard look” at the environmental consequences of a proposed action, including the “reasonably

²⁰ *Id.* at § 4331(b).

²¹ *Id.* at § 4332(2)(B) (emphasis added).

²² *Id.* at § 4331(a).

²³ *Id.* at § 4331(b)(1).

²⁴ *Id.* at § 4332(2)(C); *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 347-49 (1989) (“Section 101 of NEPA declares a broad national commitment to protecting and promoting environmental quality. To ensure that this commitment is infused into the ongoing programs and actions of the Federal Government, the act also establishes some important action-forcing procedures.”) (internal citations and quotation marks omitted).

²⁵ 42 U.S.C. §§ 4332(2)(C)(i) – (v); *see also* Council on Environmental Quality, February 19, 2025 Memorandum on Implementation of the National Environmental Policy Act, at page 2; *Robertson*, 490 U.S. at 348-49 (enumerating the statutory requirements imposed upon agencies by Congress in NEPA); *Protect Our Communities Found. v. Jewell*, 825 F.3d 571, 578-79 (9th Cir. 2016).

²⁶ *Minnesota Pub. Int. Rsch. Grp. v. Butz*, 541 F.2d 1292, 1299 (8th Cir. 1976).

foreseeable environmental effects” and “any adverse environmental effects,” in order to fulfill the national policy and statutory purpose to “prevent or eliminate damage to the environment and biosphere” “as trustee of the environment for succeeding generations.”²⁷ This “hard look” should cover “every significant aspect of the environmental impact of a proposed major federal action.”²⁸ NEPA requires a “hard look” at a proposed project’s “reasonably foreseeable impacts” before there is an “irretrievable commitment of resources” that would trigger those impacts.²⁹ NEPA requires review of the environmental effects with a “reasonably close causal relationship” to the proposed action.³⁰ The effects should be “sufficiently likely to occur that a person of ordinary prudence would take it into account in reaching a decision.”³¹

Federal courts have repeatedly held that NEPA requires agencies to adequately analyze the reasonably foreseeable climate impacts of a proposed action.³² Moreover, in the context of NEPA

²⁷ 42 U.S.C. §§ 4321, 4331, 4332; see *Kleppe v. Sierra Club*, 427 U.S. 390, 409-10 & n.21 (1976) (recognizing NEPA imposes a “duty” on agencies to provide a “comprehensive report” and take[] a ‘hard look’ at environmental consequences” of proposed action); *Robertson*, 490 U.S. at 350 (“The sweeping policy goals announced in § 101 of NEPA are thus realized through a set of ‘action-forcing’ procedures that require that agencies take a ‘hard look’ at environmental consequences”) (citing *Kleppe*, 427 U.S. at 410 n.21).

²⁸ *Oglala Sioux Tribe v. U.S. Nuclear Regul. Comm’n*, 45 F.4th 291, 300 (D.C. Cir. 2022).

²⁹ *WildEarth Guardians v. Zinke*, 368 F. Supp. 3d 41, 64 (D.D.C. 2019).

³⁰ *Seven County Infrastructure Coalition v. Eagle Cty., Col.*, 605 U.S. ___, 145 S. Ct. 1497, 1515-16 (2025) (“To be clear, the environmental effects of the project at issue may fall within NEPA even if those effects might extend outside the geographical territory of the project or might materialize later in time—for example, run-off into a river that flows many miles from the project and affects fish populations elsewhere, or emissions that travel downwind and predictably pollute other areas. Those so-called indirect effects can sometimes fall within NEPA”); *Metro. Edison Co. v. People Against Nuclear Energy*, 460 U.S. 766, 774 (1983) (explaining that the terms “environmental effect” and “environment impact” in NEPA should be read to “include a requirement of a reasonably close causal relationship between a change in the physical environment and the effect at issue”).

³¹ *Sierra Club v. Marsh*, 976 F.2d 763, 767 (1st Cir. 1992); see also *EarthReports, Inc. v. FERC*, 828 F.3d 949, 955 (D.C. Cir. 2016).

³² *Vecinos para el Bienestar de la Comunidad Costera v. FERC*, 6 F.4th 1321, 1329-30 (D.C. Cir. 2021) (setting aside EIS for failing to consider greenhouse gas emissions from liquified natural gas terminal); *350 Mont. v. Haaland*, 50 F.4th 1254, 1266-70 (9th Cir. 2022) (finding greenhouse gas disclosures for coal mine invalid where agency failed to cite “scientific evidence” to support conclusions); *Birckhead v. Fed. Energy Reg. Comm’n*, 925 F.3d 510, 520 (D.C. Cir. 2019) (explaining, in the context of quantifying GHG emissions, that “NEPA also requires the [agency] to at least attempt to obtain the information necessary to fulfill its statutory responsibilities”); *WildEarth Guardians v. U.S. Bureau of Land Mgmt.*, 870 F.3d 1222, 1236-38 (10th Cir. 2017) (rejecting NEPA analysis of greenhouse gas emissions for coal mine); *Sierra Club v. FERC*, 867 F.3d 1357, 1371-75 (D.C. Cir. 2017) (invalidating EIS for gas pipeline because it failed to consider impacts of burning transported gas); *Center for Biological Diversity v. Nat’l Highway Traffic Safety Admin.*, 538 F.3d 1172, 1217 (9th Cir. 2008) (“The impact of greenhouse gas emissions on climate change is precisely the kind of cumulative impacts analysis that NEPA requires agencies to conduct.”); *Mid States Coal. for Progress v. Surface Transp. Bd.*, 345 F.3d 520, 550 (8th Cir. 2003) (setting aside rail project EIS because it did not evaluate “effects that may occur as a result of the reasonably foreseeable increase in coal consumption”); *Columbia Riverkeeper v. U.S. Army Corps of Eng’rs.*, 706 F. Supp. 3d 1127, 1136-37

reviews of pipeline projects, foreseeability depends on the “destination and end use” of the products in question.³³ If the oil transported through a pipeline is known to be destined for and used by certain refineries, then the downstream greenhouse gas emissions from refining the oil flowing through the pipeline are a “reasonably foreseeable indirect effect of a pipeline project.”³⁴ Consistent with these principles, the Corps’ NEPA Implementing Procedures recognize that “[t]here are cases where the environmental consequences of the larger project are essentially products of the Corps permit action” if “the Corps permit bears upon the origin and destination as well as the route of the project outside the Corps regulatory boundaries, the scope of the analysis should include those portions of the project outside the boundaries of the Corps section 10/404 regulatory jurisdiction.”³⁵ And the Corps’ Procedures further state that “[i]n all cases, the scope of analysis used for analyzing both impacts and alternatives should be the same scope of analysis used for analyzing the benefits of a proposal.”³⁶

Line 5 transports oil and natural gas liquids to certain existing refineries and fractionators. For example, the DEIS states:

Line 5 is a major source of light crude oil supply for refineries in Michigan, northern Ohio, western Pennsylvania, Ontario, and Quebec. Crude oil that is transported on Line 5 is received in Superior, Wisconsin In addition to supplying three Canadian refineries in Sarnia, Line 5 connects to the Applicant’s Line 7 and Line 9 at Sarnia. The Applicant’s Line 7 connects to the Imperial refinery in Nanticoke, Ontario, as well as a third-party pipeline that delivers crude oil to the United refinery in western Pennsylvania. The Applicant’s Line 9 transports crude oil from Sarnia to Montréal, Quebec. . . .

The light crude oil transported by Line 5 represents about 28 percent of the total crude oil throughput of the U.S. refineries serviced by Line 5 and 40 percent of the total crude oil throughput of the Canadian refineries serviced by Line 5. These refineries are key sources for refined product supply for Michigan, Ohio, western

(W.D. Wash. 2020) (concluding that the Corps’ review under NEPA of a fracked gas-to-methanol refinery was arbitrary and capricious because the Corps failed to consider the “reasonably foreseeable indirect cumulative effects of the Project’s greenhouse gas emissions,” which included “increased fracking (and attendant emissions)”), *appeal dismissed*, 2021 WL 3116067 (9th Cir. June 16, 2021); *Utah Physicians for a Healthy Env’t v. U.S. Bureau of Land Mgmt.*, 528 F. Supp.3d 1222, 1228-34 (D. Utah 2021); *Wildearth Guardians v. U.S. Bureau of Land Mgmt.*, 457 F. Supp. 3d 880, 894 (D. Mont. 2020); *San Juan Citizens All. v. United States Bureau of Land Mgmt.*, 326 F. Supp. 3d 1227, 1244 (D.N.M. 2018); *High Country Conservation Advocs. v. United States Forest Serv.*, 52 F. Supp. 3d 1174, 1188-89 (D. Colo. 2014); *Border Power Plant Working Grp. v. Dep’t of Energy*, 260 F. Supp. 2d 997, 1028-29 (S.D. Cal. 2003).

³³ *Food & Water Watch v. FERC*, 28 F.4th 277, 288 (D.C. Cir. 2022).

³⁴ *Id.* (citing *Sierra Club*, 867 F.3d at 1374); *see Seven County*, 605 U.S. ___, 145 S. Ct. at 1516 (“NEPA therefore required the Board to consider the environmental effects of that 88-mile railroad line’s construction *and operation*. To the extent that . . . trains on the new line could pollute the air, NEPA *dictated* that the Board evaluate those effects.”) (emphasis added).

³⁵ 33 C.F.R. Part 325, Appendix B, at paragraphs 7b and 8d (referencing paragraph 7b).

³⁶ *Id.*

Pennsylvania, Ontario, and Quebec. Primarily, these refineries produce transportation fuels such as gasoline, jet fuel, and diesel that are used throughout the region.³⁷

The DEIS describes the purpose and need of the Tunnel Project in terms of “continued product transport,” explaining that the project “is needed to . . . transport those petroleum products . . . to allow for further delivery on the existing southern segment of Line 5 extending to Sarnia.”³⁸ The DEIS further specifies that “[a]ll deliveries of Line 5 products . . . are located south of the Straits crossing”—*e.g.*, primarily in Sarnia—“and none could be achieved absent the Straits crossing.”³⁹ The Tunnel Project is therefore needed, according to the DEIS, “to feed fractionators and refineries in Michigan, Ohio, Pennsylvania, Ontario, and Quebec” by continuing to transport through Line 5 “approximately 540,000 [barrels per day] of light crude oil and natural gas liquids.”⁴⁰

It is reasonably foreseeable that the Tunnel Project and the continuing transport of petroleum products through the pipeline across the Straits of Mackinac to refineries and fractionators in Sarnia will result in greenhouse gas emissions that will have climate impacts. Accordingly, pursuant to NEPA, the Corps must analyze the greenhouse gas emissions associated with the transport and combustion of the products that would be carried through the pipeline crossing the Straits in the proposed tunnel. As the U.S. Court of Appeals for the Ninth Circuit has explained, “[t]he impact of greenhouse gas emissions on climate change is precisely the kind of cumulative impacts analysis that NEPA requires agencies to conduct.”⁴¹ The Corps’ omission of greenhouse gas emissions and climate considerations circumvents the statutory language and congressional intent of NEPA, as interpreted by federal courts over several decades.⁴² The Tunnel Project will allow Enbridge to extend the life of Line 5 and continue transporting 540,000 barrels per day of oil and natural gas liquids to certain known and existing refineries and fractionators.⁴³ The greenhouse gas emissions associated with refining those 540,000 barrels per day will cause reasonably foreseeable effects on environmental quality. The Corps must take a “hard look” at how these emissions will affect the climate and the Michigan environment.

The Corps’ decision to exclude any analysis of the Tunnel Project’s associated greenhouse gas emissions and climate impacts necessarily will underestimate the Tunnel Project’s effects on the climate and Michigan environment. The Corps’ reasoning that climate considerations should be removed to make “the EIS consistent with Executive Order (EO) 14154, Unleashing American

³⁷ DEIS at pages 3-145, 3-146; *see also id.* at page 3-143 (stating that “approximately 97 percent of Line 5’s [natural gas liquids] are transported south of the Straits to the fractionator in Sarnia, Ontario”).

³⁸ *Id.* at page 1-14.

³⁹ *Id.*

⁴⁰ *Id.*

⁴¹ *Ctr. for Biological Diversity*, 538 F.3d 1172, 1217 (9th Cir. 2008).

⁴² *See* footnote 32 (citing cases).

⁴³ DEIS at page 4-182.

Energy,” is fundamentally flawed.⁴⁴ “[A]n executive order is not ‘law’ within the meaning of the Constitution.”⁴⁵ This stands in stark contrast to a statute, like “NEPA, which imposes statutory obligations that agencies must execute consistent with the requirements of the APA.”⁴⁶ An Executive Order cannot overturn, restrict, or nullify statutory obligations imposed by Congress, nor can it disregard judicial precedents interpreting and applying laws enacted by Congress, such as the substantial precedents holding that greenhouse gas emissions and climate impacts are reasonably foreseeable environmental effects that must be analyzed under the requirements of NEPA.⁴⁷

That NEPA imposes a requirement to analyze greenhouse gas emissions and climate impacts is not unknown to the Corps. In fact, the Corps has estimated proposed projects’ greenhouse gas emissions and assessed associated climate impacts in prior environmental impact statements, such as those for the Dakota Access Pipeline Lake Oahe Crossing Project, the Willamette Valley System, and the Amoroso Ranch Project.⁴⁸ Moreover, the Corps’ prior “*Guidance for Incorporating Greenhouse Gas Emissions Analysis in National Environmental Policy Act Reviews*” demonstrates the Corps’ understanding that NEPA requires such analysis.⁴⁹ The DEIS must be supplemented to conduct and present the result of this type of analysis in order to comply with NEPA.

The U.S. EPA, as a cooperating agency in this NEPA review, previously urged the Corps to consider and analyze greenhouse gas emissions and climate effects of the Tunnel Project. According to EPA:

The project’s Action Alternatives would directly release greenhouse gas (GHG) emissions during construction from trucks hauling materials, workers’ vehicles, and operation of construction equipment. Upstream GHG emissions from oil and natural gas production and downstream emissions from combustion are reasonably foreseeable and are causally linked to crude oil and natural gas liquids (NGL)

⁴⁴ *Id.* at page 1-6.

⁴⁵ *California v. EPA*, 72 F.4th 308, 318 (D.C. Cir. 2023).

⁴⁶ *Id.*; see also *Chrysler Corp. v. Brown*, 441 U.S. 281, 302 (1979) (“The legislative power of the United States is vested in the Congress, and the exercise of quasi-legislative authority by government departments and agencies must be rooted in a grant of such power by the Congress and subject to the limitations which that body imposes.”).

⁴⁷ See footnote 32 (citing cases).

⁴⁸ See U.S. Army Corps of Engineers, Dakota Access Pipeline Lake Oahe Crossing Project Environmental Impact Statement, at page 3-277 (September 8, 2023), available at <https://cdxapps.epa.gov/cdx-enepa-II/public/action/eis/details?eisId=428178>; U.S. Army Corps of Engineers, Willamette Valley System Environmental Impact Statement, at page 3.10-1 (April 2025), available at <https://usace.contentdm.oclc.org/digital/collection/p16021coll7/id/27619>; U.S. Army Corps of Engineers, Amoroso Ranch Project Environmental Impact Statement, at page 3.6-1, (January 2019), available at <https://cdxapps.epa.gov/cdx-enepa-II/public/action/eis/details?eisId=265221>.

⁴⁹ See U.S. Army Corps of Engineers, *Guidance for Incorporating Greenhouse Gas Emissions Analysis in National Environmental Policy Act Reviews* (August 16, 2024), available at https://stg.wbdg.org/FFC/ARMYCOE/COEECB/ARCHIVES/ecb_2024_9.pdf.

transportation infrastructure. **It is important for the DEIS to fully quantify and adequately disclose the impacts of the GHG emissions from the proposed action and discuss the implications of long-term carbon lock-in in light of science-based policies established to avoid the worsening impacts of climate change.**⁵⁰

EPA explained that estimating the upstream and downstream greenhouse gas emissions will provide useful information to the public and the Corps concerning the scale of the Tunnel Project's indirect environmental impacts.⁵¹ And "[o]mitting such emissions would result in an underestimation" of the project's indirect impacts.⁵² In addition to quantifying the greenhouse gas emissions associated with the Tunnel Project, EPA also advised the Corps to use tools such as the social cost of greenhouse gases (SC-GHG) to assess the impacts of the estimated emissions and "monetize the societal value" of the increase of greenhouse gases from the Tunnel Project.⁵³ The Corps chose to disregard this input of a cooperating agency, EPA, and entirely omitted any assessment of climate impacts and greenhouse gas emissions. The DEIS does not even address EPA's input, much less explain why the Corps chose to ignore it. However, ELPC and MiCAN reiterate their support for EPA's prior comments and request the Corps to follow the earlier recommendations of EPA, including:

- Draft an EIS with a detailed discussion of the project's reasonably foreseeable direct and indirect GHG emissions.
- Quantify estimates of all direct and indirect GHG emissions from the proposed project over its anticipated lifetime for all alternatives, including the No Action Alternative. Include and analyze potential upstream and downstream GHG emissions, including reasonably foreseeable emissions from the production, processing, transportation, and combustion of natural gas and oil.
- Use SC-GHG estimates to disclose and consider the climate damages from net changes in direct and indirect emissions of CO₂ and other GHGs resulting from the proposed project.
- Identify ways for Enbridge to reduce and mitigate GHG emissions.⁵⁴

⁵⁰ EPA Comments Concerning Line 5 Scoping, Alan Walts, Director, Tribal and Multimedia Programs Office, to Katie Otanez, U.S. Army Corps of Engineers, at page 19, (Oct. 7, 2022) (emphasis added), available at

<https://acrobat.adobe.com/link/review?uri=urn:aaid:scds:US:74d472ce-f09e-481e-9f18-ad1fb303c249> ("EPA Scoping Comments"). See *Seven County*, 605 U.S. ___, 145 S. Ct. at 1516 ("To be sure, NEPA mandates that an agency 'consult with' other agencies as appropriate.") (citing 42 U.S.C. § 4332(2)(C)).

⁵¹ EPA Scoping Comments at page 19.

⁵² *Id.*

⁵³ *Id.* ("Estimates of the social cost of carbon (SC-CO₂) and other greenhouse gases (*e.g.*, social cost of methane (SC-CH₄)) have been used for over a decade in Federal government analyses.").

⁵⁴ *Id.* at pages 19-21.

B. The Corps' Public Interest Review Must Include Climate Impacts.

Independent of NEPA's requirements, the environmental effects of greenhouse gas emissions also must be considered and analyzed pursuant to the Corps' public interest review. The Corps may not issue any permit until completing an in-depth "public interest review," evaluating "the probable impacts, including cumulative impacts, of the proposed activity and its intended use on the public interest."⁵⁵ A decision whether a permit is in the public interest "should reflect the national concern for both protection and utilization of important resources."⁵⁶ A permit may not be granted if it is found to be "contrary to the public interest."⁵⁷ Under the Corps' regulations, "[a]ll factors which *may* be relevant to the proposal *must* be considered."⁵⁸

Although climate change is not specifically enumerated in the regulation's non-exhaustive list of factors⁵⁹ affecting the public interest, climate change falls under the enumerated factors "energy needs" and "general environmental concerns" and undoubtedly impacts the public interest.⁶⁰ The Corps' public interest review must analyze "cumulative impacts," in other words, impacts of not just the construction of the Tunnel Project but also the project's broader impacts over its operational life. This necessarily includes the reasonably foreseeable greenhouse gas emissions and climate effects associated with the Tunnel Project, which the DEIS expressly states is needed in order for Enbridge to continue deliveries of oil and natural gas liquids to refineries and fractionators in Sarnia.⁶¹

The Corps must consider the full scope of environmental factors and impacts of the Tunnel Project when deciding whether a permit is in the public interest and may be issued. This public interest review must consider all aspects of the Project's contribution to greenhouse gas emissions, climate change, and resulting harm.⁶²

⁵⁵ 33 C.F.R. § 320.4(a).

⁵⁶ *Id.*

⁵⁷ *Id.*

⁵⁸ *Id.* at § 320.4(a)(1) (emphasis added).

⁵⁹ The regulation's list of factors to be considered is illustrative, not exhaustive. *See, e.g., Water Works & Sewer Bd. v. United States Dep't of Army*, 983 F. Supp. 1052, 1075 n.17 (N.D. Ala. 1997) ("This is not an exhaustive list, but solely an indicator of the factors that the Corps may find relevant to consider."); *Hough v. Marsh*, 557 F. Supp. 74, 81 (D. Mass. 1982) ("This [public interest] provision recites a non-exhaustive list of some sixteen factors . . .").

⁶⁰ *Id.*

⁶¹ DEIS at page 1-14 ("All deliveries of Line 5 products . . . are located south of the Straits crossing, and none could be achieved absent the Straits crossing.").

⁶² *See, e.g., Columbia Riverkeeper*, 706 F. Supp. 3d at 1140-41 ("Under 33 C.F.R. § 320.4(a)(1), the Corps is directed to consider evaluation of 'cumulative impacts,' and so consideration of the impacts of the Methanol Refinery was required. While the Corps did consider some of the impacts of the Methanol Refinery, it failed to properly consider the full 'cumulative impacts' It arbitrarily and capriciously relied on benefits of the Project in worldwide reduction of greenhouse gases without conducting an assessment of the detriments worldwide.").

C. Climate Impacts Due to GHG Emissions Significantly Affect the Quality of the Human Environment.

NEPA calls on agencies to “fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.”⁶³ No issue invokes this responsibility more than climate change, which is widely acknowledged as a critical environmental issue.⁶⁴ “The harms associated with climate change are serious and well recognized.”⁶⁵ Climate change touches on countless other areas of environmental concern, from air pollution to water quality to human health to wildlife.

There is a scientific consensus that, once emitted, carbon dioxide (CO₂) remains in the atmosphere for centuries where it continues to trap heat, causing significant health, safety, and environmental harms and imposing massive social costs.⁶⁶ Since the 1970s, each successive decade has been warmer than the last, with the most recent decade being the warmest of all.

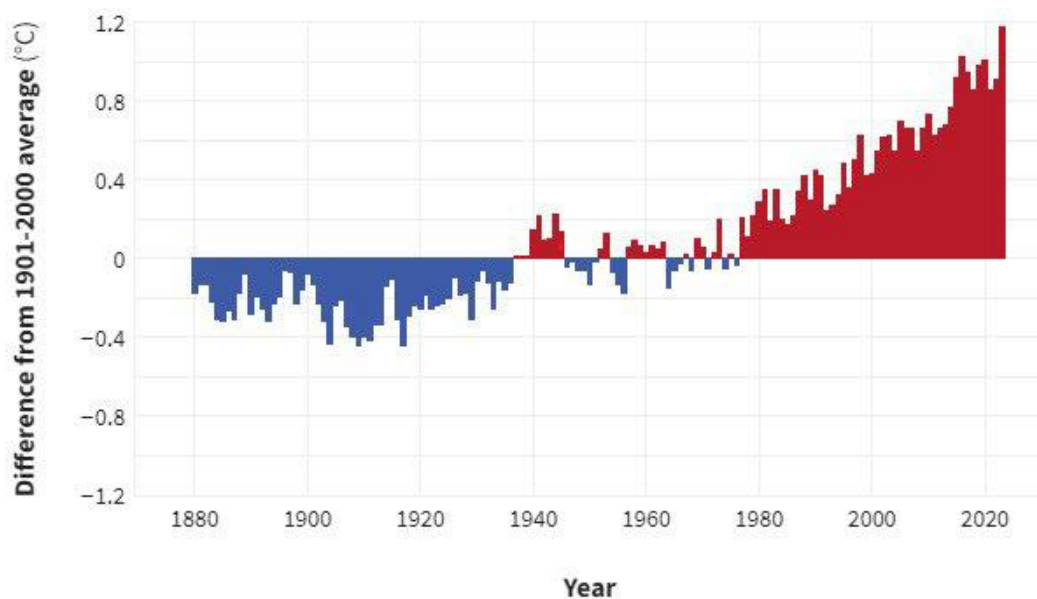


Figure: “Yearly surface temperature from 1880–2023 compared to the 20th-century average (1901–2000). Blue bars indicate cooler-than-average years; red bars show warmer-than-average years.”⁶⁷

⁶³ 42 U.S.C. § 4331(b)(1).

⁶⁴ See, e.g., 74 Fed. Reg. 66,496, 66,523 (Dec. 15, 2009) (finding that elevated concentrations of greenhouse gasses were likely to “endanger the public health and welfare of current and future generations”).

⁶⁵ *Massachusetts v. EPA*, 549 U.S. 497, 521 (2007).

⁶⁶ See generally Intergovernmental Panel on Climate Change, “Summary for Policymakers,” *Climate Change 2022: Impacts, Adaptation, and Vulnerability* (2022) (“IPCC 2022”), available at https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf.

⁶⁷ Lindsey & Dahlman, “Climate Change: Global Temperature,” Climate.gov (January 18, 2024), available at <https://www.energy.gov/sites/default/files/2024->

Additional climate pollution will only increase and intensify the broad array of climate and health harms already being experienced. Every increment of warming makes climate impacts more pronounced.⁶⁸ In addition to changes in temperature, these impacts include more frequent and intense precipitation, drought, and wildfires; reduced food and water security and increased disease; and more extreme storms and floods, unstable insurance markets, and lost homes.⁶⁹

Between 1980 and 2023, there were 376 weather and climate disasters in the United States costing more than \$1 billion each (adjusted for inflation)—and a quarter of these events occurred between 2019-2023 alone.⁷⁰ Between January and August 2024, the United States experienced another twenty instances of billion-dollar disasters.⁷¹ Last fall, for example, Hurricane Helene tore through the southeastern United States, causing hundreds of deaths and massive damage over a vast area.⁷² Researchers linked the intensity of Helene to climate change.⁷³ As with many climate-related disasters, the effects of such superstorms are likely to persist for years into the future and cause ongoing harm to the health and well-being of affected residents.⁷⁴

Climate change is particularly detrimental to public health. Excessive heat caused by climate change increases the risk of heat stroke, hospitalization for heart disease, dehydration-

[02/093.%20Rebecca%20Lindsey%20and%20Luann%20Dahlman%2C%20NOAA%2C%20Climate%20Change%20Global%20Temperature.pdf.](#)

⁶⁸ See IPCC 2022 at pages 14-18.

⁶⁹ See *id.*; see also Crimmins, *et al.*, “Overview: Understanding Risks, Impacts, and Responses,” *Fifth National Climate Assessment*, at pages 17-18 (U.S. Global Change Research Program 2023) (“Crimmins, Understanding Risks”), available at https://www.researchgate.net/publication/375826714_Ch_1_Overview_Understanding_risks_impacts_and_responses.

⁷⁰ Smith, “2023: A historic year of U.S. billion-dollar weather and climate disasters,” Climate.gov (January 8, 2024), available at <https://www.climate.gov/news-features/blogs/beyond-data/2023-historic-year-us-billion-dollar-weather-and-climate-disasters>.

⁷¹ Assessing the U.S. Climate in August 2024, National Centers for Environmental Education (September 10, 2024), available at <https://www.ncei.noaa.gov/news/national-climate-202408>.

⁷² Ferrell, “Helene is 2nd-deadliest U.S. hurricane in 50 years, could cost \$250 billion,” Accuweather.com (updated October 4, 2024), available at <https://www.accuweather.com/en/hurricane/helene-is-2nd-deadliest-u-s-hurricane-in-50-years-could-cost-250-billion/1698452>.

⁷³ World Weather Attribution, “Climate change key driver of catastrophic impacts of Hurricane Helene that devastated both coastal and inland communities” (October 9, 2024), available at <https://www.worldweatherattribution.org/climate-change-key-driver-of-catastrophic-impacts-of-hurricane-helene-that-devastated-both-coastal-and-inland-communities/>.

⁷⁴ DePillis, “Hurricane Helene Deaths Will Continue for Years, Study Suggests,” *New York Times* (October 2, 2024), available at <https://www.nytimes.com/2024/10/02/business/economy/hurricane-helene-deaths-climate.html#:~:text=deaths%2Dclimate.html-.Hurricane%20Helene%20Deaths%20Will%20Continue%20for%20Years%2C%20Study%20Suggests,reasons%20you%20might%20not%20expect> (citing Young and Hsiang, “Mortality caused by tropical cyclones in the United States,” *Nature* (October 2, 2024), available at <https://www.nature.com/articles/s41586-024-07945-5>).

related illnesses, and many other health harms.⁷⁵ In 2023, recorded heat-related deaths reached a record high number of over 2,300—triple the annual average between 2004-2018, which experts believe is likely only a fraction of the actual number.⁷⁶ Several United States regions experienced a record high of heat-related emergency room visits in 2023, totaling 119,000 visits.⁷⁷

Increased heat also will continue to deplete sources of water used for agriculture and consumption, while wastewater runoff due to extreme storms and sea-level rise will increasingly contaminate sources of clean drinking water.⁷⁸ The associated introduction of bacteria and pathogens into drinking water heightens the risk of waterborne illnesses.⁷⁹ At the same time, heat and precipitation will worsen incidences of vector-borne diseases, such as Lyme disease, Zika, and West Nile virus.⁸⁰

In addition, climate change intensifies the health harms and polluting effects caused by other air pollutants, like nitrogen oxides and particulate matter. Ground-level ozone, the primary constituent of smog, forms when nitrogen oxides in the atmosphere react with volatile organic compounds in the presence of sunlight.⁸¹ Increased temperatures due to climate change create favorable conditions for smog formation, resulting in longer-lasting and more severe smog.⁸² Higher temperatures also increase instances and severity of drought and wildfire, which release

⁷⁵ See U.S. EPA, “Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts,” at pages 32-36 (2021) (“EPA, Climate Change and Social Vulnerability”), available at https://www.epa.gov/system/files/documents/2021-09/climate-vulnerability_september-2021_508.pdf; U.S. EPA, “Climate Change and Children’s Health and Well-Being in the United States,” at pages 25-34 (2023), available at https://www.epa.gov/system/files/documents/2023-04/CLiME_Final%20Report.pdf.

⁷⁶ Davenport & Weiland, “‘New Territory’ for Americans: Deadly Heat in the Workplace,” *New York Times* (updated May 28, 2024), available at <https://www.nytimes.com/2024/05/25/climate/extreme-heat-biden-workplace.html>.

⁷⁷ Vaidyanathan, *et al.*, “Heat-Related Emergency Department Visits — United States, May–September 2023,” *73 Morbidity & Mortality Weekly Report* 324, at page 326 (2024), available at <https://www.cdc.gov/mmwr/volumes/73/wr/pdfs/mm7315a1-H.pdf>.

⁷⁸ Crimmins, *Understanding Risks*, at page 23.

⁷⁹ See U.S. Department of State & U.S. Executive Office of the President, “The Long-Term Strategy of the United States: Pathways to Net-Zero Greenhouse Gas Emissions by 2050,” at page 51 (2021), available at <https://bidenwhitehouse.archives.gov/wp-content/uploads/2021/10/US-Long-Term-Strategy.pdf>.

⁸⁰ See *id.*; U.S. EPA, “Climate Change and Children’s Health and Well-Being in the United States,” at pages 68-69, 71-75 (April 2023), available at https://www.epa.gov/system/files/documents/2023-04/CLiME_Final%20Report.pdf.

⁸¹ U.S. EPA, “Ground-level Ozone Basics” (last updated May 14, 2024), available at <https://www.epa.gov/ground-level-ozone-pollution/ground-level-ozone-basics>.

⁸² EPA, *Climate Change and Social Vulnerability*, at page 20

particulate matter (dust and smoke) into the air.⁸³ Ground-level ozone and particulate matter are linked to cardiovascular illnesses, respiratory problems, and premature death.⁸⁴

D. MiCAN and ELPC Have Provided Ample Expert Analysis of GHG Emissions.

The statutory requirement for preparing a detailed environmental impact statement “serves NEPA’s ‘action-forcing’ purpose in two important respects” by (1) “ensur[ing] that the agency, in reaching its decision, will have available, and will carefully consider, detailed information concerning significant environmental impacts,” and (2) “guaranteeing that the relevant information will be made available to the larger audience that may also play a role in both the decision-making process and the implementation of that decision.”⁸⁵ In doing so, “NEPA ensures that important effects will not be overlooked or underestimated only to be discovered after resources have been committed or the die otherwise cast.”⁸⁶ “Publication of an EIS, both in draft and final form, also serves a larger informational role. It gives the public the assurance that the agency ‘has indeed considered environmental concerns in its decision-making process,’ and, perhaps more significantly, provides a springboard for public comment.”⁸⁷

The Corps has had available to it throughout this NEPA process, and MiCAN and ELPC provide again in these comments, substantial detailed information concerning foreseeable environmental effects of greenhouse gas emissions and climate impacts associated with the Tunnel Project. The DEIS, however, does not address or analyze this relevant environmental information, nor make such information available to the larger audience so that the public both has assurance that the Corps considered and analyzed these environmental concerns and has the opportunity to engage with analysis by the Corps through public comment. The DEIS does not make use of reliable data and resources regarding greenhouse gas emissions and climate impacts, nor does it undertake scientific or technical analysis of these effects.⁸⁸

MiCAN and ELPC retained four experts in the fields of environmental analysis, greenhouse gas emission assessment, climate change, and quantification of the social costs of climate impacts, to provide expert analysis and testimony regarding the greenhouse gas emissions and climate impacts associated with the Tunnel Project. MiCAN and ELPC previously in their

⁸³ *See id.*

⁸⁴ *See id.*

⁸⁵ *Robertson*, 490 U.S. at 349.

⁸⁶ *Id.* (citing *Weinberger v. Catholic Action of Hawaii/Peace Education Project*, 454 U.S. 139, 143 (1981); *Kleppe*, 427 U.S. at 409); *see also Motor Vehicle Mfrs. Ass’n of the U.S., Inc. v. State Farm Mut. Auto. Ins.*, 463 U.S. 29, 43 (1983) (“the agency must examine the relevant data and articulate a satisfactory explanation for its action including a rational connection between the facts found and the choice made”); *Delaware Riverkeeper Network v. Fed. Energy Reg. Comm’n*, 753 F.3d 1304, 1313 (D.C. Cir. 2014) (same in context of NEPA review of pipeline project).

⁸⁷ *Id.* (quoting *Baltimore Gas & Electric Co. v. Natural Resources Defense Council, Inc.*, 462 U.S. 87, 97 (1983)).

⁸⁸ *See* 42 U.S.C. §§ 4332(2)(D) – (F); *id.* at §§ 4336(b)(3)(A), (B)

comments on NEPA scoping provided the Corps with links to these experts' work,⁸⁹ and additionally the full written testimony of these four experts are provided as Attachments 1 – 4 to these comments, and fully incorporated by reference.⁹⁰

MiCAN and ELPC have presented testimony from expert witnesses Peter Erickson, who used a well-known and peer-reviewed methodology to estimate greenhouse gas emissions from the Tunnel Project as compared to the feasible and prudent no-pipeline alternative. Mr. Erickson concluded that the Tunnel Project will result in emission of 27,000,000 metric tons of carbon dioxide equivalents (CO_{2e}). Expert Dr. Peter Howard explained how to understand those greenhouse gas estimates in the context of the social cost of such emissions, calculating that the social cost of the emissions from the Tunnel Project is at least \$41 billion. Dr. Jonathan Overpeck, Dean of the School for Environment and Sustainability at the University of Michigan, explained that greenhouse gas emissions exacerbate climate change, and that climate change is already impairing Michigan's air, water, and natural resources. Dr. Elizabeth Stanton testified that consideration of a no-pipeline alternative should have been undertaken by Enbridge, and that in her opinion, shutting down the Dual Pipelines without constructing the Tunnel Project is a reasonable and practicable alternative.

These experts collectively agree that the Tunnel Project would lead to significant increases in greenhouse gas emissions and result in significant social costs, climate impacts, economic and environmental concerns. The Corps' failure to consider, analyze, and present to the public this relevant environmental information and the Corps' evaluation of it runs contrary to the purpose and goals of NEPA. The DEIS needs to be revised and supplemented to fully address such information, and perform and present the Corps' analysis of greenhouse gas emissions and climate impacts of the Tunnel Project.

MiCAN and ELPC summarize below the analysis and conclusions of each of these four experts regarding the greenhouse gas emissions and climate impacts of the Tunnel Project.

1. Mr. Erickson's Analysis of GHG Emissions from the Tunnel Project

Peter Erickson is a climate scientist with the Climate Policy Program Director at Stockholm Environment Institute—U.S., a 501(c)(3) organization affiliated with Tufts University. He has worked in environmental research and consulting for twenty-five years, and during the past eighteen years has focused on greenhouse gas emissions accounting. Mr. Erickson's work on GHG accounting is independent, robust, diverse, and peer-reviewed. Mr. Erickson's expertise in GHG accounting has informed government decision-makers at the local, state, national and global level. He is an invited reviewer to the greenhouse gas emission reduction chapters in Working Group III

⁸⁹ See October 14, 2022 Comments of MiCAN and ELPC on NEPA Scoping, at page 12 and footnote 35; *see also id.* at footnotes 20 and 23.

⁹⁰ See Attachment 1, September 14, 2021 Direct Testimony of Peter A. Erickson; Attachment 2, September 14, 2021 Direct Testimony of Dr. Peter Howard; Attachment 3, September 14, 2021 Direct Testimony of Dr. Jonathan T. Overpeck; Attachment 4, September 14, 2021 Direct Testimony of Dr. Elizabeth A. Stanton. These four experts prepared and presented this testimony in connection with a state permitting proceeding before the Michigan Public Service Commission for the same Tunnel Project proposed by Enbridge that is the subject of the DEIS.

of the Intergovernmental Panel on Climate Change’s (“IPCC”) Sixth Assessment Report. Mr. Erickson has testified before the United States Congress, administrative agencies in the states of Washington and Oregon, and submitted an expert letter to the District Court of the Hague, Netherlands.⁹¹ Mr. Erickson’s methodology has been cited by the United States District Court for the District of Columbia, the Ninth Circuit Court of Appeals, and the United States District Court of Alaska.⁹²

Mr. Erickson estimated, quantified, and explained the level of greenhouse gas emissions associated with the Tunnel Project. First, he estimated the greenhouse gas emissions resulting from the construction and operation of the Tunnel Project, as well as the greenhouse gases contained in or associated with the oil and natural gas liquids transported by the pipeline through the Straits crossing. Second, he estimated the change in greenhouse gas emissions that would arise as a consequence of the Tunnel Project, as measured relative to a no-pipeline scenario, where Enbridge discontinues use of the existing pipeline in the Straits of Mackinac, but does not construct the Tunnel Project.⁹³

The methodology Mr. Erickson used evaluated likely differences in global oil supply and consumption when comparing the no-pipeline scenario to the Tunnel Project being constructed. This methodology is explained in his testimony and in a 2021 article published in the Peer Reviewed Journal *Environmental Research Letters*, titled “Effect of subsidies and regulatory exemptions on 2020–2030 oil and gas production and profits in the United States.” Mr. Erickson used standard greenhouse gas emissions accounting practices, consistent with those laid out in guidance by the Greenhouse Gas Protocol initiative.⁹⁴

The Tunnel Project would result in greenhouse gas emissions in two primary ways. First, greenhouse emissions would be released by the equipment used to build and operate the tunnel. Second, the Tunnel Project would handle and transport petroleum products that, once refined and combusted, release even greater quantities of greenhouse gas emissions than from construction or operation. Mr. Erickson used standard greenhouse gas accounting practices to estimate emissions from building and operating the Tunnel Project, using information provided by Enbridge, and by relying on other published information about how much energy is used to carry out the proposed activities. Mr. Erickson evaluated 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. He then used published estimates about similar equipment, machinery, and materials to estimate how much energy would be used for each activity. Finally, he gathered data about how much greenhouse gas emissions would be released from each unit of activity or energy.

⁹¹ Attachment 1, Erickson Testimony, at pages 1-3.

⁹² *Friends of the Earth v. Haaland*, 583 F. Supp. 3d 113, 142 (D.D.C. Jan. 27, 2022), *vacated as moot and remanded*, 2023 WL 3144203 (D.C. Cir. Apr. 28, 2023); *Center For Biological Diversity v. Bernhardt*, 982 F.3d 723, 738 (9th Cir. 2020); *Sovereign Inupiat for a Living Arctic v. Bureau of Land Mgmt.*, 555 F. Supp. 3d 774 n.201 (D. Alaska 2021)).

⁹³ Attachment 1, Erickson Testimony, at page 4.

⁹⁴ *Id.* at pages 4-5; *see generally* Erickson, *et al.*, “Effect of subsidies and regulatory exemptions on 2020–2030 oil and gas production and profits in the United States,” *Environmental Research Letters* (July 29, 2021), available at <https://iopscience.iop.org/article/10.1088/1748-9326/ac0a10>.

Mr. Erickson estimated the greenhouse gas emissions associated with construction of the Tunnel Project would be approximately 87,000 metric tons carbon dioxide equivalent (CO₂e). Mr. Erickson estimated that operation of the pipeline through the tunnel crossing the Straits would result in approximately 520 metric tons CO₂e annually.⁹⁵

The results of Mr. Erickson's analysis are summarized in the table below:

TABLE 1. EMISSIONS ASSOCIATED WITH CONSTRUCTION OF THE PROJECT

Source of construction-related emissions	Emissions (metric tons CO ₂ e) 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

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).

The Tunnel Project would handle and transport petroleum that, once combusted, releases even greater quantities of greenhouse gas emissions than from Project construction or operation. The DEIS repeated Enbridge's assertion that it would continue to transport the same amount of

⁹⁵ Attachment 1, Erickson Testimony, at pages 5-6, 11-15.

product through the tunnel pipeline as it has done through the existing Dual Pipelines.⁹⁶ Based on Enbridge’s assertion, and consistent with the DEIS, Mr. Erickson assumed that the Tunnel Project would be expected to handle 540,000 barrels per day (bpd) of liquid, comprising about 450,000 bpd of crude oil, and 90,000 bpd of natural gas liquids, chiefly propane and butane, for an indeterminate number of years. Greenhouse gas emissions would be released at each stage of producing, processing, and combusting petroleum. Mr. Erickson split the “life cycle” of a barrel of crude oil or natural gas liquids into stages, which are typically referred to in this type of analysis as the “upstream” and “downstream” stages. For purposes of this analysis, upstream stages are all stages that happen before, or upstream, of final combustion, including the initial extraction and processing of petroleum, operation of oil wells and other equipment needed to process or handle the oil, and oil refining. The downstream stage refers to combustion at the point of end use.⁹⁷

For the upstream stage, Mr. Erickson relied on research estimating the amount of greenhouse gas emissions released for production and processing of petroleum from Western Canada and the Bakken formation, since these regions would be the source of the petroleum transported through the pipeline crossing the Straits. Producing and refining oil from these regions releases an average of 73 kg CO₂e per barrel. For the downstream stage, Mr. Erickson relied on emissions estimates from U.S. EPA to determine that a barrel of crude oil (or its derivatives) releases an average of 432 kg CO₂ once combusted or oxidized. A barrel of propane and butane releases 236 and 282 kg CO₂, respectively.⁹⁸

Because the emissions from construction of the tunnel are measured as a single occurrence, rather than on a yearly basis, Mr. Erickson amortized the emissions from tunnel construction over the time period of Enbridge’s proposed tunnel lease—99 years—so that emissions from construction, operation, and petroleum handled can be compared in one table.⁹⁹

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

GHG emissions category	Average annual emissions (metric tons CO₂e)	Notes
Tunnel construction	870	Amortized over 99 year lifetime
Tunnel operation	520	
Liquids (crude oil and NGL) handled	87,000,000	

⁹⁶ DEIS at page 1-14.

⁹⁷ Attachment 1, Erickson Testimony, at pages 20-21.

⁹⁸ *Id.* at pages 21-22.

⁹⁹ *Id.* at page 23.

The 87,000,000 metric tons CO₂e Mr. Erickson estimated is the total annual direct and indirect emissions from the transport of 540,000 barrels per day of crude oil and natural gas liquids through the Line 5 pipeline crossing the Straits. However, if the Tunnel Project were not constructed, it is not necessarily the case that the entire 87,000,000 metric tons CO₂e would be avoided because some of the oil that would have been transported through the tunnel could find its way to market through other means of transport. Mr. Erickson conducted an additional analysis to analyze how the absence of Line 5 would affect crude oil production and consumption. That additional analysis allowed Mr. Erickson to estimate the net amount of CO₂e that would be caused by the Tunnel Project.

Although the transport of oil and natural gas liquids through the tunnel would result in 87,000,000 metric tons CO₂e each year, Mr. Erickson estimated that a smaller amount, 27,000,000 metric tons CO₂e each year, would be *caused by* the Tunnel Project—the Project would create a net annual increase in greenhouse gas emissions of 27,000,000 metric tons CO₂e compared to if the Project were not built. Mr. Erickson determined that some of the oil that would be transported through the Tunnel Project would be transported through other means, and would result in greenhouse gas emissions. However, if the Tunnel Project were *not built*, then net emissions of 27,000,000 metric tons of CO₂e annually would be avoided.¹⁰⁰

2. Dr. Howard's Calculation of the Social Cost of those GHG Emissions

Dr. Peter Howard is the Economics Director at the Institute for Policy Integrity at the New York University School of Law, whose research primarily focuses on the social cost of carbon and related economic issues. Dr. Howard's work has been published in various prestigious environmental economics, legal, and policy journals, and has been cited by the federal government and researchers, such as the National Academy of Sciences. Dr. Howard has testified about the value of using the social cost of greenhouse gases before other state legislature and agencies, and federal agencies and entities.¹⁰¹

Building on Mr. Erickson's analysis and estimate of greenhouse gas emissions, Dr. Howard applied the social cost of carbon—a globally-accepted metric used to demonstrate the effect of greenhouse gas emissions on the environment—to Mr. Erickson's calculations. Using that metric, Dr. Howard monetized the incremental climate costs of the greenhouse gas emissions from construction and operation of the Tunnel Project, as well as the life cycle emissions from the oil and natural gas products that would be transported as a result of the Project.¹⁰²

Dr. Howard quantified the total value of the Tunnel Project's net monetized climate costs to be \$41 billion. He explained that the cost was calculated by applying the Tunnel Project's 27,000,000 metric tons per year of greenhouse gas emissions into quantitative estimates over specific calendar years and then discounting the future damage estimates back to the present-day value for the year 2021. Dr. Howard's calculations focused on the years from 2027 to 2070 (despite Enbridge's plan to use the tunnel for 99 years. For the additional oil and gas products transported

¹⁰⁰ *Id.* at pages 24-42.

¹⁰¹ Attachment 2, Howard Testimony, at pages 2-3.

¹⁰² *Id.* at pages 4-28.

as a result of the Tunnel Project, Dr. Howard relied upon the federal Interagency Working Group’s estimates of the social cost of carbon calculated at a 3% discount rate, and extended by EPA through year 2070. This means at least \$41 billion of damage to Michigan, the United States, and globally, manifesting as energy system disruptions, air quality impacts, extreme temperatures, water quality and water scarcity impacts, agricultural productivity losses, property damage, biodiversity losses, and costs to other climate-vulnerable market sectors and natural resources.¹⁰³

Dr. Howard’s high, low, and central estimates of the Tunnel Project’s net monetized climate costs, using different discount rates, are summarized in the table below.

**Table 3. Total Value of the Tunnel Project’s Net Monetized Climate Costs
(Present Value in 2021; in 2020\$)**

Time Period	Estimate of the Social Cost of Carbon Dioxide			
	IWG/EPA’s Central 3% Estimates	IWG/EPA’s 2.5% Estimates	New York’s Central 2% Estimates	IWG/EPA’s High Impact Estimates
2027-2050	\$24.95 billion	\$38.45 billion	\$63.24 billion (154% higher than the 3% estimate)	\$76.24 billion
2027-2070	\$41.02 billion	\$64.95 billion	<i>not directly available; an assumed 154% increase would total \$104.00 billion</i>	\$124.38 billion
2027-2127	\$63.38 billion	\$106.84 billion	<i>not directly available; an assumed 154% increase would total \$160.68 billion</i>	\$191.45 billion

3. Dr. Overpeck’s Assessment of the GHG Emissions’ Climate Impacts

Dr. Jonathan Overpeck is an interdisciplinary climate scientist and the Samuel A. Graham Dean of the School for Environment and Sustainability at the University of Michigan. Dr. Overpeck has written and published over 220 works on climate and environmental science, including serving as a Working Group 1 Coordinating Lead Author for the Nobel Prize-winning IPCC 4th Assessment in 2007 and a Working Group 2 Lead Author for the IPCC 5th Assessment in 2014. Dozens of Dr. Overpeck’s published papers focus on the relationship between climate and vegetation, the prevalence and risks of drought, and the impacts of climate change on freshwater resources and ecosystems. In addition to his deanship at the University of Michigan, Dr. Overpeck served the state of Michigan as a member of the University of Michigan’s President’s Commission on Carbon Neutrality, and through his service on the State of Michigan’s Council on

¹⁰³ See *id.*

Climate Solutions and on Ann Arbor's Energy Commission, focused largely on sustainable energy solutions.¹⁰⁴

Dr. Overpeck explained that the concentration of carbon dioxide has risen sharply from 280 to 415 parts per million since the Industrial Revolution and carbon dioxide in the atmosphere carries a “chemical fingerprint” of fossil fuels. Scientists have seen that the known combustion of fossil fuels—over 18 trillion barrels of oil, 390 billion tons of coal, and 155 trillion cubic meters of natural gas over the past century—is reflective of the sharp increase in the chemical fingerprint. The climate has already warmed by just over 1 degree Celsius and will continue to warm several more degrees Celsius unless greenhouse gas emissions are reduced.¹⁰⁵

Dr. Overpeck described the environmental impacts of this warming effect, as moisture from the land and vegetation is held in the air, leading to droughts, stronger storms, changes in precipitation resulting in more intense rainfall along with longer dry spells. Dr. Overpeck explained how these climate impacts affect Michigan and the Great Lakes region, citing higher temperatures, greater average precipitation, and more intense precipitation, increased flooding, record high water levels, as well as extreme weather events year-round such as “polar vortex” events in winter.¹⁰⁶

Dr. Overpeck explained how these impacts in turn threaten Michigan's farms by worsening drought, putting stress on crops, and also leading to floods that prevent planting, harvesting, or management of crops. There is also “a clear trend towards warmer conditions and greater farm runoff that are combining to yield increased occurrence and risk of algal blooms in lakes” creating a public health risk to drinking water and the local ecology. Farmers in Michigan are seeing increased average amounts of rain, increased intensity of rainfall, yet also more frequent and severe dry conditions that can reduce crop yield. Climate and weather extremes lead to greater tree mortality through disturbances like fire and windthrow, and hot droughts worsen the stress on vegetation from invasive species, insect-pests, and disease. This ultimately harms the health of the forest, and the ecosystem it provides for wildlife. And greenhouse gas emissions and climate change result in worse air quality and exacerbated human health impacts of polluted air.¹⁰⁷

4. Dr. Stanton's Evaluation of Reasonable and Practicable Alternatives

Dr. Elizabeth Stanton is a Ph.D. economist with over two decades of professional experience as a political and environmental economist. She has authored more than 155 reports, policy studies, white papers, peer-reviewed journal articles, and book chapters as well as more than 45 expert comments and oral and written testimony in public proceedings on topics related to

¹⁰⁴ Attachment 3, Overpeck Testimony, at pages 3-5.

¹⁰⁵ *Id.* at pages 6-7.

¹⁰⁶ *Id.* at pages 2, 8-9, 11-14.

¹⁰⁷ *Id.* at pages 18-22, 24-28.

energy, the economy, the environment, and equity. Dr. Stanton reviewed Enbridge’s alternatives analysis in this case and to opined on the scope of alternatives that should be considered.¹⁰⁸

Dr. Stanton explained that a proper alternatives analysis for the Tunnel Project must consider an alternative in which the existing dual pipelines crossing the Straits of Mackinac no longer operate and are not replaced with a new pipeline contained in a tunnel. Dr. Stanton concluded that the no-pipeline scenario is a reasonable and practicable alternative to the Tunnel Project. The no-pipeline alternative would be consistent with the climate forecasts and policies being undertaken in the State of Michigan. This alternative would accomplish the stated purpose of the Tunnel Project—to eliminate environmental risk to the Great Lakes—while simultaneously advancing climate change goals established by the State of Michigan.¹⁰⁹

E. The DEIS Does Not Even Present the Limited GHG Emissions Analysis Promised by the Corps’ Scoping Memorandum.

In its June 28, 2023 Memorandum on “NEPA and Public Interest Review Scope of Analysis for Enbridge Line 5 Tunnel,” the Corps refused to “analyze lifecycle greenhouse gases and climate change effects” of “extraction, transport (outside the Straits crossing), refining, and use” of the products flowing through the Line 5 pipeline.¹¹⁰ The Corps’ refusal to perform such analysis fails to comply with the requirements of NEPA and public interest review for the reasons discussed above. In the Scoping Memorandum, however, the Corps did commit to performing and presenting in its forthcoming DEIS a more limited analysis of greenhouse gas emissions. Specifically, the Scoping Memorandum stated: “The Corps’ review of construction and operational impacts of the project is limited to the Straits crossing, and the Corps’ review of greenhouse gas emissions will focus on tunnel construction and operation activities at this crossing.”¹¹¹ Yet, the DEIS does not even present that very limited analysis.

The DEIS states that “emissions from the [Tunnel Project] would be dispersed over the approximately 6-year construction period and would result in direct, short-term, local, and detrimental impacts.”¹¹² Throughout that six-year period, “[c]onstruction equipment, generator sets, employee commuting, deliveries, and excavated materials [would] create direct and indirect, short-term, detrimental impacts to local air quality emissions for the duration of construction.”¹¹³ The “construction equipment” would include the tunnel boring machine, “excavators, cranes, graders, backhoes, and bulldozers” and “construction vessels.”¹¹⁴ “Increased truck traffic along public roadways would result from the transport of construction equipment, materials, and wastes throughout the entire construction period. . . . Up to 150 and 120 daily roundtrips (or 15 and ten

¹⁰⁸ Attachment 4, Stanton Testimony, at pages 1-2, 4.

¹⁰⁹ *Id.* at pages 8-21.

¹¹⁰ USACE, June 28, 2023 Memorandum re: NEPA and Public Interest Review Scope of Analysis for Enbridge Line 5 Tunnel (“Scoping Memorandum”) at Response to Comment Topic #8.

¹¹¹ *Id.* at page 10.

¹¹² DEIS at page 4-141.

¹¹³ *Id.* at pages 4-134, 4-135.

¹¹⁴ *Id.* at pages 4-133, 4-134.

hourly roundtrips) of trucks could occur”¹¹⁵ “Additionally, construction workers commuting to/from the construction sites would also contribute to increased traffic volumes. It is expected that the number of construction workers would peak during the end of Year 4 through the beginning of Year 6. Up to approximately 200 and 125 workers . . . are expected during the peak construction years.”¹¹⁶

Section 4.11 of the DEIS on “Air Quality” presents the Corps’ analysis of emissions that would result from construction of the Tunnel Project. “This section discusses direct, indirect, and cumulative impacts to air quality emissions as a result of construction and operations under the various alternatives. Impacts are discussed quantitatively and qualitatively using air calculation results and public sources.”¹¹⁷ The specific types of emissions discussed in this section, categorized in the DEIS as “Criteria and Hazardous Pollutants,” are: CO (carbon monoxide), NO_x (nitrogen oxides including NO₂, nitrogen dioxide), SO₂ (sulfur dioxide), PM₁₀ (particulate matter with diameter 10 microns or less), PM_{2.5} (particulate matter with diameter 2.5 microns or less), VOCs (volatile organic compounds), HAPs (hazardous air pollutants), and O₃ (ozone).¹¹⁸

Nowhere in Section 4.11, however, does the analysis address greenhouse gas emissions, and, specifically, nowhere does the analysis address CO₂ (carbon dioxide) emissions. According to U.S. EPA, greenhouse gases include carbon dioxide, methane, nitrous oxide, and fluorinated gases, among others.¹¹⁹ Vehicles, such as the tunnel boring machine, trucks, construction equipment, and constructions vessels that would be utilized during the 6-year construction period for the Tunnel Project, emit significant amounts of CO₂ (carbon dioxide).¹²⁰ According to the United Nations Environment Programme (UNEP), “The buildings and construction sector is by

¹¹⁵ *Id.* at page 4-158.

¹¹⁶ *Id.*

¹¹⁷ *Id.* at pages 4-133 to 4-142.

¹¹⁸ *Id.*

¹¹⁹ See U.S. EPA, “Overview of Greenhouse Gases,” available at <https://www.epa.gov/ghgemissions/overview-greenhouse-gases>. Carbon monoxide (CO) is a criteria pollutant, but unlike carbon dioxide (CO₂) it is not a direct greenhouse gas.

¹²⁰ See U.S. EPA, “Transportation Sector Emissions,” available at <https://www.epa.gov/ghgemissions/transportation-sector-emissions>.

far the largest emitter of greenhouse gases, accounting for a staggering 37% of global emissions.”¹²¹ This includes construction projects involving both tunnels¹²² and pipelines.¹²³

Despite the Corps’ prior commitment in its Scoping Memorandum to perform a “review of greenhouse gas emissions [that] will focus on tunnel construction and operation activities,” the DEIS presents no such analysis.¹²⁴ Although the very limited analysis of greenhouse gas emissions promised by the Corps’ Scoping Memorandum would not have complied with the requirements of NEPA or public interest review, the DEIS does not even present that very limited analysis. The DEIS presents no greenhouse gas emissions or climate impacts analysis at all.

II. MiCAN and ELPC Incorporate Others’ Comments on the DEIS’ Additional Flaws.

MiCAN and ELPC incorporate by reference, as if fully stated within these comments, the complete submissions of comments, supporting materials, and expert reports of the following stakeholders: (1) Bay Mills Indian Community (“Bay Mills Comments”); (2) the Great Lakes Business Network and the National Wildlife Federation (“GLBN/NWF Comments”); and (3) FLOW Water Advocates and the Sierra Club (“FLOW/Sierra Club Comments”). These other comments identify, explain, and document numerous additional fundamental flaws in the DEIS. For example:

¹²¹ <https://www.unep.org/resources/report/building-materials-and-climate-constructing-new-future>; see also <https://www.unep.org/news-and-stories/press-release/co2-emissions-buildings-and-construction-hit-new-high-leaving-sector> (“Released at the latest round of climate talks in Egypt, COP27, the 2022 Global Status Report for Buildings and Construction finds that the sector accounted for over 34 per cent of energy demand and around 37 per cent of energy and process-related CO2 emissions in 2021. The sector’s operational energy-related CO2 emissions reached ten gigatonnes of CO2 equivalent – five per cent over 2020 levels and two per cent over the pre-pandemic peak in 2019.”); see also generally Labaran, *et al.*, “Carbon footprint management: A review of construction industry,” *Cleaner Engineering and Technology*, Volume 9 (August 2022), available at <https://www.sciencedirect.com/science/article/pii/S2666790822001367>.

¹²² See, e.g., Rodriguez & Perez, “Carbon foot print evaluation in tunneling construction using conventional methods,” *Tunnelling and Underground Space Technology*, Volume 108 (February 2021) (“The construction sector is one of the most relevant related to the emissions of the greenhouse gases (GHG). Within this sector, the weight of tunneling construction is significant considering the resources employed . . .”), available at <https://www.sciencedirect.com/science/article/abs/pii/S0886779820306581>.

¹²³ See, e.g., Sizerici, *et al.*, “A Review of Carbon Footprint Reduction in Construction Industry, from Design to Operation,” *Materials*, Volume 14 (2021) (“The overall CO2 emissions from the 1008 m wastewater pipeline project in China were calculated in tons through the entire construction period; the results were found to be 452.81 tons, 61.32 tons, and 6.59 tons from transportation phase, material manufacturing phase, and installation phase, respectively.”) (citing Zhang, *et al.*, “Estimation of CO2 Emissions in a Wastewater Pipeline Project,” *Proceedings of the International Conference on Pipelines and Trenchless Technology* (October 2012)), available at <https://pmc.ncbi.nlm.nih.gov/articles/PMC8540435/#B64-materials-14-06094>.

¹²⁴ As discussed above, one of MiCAN’s and ELPC’s experts, Mr. Erickson, analyzed and quantified the greenhouse gas emissions that would result from the construction of the Tunnel Project. The DEIS, however, does not address Mr. Erickson’s analysis.

- The DEIS adopted an impermissibly narrow purpose and need statement. In doing so, the DEIS defined the project scope so narrowly that it effectively excludes the direct, indirect, and cumulative effects of the Tunnel Project, leading to a pre-determined outcome.¹²⁵ See especially Bay Mills Comments and GLBN/NWF Comments.
- The overly narrow purpose and need statement effectively precluded consideration of a reasonable range of alternatives. See especially Bay Mills Comments and GLBN/NWF Comments.
- The DEIS did not consider or evaluate information showing that there is no public need for the Tunnel Project because the products transported by the Line 5 pipeline can be supplied to refineries and consumers more safely than the proposed tunnel using existing infrastructure. See especially GLBN/NWF Comments.
- The DEIS utilized a sequential, three-tiered screening process for alternatives functionally screened out all alternatives that did not cross the Straits and ensured that reasonable alternatives that did not center on the Straits would not be considered at all in the analysis with the Tunnel Project. See especially Bay Mills Comments and GLBN/NWF Comments.
- The DEIS did not consider a no-action alternative where the Dual Pipelines would cease operation, consistent with Michigan policymakers' orders, and the products previously transported through Line 5 and the Straits crossing instead would be transported by other means. Such other means include existing capacity on Enbridge's Line 78 pipeline, waterborne shipping capacity via the St. Lawrence Seaway and Atlantic ports to refineries in Quebec, and existing rail facilities in Michigan, Ohio, and Ontario.¹²⁶ The Corps' NEPA

¹²⁵ *Protect Our Communities Found. v. Jewell*, 825 F.3d 571, 579-80 (9th Cir. 2016) ("a statement of purpose and need will fail if it unreasonably narrows the agency's consideration of alternatives so that the outcome is preordained."); *National Parks & Conservation Ass'n v. Bureau of Land Mgmt.*, 606 F.3d 1058, 1070 (9th Cir. 2010) ("An agency may not define the objectives of its action in terms so unreasonably narrow that only one alternative from among the environmentally benign ones in the agency's power would accomplish the goals of the agency's action, and the EIS would become a foreordained formality.") (quotation marks omitted); *Simmons v. U.S. Army Corps of Eng'rs*, 120 F.3d 664, 666 (7th Cir. 1997) (stating that it is contrary to NEPA for agencies "to contrive a purpose so slender as to define competing 'reasonable alternatives' out of consideration (and even out of existence)"); *Coalition for Advancement of Reg'l Transp. v. Fed. Highway Admin.*, 576 F. App'x 477, 487 (6th Cir. 2014) (stating that an agency "cannot define a project's purpose and need so narrowly that it contravenes NEPA's mandate to evaluate reasonable alternatives") (citing *Citizens Against Burlington, Inc. v. Busey*, 938 F.2d 190, 196 (D.C. Cir. 1991)).

¹²⁶ See EPA Scoping Comments at page 8 (EPA to the Corps: "Assess alternatives that: (1) examine the use of existing capacity in other pipelines and, if necessary, other transportations solutions—such as rail and truck transport of natural gas liquids—in lieu of building new pipeline infrastructure; (2) propose a connection of Enbridge's Superior, WI, and Sarnia, Ontario, terminals without crossing the Great Lakes; and (3) examine a tunnel alternative that fully eliminates the risk of oil intrusion into the Straits in the event of an explosion or other pipeline damages. If such alternatives are not assessed in the DEIS, provide a rationale for not carrying them forward."); see also *id.* at page 8, footnote 7 ("Enbridge could potentially transport additional crude oil to the region via its Line 6B pipeline (recently renamed Line 78), which was

Implementing Procedures require that the DEIS consider reasonable alternatives from the public's perspective, not from Enbridge's perspective, considering "[t]hose alternatives that are unavailable to the applicant" "to allow a complete and objective evaluation of the public interest and a fully informed decision."¹²⁷ See especially GLBN/NWF Comments.

- The DEIS did not compare the Tunnel Project to a no-action alternative that transparently accounts for the reality that the Dual Pipelines may cease operation¹²⁸ due to: revocation and termination of the easement; a potential court order enjoining operation of the Dual Pipelines in state court litigation brought by the Michigan Attorney General; required compliance with a federal court order that held Enbridge in trespass and that required that the Line 5 pipeline be shut down within three years of June 16, 2023; or the 72-year-old pipeline reaching the end of its operational life on the basis of engineering or economics.¹²⁹ See especially Bay Mills Comments.
- The DEIS's inadequately analyzed the Tunnel Project's impacts on groundwater and failed to take a hard look at issues such as include groundwater migration pathways and artesian aquifers, dewatering, tunnel geology, and contaminant releases. See especially Bay Mills Comments, and the expert report of Limnotech supporting those comments, which MiCAN and ELPC also incorporate.
- The DEIS failed to fails to include all of the direct, indirect, and cumulative impacts to wetlands and special aquatic sites, and understates the quality of wetlands that will be impacted. See especially Bay Mills Comments, and the expert comments of Alice Thompson supporting those comments, which MiCAN and ELPC also incorporate.
- The DEIS failed to identify and evaluate deficiencies in the geotechnical investigation and geological data and sampling collected by Enbridge. This resulted in unsubstantiated assumptions and flawed reasoning regarding the conditions of rock geology and conditions that would be encountered by the tunnel boring machine. See especially FLOW/Sierra Club

replaced and doubled in capacity after Enbridge's 2010 spill of a million gallons of heavy oil into the Kalamazoo River watershed near Marshall, Michigan.").

¹²⁷ 33 C.F.R. Part 325, Appendix B, at paragraphs 9(b) & (5).

¹²⁸ See *id.* at page 7 (EPA to the Corps: "Specify whether the No Action alternative would involve continuing to operate the Straits portion of Line 5 in its current state, or would involve changing operations or stopping operations completely").

¹²⁹ See *id.* at page 9 (EPA to the Corps: "Provide information on: (1) how long a pipeline built in 1953 is expected to safely function; (2) which portions of Line 5 have already been replaced, and why; (3) which portions are planned to be replaced or not, why, and when. Discuss expected changes to the structural integrity of the 1953 pipeline over time."); *id.* at page 6 (noting that Enbridge's "recent depreciation report has now reduced the system's remaining lifespan to 20 years . . . point[ing] to several reasons the company believes the line will not be viable within two decades"); *id.* at page 7 (EPA to the Corps: "Substantiate the need for any new construction on Line 5 considering that Enbridge has said the remaining life of all assets on this pipeline system, including Line 5, extends only through 2040.").

Comments and Bay Mills Comments, and the expert testimony of Brian O'Mara supporting those comments, which MiCAN and ELPC also incorporate.

III. Conclusion

For the reasons discussed above, and in the incorporated comments, MiCAN and ELPC respectfully submit that the Corps should deny the permit. Alternatively, at the very least, the Corps should revise, supplement, and issue for public review and comment a new environmental impact statement that addresses the numerous fundamental flaws in the DEIS that have been identified by commentators.

Respectfully submitted on behalf of
MiCAN and ELPC,

/s/ David C. Scott

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Attachments:

- Attachment 1, September 14, 2021 Direct Testimony of Peter A. Erickson
- Attachment 2, September 14, 2021 Direct Testimony of Dr. Peter Howard
- Attachment 3, September 14, 2021 Direct Testimony of Dr. Jonathan T. Overpeck
- Attachment 4, September 14, 2021 Direct Testimony of Dr. Elizabeth A. Stanton



**ENVIRONMENTAL LAW
& POLICY CENTER**



**MICHIGAN
CLIMATE ACTION
NETWORK**

June 30, 2025

**Comments of ELPC and MiCAN
to the U.S. Army Corps of Engineers, Detroit District on the
Draft Environmental Impact Statement for the Line 5 Tunnel Project**

Attachment 1

**STATE OF MICHIGAN
MICHIGAN PUBLIC SERVICE COMMISSION**

In the matter of ENBRIDGE ENERGY,)	
LIMITED PARTNERSHIP application for)	
the Authority to Replace and Relocate the)	Case No. U-20763
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)	

DIRECT TESTIMONY OF PETER A. ERICKSON

ON BEHALF OF

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

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>

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

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

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

9 **Q: Have you testified in other jurisdictions?**

10 A: Yes. I have testified in front of the United States House Committee on Oversight and
11 Reform, Subcommittee on Environment, on the topic of greenhouse gas emissions. I have
12 also testified in front of the Pollution Control Hearings Board for The State of Washington
13 on that topic.⁴ I have submitted expert testimony to the United States District Court, District
14 of Oregon,⁵ and to the Shoreline Hearings Board for the State of Washington⁶ regarding
15 estimates of greenhouse gas emissions. I submitted an expert letter to the District Court of
16 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 Circuit⁸ 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.

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

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

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

11 A: I use standard greenhouse gas emissions accounting practices, consistent with those laid
12 out in guidance by the Greenhouse Gas Protocol initiative,¹⁰ and report my results in
13 standard units of millions of metric tons of carbon-dioxide equivalent (CO₂e). In brief, with
14 respect to the construction of the Proposed Project, these methods involve estimating what
15 activities occur in association with the Proposed Project (for example, the use of a machine
16 to bore the tunnel under the Straits of Mackinac), how much energy is used by each activity
17 (for example, how much electricity is used by the tunnel-boring machine), and how much
18 greenhouse gas emissions are associated with each unit of energy (for example, how much
19 carbon dioxide is released by the power plants that make the electricity for the tunnel-
20 boring machine). I use similar methods to estimate the greenhouse gas emissions associated
21 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.

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

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

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

10 **Q: Can you summarize your conclusions?**

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

- 12 • First, I estimate that the Proposed Project is associated with about 87 million metric
13 tons carbon-dioxide equivalent (CO₂e) annually.
- 14 • Second, I conclude that, when compared to a scenario in which the existing Line 5
15 pipeline no longer operates, construction and operation of the Proposed Project
16 would lead to an *increase* of about 27 million metric tons CO₂e annually in global
17 greenhouse gas emissions from the production and combustion of oil.
- 18 • Third, by enabling the continued, long-term production and combustion of oil,
19 construction of the project would work against, and therefore be inconsistent with,
20 the goals of the global Paris Agreement and Michigan's Healthy Climate Plan.

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

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

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

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

15 A: To provide some context, here I first provide some basic information about the state of
16 climate science and the need for rapid and steep cuts in GHG emissions over the coming
17 decades. Around the world, with just 1.1 degree Celsius (C) of warming experienced to
18 date, we are already seeing serious harms that include increasing flooding, wildfires,
19 droughts, heat waves, expanded impacts of pests and pathogens, and other effects. As
20 addressed in more detail by other testifying experts in this case, these types of events are
21 all plausibly linked to climate change.¹¹ For example, three “five-hundred year” floods
22 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)

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

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

12 **A:** In the Midwest of the United States, climate change will lead to increased temperatures
13 and precipitation that will reduce agricultural productivity, erode soils, and lead to pest
14 outbreaks, while also leading to poor air quality, substantial loss of life, and worsening
15 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](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>

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

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

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

1 **Q: What level of reductions did the IPCC conclude would be necessary to achieve the**
2 **1.5 °C limit?**

3 A: The IPCC, in its special report, *Global Warming of 1.5 °C*, describes that net global carbon
4 dioxide (CO₂) emissions must reach zero to halt warming, and specifically that emissions
5 levels must reach zero by about the year 2050 in order to meet the 1.5 °C with no or
6 “limited” overshoot (exceedance) of the temperature limit. Even *if* other means of
7 removing CO₂ are developed and applied at large scale, the IPCC found that, between 2020
8 and 2050, gross global CO₂ emissions from fossil fuel combustion and industry would need
9 to decline by about 70%.¹⁹ These findings were broadly re-affirmed by the IPCC in its
10 recent report *Climate Change 2021: The Physical Science Basis*, even as their new report
11 on GHG emission reduction scenarios is not due until early 2022.²⁰

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

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

¹⁹ Rogelj, J., Shindell, D., Jiang, K., Ffifita, 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.

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

3 **IV. GREENHOUSE GAS EMISSIONS ASSOCIATED WITH THE PROPOSED**
4 **PROJECT**

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

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

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

16 A: I estimate the GHG emissions associated with construction of the pipeline to be about
17 87,000 metric tons carbon dioxide equivalent (CO₂e). I estimate that operation of the
18 pipeline will result in about 520 metric tons CO₂e annually.

19 **Q: What is CO₂e?**

20 A: Emissions from different greenhouse gases, each of which causes different amounts of
21 warming, are often combined into a single metric of CO₂ *equivalent* by using the concept
22 of global warming potential (GWP). For example, a ton of methane causes many times
23 more warming than a ton of carbon dioxide, and this ratio is called the GWP of methane.
24 In the IPCC's latest *Sixth Assessment Report*, the GWP of fossil methane is reported as

1 29.8 over a 100-year timeframe. One metric ton of methane is therefore 29.8 metric tons
2 CO_{2e} over 100 years according to the IPCC. Throughout my testimony, I focus my own
3 calculations mainly on CO₂; in making these calculations, I include other, non-CO₂ GHGs
4 like methane (CH₄) indirectly and only to the extent that they were calculated by primary
5 sources, such as by the US EPA's eGrid tool (on a CO_{2e} basis, and inheriting any GWP
6 assumptions made by each primary source). Further, any time I refer to a ton, I mean a
7 metric ton unless stated otherwise, and which I may occasionally abbreviate as just the
8 letter *t*.

9 **Q: How did you arrive at 87,000 metric tons CO_{2e} as an estimate of the GHG emissions**
10 **from construction of the Proposed Project?**

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

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

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

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

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

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

6 **Q: Can you summarize your estimates?**

7 A: Yes. My estimates of the GHG emissions from the activities and materials needed to
8 construct the Proposed Project are shown in Table 1 below. As shown, I estimate the total
9 GHG emissions associated with construction to be about 87,000 metric tons carbon dioxide
10 equivalent (CO₂e).

**TABLE 1. EMISSIONS ASSOCIATED WITH
CONSTRUCTION OF THE PROJECT**

Source of construction-related emissions	Emissions (metric tons CO₂e)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).

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

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

6 A: Yes. First, I assume that the tunnel excavator will, like other tunnel-boring machines, be
7 operated using electricity. Enbridge has estimated the electricity usage during construction
8 at the south terminus of the tunnel, where the tunnel boring machine (TBM) will be based,
9 to be 66,184 megawatt-hours (MWh), and so I use this figure for the electricity used by the
10 TBM and other, minor uses based at the south terminus. I then estimate the GHG emissions
11 associated with each unit of electricity, using data specific to the Straits of Mackinac region
12 from the US EPA, to be 0.851 metric tons of CO₂e per MWh of non-baseload electricity
13 consumed; that figure is for electricity from the RFC Michigan eGrid regions, as derived
14 from the US EPA's eGrid tool.²⁴

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

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

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

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

3 A: I use an electricity estimate from Enbridge²⁵ for the north side to characterize other
4 electrical equipment. For off- and on-road vehicles, such as loaders and grading equipment,
5 used to excavate and grade material, I use an estimate of energy consumption of 0.25
6 million btu per cubic meter (mmbtu / m³) for such equipment, based on another recent
7 tunnel boring project (Parsons Brinckerhoff, 2011)²⁶ and apply that estimate to the 272,000
8 cubic meters of material I anticipate will be excavated for the Proposed Project (a 24.5-
9 foot diameter bore for 20,350 feet, based on Enbridge's tunnel design documents²⁷). I
10 assume that energy for these vehicles is mostly diesel, with resulting CO₂ emissions of 74
11 kg CO₂ / mmbtu per Annex 2 of US EPA's national inventory (U.S. EPA, 2021).²⁸

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

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

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

18 A: For concrete, the main source of GHG emissions is CO₂ from making cement, which is the
19 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/>.

1 from burning coal or natural gas, and also relies on a chemical reaction, involving lime,
2 which releases CO₂ directly. I use information provided by Enbridge to estimate how much
3 cement is needed, and then information from an industry group – the Global Cement and
4 Concrete Association – to estimate that making each ton of US-made cement releases 0.75
5 tons CO₂.

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

8 A: Enbridge's report "Tunnel Design and Construction Report for the Straits Line 5
9 Replacement Segment," dated December 23, 2020 (Exhibit A-13), reports the tunnel length
10 at 20,350 feet, the tunnel inside diameter of 21 feet, and the tunnel wall thickness of 15
11 inches. This information implies a volume of concrete of about 66,000 cubic yards. This is
12 very similar to the value reported by Enbridge²⁹ that 65,330 tons of reinforced concrete
13 will be needed. Because the numbers are so close, I rely here on the 65,330 tons reported
14 by Enbridge. Further, additional project specifications report an average cement content of
15 about 800 pounds of cementitious materials per cubic yard of concrete.³⁰ Together, this
16 implies the need for about 24,000 tons of cement for the tunnel walls. Additional cement
17 would be needed for the roadway inside the tunnel; I calculate that separately.

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

19 A: For steel, similarly, emissions are released both from making heat (e.g., from burning coal
20 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.

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

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

7 A: Information provided by Enbridge (Exhibit A-14), provides specifications for the steel
8 pipeline, including the outside diameter of 30 inches and the wall thickness of 0.625. From
9 this and the 20,350 ft length, I estimated the need for about 14 million cubic inches of steel.
10 API 5L steel has a density of about 0.28 pounds per cubic inch (calculated from Table 4 of
11 the American Petroleum Institute's *Specification for Line Pipe*),³¹ implying the need for
12 about 2,000 short tons of steel, or 1,800 metric tons. The average CO₂-intensity of blast-
13 furnace steel in the U.S. is 1.83 t CO₂ / t of crude steel.³² I use the GHG-emissions intensity
14 of blast-furnace steel, not electric-arc steel, because the quantity of steel made by electric
15 arc furnaces is constrained by how much scrap steel is available, so it is more plausible that
16 the marginal source of steel is instead from blast furnaces.

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

18 A: Yes. After the Proposed Project is constructed, there are GHG emissions associated with
19 operating the tunnel, such as electricity to operate lighting and ventilation systems, and the
20 electric service vehicles that would travel inside the tunnel. I estimate that GHG emissions
21 associated with operating the tunnel itself would be approximately 520 metric tons CO₂e

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 CO₂ intensities. Global Efficiency Intelligence.

1 annually. This does not include any emissions associated with operating the existing Line
2 5 Mackinaw City Pump Station.

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

5 A: Ongoing operation of the Proposed Project will involve energy and associated greenhouse
6 gas emissions for the tunnel's ventilation fans, for the sump pump inside the tunnel, for the
7 tunnel service vehicle that operates inside the tunnel, and for lighting, all for many years
8 into the future. Based on electricity usage for these items at other similar tunnels, I estimate
9 that GHG emissions associated with operating the tunnel would be approximately 520
10 metric tons CO₂e annually. More specifically, I estimate the tunnel itself would use about
11 600 megawatt-hours (MWh) of electricity per year,³³ which is a conservative estimate
12 compared to confidential information provided by Enbridge in discovery and not cited here.
13 At the US EPA's reported GHG-intensity of electricity in the Straits of Mackinac region
14 of 0.87 tons CO₂e/MWh,³⁴ 600 MWh of electricity consumption translates into about 520
15 t CO₂e.

16 **Q: Now that you have discussed estimated GHG emissions from construction and**
17 **operation of the project, let's turn to the second source of GHG emissions you**
18 **referenced above. Are there GHG emissions associated with the oil and NGL**
19 **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.

1 A: Yes, there are GHG emissions associated with the oil and NGL that will be transported
2 using the pipeline contained in Enbridge's Proposed Project. I estimate that the GHG
3 emissions associated with the crude oil and NGLs handled by the Proposed Project will be
4 87,000,000 metric tons CO₂e annually.

5 **Q: Please explain how you arrived at 87,000,000 metric tons CO₂e annually.**

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

14 **Q: What are the upstream stages?**

15 A: Here, I use the term *upstream* to refer to all stages that happen before, or upstream, of final
16 combustion. So, *upstream* refers to the initial extraction and processing of petroleum, such
17 as the operation of oil wells and any other equipment needed to process or handle the oil,
18 as well as for oil refining (oil refining is sometimes considered *midstream*, but for my
19 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.

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

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

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

8 A: According to research by Stanford University and colleagues for the Oil-Climate Index,
9 producing light oil from these formations in Western Canada and North Dakota releases
10 about 55 kg CO₂e per barrel. Refining them releases an additional 18 kg CO₂e per barrel.
11 I calculate these numbers as the average of the flare and no-flare case for the US Bakken
12 formation in the Oil-Climate Index (Oil Climate Index, 2016).³⁷

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

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

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

16 A: For the downstream stage I estimate emissions based on how much carbon is contained in
17 a barrel of crude oil. According to the United States Environmental Protection Agency, a
18 barrel of crude oil (or its derivatives) releases an average of 432 kg CO₂ once combusted.³⁸
19 A barrel of propane and butane releases 236 and 282 kg CO₂, respectively. These figures
20 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 CO₂ per barrel from the US EPA is nearly identical to the value of 429 kg CO₂e 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.

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

3 **Q: What do you do next?**

4 A: The last step in quantifying the emissions associated with petroleum handled by the Project
5 is to estimate what, if any, of the petroleum handled would not ultimately be combusted or
6 otherwise oxidized to CO₂, and for which the emission factors above would therefore not
7 apply. I estimate that 8% of the petroleum handled would ultimately not be combusted or
8 otherwise be oxidized, since it would end up underground as long-term storage, e.g. as
9 plastics buried in landfills that no longer release CO₂. Accordingly, I reduce the per-barrel
10 emissions estimates listed above for the “downstream” stage by 8%.

11 **Q: What do you base that assumed reduction on?**

12 A: I base it on a peer-reviewed study that is the most detailed assessment I am aware of that
13 investigates what fraction of North American oil production is not ultimately combusted.⁴⁰
14 That article evaluates what fraction of oil is used for non-energy uses such as
15 petrochemicals, lubricants, and other industrial uses, as well as what fraction of these
16 otherwise “non-energy uses” are indeed ultimately combusted, such as when plastics are
17 burned at waste-to-energy plants or tires are burned at cement kilns, and concludes that
18 8.02% of petroleum liquids end up as net carbon storage.

19 **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 CO₂e 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 ₂ e)	Notes
Tunnel construction	870	Amortized over 99 year lifetime
Tunnel operation	520	
Liquids (crude oil and NGL) handled	87,000,000	

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

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

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

7 Q: **What is a “no-action” scenario?**

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

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

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

18 Q: **What are “incremental” GHG emissions, and how are they different from your**
19 **analysis above?**

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

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

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

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

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

13 A: Yes. Estimating incremental GHG emissions is a common feature of many GHG emissions
14 estimation methods, including those discussed in the GHG Protocol's *Policy and Action*
15 *Standard* and those reviewed in Burger and Wentz (2020), "Evaluating the Effects of Fossil
16 Fuel Supply Projects on Greenhouse Gas Emissions and Climate Change under NEPA".
17 The approach here is sometimes termed a *consequential* life-cycle assessment, whereas the
18 approach in the prior section is sometimes termed an *attributional* life-cycle assessment.
19 These terms and approaches are a common methodology used in the field of life cycle
20 assessment, and are discussed in peer-reviewed papers often relied upon in my field, such
21 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

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

2 A: Below I estimate the incremental GHG emissions associated with the Project to be about
3 27,000,000 metric tons CO₂e annually. This is lower than my estimate of all emissions
4 associated with the Project of 87,000,000 metric tons CO₂e annually because, in my
5 estimation, some of those emissions would occur even if the Proposed Project does not
6 proceed.

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

9 A: To quantify the incremental GHG emissions of an energy project or action, one must first
10 describe how that project or action will change the energy market. In the case of the
11 Proposed Project, the availability of oil pipelines, including Line 5, affects global GHG
12 emissions because pipelines help increase the supply of oil. Evaluation of these dynamics
13 is a typical methodology for analyzing incremental GHG emissions of an energy
14 infrastructure project. An overview of such approaches can be found in Section IV of the
15 peer-reviewed paper by Burger and Wentz (2020), “Evaluating the Effects of Fossil Fuel
16 Supply Projects on Greenhouse Gas Emissions and Climate Change under NEPA,”
17 attached as Exhibit ELP-4 (PAE-4).⁴² The oil market is well-connected globally, and there
18 is a straight-forward connection between oil supply and oil consumption. The more oil is
19 available (and at lower cost), the lower the global price of oil, and the more oil is consumed.
20 And, the more oil is consumed, the higher are GHG emissions from producing and burning
21 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.

1 **Q: How do pipelines impact global markets for oil?**

2 A: Pipelines increase the supply of oil by providing transport of oil to market when other
3 options do not exist or are higher cost. This is widely understood, and is nicely summarized
4 for Canadian oil in the peer-reviewed article, Heyes et al (2018), “The Economics of
5 Canadian Oil Sands” – attached as Exhibit ELP-5 (PAE-5).⁴³ That article focuses on oil
6 sands, but with principles that also apply to light oil. Further, when oil supply is greater,
7 prices are lower, an effect which is summarized in my own peer-reviewed work: Erickson,
8 P., & Lazarus, M. (2014), attached here as Exhibit ELP-6 (PAE-6). Impact of the Keystone
9 XL pipeline on global oil markets and greenhouse gas emissions. *Nature Climate Change*,
10 4(9), 778–781.⁴⁴ As these peer-reviewed articles demonstrate, the effects of shifts in oil
11 supply can be quantified using economic principles and models, which is what I do here.

12 **Q: Why do you compare the Proposed Project to a “no-action” scenario?**

13 A: Estimating the effect of the Proposed Project on oil supply requires clearly articulating
14 what would happen in a “no-action” scenario, so that the effect of the Proposed Project can
15 be compared to that, and the incremental effect of the Proposed Project can be quantified.
16 Given that the State of Michigan is revoking and terminating the 1953 Easement that allows
17 Line 5 to operate under the Straits, it is reasonable to consider the no-action scenario to be
18 one in which the Line 5 pipeline is not operational. Even if the 1953 Easement remained
19 valid, it would be appropriate to consider a no-action scenario in which Enbridge shuts
20 down the existing Line 5 and does not replace it with a new segment of pipeline. Enbridge’s
21 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>

1 raised by the State of Michigan relating to the approximate four miles of Enbridge's Line
2 5 that currently crosses the Straits of Mackinac."⁴⁵ One way to achieve that purpose would
3 be to remove Line 5 from the Straits and decommission the pipeline.

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

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

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

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

⁴⁵ Application at ¶2.

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

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

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

10 A: I consulted several sources. One was a statistical analysis of actual pipeline and rail crude
11 oil tariffs, conducted by researchers at the University of Waterloo in Canada.⁴⁶ An analysis
12 by university economists, Heyes *et al.* (2018), cited previously, report a range between \$3
13 per barrel (which they attribute to the US State Department) and \$9 per barrel (which they
14 attribute to the TransCanada corporation).⁴⁷ A banking and financial services company,
15 Scotiabank, also estimated that insufficient pipeline capacity would lead to an increase in
16 costs of oil from Alberta about \$6 per barrel.⁴⁸ Lastly, Alternative 3 of the Dynamic Risk
17 report *Alternatives Analysis for the Straits Pipeline*, though it was addressing a specific rail
18 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.

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

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

6 A: Yes. The other factor that relates to GHG emissions is that the GHG emissions associated
7 with moving oil by rail are, like cost, also slightly higher. The increase is small, about 6 kg
8 CO₂e per barrel transported by rail instead of by pipeline, which is just 1% of the total
9 GHG emissions associated with a barrel of oil.⁴⁹ However, this difference must also be
10 accounted for, as I do below.

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

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

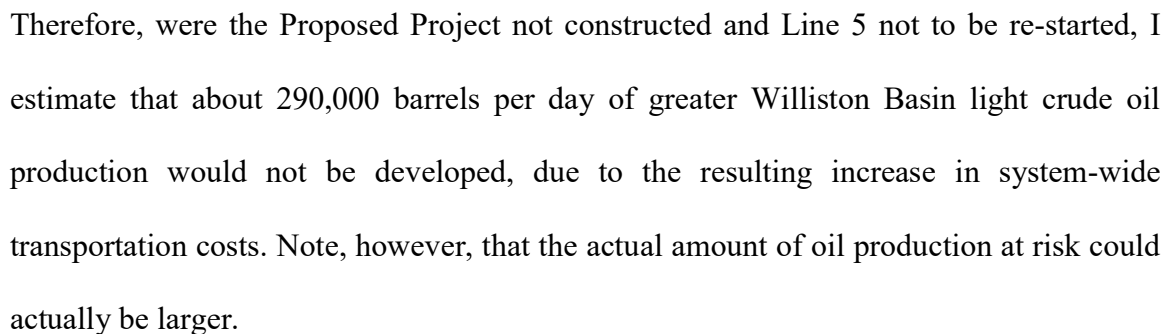
20 Indeed, the economics of oil in the greater Williston Basin may be challenging in
21 the years ahead. The Government of Canada currently foresees crude oil prices to gradually

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>.

1 drift downwards towards \$53 per barrel by the end of this decade (2030).⁵⁰ Oil fields that
2 are only profitable (“break even”) at prices just below this level – namely, between \$53 per
3 barrel and \$47 per barrel (\$53 minus the \$6 extra for rail transportation) – would therefore
4 not be able to afford an added \$6 cost per barrel of transporting their oil to markets.
5 A substantial number of oil projects in the greater Williston Basin are expected to break
6 even in this range of \$47 to \$53 per barrel, and would therefore be put at risk by the added
7 \$6 per barrel in transportation costs. Figure 1, below, shows the sources of light crude oil
8 production in the Canadian provinces of Alberta, British Columbia, Manitoba, and
9 Saskatchewan, and US States of Montana and North Dakota that could potentially feed into
10 the Enbridge mainline pipeline system, including Line 5. The oil fields colored in dark blue
11 are the ones that would be put at risk by a transport cost premium of \$6 per barrel. These
12 are new oil fields, for example, in the Bakken formation of North Dakota and the Duvernay
13 formation in Alberta. In total, the quantity of oil that would be put at risk, and ultimately
14 stranded (not developed) by an added \$6 per barrel in transportation costs (and assuming
15 an oil price outlook of \$53 per barrel) is 290,000 barrels per day. For reference, this is
16 equivalent to about 64% of Line 5’s expected crude oil throughput of 450,000 barrels per
17 day.

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

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

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

8 Takeaway capacity for crude oil from the greater Williston Basin has been
 9 constrained in the past, and likely will be constrained in the coming years. Recent draft
 10 forecasts by the Canadian Energy Regulator, a government body, show that, even *with* the
 11 Line 5 pipeline (450,000 bpd crude capacity) *and* Line 3 pipeline (full capacity: 760,000
 12 bpd, expanded from current capacity of 390,000 bpd), Western Canada will have only
 13 about 100,000 bpd of spare capacity in the system by 2030.⁵³ However, if *either* of those
 14 pipelines is not operational (and assuming continued delays in the Trans Mountain Pipeline
 15 expansion project to Vancouver, B.C.) oil transportation capacity would be insufficient. In
 16 that case, it is reasonable to expect that the no-action scenario could lead to added
 17 transportation charges of around \$9 per barrel on a long-term basis.

18 An added charge of \$9 per barrel for rail transport, instead of \$6 per barrel, would
 19 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/rev006>. 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*.

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

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

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

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

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

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

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

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

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

⁵⁴Brent 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>

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

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

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

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

19 A: I have not conducted that analysis here, but in my opinion it is unlikely that the effects
20 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>

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

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

8 A: In total, assuming a \$6 per barrel increase in transportation costs associated with rail
9 transport of petroleum, I estimate that, compared to the no-action scenario, where the
10 existing line stops operating and the Proposed Project is not built, building the Proposed
11 Project would lead to a net, incremental increase in annual global oil consumption of about
12 150,000 bpd, equivalent to 27,000,000 metric tons CO₂e per year from burning and
13 producing that oil. Nearly all of this increase in oil consumption and GHG emissions would
14 occur outside Michigan.

15 **Q: How did you calculate this estimate?**

16 A: This change in global oil price and oil consumption is calculated using a simple oil market
17 model, parameterized by elasticities (long-run elasticity of crude oil supply of 0.6, long-
18 run elasticity of crude oil demand of -0.3), a model that is described in more detail in my
19 peer-reviewed, scientific work, including, most recently: Achakulwisut, P., Erickson, P.,
20 & Koplow, D. (2021). Effect of subsidies and regulatory exemptions on 2020–2030 oil and
21 gas production and profits in the United States. *Environmental Research Letters*, 16(8),
22 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>.

1 consumption to a change in GHG emissions from burning oil by assuming a global,
2 reference GHG-intensity of crude oil of 502 kg CO₂e per barrel, while also assuming that
3 any oil now carried by rail instead of pipeline does so at an added GHG-intensity of 6 kg
4 CO₂e per barrel.

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

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

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

21 A: My source for the elasticity of supply estimate of 0.6 is taken directly from the slope of the
22 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>

1 \$50 per barrel to \$70 per barrel range, as described in Erickson *et al.* 2020. My source for
2 the elasticity of demand is taken from Hamilton (2009).

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

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

10 **Q: Did you calculate the results using different values?**

11 A: Yes. I did a sensitivity analysis in which I varied elasticities of supply and demand to see
12 how the results could vary. In the table below, I display how very different assumptions
13 about elasticities of supply and demand could make my estimate of 27 million metric tons
14 CO₂e higher or lower. While I present this to show a wide range of potential outcomes, I
15 find the lower elasticity of supply value of 0.1 to be extraordinarily unlikely, as that implies
16 a very steep supply curve in which oil producers are very insensitive to price, a situation
17 that only arises if long-term oil forecasts are very high, e.g. over \$100 per barrel. In the
18 more likely scenario – with higher elasticity of supply -- the incremental GHG emissions
19 remain over 20 million metric tons CO₂e even where assumptions regarding the elasticity
20 of demand change.

TABLE 3. INCREMENTAL GLOBAL GHG EMISSIONS (MILLION TONS CO₂E) 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 ₂ e	20 million t CO ₂ e	27 million t CO ₂ e
	-0.3 (best estimate)	4.8 million t CO ₂ e	27 million t CO₂e	38 million t CO ₂ e
	-0.5	5.4 million t CO ₂ e	37 million t CO ₂ e	55 million t CO ₂ e

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

1 “cross-price” or substitution effects in the economic literature, because they involve
2 different fuels than what would be handled by the Proposed Project and so are secondary
3 considerations. These effects could reduce my incremental estimate of 27 million metric
4 tons CO₂e somewhat; however, as the global energy transition accelerates, the marginal
5 source of the main substitute for oil – electricity – is no longer mainly fossil fuels, but
6 instead primarily very low-carbon renewable power. This strong trend towards renewable
7 power suggests that any shift away from electricity would have relatively minor effects on
8 my incremental GHG emissions estimate.

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

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

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

17 A: I believe my central estimate of 27,000,000 metric tons CO₂e is a reasonable approximation
18 of the incremental effect of the Proposed Project on global GHG emissions based on
19 available information regarding supply and demand elasticities. The methods used above
20 use standard GHG emissions accounting principles, and my specific approaches regarding
21 pipelines and oil markets have been successfully scrutinized by the scientific peer review
22 process several times for other projects. Furthermore, I have considered several possible
23 uncertainties. Finally, in other contexts involving estimations of GHG emissions, courts

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

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

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

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

11 A: No. My focus is on the global GHG emissions effect of the Line 5 pipeline. Michigan
12 represents only about one-half of 1% of global oil consumption, so the GHG emissions
13 effects inside Michigan are a small part of the overall GHG emissions effects of the Line
14 5 pipeline. Of course, the impact on Michigan’s natural resources, as the result of all global
15 GHG emissions, is significant, as discussed by other expert witnesses in this case.

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

18 A: No. In contrast to the incremental emissions from increased consumption of crude oil that
19 would result from constructing the Proposed Project (relative to the no-action scenario),
20 which are driven by effects global markets, any incremental emissions from changes in
21 propane and ethane markets would likely be more local, due to propane and ethane markets
22 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).

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

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

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

16 **A:** No. Consistent with section III of this testimony (“Overview of climate change and the
17 need for greenhouse gas emissions cuts”), the intent of global climate change policy is that
18 substantial emission reductions are needed in all regions of the world and in all sectors.
19 Accordingly, the change in warming or climate impacts that would result from actions in
20 Michigan should be viewed in that context and not as isolated (and proportionally smaller)
21 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.

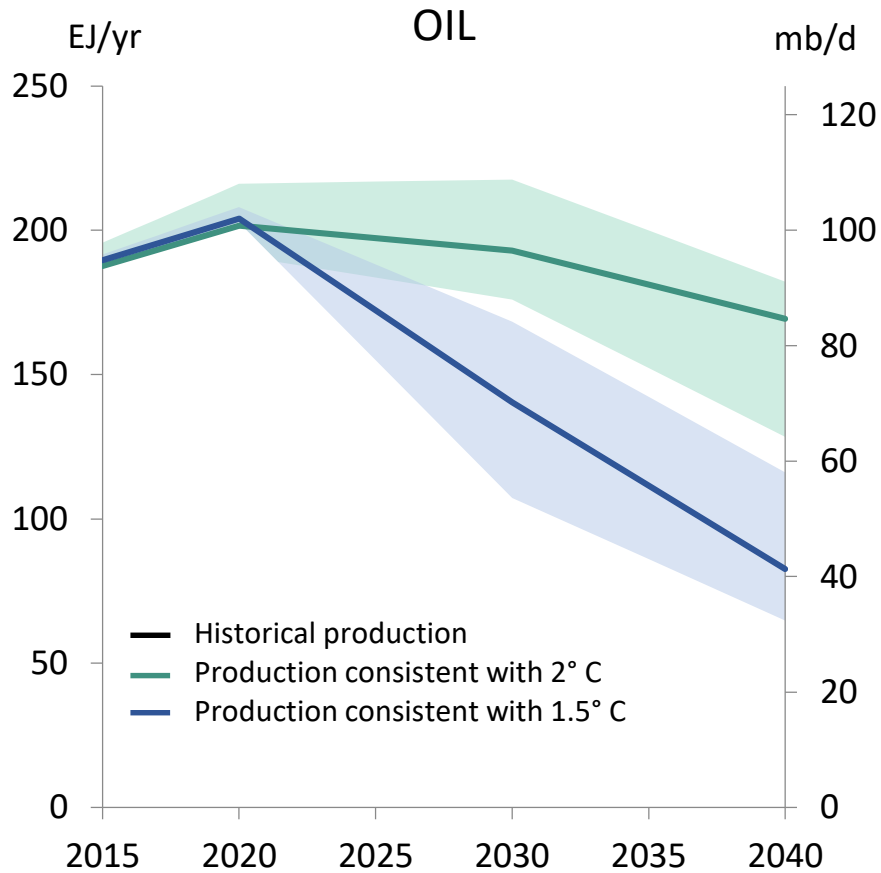
1 **VI. INCONSISTENCY OF THE PROPOSED PROJECT WITH INTERNATIONALLY**
2 **AGREED CLIMATE LIMITS**

3 **Q: Is Enbridge’s Proposed Project generally consistent with international, national and**
4 **state climate goals?**

5 A: No. Michigan’s Governor Gretchen Whitmer has initiated the MI Healthy Climate Plan
6 aimed at protecting public health and the environment, and helping to develop new clean
7 energy jobs, by putting Michigan on a path towards becoming carbon-neutral, meaning net
8 zero greenhouse gas emissions, by 2050. Further, the Governor has committed the State of
9 Michigan to advance the goals of the Paris Agreement. As described in section III of this
10 testimony, one of the goals of the Paris Agreement is “pursuing efforts” to limit global
11 warming to 1.5°C above pre-industrial levels. To meet that goal with no or “limited”
12 overshoot (exceedance) of the temperature limit, the Intergovernmental Panel on Climate
13 Change (IPCC) has found that global emissions must reach zero by about the year 2050.
14 Further, the IPCC has found that oil production and use must fall by an average of about
15 3% annually (for a total of 65%) between 2020 and 2050.

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

FIGURE 2. OIL PRODUCTION AND USE
CONSISTENT WITH 1.5 °C AND 2 °C LIMITS⁶²



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.

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

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

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

18 **SUMMARY OF TESTIMONY/CONCLUSIONS**

19 **Q: Please summarize your conclusions.**

20 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).

1 First, as described in section IV of this testimony, the Proposed Project is
2 associated with about 87 million metric tons carbon-dioxide equivalent (CO₂e)
3 annually, the overwhelming majority of which are from the use, or combustion, of the
4 oil and natural gas liquids transported by the Line 5 pipeline.

5 Second, as described in section V, compared to a no-action scenario, where the
6 Line 5 pipeline no longer operates in the Straits, the Proposed Project would lead to an
7 *increase* of about 27 million metric tons CO₂e in global greenhouse gas emissions from
8 the production and combustion of oil.

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

13 **Q: Does this conclude your testimony?**

14 **A: Yes.**



**ENVIRONMENTAL LAW
& POLICY CENTER**



**MICHIGAN
CLIMATE ACTION
NETWORK**

June 30, 2025

**Comments of ELPC and MiCAN
to the U.S. Army Corps of Engineers, Detroit District on the
Draft Environmental Impact Statement for the Line 5 Tunnel Project**

Attachment 2

**STATE OF MICHIGAN
MICHIGAN PUBLIC SERVICE COMMISSION**

In the matter of ENBRIDGE ENERGY,)	
LIMITED PARTNERSHIP application for)	
the Authority to Replace and Relocate the)	Case No. U-20763
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)	

DIRECT TESTIMONY OF DR. PETER HOWARD

ON BEHALF OF

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

September 14, 2021

1 **Q. Please state your name, business name and address.**

2 A. My name is Dr. Peter Howard. I am the economics director at the Institute for Policy
3 Integrity at the New York University School of Law.¹ Our offices are located at 139
4 MacDougal Street, Wilf Hall, 3rd Floor, New York, NY 10012. Policy Integrity is a non-
5 partisan think tank dedicated to improving the quality of government decisionmaking
6 through advocacy and scholarship in the fields of administrative law, economics, and
7 public policy.

8 **Q. What is the purpose of your testimony?**

9 A. My testimony applies a widely-accepted economic methodology, known as the Social Cost
10 of Greenhouse Gases, to monetize the incremental climate costs from the emissions from
11 construction and operation of the proposed Line 5 project, as well as the lifecycle emissions
12 from the oil and natural gas products that would be transported by that Proposed Project.
13 Specifically, based on the best available quantitative data and conservative valuations, the
14 Proposed Project will generate a present value of \$41 billion (in 2020 USD) or more in net
15 monetized climate costs from 2027 to 2070 as compared to the no-action alternative—in
16 other words, the Proposed Project will generate average annual monetized climate costs of
17 approximately \$1 billion each year over this period, plus significant unmonetized climate
18 effects and other unquantified pollution costs to human health and the environment. This
19 \$41 billion figure represents real-world, concrete climate damages to Michigan, the United
20 States, and the world, in the form of energy system disruptions, human health effects from
21 air quality impacts and extreme temperatures, water quality and water scarcity impacts,
22 agricultural productivity losses, property damage, biodiversity losses, and costs to other

¹ No part of this testimony purports to present the views, if any, of New York University or its School of Law.

1 climate-vulnerable market sectors and natural resources² that matter to the people of
2 Michigan. Translating these damages into dollar figures helps to contextualize how the
3 pollution from the Proposed Project will concretely impair the air, water, natural resources,
4 and public trust. These results further demonstrate the prudence of the no-action alternative
5 by putting the Proposed Project's incremental climate costs into terms that can more readily
6 be compared against the Proposed Project's alleged benefits and so reveal the Proposed
7 Project to be, on net, detrimental to society.

8 **Q. What is your educational background?**

9 A. I hold a Ph.D. in Agricultural and Resource Economics from the University of California,
10 Davis, where my research focused on climate change, environmental policy, and
11 agricultural policy. I also hold a Bachelor of Arts from Bard College, where I majored in
12 economics.

13 **Q. Can you briefly describe your professional background?**

14 A. After graduating with my Ph.D. in 2012, I started my academic career as an economic
15 fellow at the Institute for Policy Integrity at New York University School of Law. During
16 this time, my research focused primarily on the social cost of carbon. In 2015, I accepted
17 my current position as the Economics Director at Policy Integrity, where the primary focus
18 of my work remains on the social cost of carbon and related climate economic issues,
19 though my work and expertise has expanded to include several related topics, including
20 resource extraction. Over the last decade, my climate economics work has been published
21 in various prestigious environmental economics, legal, and policy journals. My work has

² See Climate Impacts Reflected in the SCC Estimates, <https://costofcarbon.org/scc-climate-impacts> (last visited Aug. 26, 2021) (detailing which climate impacts are included or partially included in the current estimates of the social cost of greenhouse gases).

1 been cited by the federal government (e.g., the Interagency Working Group on the Social
2 Cost of Greenhouse Gases, 2016; 2021) and researchers (National Academy of Sciences,
3 2017). My 2017 paper with Thomas Sterner on climate damages formed the basis of Nobel
4 Prize recipient William Nordhaus's alternative damage function that he published in 2019.
5 My Curriculum Vitae is attached as Exhibit ELP-8 (PH-1).

6 **Q. Have you ever testified in front of the Michigan Public Service Commission?**

7 A. No.

8 **Q. Have you testified in other jurisdictions?**

9 A. Yes. I have testified on the value of using the social cost of greenhouse gases before: the
10 New Jersey legislature, the Colorado Air Quality Control Commission, the U.S. District
11 Court for the District of Montana, the National Academies of Sciences Committee on
12 Assessing Approaches to Updating the Social Cost of Carbon, the U.S. Office of
13 Information and Regulatory Affairs, and the U.S. Interagency Working Group on the Social
14 Cost of Greenhouse Gases.

15 **Q. On whose behalf are you submitting this testimony?**

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

18 **Q. Are you sponsoring any exhibits?**

19 A. Yes. I am sponsoring the following exhibits:

20 ELP-8 (PH-1) – Curriculum Vitae of Dr. Peter Howard.PDF

21 ELP-9 (PH-2) – SCC Calculations for Line 5

22 ELP-10 (PH-3) – Extrapolation Code

1 **Q. Can you summarize your conclusions?**

2 A. By applying a widely-accepted economic methodology, known as the Social Cost of
3 Carbon, to monetize the relative climate benefits of a “no-action scenario” compared to the
4 Proposed Project, based on the available data, it is very likely that the no-action scenario
5 will generate tens, if not hundreds, of billions of dollars of net climate benefits. Our main
6 net present estimate of \$41 billion (2020 USD) as the Proposed Project’s incremental
7 climate costs from construction, operation, and lifecycle emissions from transported
8 products, is certainly a conservative underestimate for several reasons. First, the available
9 estimates of the social cost of carbon dioxide are conservative lower bounds because
10 multiple highly significant climate damages—such as wildfires, flooding and mortality
11 from inland extreme weather, groundwater overexploitation, habitat modifications, and
12 invasive species—are not currently quantified, among other reasons.³ Second, our \$41
13 billion estimate applies a social cost of carbon dioxide calculated using a conservative
14 discount rate of 3%, even though overwhelming evidence now supports decreasing the
15 discount rate to 2% or lower, which would increase the social cost of carbon dioxide values
16 substantially.⁴ Third, the \$41 billion figure reflects the net present value of the Proposed
17 Project’s climate impacts only through the year 2070, because the federal government’s

³ See Richard L. Revesz et al., *Global Warming: Improve Economic Models of Climate Change*, 508 NATURE 173 (2014) (co-authored with Nobel Laureate Kenneth Arrow, among others); see also Climate Impacts Reflected in the SCC Estimates, *supra* note 2 (listing omitted damage categories).

⁴ See Peter Howard & Jason A. Schwartz, *About Time: Recalibrating the Discount Rate for the Social Cost of Greenhouse Gases* (Policy Integrity Report 2021), https://policyintegrity.org/files/publications/About_Time.pdf (summarizing the economics literature and arguments); see also Interagency Working Group on the Social Cost of Greenhouse Gases, Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide, Interim Estimates under Executive Order 13990 at 19-21 (2021), https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf [hereinafter 2021 TSD] (conceding the updated evidence); Council of Economic Advisers, *Discounting for Public Policy: Theory and Recent Evidence on the Merits of Updating the Discount Rate* (Issue Brief, Jan. 2017), https://obamawhitehouse.archives.gov/sites/default/files/page/files/201701_cea_discounting_issue_brief.pdf (arguing to lower the consumption-based discount rate to 2%).

1 estimates of the social cost of carbon currently end in 2070. But the Proposed Project could
2 continue to have climate impacts through at least 2127, and additional values of the social
3 cost of carbon can be extrapolated from 2071 through 2127. Accounting for the latter two
4 adjustments (using a 2% discount rate and extrapolating damages through 2127) would
5 likely increase the estimate of the Proposed Project's net monetized climate damages by
6 approximately four-fold, up to roughly \$160 billion. Even this figure could underestimate
7 the Proposed Project's climate damage, because it omits key damage categories and may
8 not fully account for the risk of catastrophic impacts.

9 **Q. What is your understanding of the project for which Enbridge seeks approval?**

10 A. Enbridge Energy is proposing to build a tunnel beneath the Straits of Mackinac to house a
11 segment of its Line 5 oil and natural gas liquids pipeline (the "Proposed Project").

12 **Q. Do you know whether Enbridge considered any alternatives?**

13 A. Enbridge reports having examined two alternatives to its proposed tunnel: "(ii) a new pipe
14 installed across the Straits using an open-cut method that includes secondary containment;
15 or (iii) a new pipe installed below the Straits using the horizontal directional drilling (HDD)
16 method." (Pastoor Direct at 15:.22-25).

17 **Q. What would a no-action alternative entail?**

18 A. A no-action alternative would entail allowing the existing pipeline to shut down, and not
19 building a tunnel or installing any replacement pipelines. This would have the effect of
20 decreasing the supply of oil and natural gas liquids. Basic economic principles of supply
21 and demand dictate that with decreased supply, the quantity demanded will also drop in
22 response to price signals. Decreased demand for oil and natural gas liquids will decrease
23 the combustion of oil and natural gas liquids, which will decrease emissions of greenhouse

1 gases and other harmful pollutants. The reductions in lifecycle emissions from the oil and
2 gas products that the Proposed Project would otherwise transport, as well as avoided
3 emissions from the construction and operation of any action alternative, can be monetized
4 as the incremental benefits of selecting the no-action alternative (or, equivalently, as the
5 incremental costs of selecting the Proposed Project). This testimony provides such a
6 monetization of the greenhouse gas effects.

7 **Q: Have you reviewed any analysis of the no-action alternative?**

8 A: Yes, I have reviewed Peter A. Erickson's testimony.

9 **Q: Do you rely on Mr. Erickson's calculations?**

10 A: Yes. I rely on his finding of the Proposed Project's total greenhouse gas emissions from
11 construction and operation, and the lifecycle emissions from the transported oil and gas
12 products, as well as his calculation of the net greenhouse gas emissions compared to the
13 no-action alternative. I use his calculations of quantified tons of greenhouse gas emissions
14 to monetize the Proposed Project's climate costs.

15 **Q. Why is monetization of environmental externalities important for evaluating how**
16 **pollution from the Proposed Project impairs the air, water, natural resources, or**
17 **public trust?**

18 A. Monetization can help both decisionmakers and the public understand the nature of the
19 Proposed Project's pollution and the impairment it causes. When environmental
20 externalities are presented only qualitatively, decisionmakers and the public both will tend
21 to overly discount the importance of the effects. In general, non-monetized effects are often
22 irrationally treated as worthless.⁵ This may be especially true if some effects (like capital

⁵ Richard Revesz, *Quantifying Regulatory Benefits*, 102 Cal. L. Rev. 1424, 1434-35, 1442 (2014).

1 cost and operational costs) are monetized, while other effects (like climate and health
2 benefits) are discussed only quantitatively or qualitatively.⁶

3 It also may be especially difficult for the public and decisionmakers to fully
4 consider climate effects that are presented only quantitatively through estimates of
5 emissions volumes. As the U.S. Environmental Protection Agency’s website explains,
6 “abstract measurements” of so many tons of greenhouse gases can be less useful for the
7 public, unless “translat[ed] . . . into concrete terms you can understand.”⁷ In particular, it
8 may be difficult for many members of the public—and even for some decisionmakers
9 otherwise well-versed in climate change—to conceptualize how significant emissions of
10 27 million tons per year of greenhouse gases actually are, let alone what concrete impacts
11 those emissions will have to the air, water, natural resources, human health, economy, and
12 public trust. Comparisons of tons of greenhouse gases emitted by the Proposed Project to
13 statewide, national, or global totals of annual emissions may misleadingly make such
14 quantitative figures appear small.⁸ But in fact, even a “small portion of a gargantuan source
15 of . . . pollution” may still “constitute[] a gargantuan source of . . . pollution on its own
16 terms.”⁹ Monetization makes that clear. Specifically, while 27 million tons per year may

⁶ A well-documented mental heuristic called “salience bias” causes people to irrationally focus more on salient figures and ignore less salient figures. Because people are very familiar with money, but do not often encounter in their everyday lives statistics on the metric tons of greenhouse gas emissions, people are more likely to focus on costs and benefits presented in monetary terms, and less likely to focus on climate costs presented only quantitatively or qualitatively.

⁷ EPA, Greenhouse Gas Equivalencies Calculator, <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator> (last updated Mar. 2021), available at <https://perma.cc/UNX8-PQ3J>.

⁸ A well-documented mental heuristic called “probability neglect” causes people to irrationally reduce small probability risks entirely down to zero. Cass R. Sunstein, *Probability Neglect: Emotions, Worst Cases, and Law*, 112 Yale L.J. 61, 63, 72 (2002) (drawing from the work of recent Nobel laureate economist Richard Thaler). Another well-documented mental heuristic called “scope neglect” suggests that abstract volume estimates will fail to give people the required informational context to understand climate risks. Daniel Kahneman et al., *Economic Preferences or Attitude Expressions? An Analysis of Dollar Responses to Public Issues*, 19 J. Risk & Uncertainty 203, 212-213 (1999).

⁹ *Sw. Elec. Power Co. v. EPA*, 920 F.3d 999, 1032 (5th Cir. 2019) (internal quotation marks omitted).

1 be hard to conceptualize, the monetized expected cost of the climate risks associated with
2 those same emissions—about \$1 billion per year according to the federal Interagency
3 Working Group’s central estimate of the social cost of carbon¹⁰—is a salient, relevant, and
4 contextualized way of understanding the Proposed Project’s pollution. (This type of
5 calculation is explored in much greater detail later in this testimony.)

6 Moreover, monetization using the social cost of greenhouse gas methodology will
7 help decisionmakers and the public understand the concrete impairment to air, water,
8 natural resources, and the public trust caused by that pollution. Though the current best
9 estimates of the social cost of greenhouse gases cannot yet capture all categories of climate
10 damages, current estimates do at least partially reflect many key real-world impacts such
11 as:¹¹

- 12 • **energy system losses** and disruptions, including from temperature-related
13 changes to the demand for cooling and heating;
- 14 • human health impacts, including cardiovascular and respiratory mortality from
15 climate-induced **changes in air quality**, as well as from heat-related illnesses,

¹⁰ See *infra* and attached exhibits for more details on this calculation. To briefly summarize, the quantified metric tons of incremental carbon dioxide-equivalent emissions from the Proposed Project as compared to the no-action alternative (from Peter A. Erickson’s testimony) are monetized by the relevant central estimate of the social cost of carbon dioxide published in February 2021 by the federal Interagency Working Group (2021 TSD, *supra*), and then discounted back to present value at a 3% rate. This \$1 billion per year figure reflects that the total net present value of the incremental climate effects from 2027-2070 is conservatively estimated at \$41 billion, and \$41 billion over 44 years is nearly \$1 billion per year. The actual present value figure varies each year.

¹¹ These impacts are all included to some degree in at least one of the three integrated assessment models (IAMs) used by the Interagency Working Group (namely, the DICE, FUND, and PAGE models), though some impacts are modeled incompletely or not represented in all three models, and many other important damage categories are currently omitted from these IAMs. Compare Interagency Working Group on the Social Cost of Carbon, *Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis* at 6-8, 29-33 (2010), <https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf> [hereinafter IWG, 2010 TSD]; with Peter Howard, *Omitted Damages: What’s Missing from the Social Cost of Carbon* (Cost of Carbon Project Report, 2014),

http://costofcarbon.org/files/Omitted_Damages_Whats_Missing_From_the_Social_Cost_of_Carbon.pdf.

1 changing disease vectors like malaria and dengue fever, and **water-borne**
2 **diseases**;

- 3 • **water supply losses** and disruptions, including changes in fresh water
4 availability from extreme weather events and infrastructure impacts;
- 5 • lost productivity and other impacts to **agriculture, forestry, and fisheries**, due
6 to alterations in temperature, precipitation, CO₂ fertilization, and other climate
7 effects;
- 8 • **property lost** or damaged by coastal flooding, storms, other extreme weather
9 events, as well as the cost of protecting vulnerable property and the cost of
10 resettlement following property losses;
- 11 • some **biodiversity losses** and ecosystem service impacts;
- 12 • some impacts to **outdoor recreation** and other non-market amenities; and
- 13 • some **catastrophic impacts**, including the triggering of climate tipping point
14 events and damages at very high temperatures.

15 By translating tons of emissions into dollars of real-world climate damages,
16 applying the social cost of greenhouse gas metrics will help decisionmakers and the public
17 understand the nature of the impairment caused by the Proposed Project's greenhouse gas
18 pollution.

19 **Q. Why is monetization of environmental externalities important for evaluating whether**
20 **the no-action scenario is a feasible and prudent alternative to the Proposed Project?**

21 **A.** Monetization can help decisionmakers and the public weigh climate costs against other
22 costs and benefits of various alternatives, and so determine the relative prudence of the no-
23 action alternative as compared to the Proposed Project. In order to ensure that

1 environmental effects will be treated on par with other costs and benefits, those
2 environmental externalities should, whenever feasible, be monetized. When all costs and
3 benefits are translated into the common metric of money, the tradeoffs inherent in policy
4 choices become apparent, and decisionmakers can more readily and more transparently
5 compare society's preferences for competing priorities. Specifically, the fact that the
6 Proposed Project will inflict an additional \$41 billion or more in climate damages as
7 compared to the no-action alternative is clearly relevant in weighing the prudence of the
8 no-action alternative.

9 **Q. Why is monetization appropriate for greenhouse gas emissions in particular,**
10 **including the greenhouse gas emissions from the Proposed Project?**

11 A. Greenhouse gas emissions are particularly suitable candidates for monetization, and the
12 emissions from the Proposed Project can be readily monetized.

13 First, greenhouse gases are global pollutants, such that any ton of carbon dioxide
14 emissions causes the same environmental harms regardless of the source of the emission.
15 It does not matter what type of project caused the emission or where the emission originated
16 geographically: any ton of carbon dioxide will become well-mixed in the global
17 atmosphere, cause the same kind of additional radiative forcing and other atmospheric
18 interactions over its long lifespan, contribute the same incremental temperature increase
19 and other impacts to climate and weather, and so cause the same additional impairment to
20 air, water, natural resources, human health, and the economy. (The measurement of such
21 impacts through the application of integrated assessment models is discussed more below.)
22 For this reason, we can calculate with reasonable certainty the climate costs imposed by
23 the emissions from the Proposed Project.

1 The second reason why greenhouse gas emissions are particularly suited for
2 monetization is that a widely accepted monetization tool exists. The federal Interagency
3 Working Group's estimates of the Social Costs of Greenhouse Gases have been thoroughly
4 vetted by economists, scientists, and the courts; have been widely adopted by a growing
5 list of other U.S. states; and are freely available and easy to apply. (The development,
6 vetting, and use of these estimates is detailed more below.)

7 The global nature of the climate effects of greenhouse gases also creates a third
8 reason why monetization of greenhouse gas emissions is particularly appropriate:
9 reciprocity. By using the metrics in its decisionmaking proceedings, Michigan can help
10 build a precedent for other states to follow. As Michigan helps encourage other
11 jurisdictions to likewise weigh the social cost of greenhouse gases in their decisions,
12 Michigan will benefit as other jurisdictions' emissions are reduced. Because greenhouse
13 gases do not stay within geographic borders, but rather mix in the earth's atmosphere and
14 affect climate worldwide, greenhouse gases emitted outside Michigan contribute directly
15 to climate damages in Michigan (just as Michigan's emissions contribute directly to
16 climate damages outside Michigan). Michigan stands to benefit greatly as other U.S. states
17 apply a global social cost of greenhouse gas value to their energy policy decisions and so
18 weigh the externalities of their emissions that will fall on Michigan. It is therefore rational
19 for Michigan to use the social cost of greenhouse gases in its own decisionmaking, because
20 it will encourage other states to follow suit.¹²

¹² See Peter Howard & Jason Schwartz, *Think Global: International Reciprocity as Justification for a Global Social Cost of Carbon*, 42 Colum. J. Envtl. L. 203 (2017); Jason A. Schwartz, *Strategically Estimating Climate Pollution Costs in a Global Environment* n.34 (Policy Integrity Report, June 2021), https://policyintegrity.org/files/publications/Strategically_Estimating_Climate_Pollution_Costs_in_a_Global_Environment.pdf (making the case for state-level reciprocity).

1 Several U.S. states already apply the federal Interagency Working Group's
2 methodology in their energy policy decisions, including Colorado, Nevada, Minnesota,
3 California, Washington, and others. (See *infra* for more on how other states are valuing the
4 social cost of greenhouse gases.) Michigan should join those states as a leader in climate
5 policy by considering the social cost of greenhouse gases in its decisionmaking, and so
6 encourage additional states to follow suit—which in turn will benefit Michigan.

7 **Q. How are climate effects monetized using the social cost of greenhouse gas**
8 **methodology?**

9 A. Economists monetize climate damages by linking together global climate models with
10 global economic models, producing what are called integrated assessment models. These
11 integrated assessment models can take a single additional unit of greenhouse gas emissions
12 emitted from any source anywhere in the world (such as from burning oil or operating
13 tunnel-boring equipment) and calculate the change in atmospheric greenhouse
14 concentrations; translate that change in concentration into a change in temperature; and
15 model how that temperature change and associated weather changes will cause economic
16 damages. The resulting monetary estimate of how each additional unit of greenhouse gases
17 will impact our health, our economic activity, our quality of life, and our overall well-being
18 is called the social cost of greenhouse gases.

19 **Q. Is there a consensus among scientists, economists, and other experts on the best**
20 **methodology for monetizing climate damages from greenhouse gas emissions?**

21 A. Yes. The methodology and estimates developed by the federal Interagency Working Group
22 on the Social Cost of Greenhouse Gases, published most recently in February 2021, is
23 widely considered to be the best available calculation of the social cost of greenhouse

1 gases, even though it is also widely considered to be a conservative underestimate of true
2 costs of climate change.¹³

3 In 2009, an Interagency Working Group assembled experts from a dozen federal
4 agencies and White House offices to “estimate the monetized damages associated with an
5 incremental increase in [greenhouse gas] emissions in a given year” based on “a defensible
6 set of input assumptions that are grounded in the existing scientific and economic
7 literature.”¹⁴ The estimates are based on the three most cited, most peer-reviewed models
8 built to link physical impacts to the economic damages of each additional ton of greenhouse
9 gas emissions. Those three leading integrated assessment models are DICE (by Nobel
10 laureate William Nordhaus of Yale University), FUND (by Richard Tol and David Anthoff
11 of Sussex University and University of California-Berkeley), and PAGE (by Chris Hope
12 of Cambridge University). These models are able to estimate and monetize many¹⁵ of the
13 most important categories of climate damages, including, but not limited to: energy system
14 losses and disruptions; air quality and water quality changes and associated impacts to
15 human health; fresh water supply losses; impacts to forestry, fisheries, and agriculture;
16 property damage; biodiversity losses and ecosystem service impacts; impacts to outdoor
17 recreation and other non-market amenities; and catastrophic impacts.

18 The Working Group ran these models using inputs and reasonable assumptions
19 drawn from the peer-reviewed literature, and the Working Group updated its estimates
20 every few years—most recently in February 2021—to reflect the latest and best scientific

¹³ See IWG, 2021 TSD, *supra* note 4, at 4 (admitting that its own estimates “likely underestimate societal damages from GHG emissions”).

¹⁴ IWG, 2010 TSD, *supra* note 11.

¹⁵ See *supra* notes 2-3 & 11 and accompanying text for details on which categories are or are not currently included.

1 and economic data.¹⁶ From early 2017 through January 2021, the Trump Administration
2 disbanded the Working Group, and during that period some agencies developed much
3 lower “interim” estimates of the social cost of greenhouse gases.¹⁷ In 2020, a federal court
4 found those “interim” estimates to be arbitrarily and illegally inconsistent with the best
5 available science and economics;¹⁸ a report by the U.S. Governmental Accountability
6 Office (GAO) similarly concluded that those “interim” estimates had no process for
7 ensuring consistency with the best available science and economics.¹⁹ In 2021, the Biden
8 Administration reconstituted the Working Group, which quickly readopted the prior values
9 from 2016 (adjusting them for inflation into 2020\$).²⁰ The Working Group expects to more
10 thoroughly update the estimates by January 2022, and in particular has expressed a need to
11 reexamine the selection of the discount rate.²¹

12 **Q. What discount rates did the Working Group select, and what range of estimates has**
13 **the Working Group issued?**

14 A. For each greenhouse gas (i.e., carbon dioxide, methane, nitrous oxide), the Working Group
15 has issued a “central estimate” of social costs per metric ton of emissions per year based
16 on a 3% discount rate and taking the average from a probability distribution; a “high-impact
17 estimate” based on the 95th percentile of that probability distribution calculated at a 3%
18 discount rate; as well as additional estimates that explore the calculation’s sensitivity to a

¹⁶ IWG, 2021 TSD, *supra* note 4.

¹⁷ See Policy Integrity, *How the Trump Administration Is Obscuring the Costs of Climate Change* (2018), https://policyintegrity.org/files/publications/Obscuring_Costs_of_Climate_Change_Issue_Brief.pdf.

¹⁸ *California v. Bernhardt*, 472 F.Supp.3d 573, 611-14 (N.D.Cal. 2020).

¹⁹ GAO, GAO-20-254, *Social Cost of Carbon: Identifying a Federal Entity to address the National Academies’ Recommendations Could Strengthen Regulatory Analysis* 29 (2020) (concluding that the “interim” estimates “may not be well positioned to ensure agencies’ future regulatory analyses are using the best available science”).

²⁰ IWG, 2021 TSD, *supra* note 4.

²¹ *Id.*

1 lower (2.5%) or higher (5%) discount rate.²² Discount rates are important because of the
2 nature of greenhouse gases and climate change. Once emitted, greenhouse gases can linger
3 in the atmosphere for centuries, building up the concentration of radiative-forcing pollution
4 and affecting the climate in cumulative, non-linear ways.²³ The integrated assessment
5 models project future climate damages over roughly a 300-year timescale. However,
6 society tends to value economic effects today more than future effects.²⁴ A discount rate is
7 used to take all the marginal climate damages that an additional ton of emissions emitted
8 in the near future will inflict over the next 300 years, and translate those future damages
9 back into present-day values.

10 Since its founding in 2009 through its most recent updated guidance, the Working
11 Group has chosen a 3% discount rate for its central estimate based on available data and
12 historical precedents on federal agencies' default choice of discount rates.

13 **Q. Is the Working Group's choice of discount rates appropriate, and should other**
14 **discount rates be considered?**

15 A. Though the choice of a 3% central discount rate was appropriate as a conservative selection
16 a decade ago, more recently updated market data on U.S. Treasury rates, consumer saving
17 rates, and economic forecasts—as well as updated economic literature on uncertainty,
18 correlations between climate damages and economic growth, preferences for inter-

²² See generally 2010 TSD, *supra* note 11. The 5% discount rate was selected as an “upper value” to reflect “possibility that climate damages are positively correlated with market returns,” *id.* at 23, while the 2.5% rate was used to reflect the fact that “interest rates are highly uncertain over time,” *id.*

²³ Carbon dioxide also has cumulative effects on ocean acidification, in addition to cumulative radiative-forcing.

²⁴ However, many experts on climate policy and economics believe that a non-zero rate of time preference is inappropriate in the context of long-term climate change, because society really does not or should not care less about the welfare of future generations. See Richard Revesz & Matthew Shahabian, *Climate Change and Future Generations*, 84 S. Cal. L. Rev. 1097 (2011).

1 generational equity, expert elicitations, and other technical concepts²⁵—all point strongly
2 in the direction of a lower discount rate being more appropriate. Based on such economic
3 and ethical considerations, New York has already moved to estimates based on a 2%
4 discount rate (calculated through a methodology otherwise based on and consistent with
5 the Working Group’s estimates), and Washington and Colorado have adopted the Working
6 Group’s estimates at 2.5%.²⁶ In February 2021, the Working Group expressed that a rate
7 of 2.5% *or lower* may be appropriate, and the Working Group will revisit its choice of
8 discount rates when it updates its values in January 2022.²⁷ For that reason, this testimony
9 shows both the Working Group’s estimates at the 3% and 2.5% discount rates, but cautions
10 that even the 2.5% estimates are likely conservative underestimates because the most
11 appropriate discount rate is likely at or below 2%.²⁸ To further address this potential source
12 of underestimation, we also ran the analysis using New York State’s valuations of the social
13 cost of carbon dioxide at a 2% discount rate, though these estimates are available only
14 through the year 2050.

15 **Q. What are the values of the social cost of carbon dioxide over time?**

16 A. The social cost of greenhouse gases increases over time, because an additional ton of
17 emissions will inflict greater damages in the future as emissions accumulate in the
18 atmosphere and climate and economic systems become increasingly stressed. The
19 following table shows the Interagency Working Group’s estimates for the social cost of

²⁵ Howard & Schwartz, *About Time*, *supra* note 4.

²⁶ N.Y. Dep’t of Env’tl. Conserv., Establishing a Value of Carbon: Guidelines for Use by State Agencies 18 (2020; revised 2021), https://www.dec.ny.gov/docs/administration_pdf/vocguidrev.pdf; Wash. Dept. of Commerce, *Recommendation for Standardizing the Social Cost of Carbon When Used for Public Decision-Making Processes* (2014) <http://www.commerce.wa.gov/wp-content/uploads/2015/11/Energy-EV-Planning-Social-Cost-of-Carbon-Sept-2014.pdf>; Colo. H.B. 21-1238 (2021).

²⁷ 2021 TSD, *supra* note 4, at 21, 35.

²⁸ See Howard & Schwartz *About Time*, *supra* note 4.

1 carbon, by year of emissions, calculated at both the 3% and 2.5% discount rates, as well as
2 corresponding social cost of carbon dioxide estimates calculated at the 2% rate by New
3 York State in a manner consistent with the Working Group’s method.

4 Importantly, the Working Group’s central estimate omits key categories of climate
5 damages—like many of the risks of catastrophic and irreversible consequences, including
6 environmental and social “tipping points.” The Working Group developed a set of high-
7 impact estimates (calculated at the 95th-percentile of the probability distribution for the 3%
8 discount rate estimates), which serve as a partial proxy for, among other things, omitted
9 catastrophic damages, risk aversion, and other uncertainties.²⁹ Policy decisions should
10 therefore be informed by the Working Group’s full range of estimates, and the high-impact
11 estimates are provided in the following table as well.

12 The Working Group’s most recent set of estimates, published in February 2021, run
13 through year 2050. Recently, in June 2021, the U.S. Environmental Protection Agency
14 (EPA)—a key member of the Working Group—extended the Working Group’s estimates
15 from 2050 out through year 2070. New York’s estimates are currently available only
16 through year 2050.

²⁹ IWG, 2010 TSD, *supra* note 11, at 25, 30.

Table 1. Social Cost of Carbon Dioxide Estimates (in 2020\$, per metric ton)³⁰

Year	IWG/EPA's Central Estimates at a 3% Discount Rate	IWG/EPA's Estimates at a 2.5% Discount Rate	New York's Central Estimates at a 2.0% Discount Rate	IWG/EPA's High Impact Estimates (95 th -percentile at a 3% discount rate)
2020	\$51	\$76	\$121	\$152
2025	\$56	\$83	\$129	\$169
2030	\$62	\$89	\$137	\$187
2035	\$67	\$96	\$146	\$206
2040	\$73	\$103	\$154	\$225
2045	\$79	\$110	\$164	\$242
2050	\$85	\$116	\$172	\$260
2060	\$94	\$128	<i>not available</i>	\$276
2070	\$108	\$144	<i>not available</i>	\$328

Q. Have the Working Group's estimates been reviewed by third parties?

A. Yes, the Working Group's estimates have been repeatedly endorsed by reviewers. In 2014, the U.S. Government Accountability Office reviewed the Working Group's methodology and concluded that it had followed a "consensus-based" approach, relied on peer-reviewed academic literature, disclosed relevant limitations, and adequately planned to incorporate new information via public comments and updated research.³¹ In 2016, the U.S. Court of Appeals for the Seventh Circuit held that estimates of the social cost of carbon used to date by agencies were reasonable.³² In 2016 and 2017, the National Academies of Sciences issued two reports that, while recommending future improvements to the methodology,

³⁰ The table shows rounded figures. Unrounded values are available at https://www.whitehouse.gov/wp-content/uploads/2021/02/tsd_2021_annual_unrounded.csv. See IWG, 2021 TSD, *supra* note 4; EPA, *Social Cost of Greenhouse Gases (SC-GHG) Unrounded Annual Estimates through 2070*, June 2021 <https://www.regulations.gov/document/EPA-HQ-OAR-2021-0208-0161>; N.Y. Dep't of Env'tl. Conserv., *supra* note 26.

³¹ Gov't Accountability Office, *Regulatory Impact Analysis: Development of Social Cost of Carbon Estimates* 12-19 (2014).

³² *Zero Zone, Inc. v. Dep't of Energy*, 832 F.3d 654, 679 (7th Cir. 2016).

1 supported the continued use of the existing Working Group estimates.³³ In 2020, the U.S.
2 District Court for the Northern District of California held that by breaking from the
3 Working Group's estimates, the Trump Administration had ignored the best available
4 science and economics.³⁴ It is, therefore, unsurprising that scores of economists and climate
5 policy experts have endorsed the Working Group's values as the best available estimates,
6 even while stressing that the estimates are conservative underestimates.³⁵ The Working
7 Group's estimates have been used in well over 100 federal regulatory proceedings, and
8 counting, each subject to a thorough public comment period.³⁶

9 **Q. Do other states use the Working Group's estimates for the social cost of greenhouse**
10 **gases?**

11 **A.** A number of states have recognized the importance of considering the social cost of carbon
12 estimates and have begun using the federal Interagency Working Group's estimates or
13 methodology to measure the harms from carbon dioxide emissions in their proceedings.
14 States that consider the damage of carbon dioxide emissions in various energy and climate
15 policy proceedings include Colorado, Minnesota, Nevada, Virginia, Washington,
16 California, Illinois, Maine, New Jersey, New Mexico, and New York.³⁷ Notably, all states
17 that have to date incorporated or are considering incorporating the social cost of greenhouse

³³ Nat'l Acad. Sci., Eng. & Medicine, *Valuing Climate Damages: Updating Estimates of the Social Cost of Carbon Dioxide* 3 (2017); Nat'l Acad. Sci., Eng. & Medicine, *Assessment of Approaches to Updating the Social Cost of Carbon: Phase I Report on a Near-Term Update* 1 (2016).

³⁴ California v. Bernhardt, 472 F.Supp.3d at 611-14.

³⁵ See, e.g., Joseph E. Aldy et al., *Keep Climate Policy Focused on the Social Cost of Carbon*, 373 SCIENCE 950 (2021); Richard Revesz et al., *Best Cost Estimate of Greenhouse Gases*, 357 SCIENCE 655 (2017); Michael Greenstone et al., *Developing a Social Cost of Carbon for U.S. Regulatory Analysis: A Methodology and Interpretation*, 7 REV. ENVTL. ECON. & POL'Y 23, 42 (2013); Richard L. Revesz et al., *Global Warming: Improve Economic Models of Climate Change*, 508 NATURE 173 (2014) (co-authored with Nobel Laureate Kenneth Arrow, among others).

³⁶ See Howard & Schwartz, *Think Global*, *supra* note 12, App. A (cataloguing uses in federal proceeding).

³⁷ See Cost of Carbon, States Using the SCC, <https://costofcarbon.org/states>.

1 gases into their electricity decisionmaking have relied at least in part—and, more often,
2 exclusively—on the Interagency Working Group’s numbers or methodology.

3 A few key examples are worth exploring in more detail. Several states have decided
4 to focus on estimates that are greater than the Working Group’s “central” estimates
5 calculated at the 3% discount rate. As mentioned above, New York States has adapted the
6 Working Group’s methodology but applied a 2% discount rate, to be consistent with more
7 recent economic data and also to help offset the fact that the social cost of greenhouse gases
8 is underestimated because many significant categories of climate damages cannot currently
9 be estimated due to data limitations.³⁸ Back in 2014, Washington decided to focus on the
10 Working Group’s estimates at the 2.5% discount rate for similar reasons, and to fulfill
11 ethical obligations to future generations and maintain Washington’s role as a leader on
12 climate change.³⁹ Colorado also requires its gas and electricity utilities to focus on the 2.5%
13 estimates.⁴⁰ Similarly, California’s Public Utilities Commission requires consideration of
14 the Working Group’s high-impact estimates,⁴¹ because many of the climate damage
15 categories most relevant to the state’s energy infrastructure and economy—such as
16 wildfires, thermal efficiency decreases, and overheating of electricity system
17 components—are not fully incorporated into the central estimates of the social cost of
18 carbon.⁴²

³⁸ N.Y. Dep’t of Envtl. Conserv., *supra* note 26, at 18-19.

³⁹ Wash. Dept. of Commerce, *supra* note 26, at 3-5.

⁴⁰ Colo. HB 21-1238, *supra* note 26.

⁴¹ Before the Cal. PUC, 19-05-019, Decision Adopting Cost-Effectiveness Analysis Framework Policies for All Distributed Energy Resources at 42 (May 16, 2019),

<http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M293/K833/2938333387.PDF>.

⁴² See Before the Cal. PUC, ALJ’s Ruling Seeking Responses to Questions and Comment on Staff Amended Proposal on Societal Cost Test (Mar. 14, 2018),

<http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M212/K023/212023660.PDF>.

Michigan should join these states as a climate leader by considering the Working Group's estimates—including high-impact estimates and estimates at lower discount rates—as it weighs the impairment caused by the Proposed Project's pollution and the comparative prudence of the no-action alternative. As the Governor recently recognized in an Executive Directive, "Michigan must be a leader in this fight."⁴³

Q. Why is a global perspective necessary and appropriate when valuing the social cost of greenhouse gas emissions?

A. Several reasons explain why a full accounting of climate costs requires a global estimate of the social cost of greenhouse gases. First, the principles of reciprocity discussed above dictate the need for a global perspective. Michigan cannot solve climate change on its own, and Michigan benefits tremendously when other states and other countries reduce their greenhouse gas emissions. In prioritizing the actions that Michigan should take to contribute to the global efforts to combat climate change, Michigan should think about the climate damages it inflicts on the rest of the world, just as Michigan would want the rest of the world to think about the damages their actions cause to Michigan's air, water, natural resources, and public trust. As Michigan recognized when joining the U.S. Climate Alliance:

Smart, coordinated state action can ensure that the United States continues to contribute to the global effort to address climate change....Alliance members are committed to supporting the international agreement, and are pursuing climate action to make progress toward its goals. It is time for Michigan to join the effort.⁴⁴

To encourage other jurisdictions to continue to take account of the externalities of their emissions impose on Michigan, Michigan must likewise take account of the

⁴³ Gov. Gretchen Whitmer, Executive Directive 2020-10: Building a Carbon-Neutral Michigan (Sept. 23, 2020).

⁴⁴ Gov. Gretchen Whitmer, Executive Directive 2019-12: Responding to Climate Change (Feb. 4, 2019).

1 externalities of its emissions that fall outside state borders. The fragile tit-for-tat dynamic
2 could fall apart in the face of too many jurisdictions turning a blind eye to their global
3 externalities and considering only local effects. For example, soon after the Trump
4 administration reversed course and developed its own, flawed, domestic-only “interim”
5 values of the social cost of greenhouse gases, the country of Mexico also moved toward
6 considering only domestic climate impacts in its regulatory analyses.⁴⁵ To secure the
7 reciprocal level of efficient action of greenhouse gas emissions, Michigan should follow
8 the lead of Colorado, Minnesota, Nevada, and other states, and use a global number.

9 Second, climate damages do not respect political borders. The people of Michigan
10 have financial and personal interests in businesses and property located outside Michigan
11 that may be affected by climate change. Michigan’s businesses depend on non-local
12 economies to buy their exports, sell imports, and fill their supply chains. If rising
13 temperatures and rising seas cause climate refugees or infectious disease vectors to migrate
14 toward or within the United States, Michigan will feel the impacts along with the rest of
15 the country. Michigan’s economy, public health, and security are all linked to globally
16 interconnected systems. Because climate damages occurring outside Michigan borders can
17 spill over and affect the people of Michigan, a global perspective on the social cost of
18 greenhouse gases is required.⁴⁶ In fact, a federal judge recently found it was arbitrary and
19 illegal to focus on climate effects occurring only within strict geographic borders given
20 that effects occurring beyond those borders will spill back and inflict local economic,
21 health, and security damages.⁴⁷

⁴⁵ See Schwartz, *Strategically Estimating Climate Pollution Costs in a Global Environment*, *supra* note 12, at n.38.

⁴⁶ See *id.*; Howard & Schwartz, *Think Global*, *supra* note 12.

⁴⁷ *California v. Bernhardt*, 472 F.Supp.3d at 611-14.

1 Finally, no existing methodology can calculate accurately a domestic-only
2 estimate. The models simply were not designed to produce such estimates: for example,
3 the models do not account for any inter-regional spillover effects. Any approximate and
4 speculative estimate based on factors like percentage of global GDP, or share of global
5 coastline or landmass, will be inherently misleading, as they ignore inter-regional spillover
6 effects and extraterritorial interests of citizens.⁴⁸ While many scientists can and do describe
7 the impact of climate change on natural resources in Michigan,⁴⁹ and there is no question
8 that specific natural resources in Michigan will be impacted in individual ways, there is no
9 Michigan-only estimate of the social cost of greenhouse gases; only global estimates.⁵⁰

10 Every state that has begun to incorporate the social cost of greenhouse gases is
11 using a global damage estimate. Attempting to apply a Michigan-specific estimate would
12 be akin to a homeowner throwing trash in her neighbor's yard without considering the
13 odors and pests that will spill back to her own property, or how the neighbor might retaliate
14 in kind.

15 **Q. What quantitative figures do you use to monetize the climate damages from the**
16 **Proposed Project's emissions?**

17 A. We take as given Peter A. Erickson's quantitative estimates of the metric tons of carbon
18 dioxide-equivalent⁵¹ emissions that the Proposed Project's construction and operation will

⁴⁸ See Schwartz, *Strategically Estimating Climate Pollution Costs in a Global Environment*, *supra* note 12, at 29 (explaining, for example, that the coastline-based scaling would absurdly suggest that landlocked or non-coastal states have a zero valuation of the social cost of greenhouse gases).

⁴⁹ See, e.g., Direct Testimony of Dr. Overpeck.

⁵⁰ See e.g., Joint Comments to U.S. Forest Service on Use of Social Cost of Carbon in Colorado Roadless Rule, at 11-14 (Jan. 15, 2016), available at http://policyintegrity.org/documents/Forest_Service_SDEIS_comments.pdf (explaining, for example, that there is no national-, Colorado-, or forest-only estimate of the social cost of carbon).

⁵¹ Erickson presents his quantitative figures in carbon dioxide-equivalent totals, using a relative global warming potential for methane as 29.8 over a 100-year timeframe. Considering the nearer-term relative potency of methane, however, puts methane's relative global warming potential much higher, at 82.5 over a 20-year timeframe. See IPCC, AR6: Chapter 7, at 7-125 (2021). Ultimately, because of different lifespans and other atmospheric interactions, it is

1 generate, and the lifecycle emissions from the oil and gas products transported by the
2 Proposed Project relative to emissions under the no-action scenario. As Erickson's
3 testimony explains, his figures could under- or over-estimate some emissions, and overall
4 Erickson's testimony states that its results may be conservative.

5 **Q. How did you monetize the climate costs from construction of the Proposed Project,**
6 **and what assumptions did you make about the Proposed Project's construction**
7 **timeline?**

8 A. Because the social cost of carbon dioxide increases over time, we must place Erickson's
9 quantitative estimates into specific calendar years. To do this, we assume that it could take
10 about another six years from 2021 for the Proposed Project to clear the remaining
11 environmental reviews and other procedures before construction could begin in 2027.⁵²
12 Then based on Enbridge's estimate of a two-year construction period,⁵³ we assume
13 construction will be completed from 2027-2028, and we assume that Erickson's calculation
14 of 87,000 metric tons of carbon dioxide-equivalent emissions from construction would be
15 split equally between 2027 and 2028 (i.e., 43,500 metric tons per year). We then multiplied
16 these annual construction emissions by the corresponding year's estimates of the social
17 cost of carbon dioxide, considering the four sets of values defined above (3%, 2.5%, 2%,
18 and high-impact). We then discounted these future damage estimates back to their present-

somewhat more accurate to directly estimate the social cost of methane rather than to convert tons of methane into carbon dioxide-equivalents using relative global warming potentials. The Working Group has developed estimates for the social cost of methane, which range from about 29-37 times greater than the social cost of carbon estimate for the corresponding year. IWG, 2021 TSD, *supra* note 4, at 5. However, given the tons of methane at stake here compared to the tons of carbon dioxide, using the social cost of methane would not be significantly different from using the global warming potential-adjusted figures here.

⁵² See U.S. Council on Environmental Quality, *Environmental Impact Statement Timelines (2010-2018)* at 8 (2020), https://ceq.doe.gov/docs/nepa-practice/CEQ_EIS_Timeline_Report_2020-6-12.pdf (noting that U.S. Army Corps of Engineers-approved projects take about 6 years to complete environmental review).

⁵³ Enbridge, *Line 5 Straits of Mackinac Crossing* at 2, https://www.enbridge.com/~media/Enb/Documents/Factsheets/FS_Line5_Straits_tunnel_project.pdf?la=en.

1 day value in the current year of 2021 using the discount rate that corresponds to the
2 underlying rate used to calculate the relevant social cost of carbon values (i.e., a 2.5%
3 discount rate is used when applying the social cost of carbon values calculated at a 2.5%
4 rate).

5 **Q. How did you monetize the climate costs from operation of the Proposed Project,**
6 **including costs for emissions occurring after the year 2070?**

7 A. Following Erickson's calculations, we assume that the Proposed Project's annual operating
8 emissions are 520 metric tons of carbon dioxide-equivalents, and that the Proposed
9 Project's lifespan was 99 years. Therefore, if we assume construction will end in 2028 and
10 operations will begin in 2029, operations will continue through to at least 2127.

11 Neither the social cost of carbon dioxide estimates published by the federal
12 government or those issued by New York are available through 2127. The federal
13 Interagency Working Group's latest estimates run through 2050, though EPA has extended
14 this analysis through to 2070. New York's estimates run through 2050.

15 However, estimates of the social cost of carbon dioxide grow at relatively stable
16 rates over time. As such, we can extend the Working Group/EPA's estimates beyond 2070
17 to 2127 using linear extrapolation. We select linear extrapolation over other alternatives
18 (such as polynomial and box-cox transformation) as these more flexible alternative
19 functions are essentially linear for the average social cost of carbon estimates
20 corresponding to the 3% and 2.5% discount rates, avoids overfitting the model based on its
21 simplicity, and produces a lower-bound approximation. The projected, extrapolated values
22 through 2127 are available in Exhibit PH-2 and the extrapolation code is available in
23 Exhibit PH-3.

1 Given the different timeframes during which different estimates of the social cost
2 of carbon dioxide are available, we have made calculations based on three separate time
3 periods. Our central estimates are calculated for emissions occurring over the time period
4 2027-2070, using EPA's estimates of the social cost of carbon. However, we also calculate
5 from 2027-2050, to limit the estimate to the Working Group's set of values. And we also
6 calculate from 2027-2127, applying our extrapolation of social cost of carbon dioxide
7 figures into the future.

8 **Q: What is your estimate of the climate costs from the construction and operation of the**
9 **Proposed Project?**

10 **A:** From 2027 to 2070, the climate costs of the Proposed Project's emissions from the
11 construction and operation of the pipeline equals \$5.0 million dollars when applying the
12 social cost of carbon values calculated at the 3% discount rate. 84% of these effects stem
13 from the pipeline's construction. Using the 2.5% discount rate and the high-impact SCC
14 estimate increases the joint GHG cost of construction and operation up to \$7.6 million and
15 \$15.2 million, respectively. A longer timeline to 2127 slightly increases the GHG cost
16 estimates, as does using a lower discount rate of 2%. Considering these issues jointly could
17 increase these cost estimates to approximately \$13 million. See the attached spreadsheet
18 (Exhibit PH-2) for a more complete breakdown of climate costs associated with various
19 emissions sources. However, as explained above, the per-ton monetized damages from
20 carbon dioxide does not change depending on the source of emissions. From an economic
21 perspective, it does not matter whether a ton of carbon dioxide is emitted by construction,
22 operation, or downstream combustion of transported products—all those emissions will
23 cause climate damages. Basic economic principles of supply and demand indicate that

1 construction and operation of the Proposed Project will increase the net supply and demand
2 of oil and gas products, and so increase net lifecycle emissions from the production,
3 transport, and combustion of those oil and gas products. All those emissions can and should
4 be monetized as well.

5 **Q. Mr. Erickson also estimated incremental greenhouse gas emissions resulting from the**
6 **transport of oil and NGL through the Proposed Project, as compared to a no-action**
7 **alternative. How did you monetize the net climate costs from the products delivered**
8 **by the Proposed Project, as compared to emissions under the no-action alternative?**

9 A. Following Erickson's testimony, we assumed a net increase of 27 million metric tons of
10 greenhouse gas emissions (CO₂e) annually from the fuel transported by the pipeline, as
11 compared to emissions under the no-action alternative. As explained above for operational
12 emissions, we assumed that the lifespan of the pipeline will be at least 99 years, such that
13 the pipeline will begin transporting oil and gas in 2029, and run through at least 2127.
14 Given those assumptions, the monetization of lifecycle emissions from the transported
15 products is then identical to above.

16 **Q. What are the total monetized climate costs of the Proposed Project's emissions from**
17 **construction and operation and the lifecycle emissions from additional oil and gas**
18 **products transported by the Proposed Project?**

19 A. As explained above, we use the federal Interagency Working Group's estimates of the
20 social cost of carbon calculated at a 3% discount rate, and extended by EPA through year
21 2070, for our main, conservative estimate. But we also test our calculation's sensitivity to
22 using other social cost of carbon figures (specifically, estimates at the 2.5% and 2%
23 discount rates, and the Working Group's high-impact estimates), as well as over different

time periods (through 2050, or through 2127). In all cases, we discount future effects back to present value as of 2021. For undiscounted totals, estimates additional discount rates (0%, 1%, and 5%), and breakdowns of estimates by construction source or lifecycle stage, please see Exhibit PH-2.

**Table 3. Total Value of the Proposed Project's Net Monetized Climate Costs
(Present Value in 2021; in 2020\$)**

Time Period	Estimate of the Social Cost of Carbon Dioxide			
	IWG/EPA's Central 3% Estimates	IWG/EPA's 2.5% Estimates	New York's Central 2% Estimates	IWG/EPA's High Impact Estimates
2027-2050	\$24.95 billion	\$38.45 billion	\$63.24 billion (154% higher than the 3% estimate)	\$76.24 billion
2027-2070	\$41.02 billion	\$64.95 billion	<i>not directly available; an assumed 154% increase would total \$104.00 billion</i>	\$124.38 billion
2027-2127	\$63.38 billion	\$106.84 billion	<i>not directly available; an assumed 154% increase would total \$160.68 billion</i>	\$191.45 billion

Q. Is your monetization of the environmental costs of the Proposed Project a conservative estimate?

A. Yes, our estimate of \$41 billion in net present value climate costs from the Proposed Project's emissions from 2027 through 2070, calculated using the 3% social cost of carbon figures, is a very conservative for several reasons.⁵⁴

⁵⁴ Again, this analysis takes as given the quantified totals from Erickson's testimony. The monetized totals presented here may be under- or over-estimates to the extent those quantified totals are under- or over-estimates.

1 First, the pipeline is expected to have at least a 99-year lifespan, implying an end
2 date of 2127, not 2070. Extrapolating and applying the 3% social cost of carbon estimates
3 through 2127 would increase the net present value from \$41 billion to \$63 billion.

4 Second, as discussed above, considerable recent evidence strongly points to a
5 discount rate below 3%, of 2% or lower. If the Working Group's 2.5% estimates are applied
6 over the 2027-2070 period rather than the 3% figures, the net present value of climate costs
7 would increase to almost \$65 billion. Similarly, over the shorter 2027-2050 time period,
8 moving from the 3% estimates to New York's estimates of the social cost of carbon at a
9 2% discount rate would increase the net present value of the project's climate costs by
10 154% (from \$25 billion to \$63 billion). If that same relative percentage increase holds true
11 over the longer analysis period of 2027-2127, then we can predict that applying 2% social
12 cost of carbon figures over the 2027-2127 period instead of the 3% figures would increase
13 the net present total value to over \$160 billion.⁵⁵ Even this may be a low estimate, as some
14 recent evidence supports a discount rate below 2%.

15 Third, the methodology for calculating the social cost of greenhouse gases currently
16 excludes many significant health, environmental, and welfare impacts due to data
17 limitations, such as:

- 18 • Wildfires, including acreage burned, health impacts from smoke, property
19 losses, and deaths;
- 20 • Agricultural impacts, including food price spikes and changes from heat and
21 precipitation extremes;

⁵⁵ That is, a 154% increase of \$63.38 billion = $63.38 \text{ billion} * (1+1.54) = 160.65 \text{ billion}$.

- 1 • Death, injuries, and illnesses from omitted natural disasters and interruptions in
- 2 the supply of water, food, sanitation, and shelter;
- 3 • Impacts on labor productivity from extreme heat and weather;
- 4 • Catastrophic impacts and tipping points, including rapid sea level rise and
- 5 damages at very high temperatures;
- 6 • Ocean acidification and extreme weather effects on fisheries and coral reefs;
- 7 • Biodiversity and habitat loss, and species extinction;
- 8 • Changes in land and ocean transportation;
- 9 • National security impacts from regional conflict, including from refugee
- 10 migration stemming from extreme weather and from food, water, and land
- 11 scarcity;
- 12 • And many more categories.⁵⁶

13 Consequently, while the Working Group's estimates remain among the best
14 available for government decisionmakers to use, they are widely acknowledged to be
15 underestimates, perhaps severely so.⁵⁷ To proxy for these omitted impacts, the Working
16 Group has recommended considering its high-impact estimates. Over the 2027-2127

⁵⁶ Howard, *Omitted Damages*, *supra* note 11. For more on wildfires specifically, see Peter H. Howard, *Flammable Planet: Wildfires and the Social Cost of Carbon* (Policy Integrity/Cost of Carbon Report, 2014), [https://costofcarbon.org/files/Flammable Planet Wildfires and Social Cost of Carbon.pdf](https://costofcarbon.org/files/Flammable_Planet_Wildfires_and_Social_Cost_of_Carbon.pdf). For other lists of actual climate effects, including air quality mortality, extreme temperature mortality, lost labor productivity, harmful algal blooms, spread of West Nile virus, damage to roads and other infrastructure, effects on urban drainage, damage to coastal property, electricity demand and supply effects, water supply and quality effects, inland flooding, lost winter recreation, effects on agriculture and fish, lost ecosystem services from coral reefs, and wildfires, *see* EPA, *Multi-Model Framework for Quantitative Sectoral Impacts Analysis: A Technical Report for the Fourth National Climate Assessment* (2017); U.S. Global Change Research Program, *Climate Science Special Report: Fourth National Climate Assessment* (2017); EPA, *Climate Change in the United States: Benefits of Global Action* (2015); Union of Concerned Scientists, *Underwater: Rising Seas, Chronic Floods, and the Implications for U.S. Coastal Real Estate* (2018).

⁵⁷ *See* Revesz et al., *Global Warming: Improve Economic Models of Climate Change*, *supra* note 4.

1 timeframe, applying the high-impact estimates would calculate total net present climate
2 damages as \$194 billion. Note that this estimate would be even higher if the 95th percentile
3 of the probability distribution associated with a 2% discount rate were taken, instead of the
4 95th percentile for the 3% rate's distribution that the Working Group used.

5 Finally, these estimates cover climate only damages from greenhouse gas
6 emissions. But the construction and operation of the Proposed Project, as well as the
7 production and combustion of products delivered by the Proposed Project, will emit a
8 variety of other harmful air emissions and also have other impacts to water and natural
9 resources. Some of those additional environmental impacts could be monetized with
10 additional data collection and analysis; others cannot currently be quantified or monetized
11 but may still be highly significant and should be considered. Their omission from this
12 analysis further confirms that the estimate of \$41 billion in damages is a conservative
13 underestimate of the Proposed Project's environmental externalities.

14 **Q. Does this conclude your testimony?**

15 **A. Yes.**



**ENVIRONMENTAL LAW
& POLICY CENTER**



**MICHIGAN
CLIMATE ACTION
NETWORK**

June 30, 2025

**Comments of ELPC and MiCAN
to the U.S. Army Corps of Engineers, Detroit District on the
Draft Environmental Impact Statement for the Line 5 Tunnel Project**

Attachment 3

**STATE OF MICHIGAN
MICHIGAN PUBLIC SERVICE COMMISSION**

In the matter of ENBRIDGE ENERGY,)	
LIMITED PARTNERSHIP application for)	
the Authority to Replace and Relocate the)	Case No. U-20763
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)	

DIRECT TESTIMONY OF DR. JONATHAN T. OVERPECK

ON BEHALF OF

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

September 14, 2021

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

2 A: My name is Jonathan T. Overpeck. I am an interdisciplinary climate scientist and the
3 Samuel A. Graham Dean of the School for Environment and Sustainability at the
4 University of Michigan. My office is located at the University of Michigan, Samuel T.
5 Dana Building, 440 Church Street Ann Arbor, MI 48109. I appear here in my capacity as
6 an expert witness on behalf of the Environmental Law & Policy Center and the Michigan
7 Climate Action Network.¹

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

9 A: No.

10 **Q: Have you testified in other settings?**

11 A: I have not testified in judicial proceedings, but I have testified before Congress on several
12 occasions.

13 **Q: On whose behalf are you submitting this testimony?**

14 A: On behalf of the Environmental Law & Policy Center and the Michigan Climate Action
15 Network.

16 **Q: What is the purpose of your testimony?**

17 A: The purpose of my testimony is to explain the impacts of greenhouse gas emissions to the
18 atmosphere (e.g., due to the burning of fossil fuels) and climate change, from the scale of
19 the globe down to regional, and with a particular focus on how climate change impacts
20 natural resources in Michigan and the Great Lakes region.

¹ This testimony contains my independent scientific opinion. It is being provided in my individual capacity, and no part of this testimony purports to present the views, if any, of the University of Michigan.

1 **Q: Can you summarize how climate change will impact natural resources in Michigan**
2 **and the Great Lakes region?**

3 A: Yes. Climate change is manifesting both as changes in average climate, as well as in terms
4 of the increasing frequency and severity of extremes around the planet. Higher
5 temperatures, greater average precipitation and more intense precipitation are the three
6 types of change that have become most troubling for Michigan and the Great Lakes region.
7 There is a clear trend towards warmer conditions and greater farm runoff that are
8 combining to yield increased occurrence and risk of algal blooms in lakes - blooms that are
9 often toxic. Moreover, farms and infrastructure are starting to be overwhelmed by both
10 increased average amounts of rain, and increased intensity of the rainfall. Paradoxically,
11 the rapidly increasing average temperatures and temperature extremes mean more frequent
12 and severe dry conditions in the region. Many farmers in Michigan are already moving to
13 irrigation to help make sure the warmer temperatures don't reduce crop yield. Michigan
14 has a history of drought, although generally Michigan droughts only last a season or two.
15 However, just like everywhere else, warming temperatures will make the impacts of these
16 droughts worse when the droughts occur in the future. These are just some of the serious
17 impacts of climate change in Michigan and the Great Lakes region that I expand on later
18 in my testimony. Continuing to add greenhouse gases to the atmosphere will make climate
19 change impacts much worse in Michigan, the Great Lakes and the region.

20 **Q: Are you sponsoring any exhibits?**

21 A: Yes. I am sponsoring the following exhibits:

- 22 • ELP-11 (JTO-1) – Curriculum Vitae of Dr. Jonathan T. Overpeck

- 1 • ELP-12 (JTO-2) – IPCC Report on Climate Change 2014, Impacts, Adaptation, and
2 Vulnerability. Chapter 4, *Terrestrial and Inland Water Systems*.
- 3 • ELP-13 (JTO-3) – IPCC Report on Climate Change 2014, Impacts, Adaptation, and
4 Vulnerability. *Summary for Policymakers*.
- 5 • ELP-14 (JTO-4) – IPCC Report on Climate Change 2021, The Physical Science
6 Basis.
- 7 • ELP-15 (JTO-5) – 2018 Fourth National Climate Assessment.
- 8 • ELP-16 (JTO-6) – New England Journal of Medicine, Call for emergency Action
9 to Limit Global Temperature Increases, Restore Biodiversity, and Protect Health

10 **Q: What is your educational background?**

11 A: I received a PhD in Geological Sciences from Brown University in 1985. Prior to that, I
12 received my Master of Science in Geological Sciences from Brown University in 1981 and
13 a Bachelor of Arts in Geology from Hamilton College in 1979. I completed a postdoctoral
14 fellowship sponsored by the NASA Goddard Institute for Space Studies (one of the nation's
15 premier climate modeling centers) and Columbia University.

16 **Q: Please summarize your professional experience and expertise in the field of climate
17 and environmental sciences.**

18 A: I have more than 40 years of experience studying climate change, climate impacts,
19 vegetation change, environmental sciences and related fields. I am actively involved in a
20 wide range of research and publications relating to climate and the environmental sciences
21 across the United States and globally. I have written and published over 220 works on
22 climate and the environmental sciences. I served as a Working Group 1 Coordinating Lead
23 Author for the Nobel Prize-winning IPCC 4th Assessment (2007), and as a Working Group

1 2 Lead Author for the IPCC 5th Assessment (2014). I have conducted climate research
2 programs on five continents, focused on understanding drought and megadrought
3 dynamics (and risk) the world over, and I served as the lead investigator of Climate
4 Assessment for the Southwest and the Southwest Climate Adaptation Science Center – two
5 major programs focused on regional climate adaptation in the Southwest United States.
6 Recently, I contributed as a member of the University of Michigan’s President’s
7 Commission on Carbon Neutrality, and I currently serve on the State of Michigan’s
8 Council on Climate Solutions and on Ann Arbor’s Energy Commission, focused largely
9 on sustainable energy solutions. I have appeared and testified before Congress multiple
10 times. I am a Fellow of the American Geophysical Union and the American Association
11 for the Advancement of Science, and have received additional honors from the American
12 Meteorological Society, the Department of Commerce, and the Quivira Coalition, among
13 others. A detailed resume is attached as Exhibit ELP-11 (JTO-1).

14 **Q: Do you have experience related to the impacts of climate change on natural resources?**

15 A: Yes. I have published dozens of papers that focus on the relationship between climate and
16 vegetation, the prevalence and risks of drought, and the impacts of climate change on
17 freshwater resources and ecosystems. For example, I recently published: *Climate change*
18 *and the aridification of North America and Southwestern fish and aquatic systems: the*
19 *climate challenge. In: Standing between life and extinction: ethics and ecology of*
20 *conserving aquatic species in the American Southwest.* I was also a lead author of Chapter
21 4, *Terrestrial and Inland Water Systems*, and a drafting author of *Summary for*
22 *Policymakers*, in *Climate Change 2014, Impacts, Adaptation, and Vulnerability*, which is
23 the most recent published IPCC climate change assessment focused on how climate change

1 is affecting, and will impact, terrestrial vegetation, wildlife, inland waters and natural
2 resources. I attach Chapter 4 as Exhibit ELP-12 (JTO-2) and the Summary for
3 Policymakers as Exhibit ELP-13 (JTO-3).² I am very familiar with the extensive body of
4 research that addresses the impacts of climate change on other natural resources.

5 **Q: What are the scientific sources that you draw upon in this testimony?**

6 A: My testimony draws on a variety of published and peer-reviewed sources, including recent
7 reports of the Intergovernmental Panel on Climate Change (IPCC),³ the most recent U.S.
8 National Climate Assessment, and research published in peer-reviewed journals. Although
9 they are lengthy, I have attached the full report of the recently released IPCC Report
10 Climate Change 2021, The Physical Science Basis as Exhibit ELP-14 (JTO-4) and the 2018
11 Fourth National Climate Assessment as Exhibit ELP-15 (JTO-5). In this testimony, I
12 synthesize this material to illustrate how climate change will, without strong intervention,
13 have devastating impacts on the world and in particular on Michigan and the Great Lakes.
14 While I cite to specific sources where I felt it would be helpful, due to the sheer volume of
15 peer-reviewed research on climate change, it would not be possible to provide a
16 comprehensive bibliography of all peer-reviewed articles relevant to the subject matter.
17 However, the considerable literature on the topic is clear: our region will experience more
18 moderate and manageable climate change impacts if greenhouse gas emissions are rapidly
19 reduced. To avoid unmanageable climate impacts requires the rapid phase-out of fossil
20 fuels and an end to construction of new fossil fuel infrastructure.

² The full report is voluminous and publicly available at <https://www.ipcc.ch/report/ar5/wg2/>

³ These reports are voluminous, but can be accessed in full at <https://www.ipcc.ch/> under the tab named "REPORTS."

1 **Q: How are humans impacting the global climate?**

2 A: Climate warming over the past century is indisputably tied to human activity – specifically,
3 activity that increases the heat-trapping or “greenhouse” capacity of the atmosphere. The
4 warming itself is well documented by research at multiple independent laboratories; the
5 global average surface air temperature has risen just over 1°C (1.8°F) since the 19th century.
6 Each of the last 4 decades has been warmer than the previous, and the warmest 10 years of
7 the past 140 have all occurred since 2005. Warmer air temperatures join many other lines
8 of evidence, including warmer oceans, melting ice sheets and glaciers, less snow cover,
9 less sea ice, and rising sea level, to paint an unmistakable picture of a warming planet.

10 **Q: What is the cause of that warming?**

11 A: The cause of the warming is clear. The greenhouse effect is not only theoretical: we can
12 measure the heat-trapping properties of CO₂, methane, nitrous oxide, and other greenhouse
13 gases in the laboratory, and we know from the physics of radiation that greenhouse gases
14 maintain the Earth’s temperature above what the Sun’s radiation alone would provide.
15 Rising greenhouse gas concentrations are well documented from sites all over the globe
16 and, prior to direct atmospheric measurements, from bubbles of air trapped in glacial ice.
17 The modern concentration of CO₂ has risen sharply from 280 to 415 parts per million since
18 the Industrial Revolution⁴ – a level not seen for millions of years. This rise stems primarily
19 from the burning of fossil fuels – coal, oil, and gas. The CO₂ in the atmosphere carries the
20 chemical fingerprint of fossil fuels in its carbon isotopes, and the increase reflects the
21 known combustion of over 18 trillion barrels of oil, 390 billion tonnes of coal, and 155

⁴ See the National Oceanic and Atmospheric Administration *Trends in Atmospheric Carbon Dioxide*, accessible at <https://gml.noaa.gov/ccgg/trends/history.html> and <https://gml.noaa.gov/ccgg/trends/global.html>, both updated monthly.

1 trillion cubic meters of natural gas over the past century,⁵ all releasing CO₂ into the
2 atmosphere. Deforestation also adds CO₂ to the atmosphere, but these emissions have been
3 balanced by forest regrowth over the past 170 years.⁶ The consensus among active climate
4 scientists, that burning fossil fuels is warming the planet, is exceptionally strong - between
5 97-100% of scientists have reached this conclusion.⁷

6 **Q: How much has the world warmed already?**

7 A: According to the IPCC and multiple other sources, the world has warmed by just over 1°C
8 and is on a path to warm several more degrees C unless greenhouse gas emissions are
9 slashed quickly.⁸ The summer of 2021 offers a preview of the consequences of such
10 warming: heat waves, drought, floods, wildfires, more devastating hurricanes, sea level
11 rise, human suffering and mortality. The science linking mean annual global warming –
12 even just 1°C – with an increased range of extreme weather and climate conditions is clear.⁹

13 **Q: Is that warming consistent across the globe?**

14 A: Global warming is unevenly distributed. Land areas warm more than ocean; high latitudes
15 warm more than the tropics and midlatitudes. On a smaller scale, weather systems create a
16 patchwork of hot and cold conditions, and city dwellers suffer more heat than rural and
17 suburban residents because human infrastructure (roads, buildings, parking lots, etc.)

⁵ See Interactive tool available at <https://www.theguardian.com/environment/ng-interactive/2015/apr/10/how-much-fossil-fuel-are-we-using-right-now> for an illustration of the magnitude of the extraction of gas, oil and coal.

⁶ Friedlingstein, P. et al. (85 co-authors), *Global Carbon Budget 2020* (2020). Earth System Science Data, 12, 3269–3340. DOI: 10.5194/essd-12-3269-2020. Available at www.globalcarbonproject.org/carbonbudget

⁷ See Powell, J. (2019), *Scientists Reach 100% Consensus on Anthropogenic Global Warming*, Bulletin of Science, Technology & Society. Vol. 37, Issue 4, 2017, 183–184; Anderegg, William R L; Prall, James W.; Harold, Jacob; Schneider, Stephen H. (2010). *Expert credibility in climate change*, Proc. Natl. Acad. Sci. USA. 107 (27): 12107–9; Benestad, Rasmus E.; Nuccitelli, Dana; Lewandowsky, Stephan; Hayhoe, Katharine; Hygen, Hans Olav; van Dorland, Rob; Cook, John (1 November 2016). *Learning from mistakes in climate research*. Theoretical and Applied Climatology. 126 (3): 699–703.

⁸ See IPCC Report, Climate Change 2021, Summary for Policymakers, Exhibit ELP-14 (JTO-4) at Figure 8.

⁹ See, e.g., IPCC Report, Climate Change 2021, The Physical Science Basis, Exhibit ELP-14 (JTO-4).

1 amplifies urban warming, and greenery generally reduces extreme heat. Regional mean
2 annual warming of a degree or two has led to increases in extreme conditions as well. The
3 frequency and severity of heat waves are increasing around the planet, with clear health
4 consequences, especially for the elderly, those with chronic heart or lung ailments, outdoor
5 workers, and those without air conditioning. Heat combined with humidity creates
6 conditions that are literally not survivable, even for the healthy; these conditions are
7 beginning to occur now and will become more common as warming proceeds.¹⁰

8 **Q: What impacts is this warming having on the Earth?**

9 A: As climate warms, other aspects of the Earth system respond. Precipitation is changing in
10 many ways. First, air that is warmer can hold more moisture as water vapor. This fact
11 creates a seeming paradox: warmer air draws more moisture from plants and soils, drying
12 the land and vegetation, and creating drought. But when storms do develop, the higher
13 atmospheric water vapor content provides more moisture for precipitation and creates
14 stronger storms because of the energy released when vapor turns to liquid. As a result, we
15 can expect more intense rainfall along with longer dry spells – i.e., intensified hydrologic
16 extremes. These worsening trends have long been anticipated by climate scientists and
17 climate models, and they are now being observed in real time. Second, in a warmer world,
18 we expect – and observe – changes in the position of storm tracks that bring rainfall onto
19 continents, and in the behavior of monsoon systems and other rainfall-related climate
20 patterns. For example, the tropical belt is expanding, widening the wet region around the
21 equatorial zones and shifting deserts poleward. Third, places that receive both snow and
22 rainfall are seeing an increased fraction of their precipitation falling as rain, due to warming

¹⁰ Mora, C. et al. (2017). *Global risk of deadly heat*. Nature Climate Change 7:501-506.

1 temperatures. This has tremendous implications for places that receive water from
2 mountain snowpack, where runoff is peaking earlier and where summers (i.e., growing
3 seasons) are experiencing reduced water availability. Combined with the loss of mountain
4 glaciers, hydropower generation will also suffer. Finally, tropical hurricanes are expected
5 to become stronger, carry more precipitation, and be able to reach further out of the tropics
6 as ocean temperatures warm. The “hurricane season” in which storms develop is also likely
7 to grow longer as temperature rises.

8 **Q: Are these changes happening now?**

9 A: Yes. These changes in climate are happening now, around the planet, and they are
10 accelerating. They bring with them major global impacts on critical aspects of human well-
11 being. Changing patterns of rainfall, increasing drought, and stronger storms pose
12 significant challenges to agriculture, particularly in warm regions, and especially for
13 smaller-scale and subsistence farmers with modest resources for adaptation. Warmth
14 favors microbial growth and reproduction, posing a disease threat to crops as well as to
15 human health and natural ecosystems. Insects also thrive in warm temperatures; the spread
16 of disease-bearing insects will, unless strong public health measures are followed, expand
17 the boundaries of “tropical” ailments such as dengue fever and malaria. A changing
18 landscape of temperature and precipitation will alter the distribution and health of natural
19 ecosystems. Where we have set aside protected lands to preserve notable ecosystems, we
20 may find that the climate no longer allows that system to thrive there. In some cases,
21 wildlife species are on the move or changing the seasonal timing of their migrations to
22 avoid suboptimal conditions. Climate change is expected to increasingly drive a global
23 biodiversity extinction crisis.

1 **Q: Are the Earth’s oceans impacted by climate change?**

2 A: Yes. In the oceans, rising temperatures and the melting of land-based ice are causing an
3 accelerating rate of sea level rise, the costs of which will be increasingly massive in terms
4 of economic, human well-being, ecological, and cultural losses. The oceans are also
5 experiencing chemical changes, as fossil-fuel carbon reacts with ocean chemistry to raise
6 the acidity, and ocean oxygen levels drop as warmer waters can hold less oxygen. The
7 warming of the tropical oceans is exceeding the tolerance of many species; coral reef
8 ecosystems have declined by over half, and coral mortality across the full tropical belt has
9 accelerated with record warm temperatures. These systems support the livelihoods and
10 sustenance of hundreds of millions of people.

11 **Q: Do you expect these impacts to be constant over time?**

12 A: No. The impacts of climate change become stronger as the scale of the warming grows.
13 Today, we are already struggling to adapt to the impacts of climate change. Recent events
14 have left no doubt that even in wealthy nations, climate change can cause extensive human
15 suffering and loss. Hundreds of people perished in the late-June 2021 heat wave that struck
16 the Pacific Northwest and British Columbia;¹¹ fires in California during 2020 damaged or
17 destroyed 10,488 homes, produced 1.2 million tonnes of fine particles that clouded the air
18 nationwide, and killed 31 people.¹² As climate warms further, such events will intensify,
19 and adapting to these changes will become even more difficult. To avoid massive costs in

¹¹ See Nadja Popovich and Winston Choi-Schagrin, *Hidden Toll of the Northwest Heat Wave: Hundreds of Extra Deaths*, New York Times, August 11, 2021, available at <https://www.nytimes.com/interactive/2021/08/11/climate/deaths-pacific-northwest-heat-wave.html>

¹² See *California’s 2020 fire siege: wildfires by the numbers*, available at <https://calmatters.org/environment/2021/07/california-fires-2020/>, and Cal Fire’s *2020 Fire Siege Report*, available at <https://www.fire.ca.gov/>, (“The 2020 Fire Season will be counted among the most severe since the founding of our nation; only the ‘Big Burn’ of 1910 stands in grim comparison. Since 2015, the term ‘unprecedented’ has been used year over year as conditions have worsened, and the operational reality of a changing climate sets in.”).

1 human suffering, economic resources, and ecological devastation, we need to address the
2 root cause of climate change – the burning of fossil fuels.

3 **Q: How is climate already changing in Michigan and the Great Lakes Region?**

4 A: Human-driven climate change, caused by increases in greenhouse gas emissions, is already
5 impacting every region of the globe, and the Great Lakes region is no exception. Most of
6 the changes that have already been observed agree with those anticipated by climate
7 scientists and climate modeling, and this gives us greater confidence in attributing these
8 changes to human causes, as well as in projecting continued change into the future. Both
9 temperature- and precipitation-related changes have been significant in the region, and are
10 clearly linked to human-driven climate change. These changes, in turn, are having notable
11 impacts on the Great Lakes themselves.

12 **Q: Do you have a concrete example of how climate has impacted Michigan?**

13 A; Surface air warming in Michigan and the Great Lakes region has been substantial in all
14 seasons,¹³ in agreement with what was expected and simulated by global climate models.
15 In addition, this warming has accelerated since 1980, just as the magnitude of greenhouse
16 gas emissions has accelerated has accelerated.¹⁴ As annual and seasonal mean temperatures
17 have increased, the incidence and magnitude of extreme hot temperatures and heat waves
18 have also increased at the global scale, as well as across much of North America¹⁵ The
19 ability to attribute an increase in the *occurrence* of extreme temperatures and heat waves
20 to human activities that emit greenhouse gases appears to be robust at the scale of North

¹³ Data demonstrating this warming can be accessed at <https://data.giss.nasa.gov/gistemp/maps/>

¹⁴ See Climate Change 2021, The Physical Science Basis, Exhibit ELP-14 (JTO-4) at Chapter 2.

¹⁵ See Climate Change 2021, The Physical Science Basis, Exhibit ELP-14 (JTO-4) at Chapter 11.

1 America,¹⁶ and emerging in the Great Lakes region;¹⁷ there is also growing confidence that
2 the *severity* of extreme hot temperatures and heat waves is linked to the human-driven
3 warming of the region. As hot temperature extremes increase, there is also evidence that
4 the incidence and intensity of cold extremes will decrease.¹⁸ However, recent research on
5 the linkages between climate change-caused rapid Arctic warming and winter-time cold air
6 outbreaks in Eastern North America, including the Great Lakes region, suggest that
7 extreme cold temperatures associated with “polar vortex” events will continue to plague
8 Michigan and the Great Lakes, even as average winter-time temperatures warm.¹⁹

9 **Q: Has climate change impacted precipitation in Michigan?**

10 A: Yes. Human-driven climate change appears to be the cause of a significant increase in
11 mean average precipitation, and particularly in winter and spring, across Michigan and the
12 Great Lakes watershed. According to new research out of the University of Michigan, this
13 is the primary cause of recent record high water levels in the Great Lakes,²⁰ and has also
14 set the stage for more frequent flooding across the region. Flooding in the state and region
15 has been made much worse, however, by another well-known result of global warming,
16 the intensification of rainfall due to the fact that a warming atmosphere can hold – and
17 release – increasing amounts of water vapor. The total annual precipitation falling in the

¹⁶ *Id.*

¹⁷ *Id.*; see also Lopez, H., West, R., Dong, S. et al. *Early emergence of anthropogenically forced heat waves in the western United States and Great Lakes*. *Nature Clim Change* 8, 414–420 (2018). Available at <https://doi.org/10.1038/s41558-018-0116-y>

¹⁸ See Climate Change 2021, The Physical Science Basis, Exhibit ELP-14 (JTO-4) at Chapter 11.

¹⁹ Cohen et al., *Linking Arctic variability and change with extreme winter weather in the United States*, *Science* 373, 1116–1121 (2021).

²⁰ Gronewold, A. D., Do, H. X., Mei, Y., & Stow, C. A. (2021). *A tug-of-war within the hydrologic cycle of a continental freshwater basin*. *Geophysical Research Letters*, 48, e2020GL090374. Available at: <https://doi.org/10.1029/2020GL090374>

1 heaviest one percent of storm events has increased by more than 40% since the start of the
2 20th century in the Midwest U.S. region including Michigan.²¹

3 **Q: Will we be able to predict these extreme weather events?**

4 A: Unfortunately, a net result of on-going human-caused temperature and precipitation change
5 in Michigan and the Great Lakes region is a loss of prediction skill for extreme *weather*
6 events. It is difficult to anticipate the *exact timing* of record heat, cold, or rainfall events
7 simply because the burning of fossil fuels and other human activities are pushing the
8 Earth's climate system into uncharted territory. This means we need to learn, more than
9 ever, to expect the unexpected.

10 **Q: Michigan is the Great Lakes State. How is climate change impacting the Great**
11 **Lakes?**

12 A: The Great Lakes themselves have responded to human-caused climate change as already
13 noted: levels in each of the lakes has experienced recent record highs due largely to the
14 observed increase in precipitation. The Great Lakes, as well as smaller water bodies in the
15 region, are all warming substantially, and the increase in average and extreme precipitation
16 is also generating more runoff into the lakes. Collectively, human-driven climate changes
17 are changing the lake environments in dramatic ways, altering the temperature, nutrient
18 and oxygen gradients in the lakes. Moreover, the warming is reducing lake ice duration,
19 coverage and thickness, which affects the lake's ecosystems and the region's climate. As
20 noted above, extreme cold air outbreaks into the region are still common, and thus some
21 years still have extensive lake ice coverage. There also appears to be an on-going increase

²¹ See Exhibit ELP-15 (JTO-5), 2018 Fourth National Climate Assessment at Chapter 21.

1 in lake level variability, with both record low and high lake levels taking place in recent
2 years.

3 **Q: How will global climate change impact people and natural systems in the future?**

4 A: If greenhouse gases continue to accumulate in the atmosphere and drive additional climate
5 change, the impacts of climate change will continue to intensify. The largest uncertainty in
6 projecting future climate change is estimating the future trajectory, year to year, of
7 greenhouse gas emissions. If the current upward trends in greenhouse gas emissions
8 continue, future climate change will be substantially larger, more dangerous, and more
9 destructive.

10 **Q: Is there a method for assessing future climate change that is generally accepted in the**
11 **field of climate science?**

12 A; Yes. The standard scientific approach to assessing future climate change is to rely on
13 climate and Earth system models that have grown increasingly sophisticated and skilled at
14 simulating observed patterns and trends in past and modern climate. Model performance
15 and realism is assessed using agreement among models and with observed climate changes;
16 all IPCC climate and Earth system models simulate warming as a response to increases in
17 atmospheric greenhouse gas concentrations. Models have proven skillful in simulating
18 many aspects of climate change, and the physics represented in the models are consistent
19 with those observed in the real world. Since the exact future trajectory of future greenhouse
20 gas emissions into the atmosphere is not known, climate scientists utilize a range of
21 possible future emission scenarios. This, plus the use of dozens of different models, allow
22 for quantitative projections of future climate change for any trajectory of future greenhouse
23 gas emissions.

1 **Q: What are some of these possible climate futures?**

2 A: Based on the extensive scientific literature, the IPCC has identified a range of plausible
3 climate futures for the 21st century. The most extreme widely used scenario which I refer
4 to as a “continued fossil-fuel-rich scenario” (after the IPCC; this widely used scenario is
5 also known as RCP8.5 or SSP5-8.5) posits a relatively slow move away from fossil fuels
6 over this century, and results in a global temperature increase of 4.5°C (±1.2°C uncertainty)
7 by 2100. In “low-emissions” scenarios that limit global warming to 1.5-2°C, greenhouse
8 gas emissions must stabilize quickly, begin to drop by mid-decade, and reach zero between
9 2050-2075. The climate science community and the 195 signatory countries to the United
10 Nations Paris Agreement have determined that it is critical to limit global warming to 1.5
11 to 2.0°C above pre-industrial levels to avoid dangerous interference with the climate
12 system. For context, the last time the Earth experienced global warmth above 2.5°C was
13 about 3 million years ago, when global vegetation patterns were much different from today,
14 the Arctic was seasonally ice-free, the Greenland and Antarctic Ice Sheets were much
15 smaller, and sea level was as much as 25m higher than today.²² Seemingly small changes
16 in global average temperatures have far-reaching and unevenly distributed consequences
17 for the Earth’s environment and regional habitability.

18 **Q: Can you describe the relationship between a given amount of warming and impacts**
19 **on the Earth and its natural resources?**

20 A: The latest IPCC report documents clearly that the impacts of warming become more intense
21 as warming increases. In other words, a 2°C warmer world is more perilous than one at
22 1.5°C warmer, and in a 4°C warmer world, massive losses from heat, drought, fires, storms,

²² See, e.g., Climate Change 2021, The Physical Science Basis, Exhibit ELP-14 (JTO-4).

1 and sea level change become the norm. This dependence of impacts on the degree of
2 warming highlights the imperative to reduce emissions as much as possible, as fast as
3 possible. Consistent with this observation, we are now experiencing increasing climate
4 change impacts that are in agreement with IPCC projections and that are certain to intensify
5 in a warmer world. As these impacts become more common and more extreme, they are
6 also likely to co-occur and compound in ways that multiply their costs to humans, society,
7 and natural systems. Moreover, warming beyond 1.5°C increases the likelihood of crossing
8 one or more of many climate thresholds, or “tipping points,” that would accelerate warming
9 and/or its impacts beyond a point that is irreversible on human time scales.²³

10 **Q: What are some examples of one of these tipping points?**

11 A: The *cryosphere* – the Earth’s frozen water – will be profoundly affected by warmer
12 temperatures. The Greenland and Antarctic ice sheets are losing mass at accelerating rates,
13 amplifying sea level rise and the threats it poses to coastal communities around the planet.
14 These include flooding, human casualties, groundwater salination, losses of infrastructure
15 and structures, and the obliteration of whole island nations and coastal cultures, from the
16 low-lying islands of the Pacific to the Mississippi River delta. Melting ice sheets represent
17 a tipping element because reversing ice sheet melt is unlikely on century or shorter time
18 scales. The cryosphere includes permafrost, which, as it melts, may release large amounts
19 of additional greenhouse gases (CO₂ and methane) – another potent climate tipping point
20 that would add substantially to the atmosphere’s greenhouse capacity. Finally, the melting
21 of Arctic sea ice is well underway, and its future rate will depend on how fast the climate

²³ See Steffen, W., et al., (2018). *Trajectories of the Earth system in the Anthropocene*. Proceedings of the National Academy of Sciences of the United States of America. 115: 8252-8259; IPCC special report on Global Warming of 1.5° C (2018). Available at: <https://www.ipcc.ch/sr15/>

1 warms. Sea ice acts as a potent climate amplifier in that the loss of the reflective ice surface
2 will increase radiation absorption. Ice loss also changes the gradient of temperature
3 between high and mid-latitudes, thought to increase the “waviness” of the jet stream and
4 thus accentuate climate variability across the midlatitudes (including more frigid “polar
5 vortex” conditions across the Great Lakes).

6 **Q: Do you have other examples of tipping points?**

7 A: Yes. Future precipitation changes around the globe reflect an intensification of the
8 hydrological cycle. Because warm air holds more moisture, both wet and dry extremes
9 occur more frequently and become stronger. A day of extreme rainfall that would have
10 happened once per decade in a climate without human influence can be expected to happen
11 1.7 times under 2°C warming and 2.7 times under 4°C; these events are 14% and 30%
12 wetter, respectively. Similarly, a once-per-decade dry year for a natural climate state will
13 become a once-per-4-years event under 2°C and an every-other-year event if climate
14 warms to 4°C, with greater intensity as climate warms. These values represent global
15 averages of regionally variable responses. Prolonged dry conditions can result in the
16 wholesale transformation of a regional ecosystem, for example a huge expanse of forest
17 shifting to grassland, which reduces that system’s capacity to recycle moisture, absorb
18 carbon, and provide key ecosystem services. Widespread severe wildfire may accompany
19 such a vegetation shift from forest to non-forest, and this in turn would release a great deal
20 of additional CO₂ to the atmosphere – CO₂ that is currently sequestered naturally in forest
21 plants and soils. Ecosystem tipping points are major causes for concern, from tropical
22 rainforests and coral reefs to Arctic sea ice-dependent communities.

1 **Q: What happens when more than one effect of climate change happens at once?**

2 A: Compound events pose substantial threats to human and natural systems in a warming
3 world, more so if the warming is stronger. As an example, consider the interaction of
4 precipitation and temperature in the Colorado River Basin, where the heavily managed
5 river provides water and hydropower to a population of 40 million (and growing), along
6 with protected areas, Native nations, and agricultural lands.²⁴ The Colorado River flow
7 depends on snowpack in the Colorado Rocky Mountains. The fraction of precipitation
8 falling as snow is declining as climate warms, and rain falling on snow-covered ground
9 accelerates melting. Drought in the surrounding lowlands is creating dust (exacerbated by
10 oil and gas development road-building) that darkens the alpine snowfields, further speeding
11 their seasonal melt and reducing the water that they yield to the rivers. Peak runoff is
12 occurring earlier in the year, and river flows are lower,²⁵ creating a longer summer dry
13 season that compounds anthropogenic drought. Widespread forest mortality has resulted
14 from the combination of hot drought and mortality from deadly insect pests, e.g., the pine
15 bark beetle and spruce budworm, who are thriving in a warmer climate that allows a longer
16 breeding season and reduces winter cold mortality. The abundance of dead trees and
17 decades-long drought has fueled wildland fires that reduce air quality and visibility across
18 the West. Fires strip the land of vegetation that stabilizes the soil and helps it retain
19 moisture. Meanwhile, the reservoirs on the Colorado have not been full for 20 years, and
20 this summer they dropped so low that the first-ever federal shortage declaration was made,
21 cutting water promised to Arizona and Nevada. The western US is facing a perfect storm

²⁴ See Colorado River Basin Fact Sheet. Available at:

<https://www.usbr.gov/climate/secure/docs/2021secure/factsheets/Colorado.pdf>

²⁵ Udall, B. and J. Overpeck (2017). *The twenty-first century Colorado River hot drought and implications for the future*. Water Resources Research, 53, doi:10.1002/2016WR019638.

1 of heat, drought, dependence on a failing water system, and the loss of iconic and valuable
2 ecosystems – what one writer has termed the “dust-bowlification” of the West.²⁶ All of
3 these impacts are currently worsening, and they become even grimmer in a 4°C world,
4 compared to one where warming is kept below 2°C.

5 **Q: Could these types of compound events happen in Michigan and the Great Lakes?**

6 Yes, in multiple ways. Increasing greenhouse gases in the atmosphere are causing warming
7 and the intensification of the hydrological cycle in Michigan and the Great Lakes. This
8 warming means more extreme warm temperatures and more severe drought conditions,
9 coupled with more intense storms when rain does materialize. These pose significant
10 challenges for agriculture: direct heat and water stress on plants, favorable conditions for
11 pests and disease-causing organisms to infest stressed plants, and flooding that inhibits
12 farmers’ ability to plant, harvest, and manage their crops. More intense rainfall will
13 translate to increased and more concentrated runoff of nutrient-laden water into the Great
14 Lakes and other inland water bodies, where the increased nutrient loading will combine
15 with warmer temperatures to favor more algal blooms, including blooms of harmful (toxic)
16 blooms. Lake Erie is already plagued by such harmful algae blooms, and as climate warms,
17 all of the Great Lakes will experience greater frequency and extent of such blooms, as will
18 many smaller water bodies in the state and region. These blooms, in turn, can cause serious
19 drinking water concerns (as happened in Toledo in 2014), adding to the water treatment
20 challenges posed by more intense rainfall, flooding and sediment transport. Blooms have
21 profound negative impacts on freshwater ecology of the Great Lakes and smaller water
22 bodies, including depletion of oxygen that can reach lethal levels for fish and other aquatic

²⁶ Romm, J. *The next dust bowl*. Nature 478, 450–451 (2011). Available at: <https://doi.org/10.1038/478450a>

1 organisms. Lastly, we have recently learned that toxins produced by harmful algae can
2 become airborne.²⁷ These toxins would add to other air quality threats likely to increase
3 in a warmer, drier world (e.g., wildfire smoke, dust, ground-level ozone, and – if fossil fuel
4 production and use continues – industrial and combustion byproducts.

5 **Q: Are there concerns about a tipping point for the Earth's oceans?**

6 A: Yes. The oceans will experience significant changes in their physical, chemical, and
7 biological properties as a consequence of warming. Marine heatwaves are becoming longer
8 and more frequent, extensive, and intense under warmer climate. In a 2°C warmer world,
9 the number of marine heatwave days is expected to increase globally by a factor of 4; this
10 factor rises to 12 in a 4°C world.²⁸ Marine heatwaves have devastating ecological and
11 human consequences, including mass mortality of benthic species (e.g., coral), toxic algal
12 blooms, and declines in fisheries and mariculture. In addition to warming, the oceans will
13 experience chemical changes – rising CO₂ inexorably lowers the ocean's pH, creating
14 more acidic conditions that compromise the health of most marine biota. Rising
15 temperatures lead directly to increased ocean stratification, which reduces the upward
16 mixing of nutrients and allows the surface to warm more dramatically. The ocean's
17 dissolved oxygen levels will drop as waters warm, reducing habitat favorability for most
18 organisms. These trends contribute to expectations that the oceans primary productivity –
19 the base of the ocean food chain – will decrease in the future, with greater impacts in a 4°C
20 world than in a 2°C world.

²⁷ Olson et al., *Harmful Algal Bloom Toxins in Aerosol Generated from Inland Lake Water*, Env. Sci. Technol. 2020, 54, 4769–4780.

²⁸ IPCC 2019 Special Report on the Ocean and Cryosphere in a Changing Climate, Technical Summary, Figure 3. Available at: https://www.ipcc.ch/srocc/chapter/technical-summary/ts-0-introduction/ipcc-srocc-ts_3/

1 **Q: Will the Earth’s ecosystems reach a tipping point?**

2 A: Yes, such tipping points are a big risk if we don’t rapidly slow greenhouse gas emissions.
3 Valuable and cherished natural ecosystems are at risk from changing climate. These
4 include coral reefs and tropical rainforests – among the most diverse ecosystems on Earth.
5 The warming that has already killed half the world’s coral will continue to exact a toll,
6 greater with every degree of heating. In the Arctic, as temperatures rise, the hydrological
7 cycle is being transformed, wildfires are becoming more extensive, and infrastructure and
8 homes are being destabilized by melting permafrost. Across the globe, warming is shifting
9 the preferred habitats of species, resulting in changed migration patterns, their altitudinal
10 and latitudinal distributions, and interspecies interactions that maintain ecosystem
11 resilience. Ecosystems will continue to reshuffle as climate warms, sometimes dramatically
12 (e.g., through fire, marine heatwaves, and other major disturbances), with consequences
13 for the humans who depend on these systems. Wildlife conservation areas, national parks,
14 and marine protected areas may find themselves abandoned by the species they were
15 designed to support. Global warming above 2°C will likely increase global extinction rates
16 significantly, perhaps triggering the Earth’s sixth major mass extinction event.

17 **Q: Are there other impacts of climate change that you would like to discuss?**

18 A: The impacts of global warming go beyond this summary and are described in reports from
19 the IPCC, the U.S. National Climate Assessment, and many other reports and papers that
20 emphasize particular regions or sectors. What is clear from this immense body of work,
21 building on many decades of science, is that human-caused climate change is now having
22 the impacts that climate science foresaw many years ago, and that these impacts will
23 become more intense as warming continues. Most scientists seem to be surprised at the

1 rapidity with which these projections of the future have materialized – if anything our
2 predictions have been conservative. But if we can curb greenhouse gas emissions, we will
3 limit the warming, and we can limit the damage and the suffering. Adapting to climate
4 change – even if warming is kept to 2°C – is a formidable challenge, as the summer of
5 2021 demonstrated. If warming is allowed to reach 4°C or more, effective adaptation
6 becomes largely wishful thinking.

7 **Q: You testified earlier about how climate change is currently impacting Michigan and**
8 **the Great Lakes. How do you anticipate climate change will impact Michigan and**
9 **the Great Lakes in the future?**

10 A: If global warming is limited to 1.5 to 2.0°C above pre-industrial levels (about 0.5 to 1.0°C
11 above present-day, the “low-emissions” scenario), then the changes the state and region
12 are already seeing, many of which I describe above, will likely worsen to a limited degree.
13 However, if the current trajectory of climate change is allowed to continue, referred to here
14 as a “continued fossil-fuel-rich scenario,” the impacts on the climate of Michigan and the
15 Great Lakes will become much more substantial.

16 **Q: What is the “continued fossil-fuel-rich” scenario?**

17 A: Because future human behavior is not yet predictable, the IPCC uses a range of greenhouse
18 gas emission scenarios to put boundaries on the expected range of future climate change
19 between now and 2100. Our current path is a high-emissions pattern, and the IPCC’s most
20 extreme warming scenario assumes that we will do very little to constrain our emissions in
21 the near term (although emissions do plateau in 2080 in this scenario, which is called SSP5-
22 8.5 in that report).²⁹ To evaluate the climate consequences of this emissions path, we use a

²⁹ See Climate Change 2021, The Physical Science Basis Summary for Policymakers, Exhibit ELP-14 (JTO-4) at Figure SPM4a.

1 greenhouse gas emissions scenario that captures a trajectory of emissions that assumes
2 continued heavy use of fossil fuels into the future, and that postpones meaningful
3 greenhouse gas emissions reductions into the future. I refer to this as a continued fossil-
4 fuel-rich scenario because it largely represents what could happen if we continue a heavy
5 reliance on fossil fuels and fossil fuel infrastructure.

6 **Q: Is there a “low-emissions” scenario?**

7 A: In contrast to the relative inaction on greenhouse gas emissions that is built into the
8 continued fossil-fuel-rich scenario, I also draw upon “low-emissions” scenarios to
9 highlight the climate change and impacts we will likely get if we act quickly on climate
10 change in order to meet the goal of the Paris Agreement, that is to limit global warming to
11 1.5 to 2.0°C above pre-industrial levels. In this testimony, I am considering the IPCC’s
12 SSP1-1.9 and SSP1-2.6 scenarios to represent these lower risk, lower emission pathways.

13 **Q: What impact will the “continued fossil-fuel-rich” scenario have on Michigan?**

14 A: Continued fossil-fuel-rich greenhouse gas emissions have the potential to warm Michigan
15 and the Great Lakes region by an additional 5°C or more by the end of the century,
16 compared to the current level of warming of about 1°C, whereas a low-emissions warming
17 scenario would increase temperatures in the state and region by a much more modest 0.5
18 to 1°C. Moreover, for Michigan continued fossil-fuel-rich warming would mean:

- 19 • Dramatic mean surface air warming in all seasons, with significantly higher
20 daily maximum temperatures and daily minimum temperatures (i.e., hotter
21 nights); peak annual maximum daily temperatures would increase by 5°C or
22 more.

- 1 • Many more days with extreme heat. For example, southern Michigan could
2 experience over 40 days a year with temperatures exceeding 100°F, which in
3 many cases will be coupled with the high humidity; the risk of longer and hotter
4 heat waves would continue to rise through the coming decades.³⁰
- 5 • Warmer winter temperatures, and significantly diminished snow cover,
6 although extremely cold “polar vortex” events could persist for some time into
7 the future, creating variability that would challenge agricultural and natural
8 systems.

9 **Q: What are some other impacts on Michigan from continued fossil-fuel-rich greenhouse**
10 **gas emissions?**

11 A: Continued fossil-fuel-rich greenhouse gas emissions will continue to favor the on-going
12 trend towards more mean annual precipitation in Michigan and the Great Lakes, with much
13 of the increase occurring in the cooler part of the year. This change will be associated with
14 a continued increase in the frequency and intensity of extreme precipitation events, and
15 increased runoff and risk of river, urban and rural flooding. Intensification of precipitation
16 compared to pre-industrial is very likely. In contrast, the low-emissions scenario suggests
17 that rapid reductions in greenhouse gas emissions will mean a substantially smaller
18 increase in the frequency and intensity of precipitation, as well as the associated runoff
19 rates and flooding.

20 Warming under the continued fossil-fuel-rich scenario will likely also lead to more
21 intense, hotter, droughts in Michigan and the Great Lakes region. What are now merely
22 summer dry spells will have a substantially higher risk of becoming hot droughts, with

³⁰ See 2018 Fourth National Climate Assessment as Exhibit ELP-15 (JTO-5) at Chapter 21.

1 impactful decreases in soil moisture driven by hotter temperatures. Hotter temperatures and
2 associated drier conditions will also give rise to increased wildfire weather of the type now
3 widely occurring in the Western United States.

4 Severe warm season thunderstorms storms and windstorms in Michigan are also
5 likely to increase under the larger warming scenario, whereas it is unclear if climate change
6 associated with low emissions would yield significant changes to thunderstorms and
7 windstorms. Similarly, given continued fossil-fuel-rich emissions, the Great Lakes and
8 smaller bodies of water see much more dramatic continued warming (including lake
9 heatwaves),³¹ lake ice decline, increases in runoff, and circulation changes than if
10 emissions are curbed in line with the low-emissions scenario. Water level variability in the
11 Great Lakes is likely to increase more substantially, with both more high and low record
12 levels likely if warming continues along a continued fossil-fuel-rich trajectory. This
13 response results from the “tug-of-war” between stronger evaporation in a warmer world
14 (driving lake levels down) and increasing precipitation (pushing them higher) – factors that
15 explain the recent oscillations between high and low lake levels.³²

16 **Q: Do you have an understanding of how those effects of climate change will impact**
17 **Michigan’s natural resources?**

18 **A:** Yes. Climate change greatly increases the risk of profound disruption of natural resources
19 in Michigan and the Great Lakes region. Warming will cause large-scale shifts in forest
20 tree species and other vegetation across the region, and the process by which this takes

³¹ Woolway et al. 2021, *Lake heatwaves under climate change*, Nature v589, Available at:
<https://doi.org/10.1038/s41586-020-03119-1>

³² Gronewold, A. D., Do, H. X., Mei, Y., & Stow, C. A. (2021). *A tug-of-war within the hydrologic cycle of a continental freshwater basin*. Geophysical Research Letters, 48, e2020GL090374.
<https://doi.org/10.1029/2020GL090374>

1 place will involve greater tree mortality and disturbance due to climate and weather
2 extremes – in other words, it will happen through abrupt disturbances such as fire or
3 windthrow, followed by regrowth of species that can thrive under the new climate.³³
4 Increasing aridity by itself will hurt iconic tree species such as sugar maple.³⁴ Moreover,
5 increasingly hot and dry spells (a.k.a. hot drought) will increase forest stresses due to
6 invasive species, insect pests and plant disease, and increase the likelihood of severe
7 wildfire - just as we're already seeing in the western United States.³⁵ The result is a decline
8 in forest health, and in the ecosystem goods and services that forests currently provide. As
9 the vegetation suffers, so will the wildlife that depends on the vegetation for food and
10 habitat.

11 Aquatic natural resources will also be hit increasingly hard by continued climate
12 change.³⁶ I've already described how warming, increased precipitation, and more intense
13 rainfall are combining to increase the incidence of algal blooms – including toxic varieties
14 – in all of the Great Lakes. Lake Erie is the poster child for this serious problem, where the
15 toxic algae is creating lethal anoxic conditions, killing fish and repelling recreationalists.
16 Toxic blooms threaten the drinking water of communities who rely on the lake for water.
17 With continued fossil fuel emissions of greenhouse gases, similar algae problems could
18 become much more widespread along many of the region's coasts and inland waters. Fish
19 habitats are already being impacted by warming waters, and a weakened natural ecosystem
20 creates opportunities for invasive species from warmer parts of the globe, which in turn

³³ See Exhibit ELP-12 (JTO-2).

³⁴ Ibanez, I. et al., (2018). *Anthropogenic nitrogen deposition ameliorates the decline in tree growth caused by a drier climate*. Ecology 99: 411-420.

³⁵ See Exhibit ELP-15 (JTO-5).

³⁶ See Exhibit ELP-15 (JTO-5).

1 could mean more problems for native fish species. Tourism, recreation, water supplies,
2 healthy natural resources and more are all at increasing risk in Michigan and the Great
3 Lakes region as long as we permit greenhouse gas emissions to continue.

4 A notable increase in rainfall intensity has already occurred in the Midwest due to
5 greenhouse gas emissions, and further emissions threaten our natural resources with a
6 greater risk of flooding, erosion and degradation of waterway and coastal habitats.³⁷
7 Coastal impacts are compounded by the ongoing increase in Great Lakes water level
8 extremes and variability, as well as the reduction in lake ice in winter. Based on trends that
9 we already observe, Michigan and the Great Lakes are clearly sensitive to warming when
10 it comes to extreme rainfall, algal blooms, water level variability, and the impacts on
11 human and natural systems that accompany these changes. Further warming will amplify
12 these effects, highlighting the need to keep future emissions to a minimum.

13 Q: **Do you have an understanding of how climate change will impact human health will**
14 **impact people in Michigan?**

15 A: Yes, as I have testified above, extreme heat and heatwaves are already becoming a major
16 human health challenge, both in urban and rural areas. Michigan and the Great Lakes region
17 will likely see a large increase in extreme temperature-related premature deaths if
18 greenhouse gas emissions are not halted quickly. Increased flooding, fueled by greenhouse
19 gas emissions, will become even more lethal and increase health risks related to degraded
20 water treatment, disease spread, and access to critical health services. Risks from disease
21 are also made worse by climate change.³⁸ Warming temperatures have hastened the spread
22 of tick-borne Lyme disease in Michigan, and has combined with increased precipitation

³⁷ See Exhibit ELP-15 (JTO-5).

³⁸ See Exhibit ELP-15 (JTO-5).

1 and runoff to worsen the risk from harmful algae blooms in the Great Lakes; most recently,
2 we are learning that the toxic algae can also become airborne and cause elevated health
3 risks as the more prevalent toxic algae blows over land. The habitat of disease-carrying
4 mosquitos is also expected to expand in Michigan and the Great Lakes if warming is not
5 halted.

6 At present, air pollution in Michigan and the Great Lakes, often deemed unhealthy
7 by public health officials, is a direct result of fossil fuel burning for industry and
8 transportation in the region. Poor air quality has been implicated in significant numbers of
9 premature deaths each year,³⁹ as well as a greater susceptibility to diseases including
10 dementia,⁴⁰ asthma,⁴¹ and COVID-19.⁴² Continued use of fossil fuels means continued air
11 pollution-related health problems, compounded by the additive effects of warming on smog
12 production and the likely increase in smoke from wildfires, both nearby and remote.
13 Conversely, a strong shift away from fossil fuel production and use could actually improve
14 air and water quality in the Great Lakes region, particularly for those who are
15 disproportionately impacted through their proximity to refineries, pipeline leaks, highways,
16 and smokestacks.

17 **Q: Are there any solutions to climate change?**

18 A: The solutions to climate change fall into two major categories. The first is climate change
19 adaptation where strategies are developed to live and cope with changes already happening,

³⁹ Cohen A.J. et al. (2017). *Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: an analysis of data from the Global Burden of Diseases Study 2015*. Lancet 2017; 389: 1907–18.

⁴⁰ Peeples, L. (2020). *How air pollution threatens brain health*. Proceedings of the National Academy of Sciences of the United States of America 117: 13856–13860.

⁴¹ The Lancet Commission on pollution and health (2017). Published online October 19, 2017
[http://dx.doi.org/10.1016/S0140-6736\(17\)32345-0](http://dx.doi.org/10.1016/S0140-6736(17)32345-0).

⁴² Zhou X. et al., (2021). *Excess of COVID-19 cases and deaths due to fine particulate matter exposure during the 2020 wildfires in the United States*. Science Advances 7: eabi8789

1 and expected to happen. The second broad category of solution is climate change
2 mitigation, which includes all means to slow, and eventually halt climate change before the
3 magnitude of global warming above pre-industrial levels reaches 1.5 to 2.0°C. A third
4 proposed approach for dealing with climate change involves efforts to further geoengineer,
5 or alter, the Earth's climate system, so that it cools in ways that may offset the impacts of
6 continued fossil fuel use and greenhouse gases. However, no form of proposed
7 geoengineering has yet proved to be effective, safe and not cost-prohibitive, despite
8 increased focus by the scientific community.

9 **Q: In your opinion, is climate change adaptation a reasonable solution to climate**
10 **change?**

11 A: No. Whereas climate change adaption strategies are already necessary and being
12 increasingly deployed, the science has convincingly shown that adaptation is unlikely to
13 be cost-effective or sufficient once global warming reaches 1.5 to 2.0°C. The loss of life
14 and property from recent climate change disasters brutally illustrates how challenging
15 adaptation is in practice, even at the current warming of 1°C. Beyond 1.5-2°C, there are
16 many ways that adaption strategies will fall short of protecting key human and natural
17 systems. For example, there would be a real risk of ice sheet collapse and the resulting
18 global sea level rise of many meters would submerge huge swaths of coastlines,
19 infrastructure, and communities around the world. Extreme heat and drought, and the
20 associated disruption of water and food systems, would become overwhelming across
21 significant regions of the globe. The stresses on ecosystems and biodiversity would
22 increase the odds of triggering the sixth mass extinction in Earth history.⁴³ Human health

⁴³ Exhibit ELP-12 (JTO-2).

1 would likely be one of the biggest casualties. Over 200 medical journals teamed up in 2021
2 to publish a joint statement emphasizing that no temperature rise is “safe,” and that
3 allowing temperatures to increase more than 2°C above pre-industrial levels would be “a
4 catastrophic outcome for [human] health and environmental stability.”⁴⁴ The impacts of
5 climate change on geopolitics, social stability, national security, and “climate refugee”
6 movements have long been acknowledged by the US Department of Defense, the United
7 Nations, and expert researchers. Climate change adaptation will simply be unable to
8 address the scale and scope of the changes we expect, if fossil fuel and other greenhouse
9 gas emissions continue on their current trajectory.

10 **Q: What about climate change mitigation?**

11 A: Climate change mitigation involves slowing or stopping climate change by deploying
12 human interventions to reduce greenhouse gas emissions, or to enhance the sinks of
13 greenhouse gases. The technologies to do this exist and are already being deployed, for
14 example replacing fossil fuel-based energy generation with renewable energy plus energy
15 storage, and internal combustion engine vehicles with electrified mobility. These
16 technologies are already cost-effective relative to their fossil-fuel alternatives and continue
17 to see cost declines. More energy efficient buildings and electrified heating and cooling
18 also eliminate the need for fossil fuel, and reduce costs for heating and cooling.

19 A theoretical alternative to eliminating fossil fuel use is to capture CO₂ from the
20 atmosphere and sequester it in robust storage. At present, there are no realistic sinks for
21 greenhouse gases that make it possible to continue the fossil-fuel-rich level of greenhouse
22 gas emissions while limiting global warming to 1.5 to 2.0°C. Natural carbon sinks,

⁴⁴See Exhibit ELP-16 (JTO-6).

1 including both the large ocean carbon sink and terrestrial vegetation sinks, are unlikely to
2 help reduce greenhouse gas emissions beyond the role they now play. Even the current
3 ability to serve as sinks is threatened by climate change. In addition, no human technology
4 has yet been developed to remove greenhouse gases from the atmosphere at scale, or in a
5 cost-effective manner. This means that the only proven, cost-effective way to stop climate
6 change from becoming dangerously large (i.e., more than 1.5 to 2.0°C global warming
7 above pre-industrial levels) is to eliminate the existing and new emissions of greenhouse
8 gases. Critical to achieving this goal, in turn, is leaving much of the available recoverable
9 fossil fuels in the ground, and reducing oil and gas production steadily into the future.⁴⁵

10 **Q: Can you please summarize your conclusions?**

11 A: Human-driven climate change, caused by increases in greenhouse gas emissions, is
12 already impacting every region of the globe, and the Great Lakes region is no exception.
13 If greenhouse gases continue to accumulate in the atmosphere and drive additional
14 climate change, the impacts of climate change will continue to intensify. The impacts of
15 warming become more intense as warming increases. Higher temperatures, greater
16 average precipitation and more intense precipitation are the three types of change that
17 have become most troubling for Michigan and the Great Lakes region. A notable increase
18 in rainfall intensity has already occurred in the Midwest due to greenhouse gas emissions,
19 and further emissions threaten our natural resources with a greater risk of flooding,
20 erosion and degradation of waterway and coastal habitats. Increasing greenhouse gases in
21 the atmosphere are causing warming and the intensification of the hydrological cycle in
22 Michigan and the Great Lakes. This warming means more extreme warm temperatures

⁴⁵ Welsby D. et al., (2021). *Unextractable fossil fuels in a 1.5 °C world*. Nature 597: 230
<https://doi.org/10.1038/s41586-021-03821-8>

1 and more severe drought conditions, coupled with more intense storms when rain does
2 materialize. Climate change greatly increases the risk of profound disruption of natural
3 resources and human health in Michigan and the Great Lakes region.

4 **Q. Does this conclude your testimony?**

5 A. Yes.



**ENVIRONMENTAL LAW
& POLICY CENTER**



**MICHIGAN
CLIMATE ACTION
NETWORK**

June 30, 2025

**Comments of ELPC and MiCAN
to the U.S. Army Corps of Engineers, Detroit District on the
Draft Environmental Impact Statement for the Line 5 Tunnel Project**

Attachment 4

**STATE OF MICHIGAN
MICHIGAN PUBLIC SERVICE COMMISSION**

In the matter of ENBRIDGE ENERGY,)	
LIMITED PARTNERSHIP application for)	
the Authority to Replace and Relocate the)	Case No. U-20763
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)	

DIRECT TESTIMONY OF DR. ELIZABETH A. STANTON

ON BEHALF OF

**THE ENVIRONMENTAL LAW & POLICY CENTER, THE MICHIGAN CLIMATE
ACTION NETWORK, AND THE BAY MILLS INDIAN COMMUNITY**

September 14, 2021

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

2 A: My name is Elizabeth A. Stanton. I am the Director and a Senior Economist at the Applied
3 Economics Clinic. Our offices are located at 1012 Massachusetts Avenue, Arlington MA,
4 02476.

5 **Q: What is your educational background?**

6 A: I received a PhD in Economics from the University of Massachusetts-Amherst in 2007.
7 Prior to that, I received my Master of Arts in Economics from New Mexico State University
8 in 2000 and a Bachelor of International Studies at the School for International Training in
9 Brattleboro, Vermont.

10 **Q: Can you briefly describe your professional background?**

11 A: I am the founder and Director of the Applied Economics Clinic (“AEC”), a non-profit
12 consulting group. AEC provides expert testimony, analysis, modeling, policy briefs, and
13 reports for municipalities and other public interest groups on the topics of energy,
14 environment, consumer protection, and equity. AEC also provides training to the next
15 generation of expert technical witnesses and analysts through applied, on-the-job
16 experience for graduate students in related fields and works proactively to enhance
17 diversity among the people who do our jobs today and in the future. As a researcher and
18 analyst with two decades of professional experience as a political and environmental
19 economist, I have authored more than 155 reports, policy studies, white papers, journal
20 articles, and book chapters as well as more than 45 expert comments and oral and written
21 testimony in public proceedings on topics related to energy, the economy, the environment,
22 and equity. My articles have been published in Ecological Economics, Climatic Change,
23 Environmental and Resource Economics, Environmental Science & Technology, and other
24 journals. I have also published books, including Climate Change and Global Equity

1 (Anthem Press, 2014) and Climate Economics: The State of the Art (Routledge, 2013),
2 which I co-wrote with Frank Ackerman. I am also co-author of Environment for the People
3 (Political Economy Research Institute, 2005, with James K. Boyce) and co-editor of
4 Reclaiming Nature: Worldwide Strategies for Building Natural Assets (Anthem Press,
5 2007, with Boyce and Sunita Narain). My recent work includes review and analysis of
6 electric and gas sector planning in several states, Integrated Resource Plan (IRP) and
7 Demand-Side Management (DSM) planning review, analysis and testimony of state
8 climate laws as they relate to proposed capacity additions, and other issues related to
9 consumer and environmental protection in the electric and gas sectors. In my previous
10 position as a Principal Economist at Synapse Energy Economics, I provided expert
11 testimony in electric and gas sector dockets, and led studies examining environmental
12 regulation, cost-benefit analyses, and the economics of energy efficiency and renewable
13 energy. Prior to joining Synapse, I was a Senior Economist with the Stockholm
14 Environment Institute's (SEI) Climate Economics Group, where I was responsible for
15 leading the organization's work on the Consumption-Based Emissions Inventory (CBEI)
16 model and on water issues and climate change in the western United States. While at SEI,
17 I led domestic and international studies commissioned by the United Nations Development
18 Programme, Friends of the Earth-U.K., and Environmental Defense Fund, among others.
19 My Curriculum Vitae is attached as Exhibit ELP-17 (EAS-1).

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

21 A: No.

22 **Q: Have you testified in other jurisdictions?**

23 A: Yes. I have testified in public utility and other related dockets in Massachusetts, New
24 Hampshire, South Carolina, District of Columbia, Pennsylvania, Indiana, Minnesota,

1 Louisiana, Florida, Illinois, Puerto Rico, and Vermont, and have submitted comments in
2 several federal dockets, including in front of the U.S. EPA.

3 **Q: On whose behalf are you submitting this testimony?**

4 A: I am submitting this testimony on behalf of the Environmental Law & Policy Center, the
5 Michigan Climate Action Network, and the Bay Mills Indian Community.

6 **Q: Are you sponsoring any exhibits?**

7 A: Yes. I am sponsoring the following exhibits:

- 8 • ELP-17 (EAS-1) – Curriculum Vitae of Dr. Elizabeth A. Stanton.
- 9 • ELP-18 (EAS-2) – Notice of Revocation and Termination of Easement.
- 10 • ELP-19 (EAS-3) – Governor Whitmer Executive Directive 2020-10.
- 11 • ELP-20 (EAS-4) – May 11, 2021, Letter from Governor Whitmer to Enbridge.
- 12 • ELP-21 (EAS-5) – Enbridge Response to Notification of Revocation and
13 Termination.
- 14 • Exhibit ELP-22 (EAS-6) MPSC. 2021. *MI Propane Security Plan: Ensuring*
15 *Resilience without Line 5.*
- 16 • Exhibit ELP-23 (EAS-7) Public Sector Consultants. 2020. *Analysis of Propane*
17 *Supply Alternatives for Michigan.* Prepared for Michigan DEP and PSC.
- 18 • Exhibit ELP-24 (EAS-8) Dynamic Risk's 2017 *Alternatives Analysis for the Straits*
19 *Pipelines.*
- 20 • Exhibit ELP-25 (EAS-9) Executive Order No. 2020-182.

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

22 A: Any document upon which I relied directly is cited in my testimony.

23 **Q: What is the purpose of your testimony?**

1 A: The purpose of my testimony is to determine whether “no-action” was considered by
2 Enbridge as an alternative that would meet the Company’s stated purpose for the Proposed
3 Project and whether such an alternative is feasible.

4 **Q: Can you summarize your conclusions?**

5 A: I conclude that Enbridge failed to consider a “no-action” alternative and that a “no-action”
6 alternative is feasible here. As I describe more fully below, Enbridge’s stated purpose is to
7 remove the threat of an oil spill from the existing pipelines in the Mackinac Straits.
8 Enbridge proposes shutting down the existing pipeline and considers three alternatives for
9 replacing the pipeline. However, Enbridge does not consider a “no action” alternative. A
10 “no action” alternative would be not constructing the tunnel and not continuing to operate
11 the existing dual pipelines. Not continuing to operate the dual pipelines, i.e., “shutting
12 down” Line 5, is a reasonable component of a no-action alternative because it is a likely
13 outcome even if the project is not approved. It is likely because it has already been ordered
14 by the State government, and also because it is another way to remove the threat of an oil
15 spill. A no-action alternative is feasible because Michigan’s energy needs can be met
16 without propane through electrification. During a transition to heating with modern electric
17 heat pumps, Governor Whitmer’s Upper Peninsula Energy Task Force Committee’s short-
18 and long-term recommendations lay out steps to securing energy supplies in the event of a
19 shutdown of Line 5.

20 **II. OVERVIEW OF ENBRIDGE’S PROPOSED PROJECT**

21 **Q: Please describe the project for which Enbridge seeks approval under Act 16.**

22 A: In Case No. U-20763, before the Michigan Public Service Commission (“MPSC” or the
23 “Commission”), Enbridge Energy is proposing to build a tunnel beneath the Straits of
24 Mackinac to house a new segment of its Line 5 oil and natural gas liquids pipeline (the

1 “Proposed Project”). This proposed segment would be a single 30-inch diameter pipeline
2 to replace current dual-pipelines, each with 20-inch diameters.

3 **Q: What is the purpose of the Proposed Project?**

4 A: Enbridge states in the testimony supporting its application that the purpose of the Proposed
5 Project is to alleviate environmental risk:

6 The purpose of the Project is to alleviate an environmental concern
7 to the Great Lakes raised by the State of Michigan relating to the
8 approximate four miles of Enbridge’s Line 5 that currently crosses
9 the Straits of Mackinac (“Straits”). Line 5 is a fully operational 645-
10 mile interstate pipeline, and the approximate four-mile segment that
11 crosses the Straits -- which is known as the “Dual Pipelines” -- lies
12 on top of the lakebed with the exception of portions buried near each
13 shoreline. (Pastoor Direct at 3:25-4:5).

14 **Q. Who is Enbridge?**

15 A. Enbridge is a Canadian fossil fuel pipeline transport company. According to the
16 Company’s website, “We operate across North America, fueling the economy and people’s
17 quality of life. We move about 25% of the crude oil produced in North America, we
18 transport nearly 20% of the natural gas consumed in the U.S., and we operate North
19 America’s third-largest natural gas utility by consumer count.”¹

20 **Q: Do you have an understanding of the environmental concerns to which Enbridge**
21 **refers in its testimony?**

22 A: Yes. According to Michigan Governor Gretchen Whitmer’s November 2020 notice
23 terminating Enbridge’s Straits of Mackinac easement, the existing Line 5 pipeline is at risk
24 of leaking oil and natural gas liquids into the Straits of Mackinac and from there into the
25 Great Lakes:

26 Enbridge’s operation of the Straits Pipelines presents a substantial,
27 inherent and unreasonable risk of an oil spill and such a spill would
28 have grave ecological and economic consequences, severely
29 impairing public rights in the Great Lakes and their public trust

¹ <https://www.enbridge.com/about-us>

resources. While Enbridge has proposed to replace the existing Pipelines with a new pipeline to be constructed in a tunnel beneath the lakebed, that project is likely years away from completion at best. For all these reasons, the Governor and the Director of the Department of Natural Resources find that Enbridge's use of the Straits Pipelines is contrary to and in violation of the public trust.²

These environmental concerns are also referenced in a number of documents that are available on the Michigan Pipeline Safety Advisory Board website, which was created by Michigan's previous Governor, Rick Snyder.³

Q: Are you aware of any additional environmental concerns associated with the Proposed Project?

A: Yes. The existing pipeline transports hydrocarbons, which result in greenhouse gas emissions that contribute to climate change. Shutting down the existing pipelines resolves concerns about an oil spill in the Great Lakes, but it also reduces the emissions of greenhouse gases. Michigan's Executive Directive No. 2020-10 states that:

The science is clear, and message urgent: the earth's climate is now changing faster than at any point in the history of modern civilization, and human activities are largely responsible for this change. Climate change already degrades Michigan's environment, hurts our economy, and threatens the health and well-being of our residents, with communities of color and low-income Michiganders suffering most. Inaction over the last half-century has already wrought devastating consequences for future generations, and absent immediate action, these harmful effects will only intensify. But we can avoid some of the worst harms by quickly reducing greenhouse gas emissions and adapting nimbly to our changing environment.⁴

Q: Does Enbridge take the negative environmental effects of greenhouse gas emissions from the Proposed Project into account in its application?

² Exhibit ELP-18 (EAS-2), Notice of Revocation and Termination of Easement at 9.

³ See <https://mipetroleumpipelines.org/resources-reports>

⁴ See Exhibit ELP-19 (EAS-3), Governor Whitmer Executive Directive 2020-10.

1 A: No, Enbridge does not address greenhouse gas emissions in its application. However, I am
2 aware that testimony from Expert Witness Pete Erickson discusses the greenhouse gas
3 emissions associated with Enbridge's Proposed Project, and that Expert Witness Dr. Peter
4 Howard applies the Social Cost of Greenhouse Gases to Mr. Erickson's estimates.

5 **Q: Is Enbridge currently authorized to run the dual pipelines across the Straits?**

6 A: No. Governor Whitmer revoked and terminated Enbridge's easement, requiring the
7 pipelines across the Straits to be shut down.⁵ I understand Enbridge has refused to terminate
8 operation of the existing pipelines pursuant to the Governor's notice, and is challenging
9 the revocation and termination of the 1953 easement in court.⁶ I am further aware that
10 Governor Whitmer has put Enbridge on notice that the State of Michigan considers the
11 Company's continued operations in the Straits to be an intentional trespass.⁷

12 **Q. Are you aware of any alternatives that Enbridge has considered to alleviate**
13 **environmental risk instead of its proposed tunnel?**

14 A. Enbridge examined three alternatives to operating the existing dual pipelines. The first
15 alternative was the proposed tunnel, which is at issue in this case. The other two alternatives
16 were: "(ii) a new pipe installed across the Straits using an open-cut method that includes
17 secondary containment; or (iii) a new pipe installed below the Straits using the horizontal
18 directional drilling (HDD) method." (Pastoor Direct at 15:22-25) All three alternatives
19 involve transporting hydrocarbon in a pipeline across the Straits. Enbridge did not consider
20 any alternative that involved not replacing the existing line, resulting in Line 5 ceasing
21 operations.

⁵ ELP-18 (EAS-2) "[t]he Easement is being revoked for violation of the public trust doctrine, and is being terminated based on Enbridge's longstanding, persistent, and incurable violations of the Easement's conditions and standard of due care." p.20.

⁶ See *Michigan, State of et al v. Enbridge Energy, Limited Partnership et al*, 1:20CV01142

⁷ ELP-20 (EAS-4) May 11, 2021, Letter from Governor Whitmer to Enbridge.

1 **Q. Has Enbridge considered an appropriate range of alternatives?**

2 A. No. Enbridge has artificially limited its analysis of alternatives to include only methods
3 that involve (1) shutting down the existing dual pipelines, **and** (2) transporting hydrocarbon
4 in a pipeline across the Straits, allowing for continued operation of Line 5. Enbridge has
5 overlooked an essential alternative that would meet its stated purpose of alleviating
6 environmental risks to the Great Lakes: (1) shutting down the existing dual pipelines, **and**
7 (2) taking no action to replace the pipelines with a new segment.

8 **Q. Is that overlooked alternative what you refer to as the “no-action alternative”?**

9 A. Yes, although I recognize that this terminology can be somewhat awkward when applied.
10 In my experience, when alternatives analyses are undertaken, considering a “no-action
11 alternative” is best practice. The no-action alternative evaluates what would happen if the
12 proposed action were not to be undertaken. Here, the proposed action is the construction
13 of a tunnel. Enbridge should have included in its alternatives analysis an alternative in
14 which the existing pipeline no longer operates, but is not replaced with a new pipeline. In
15 short, the “no-action” alternative is to eliminate the environmental risk to the Great Lakes
16 by shutting down the existing pipeline, but take “no action” to construct a new pipeline
17 segment through the Straits.

18 **Q. Is the shut-down of the existing pipeline a necessary component of every alternative**
19 **in a proper alternatives analysis?**

20 A: Yes. Not only has Enbridge been ordered by the State to shut down the existing dual
21 pipeline segment in the Straits, the Company’s stated purpose is eliminating the
22 environmental threat of a spill from the existing dual pipelines. Continuing to operate the
23 existing pipelines would not achieve Enbridge’s stated purpose, and therefore cannot be
24 considered as a component of an alternative here. It is important to consider the no-action

1 alternative because, even if a tunnel reduced some of the threat of an oil spill in the Straits,
2 it would not eliminate the threat, and, when compared to discontinuing operation of Line
3 5, would exacerbate the harm to natural resources caused by climate change.

4 **Q: Is the shutdown of the existing line a certainty?**

5 A: No. I understand that Enbridge is contesting the shutdown order and says that it will
6 continue to operate the dual pipelines if it is not allowed to build the tunnel.⁸ By refusing
7 to comply with the Governor's order, Enbridge sets up a false choice between a pipeline
8 within the tunnel and a pipeline without a tunnel, thus avoiding discussion of a true no
9 action alternative.

10 **Q: Why do you say Enbridge set up a false choice?**

11 A: Enbridge has made clear that the purpose of the Proposed Project is to alleviate
12 environmental harm by shutting down the existing pipeline and must consider all available
13 alternatives that would serve this same purpose. Enbridge's testimony implies that the
14 choice in front of the Commission is between different methods of transporting
15 hydrocarbons across the Straits. But Enbridge has not presented the Commission with a
16 true no action alternative. Taking "no action" would be not developing a new method by
17 which to transport hydrocarbons across the Straits, regardless of the outcome of Enbridge's
18 contestation of the Governor's order to shut down the line.

19 **Q. Would it be feasible and prudent to shut down the existing line and not replace it with**
20 **a new line, resulting in the shutdown of Line 5 in its entirety?**

21 A: Yes.

22 **Q. What do you understand feasible and prudent to mean?**

⁸ ELP-21 (EAS-5) Enbridge Response to Notification of Revocation and Termination.

1 A: My understanding is that the words “feasible” and “prudent” are not defined in the
2 Michigan Environmental Protection Act. An acceptable method of determining intent is to
3 refer to a dictionary for the common usage of the words.⁹ A “feasible” alternative is one
4 that is “capable of being put into effect or accomplished; practicable” or “capable of being
5 successfully utilized; suitable.”¹⁰ “Prudent” is defined as “exercising sound judgment.”¹¹

6 **Q: What is the basis for your opinion that it would be feasible and prudent to shut down**
7 **the existing line and not replace it with a new line?**

8 A. Shutting down the existing line and taking no action to replace it is practicable and
9 represents the exercise of sound judgment.

10 A no-action alternative is practicable: Without Line 5 at the Straits of Mackinac current
11 consumers of propane and related products would either purchase fuels transported in a
12 different way (other pipelines, road and rail) or would switch to non-hydrocarbon fuels,
13 likely electrification via modern heat pumps. Michiganders would still have access to the
14 energy they need to heat their homes (see Section III). There are viable alternatives to
15 heating with propane (see Section IV). Michigan agencies are obligated to create policies
16 and incentives to reduce emissions, including in the building sector (see Section IV).

17 A no-action alternative represents the exercise of sound judgment: Taking no action to
18 build a tunnel for Line 5 would shut down one of many sources of energy while achieving
19 the express purpose of the Proposed Project: eliminating environmental risk to the Straits.
20 In my opinion this course of action represents sound judgment because it simultaneously
21 advances climate change goals established by the State of Michigan. Indeed, with
22 Michigan’s requirement to achieve a 28 percent reduction in emissions (from 2005 levels)

⁹ Nelson v. Grays, 209 Mich.App. 661, 664, 531 N.W.2d 826 (1995).

¹⁰ Funk & Wagnalls Standard Dictionary (1980).

¹¹ Funk & Wagnalls Standard Dictionary (1980).

1 by 2025 and carbon neutrality no later than 2050, investments in propane heating (and the
2 infrastructure to transport that propane) will become “stranded assets” by 2050 at the very
3 latest. These investments will lose all value, regardless of the age or condition of the
4 equipment. Investments that extend the life of propane heating and transmission equipment
5 do not seem to represent sound judgment whether for households or for energy companies
6 (see Section V).

7 **III. IN A NO-ACTION ALTERNATIVE, MICHIGANDERS WOULD STILL BE**
8 **ABLE TO HEAT THEIR HOMES**

9 **Q. Has there been any analysis of what Michigan consumers would do in the event that**
10 **Enbridge’s Line 5 supply were no longer available?**

11 A. Yes. Governor Whitmer’s Upper Peninsula Energy Task Force Committee (“UP Energy
12 Task Force”) published short- and long-term recommendations on securing energy supplies
13 in the event of a shutdown (accidental or by policy) of Line 5. The UP Energy Task Force
14 identified a number of policies that would mitigate the short-term energy supply
15 disruptions including evaluating potential changes in supply and distribution, investing in
16 the propane supply infrastructure, monitoring market conditions, addressing energy costs
17 in the Upper Peninsula, enabling state contracting of propane, and instituting consumer
18 protections. The UP Energy Task Force’s longer-term recommendations focus on creating
19 alternative supplies to meet consumer demand for heat. These policies include financing
20 energy waste reduction, supporting development of renewables and energy storage options,
21 promoting affordable electricity for consumers, and promoting environmental justice
22 actions.

23 **Q. How is propane currently used in Michigan?**

A. According to the U.S. Energy Information Administration’s (EIA) Residential Energy Consumption Survey most of Michigan’s residential propane sales are used for space and water heating.¹²

According to the U.S. Census Bureau, eight percent of Michigan households use some form of bottled fuel to heat their homes. In Detroit, less than 1 percent of homes heat with propane while in the Upper Peninsula the share rises to 19 percent (see Table 1).¹³ Three percent of homes in the Michigan region use propane to heat water.¹⁴

Table 1. Michigan home heating fuels

	MI		Detroit		UP	
	Homes	%	Homes	%	Homes	%
Bottled, tank, or LP gas	326,681	8%	2,168	1%	24,057	19%
Gas	3,006,749	76%	227,405	86%	71,353	57%
Electricity	385,768	10%	29,250	11%	12,947	10%
Fuel Oil	42,597	1%	641	0%	3,497	3%
Wood	116,756	3%	413	0%	11,281	9%
Other	37,784	1%	1,702	1%	1,211	1%

Q. What are the alternatives to propane in the Governor’s Upper Peninsula Energy Task Force Committee report?

A. The UP Energy Task Force report suggests the following alternatives to propane supplies via Line 5: the increased use of rail infrastructure and the creation of new track capacity; improvement of transloading in the Upper Peninsula; new wholesale and retail storage capacity, maximizing propane injected into storage reserves; developing a “Strategic Propane Reserve;” requiring contracts with the state government to have an attestation that

¹² U.S. EIA. 2015 Residential Energy Consumption Survey (RECS). Available: <https://www.eia.gov/consumption/residential/data/2015/#waterheating>. Data are for EIA’s East North Central region, which consists of Illinois, Indiana, Michigan, Ohio, and Wisconsin.

¹³ U.S. Census. 2019 ACS 5-Year Estimates Detailed Tables [Table: B25040]

¹⁴ U.S. EIA. 2015 Residential Energy Consumption Survey (RECS). Available: <https://www.eia.gov/consumption/residential/data/2015/#waterheating>. Data are for EIA’s East North Central region, which consists of Illinois, Indiana, Michigan, Ohio, and Wisconsin.

1 companies will meet their supply obligations if Line 5 is shut down; pre-buying of propane
2 to lock-in supply; and removal of barriers to propane deliverability (land acquisition,
3 brownfield redevelopment assistance and permitting).¹⁵ The UP Energy Task Force's
4 analysis of propane supply alternatives also considered trucking.¹⁶ Much of the 2020 report
5 by Michigan DEP and PSC's Public Sector Consultants focused on "estimated commodity
6 costs at major hubs within the U.S. and Canada, costs of available transportation options,
7 and associated storage costs" based on a number of delivery points.¹⁷ The lowest-cost
8 option identified originates in Edmonton, Alberta and relies on a mixture of rail
9 transportation to deliver to a site in the vicinity and then rely on trucks for the remaining
10 short distance (trucking the whole way is cost prohibitive).¹⁸ The key limitation of this
11 option is that rail is relied upon for most of the distance.¹⁹ No options were identified for
12 pipeline transit and only one option using shipping from Western Canada to the United
13 States.²⁰

14 **Q: What scenarios for supply disruption have been examined by the Michigan PSC?**

15 A. The Public Sector Consultants report considered three scenarios from which it assessed
16 supply alternatives to Line 5: a supply disruption of the Lakehead System via Line 1; a
17 potential disruption in Line 5; and a weather-related disruption of propane supply and
18 consumption similar to the 2013-2014 winter season.²¹ The first scenario assumes Line 5
19 would not continue operating, removing 51 percent of Michigan's propane supplies
20 because of the loss of crude and natural gas supplies to propane production facilities.²² The

¹⁵ Exhibit ELP-22 (EAS-6) MPSC. 2021. *MI Propane Security Plan: Ensuring Resilience without Line 5*.

¹⁶ Exhibit ELP-23 (EAS-7) Public Sector Consultants. 2020. *Analysis of Propane Supply Alternatives for Michigan*. Prepared for Michigan DEP and PSC.

¹⁷ *Ibid*, pg. 82.

¹⁸ *Ibid*.

¹⁹ *Ibid*.

²⁰ *Ibid*.

²¹ Exhibit ELP-23 (EAS-7) at 7.

²² *Ibid*.

1 second removes 46 percent of Michigan's propane supplies.²³ Finally, a polar vortex
2 similar to 2013-2014 would result in sharply increased demand, associated price spikes,
3 and supply shortages as Michigan's current supply options would be insufficient to meet
4 demand.²⁴

5 **IV. THERE ARE VIABLE ALTERNATIVES TO HEATING WITH PROPANE**

6 **Q. What alternatives to propane exist?**

7 A. Modern electric heat pumps are a practical and economic alternative to propane space
8 heating; electric hot water heaters (including heat pump hot water heaters), stoves and
9 dryers can replace propane water heaters, stoves and dryers. Propane has the advantage of
10 not requiring a transmission and distribution system in the ways that utility gas (local
11 distribution pipelines) or fuel oil (tanker trucks) do. That means that homes and businesses
12 can heat and serve other energy end uses with propane that they can self-deliver in bottles
13 or small tanks. Very nearly all Michigan properties, however, are already served by grid-
14 based electricity.²⁵ While old-fashioned electric resistance heating vies with propane for
15 the least economic space heating fuel source, modern electric heat pumps are among the
16 most economic heating sources to run and have the advantage of the same unit also
17 providing cooling at a lower cost than window air conditioners.

18 **Q. What are the cost impacts of propane usage versus electric heat pump usage?**

19 A. Electric heat pump usage is less expensive than propane for heating homes. According to
20 research by the Massachusetts Department of Energy, propane is far more expensive than
21 other forms of heating—its costs are exceeded only by old fashioned electric resistance

²³ *Ibid.*

²⁴ *Ibid.*

²⁵ U.S. EIA. 2015 Residential Energy Consumption Survey (RECS). Available:
<https://www.eia.gov/consumption/residential/data/2015/#waterheating>. Data are for EIA's East North Central
region, which consists of Illinois, Indiana, Michigan, Ohio, and Wisconsin.

1 heating. For example, heating with air source heat pumps, which are all electric heating
2 and cooling systems designed for cold climates like Michigan, provides 44 percent
3 reduction in heating costs compared to heat pumps.²⁶ Research (of which I am an author)
4 from the AEC found that the relative costs of heating methods depend on fuel and electric
5 prices and that in Massachusetts air source heat pumps will have lower heating costs than
6 utility gas furnaces somewhere between 2026 and 2030 (depending on the cost to repair
7 the state's aging pipeline infrastructure).²⁷ Recent research from the Rocky Mountain
8 Institute showed modern air source heat pumps to have excellent efficiency in cold climate.
9 Air source heat pumps coefficient of performance (COP, a measure of efficiency where 0.0
10 to 0.9 is a loss of energy, 1.0 is no loss, and higher than one is a gain of energy above that
11 embedded in the fuel used) was 2.34 in Minneapolis, MN, compared to propane's COP of
12 around 0.8.²⁸ A study performed for the City of San Francisco found that heat pumps are
13 currently cost-effective as an end-of-life replacement for other heating sources.²⁹

14 **Q. What are the emission impacts of propane usage versus electric heat pump usage?**

15 A. Air source heat pumps are almost four times more efficient than propane heaters and today
16 Michigan's electric grid provides energy (MMBtus) at an emissions rate that is almost
17 double that of burning propane directly for heat. I have determined that these two facts
18 taken together result in propane heaters in Michigan emitting twice the greenhouse gases
19 than air source heat pumps do for the same amount of heat.

20 **Q. How will the emissions impacts of heat pumps and propane change over time?**

²⁶ <https://www.mass.gov/info-details/household-heating-costs>

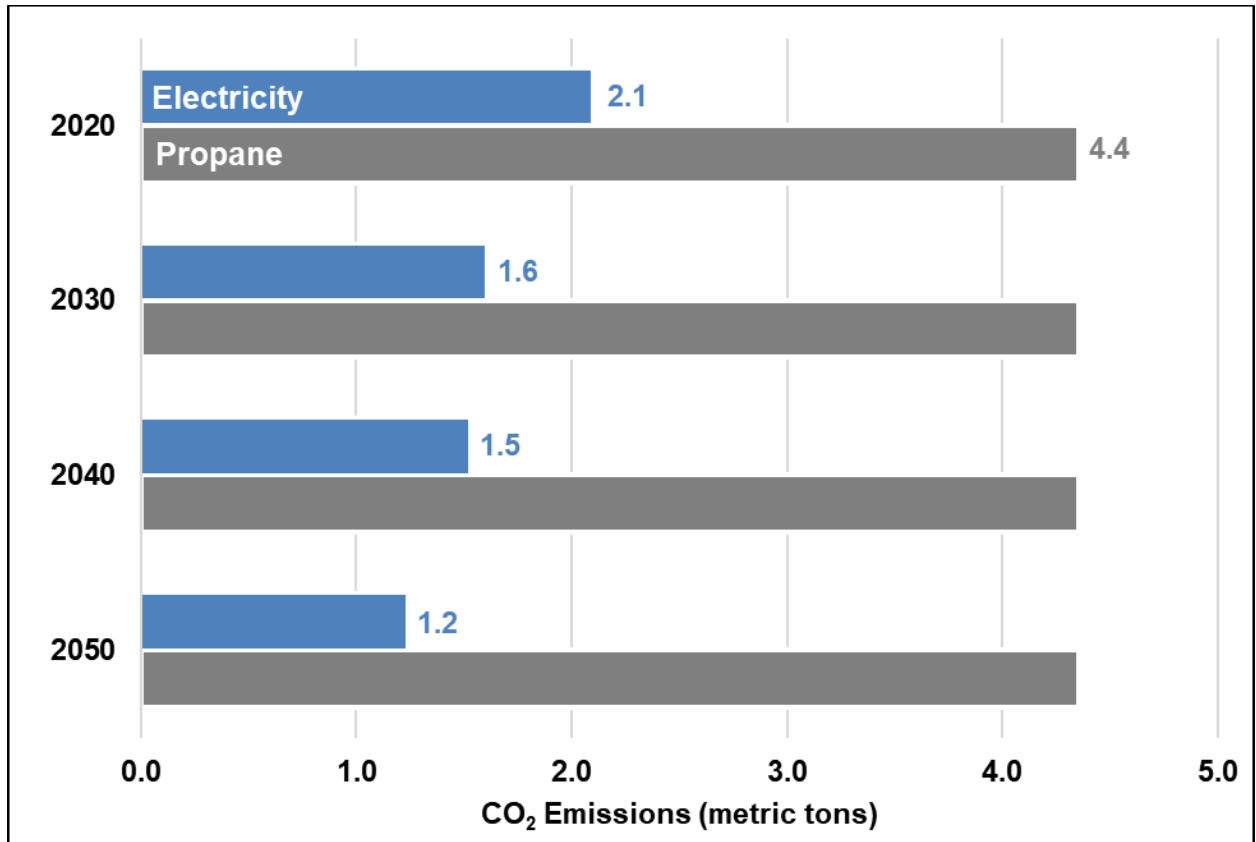
²⁷ <https://aeclinic.org/publicationpages/2021/01/13/inflexion-point-when-heating-with-gas-costs-more>

²⁸ <https://rmi.org/its-time-to-incentivize-residential-heat-pumps/> and U.S. EIA. June 2017. "Residential End Uses: Historical Efficiency Data and Incremental Installed Costs for Efficiency." Available at: https://www.eia.gov/analysis/studies/residential/pdf/res_ee_fuel_switch.pdf, p. 68

²⁹ https://sfenvironment.org/sites/default/files/fliers/files/sfe_cc_sustainable_future_siemens_climate_report.pdf, p25

A. While greenhouse gas emissions from propane heaters will stay constant, the emissions from air source heat pumps will fall as Michigan's electric grid becomes green (see **Error! Reference source not found.**).

Figure 1. Heat pump versus propane emissions from heating an average home in Michigan



Q. Are heat pumps available today in Michigan?

A. Heat pumps are available today in Michigan³⁰ and the state's utilities offer a small rebate for their installation.³¹

Q: Is converting to heat pumps cost-effective when equipment and installation costs are included?

³⁰ https://www.michigan.gov/documents/mpsc/MPG_New_Tech_Heat_Pumps_Full_Slides_717380_7.pdf

³¹ https://www.michigan.gov/documents/mdcd/Residential_Incentives_Flyer_2011_367083_7.pdf

1 A: Yes, heat pumps are less expensive to purchase, install and run over the course of their
2 lifetimes as compared to fossil fuel heating. However, any change in heating system
3 requires significant upfront costs. This disincentive can be addressed by state or utility
4 sponsored zero-interest loans for green energy investments and/or by rebates to offset
5 these costs (for example: [https://www.masssave.com/saving/residential-rebates/heat-loan-](https://www.masssave.com/saving/residential-rebates/heat-loan-program)
6 [program](https://www.masssave.com/saving/residential-rebates/heat-loan-program) and <https://michigansaves.org/>). Research by the American Council for an
7 Energy-Efficient Economy has found that median payback period for a heat pump is
8 about 5 years if the equipment is also used to provide central air conditioning and 15
9 years if it is not.[https://www.aceee.org/blog/2016/05/should-we-promote-heat-pumps-](https://www.aceee.org/blog/2016/05/should-we-promote-heat-pumps-save)
10 [save](https://www.aceee.org/blog/2016/05/should-we-promote-heat-pumps-save)). Other potential obstacles in heat pump installation include the costs of
11 modernizing older electric systems to be able to support a heat pump (usually 200+
12 amps).

13 III. OTHER POTENTIAL IMPACTS ON MICHIGAN CAN BE RESOLVED

14 Q: Are you aware of any concerns with the no-action alternative other than the
15 availability of propane for heating homes?

16 A: Yes. I am aware of Enbridge's argument that failing to transport hydrocarbons across the
17 Straits will have negative impacts on Michigan oil producers, Michigan refineries, and
18 consumers of jet fuel and other fuels in Michigan.³²

19 Q: Have you formed any opinions about whether those concerns make the no-action
20 alternative infeasible?

21 A: Yes. I have not done an independent analysis on each of these issues, but I have reviewed
22 a variety of analyses and information on these issues, and I do not believe that these
23 concerns render the no-action alternative either unreasonable or imprudent. Some

³² See Enbridge. *The impact of a Line 5 shutdown*. Available at:
https://www.enbridge.com/~media/Enb/Documents/Factsheets/FS_Without_Line5_econ_impact.pdf

1 businesses with investments concentrated in fossil fuels may see reduced profits with a
2 transition to electrification, while other businesses (electric utilities and generators,
3 manufacturers and installers of heat pumps, efficiency measures and other electric
4 equipment) will prosper. The State of Michigan does not have a role to play in choosing
5 winners and losers among particular business actors in the economy. The fact that a
6 particular alternative to a risky pipeline in a critical water body may benefit some
7 businesses more than others makes no difference to a determination of whether it is
8 reasonable and prudent.

9 **Q: Can you explain the likely impact on jet fuel in Michigan?**

10 A: Enbridge claims a Line 5 shutdown would impact half of jet fuel supplies to Detroit
11 Metropolitan Wayne County Airport.³³ Enbridge also argues that Michigan would have to
12 find alternative crude oil to supply refined products like jet fuel, but does not provide
13 specific analysis or sources for third-party verification.³⁴ Enbridge's claim echoes that of
14 Ohio Governor Mike DeWine who argued Line 5 supplies 40 percent of the jet fuel in
15 DTW.³⁵ However, a recent "fact check" assessment suggests that Line 5 only provides 10
16 percent of DTW's jet fuel, from the following refineries: PBF, Husky, and Marathon.³⁶
17 (Note however that 2020 fuel consumption numbers at DTW for this assessment were
18 based on numbers from the 2010 DTW Master Plan.³⁷) While I have not independently
19 verified the methods or results of this fact check, it does suggest that Enbridge has provided
20 insufficient evidence to back up its claims.

³³ Enbridge. *The impact of a Line 5 shutdown*. Available at:

https://www.enbridge.com/~media/Enb/Documents/Factsheets/FS_Without_Line5_econ_impact.pdf

³⁴ *Ibid.*

³⁵ FLOW. 2021. "Fact Check: When Line 5 Shuts Down, Detroit Jets Will Still Fly and Union Refinery Jobs Will Still Exist." Available at: <https://forloveofwater.org/fact-check-when-line-5-shuts-down-detroit-jets-will-still-fly-and-union-refinery-jobs-will-still-exist-3/>

³⁶ *Ibid.*

³⁷ *Ibid.*

1 **Q. Can you explain the likely impact on Michigan refineries?**

2 A. In the event of a Line 5 shutdown, the industry association Consumer Energy Alliance's
3 (CEA) 2021 report suggests that two refineries in Ohio (PBF Energy and BP Husky) would
4 cease operation while the Marathon Refinery near Detroit and refineries in Indiana and
5 Pennsylvania will remain open but operate at reduced levels; overall, CEA estimates that
6 refineries in Michigan, Ohio, Pennsylvania, Ontario, and Quebec would lose 45 percent of
7 their crude oil input with a Line 5 disruption.³⁸ Another 2021 assessment by IHS Markit
8 notes that there are nine refineries affected by the Line 5 and Line 78 system that have the
9 collective potential to refine 1 million b/d, including 150,000 b/d of jet fuel.³⁹ Line 5 ships
10 540,000 b/d of light crude and natural gas, while the remaining (excluding Line 5) mainline
11 capacity starting at the Wisconsin border is 2 million b/d, suggestion an impact on area
12 refineries closer to 20 percent. Again, Enbridge has not provided analysis, sources, or data
13 for third-party verification of any negative impacts on Michigan refineries

14 **Q. Overall, in your opinion, what impacts would a closure of Line 5 have on the Michigan**
15 **economy?**

16 A. Overall, I would expect a closure of Line 5 to have a positive or neutral effect on the
17 Michigan economy. Certainly, there would be losses to some businesses that have
18 concentrated all of their investment in fossil fuel-related activities. But losses and gains in
19 business sectors are the normal workings of a capitalist economy; and losses to businesses
20 with concentrated investments in greenhouse-gas emitting fuels and technologies are
21 inevitable as Michigan, the United States, and the world decarbonize.

³⁸ Consumer Energy Alliance. 2021. *The Regional Economic and Fiscal Impacts of an Enbridge Line 5 Shutdown*. Available at: https://consumerenergyalliance.org/cms/wp-content/uploads/2021/05/CEA_LINE5_REPORT_2021_DIGITAL_FINAL.pdf. Pg. 3; 7; 9.

³⁹ Bradley, A. 2021. "Line 5 shutdown could create a logistical scramble, reducing competitiveness of crude oil producers and refiners." HIS Markit. Available at: <https://ihsmarkit.com/research-analysis/line-5-shutdown-could-create-a-logistical-scramble-reduci.html>.

1 Businesses with diverse investments that include some fossil fuels and other non-energy
2 businesses should experience a neutral impact from a Line 5 closure, while businesses with
3 investments in electric supply, electric equipment manufacture and installation, and other
4 “green” goods and services should benefit from a Line 5 closure.

5 Workers in these industries would experience related impacts, with jobs added in
6 electric supply and equipment manufacture and installation, and some job losses in
7 businesses with concentrated investments in fossil fuel-related activities. State policy to
8 support retraining fossil-fuel-related workers for skills in zero-carbon industries could play
9 an important role in smoothing the decarbonization transition for workers, while insuring
10 that a loss of worker income (while limited to a small set of workers) does not negatively
11 impact on the economy as a whole.

12 Energy consumers (households and businesses) may need state assistance in the
13 form of rebates and no-interest loans to transition to heat pumps and other electric
14 equipment. But after this transition is complete will benefit from lower energy bills.

15 Overall, while the closure of Line 5 (and the greater project of Michigan
16 decarbonization) will cause some shift in consumer expenditures I see no reason to believe
17 that it will be a detriment to consumers or the economy as a whole.

18 **Q. Are your conclusions consistent with other analyses that you have reviewed?**

19 A. Yes. As I discussed above, Governor Whitmer’s Upper Peninsula Energy Task Force
20 Committee’s report provide detailed plans for addressing a temporary energy shortfall from
21 a Line 5 closure. Dynamic Risk’s 2017 *Alternatives Analysis for the Straits Pipelines* (on
22 behalf of the State of Michigan) includes a no action alternative (Alternative 6) that
23 “Eliminate[s] the transportation of all petroleum products and natural gas liquids...through
24 the Straits of Mackinac segment of Enbridge’s Link 5 and then decommission[s] that

1 segment.”⁴⁰ This alternative eliminates all risks to the Straits and results in increases to
2 some fossil fuel prices and decreases to other prices. The report does not examine impacts
3 on other related industries or non-fossil-fuel energy alternatives.

4 Similarly, London Economics’ analysis of alternatives to Line 5 found that losses to
5 Michigan refineries would be limited to 15 percent of supply (much lower than Enbridge’s
6 estimate) and that the related increase in gasoline prices would be lower than 1 cent per
7 gallon. London Economics’ also suggests that Enbridge has the capacity to increase
8 supplies using its existing Line 78, reducing economic impacts still further.⁴¹

9 **IV. MICHIGAN AGENCIES ARE OBLIGATED TO REDUCE EMISSIONS,**
10 **INCLUDING IN THE BUILDING SECTOR**

11 **Q. Is public policy relevant to the future demand for fossil fuels and related products in**
12 **Michigan?**

13 A. Yes. Michigan’s energy plans and policies, climate plans and policies, and environmental
14 standards and regulations all impact on the future demand for fossil fuels, today and in the
15 future. As an economist, I am aware of the importance of considering costs and benefits
16 throughout (and often beyond) a project’s lifetime. For energy projects, that includes
17 consideration of demand for the type of energy in question over the lifespan of the project
18 and the lifetime of the projects impacts on local communities, local environments and the
19 climate. In other words, an appropriate alternatives analysis must consider whether demand
20 for fossil fuel will be the same or different in 10 years, 25 years, and 100 years.

⁴⁰ Exhibit ELP-24 (EAS-8) Dynamic Risk’s 2017 *Alternatives Analysis for the Straits Pipelines* at p.ES-2.

⁴¹ http://blog.nwf.org/wp-content/blogs.dir/11/files/2018/09/LEI-Enbridge-Line-5-Michigan-Refining_9_12_2018.pdf

1 Climate forecasts, regulations, and policies, like those being undertaken in the State of
2 Michigan today, suggest that it is not sensible to assume that fossil fuel demand will be the
3 same or higher in future years.

4 **Q. What efforts is the State of Michigan undertaking to reduce Michigan’s carbon**
5 **footprint?**

6 A. Michigan’s EO 2020-182 requires the Department of Environment, Great Lakes, and
7 Energy to “develop, issue, and oversee the implementation of the MI Healthy Climate
8 Plan..., which will serve as the action plan for this state to reduce greenhouse gas emissions
9 and transition towards economywide carbon neutrality.”⁴² The MI Healthy Climate Plan
10 must be submitted to the Governor by December 31, 2021.⁴³ ED 2020-10 requires the
11 Department of Environment, Great Lakes, and Energy to oversee the Plan’s
12 implementation. In addition, the Department of Treasure is charged with developing and
13 implementing an Energy Transition Impact Project to identify and minimize impacts of
14 clean energy transition on vulnerable communities.⁴⁴

15 **Q. How will the states’ actions towards carbon neutrality impact the use of fossil fuels in**
16 **Michigan?**

17 A. To achieve carbon neutrality, Michigan must transition away from fossil fuel energy
18 towards zero-emitting energy resources like wind and solar. The forthcoming MI Healthy
19 Climate Plan will likely set out an expected pace for this transition. Within the next two to
20 three decades, operating fossil fuel-fired equipment will not be permitted in the State of
21 Michigan.

⁴² Exhibit ELP-25 (EAS-9) Executive Order No. 2020-182.

⁴³ Exhibit ELP-19 (EAS-3), Executive Directive 2020-10.

⁴⁴ *Ibid.*

1 **Q. Are you aware of any efforts by the U.S. federal government to reduce the national**
2 **carbon footprint?**

3 A. The Biden Administration has promised to rejoin the Paris Agreement and achieve
4 nationwide carbon neutrality by 2050. Biden's National Climate Task Force is in the
5 process of setting a new 2030 emission target and develop a detailed plan for lower
6 emissions while improving environmental justice outcomes.⁴⁵

7 **V. INVESTMENT THAT EXTENDS THE LIFE OF PROPANE HEATING AND**
8 **TRANSMISSION EQUIPMENT IS NOT PRUDENT**

9 **Q. What is a stranded asset?**

10 A. A stranded asset is an investment in equipment or infrastructure that is no longer of use
11 before it has been paid off. For example, fossil fuel heaters built today may have a 30-year
12 economic life and their financing decision will be made on that basis: 30 years of revenues
13 (or value) to cover the initial cost, plus upkeep. If greenhouse gas emissions limits or other
14 zero emission energy requirements (such as a renewable portfolio standard) require
15 substantial emission reductions before the end of those 30 years, use of the fossil fuel
16 equipment will no longer be permitted and the value of the asset will become "stranded":
17 the equipment is there but it cannot be used, and it cannot generate value for its owner.

18 **Q. Why are fossil-fuel heaters, water heaters, dryers and stoves likely to become**
19 **stranded assets in Michigan?**

20 A. Michigan's ED 2020-10 requires agencies to achieve a statewide 28 percent reduction in
21 emissions (from 2005 levels) by 2025 and carbon neutrality no later than 2050.⁴⁶ EIA

⁴⁵ <https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/>

⁴⁶ Exhibit ELP-19 (EAS-3), Executive Directive 2020-10.

1 assumes a lifetime for a propane furnace of between 16 and 27 years.⁴⁷ That means that a
2 propane furnace installed today has the potential—with appropriate maintenance—to
3 continue to provide heat through the year 2048. But by 2050 at the latest, Michigan will no
4 longer permit carbon emissions. Furthermore, it is likely that many carbon reduction goals
5 will not permit any significant number of emissions “offsets,” requiring true and significant
6 reductions in greenhouse gas emissions. With every passing year, new purchases of fossil
7 fuel heaters and new investments in pipelines and related infrastructure become less likely
8 to remain operational throughout their economic lifetimes.

9 VI. CONCLUSIONS

10 **Q. Can you please summarize your conclusions?**

11 A. In its application to build a tunnel beneath the Straits of Mackinac to house a new segment
12 of its Line 5 oil and natural gas liquids pipeline, Enbridge has failed to consider and present
13 a reasonable and prudent no-action alternative to shut down Line 5 (thus achieving the
14 stated purpose of eliminating environmental risk) and not building a new pipeline or tunnel
15 to replace it.

16 The closure of Line 5 would accelerate Michigan’s transition to a zero-carbon economy,
17 benefit “green” and electric-related businesses, and reduce consumer energy costs—
18 important positive effects on Michigan’s economy. Governor Whitmer’s task force
19 provides detailed plans for addressing temporary energy supply concerns from a closure,
20 and any more permanent shift away from spending on fossil fuel-related business towards
21 green and electric businesses is inevitable given the state’s greenhouse gas emission
22 requirements.

⁴⁷ <https://www.eia.gov/outlooks/aeo/assumptions/pdf/residential.pdf>

1 A no action alternative eliminates environmental (including climate) risks, moves
2 Michigan forward in its climate goals, and does not prevent consumers from getting the
3 energy supply that they need.

4 **Q. Does this conclude your testimony?**

5 A. Yes.