ONTARIO ENERGY BOARD

IN THE MATTER OF the *Ontario Energy Board Act, 1998*, S.O. 1998, c. 15, Schedule B; and in particular section 90(1) and section 97 thereof;

AND IN THE MATTER OF an application by Enbridge Gas Inc. for an order granting leave to construct natural gas pipelines in the Municipality of Chatham Kent and Essex County.

ENBRIDGE GAS INC.

REPLY EVIDENCE

OEB File No. EB-2022-0157

November 3, 2023

Contents

A. <u>Introduction</u>

1. Enbridge Gas Inc. (“Enbridge Gas” or the “Company”) is in receipt of and has reviewed the evidence prepared by Dr. Heather McDiarmid on behalf of Environmental Defence (“ED”) filed on October 28, 2022 and updated on October 18, 2023 (the “ED Evidence”) related to the Panhandle Regional Expansion Project (the “Project”). /u

2. ED’s Evidence reviews and remodels Enbridge Gas’s Stage 2 analysis, and provides an analysis of alternatives to natural gas for new construction greenhouses in Ontario.

3. In accordance with the OEB’s Procedural Order No. 2 dated October 14, 2022, and OEB staff’s notification dated November 3, 2022, the following is Enbridge Gas’s Reply Evidence.

4. Enbridge Gas will not comment upon each specific assumption or argument made in the ED Evidence. Any assumption or argument contained in the ED Evidence that is not addressed by Enbridge Gas should not be interpreted as agreement with it.

B. <u>Dr. McDiarmid’s Selective Modifications to the OEB’s E.B.O. 134 Economic Test</u>

5. This section of Reply Evidence is in response to Section 1 of ED’s Evidence titled *Review of Enbridge Gas’ stage 2 analysis of the economics of natural gas and electrified alternatives for customers in the Ontario Panhandle*.

6. Since its inception and as approved by the OEB, the E.B.O. 134 Report of the Board (“E.B.O. 134”) economic test is a cumulative three-stage economic test that measures the net benefits of a transmission system expansion, i.e., an

assessment of the benefits associated with the pipeline compared to the costs associated with the pipeline.

7. Dr. McDiarmid has misused the OEB's E.B.O. 134 economic test and relies on inappropriate simplifying assumptions, which results in a flawed outcome that cannot be relied upon to properly assess the economic feasibility of the Project. Ignoring the basis of the E.B.O. 134 economic test and its OEB approved application, Dr. McDiarmid has developed a new economic test that is untested and inconsistent with the intent and purpose of the E.B.O. 134 economic test.

8. Dr. McDiarmid's proposed Stage 2 economic analysis is not part of a cumulative three-stage economic assessment of the net benefits associated with the natural gas system expansion project. Rather, Dr. McDiarmid assesses customer energy bill impacts using an electrification scenario that assumes 100% of incremental general service residential and commercial premises use high-efficiency all-electric configurations as of 2024. Dr. /u
McDiarmid embeds the outcomes of the customer energy bill impact analysis as a net cost between Stages 1 and 3 of the natural gas system expansion assessment (i.e., into Stage 2). This creates an inherent inconsistency among the stages of the E.B.O. 134 cumulative three-stage economic assessment.

9. It is not appropriate to include the result of Dr. McDiarmid's assessment in the E.B.O. 134 economic evaluation since it is not consistent with and therefore not additive to the results of Stages 1 and 3 with respect to the pipeline in question. In addition to being inconsistent, Dr. McDiarmid also relies upon a variety of inappropriate simplifying assumptions.

i. *Dr. McDiarmid calculates a negative Net Present Value ("NPV") in Stage 2*

10. Based on the OEB's historical approvals of the use of E.B.O. 134, Stage 2 assesses the net benefits that new general service customers realize by attaching to the natural gas system due to the incremental capacity provided by the transmission system expansion project that is the subject of the assessment. Dr. McDiarmid states on page 2 of the ED Evidence that the assessment results in a 20-year Stage 2 NPV of negative $48 million. /u

11. Using Dr. McDiarmid's assumption that as of 2024 all incremental residential /u and commercial general service natural gas attachments would choose high-efficiency all-electric configurations instead of attaching to the natural gas system (which is an unrealistic and baseless assumption), zero is the lowest result for Stage 2 in the assumed scenario for purposes of the E.B.O. 134 economic evaluation and not negative $48 million. If no incremental general /u service premises attach to the natural gas system and all-electric configurations were chosen instead, there would be no benefit in Stage 2 to incremental general service customers from the natural gas expansion project. Consequently, there would also be no cost in Stage 2 to incremental general service customers from the natural gas expansion project. The cost of the proposed transmission pipeline project is already included in Stage 1.

12. In the alternative, for illustrative purposes, if the assumption used by Dr. McDiarmid in the ED Evidence (that high-efficiency electric end-use equipment is 312% efficient) was incorporated into Enbridge Gas's Stage 2 assessment by adjusting the cost of electricity in the alternative energy mix,

this results in a 20-year Stage 2 NPV of positive $79 million.[1] This calculation incorporates the electric efficiency assumption and also provides for a more appropriate representative alternative energy mix. /u

ii. *Dr. McDiarmid inappropriately nullifies incremental Project revenues in Stage 2*

13. By including natural gas delivery charges as a cost in Stage 2 of the economic evaluation,[2] Dr. McDiarmid assigns incremental revenues from the Project as a **cost** to the Project. This is in direct conflict with the OEB's historical approval of the use of E.B.O. 134, which considers incremental revenues as a **benefit** to the Project in Stage 1.[3] Dr. McDiarmid's analysis negates benefits from the Project calculated in Stage 1, where revenues are treated as a benefit by reducing or eliminating potential subsidy.

iii. *Dr. McDiarmid assumes an electrification scenario in which 100% of incremental general service premises use high-efficiency all-electric configurations as of 2023*

14. Dr. McDiarmid assumes a scenario that as of 2024 (less than two months from the time of this Reply Evidence) 100% of incremental general service residential and commercial premises would use all-electric configurations, /u

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[1] See Attachment 1 to Enbridge Gas's Reply Evidence for Enbridge Gas's Stage 2 assessment using the average posted energy prices for the 12 months ending October 2023, without any adjustments due to assumed high-efficiency electric end-use equipment. See Attachment 2 to Enbridge Gas's Reply Evidence for Enbridge Gas's Stage 2 assessment using the average posted energy prices for the 12 months ending October 2023, with an adjustment to reflect the assumption used by Dr. McDiarmid in the ED Evidence that high-efficiency electric end-use equipment is 312% efficient. Cells that have been adjusted in Attachment 2 are highlighted in yellow.

[2] ED Evidence, Attachment 2.

[3] EB-2018-0013, Decision and Order, September 20, 2018, p. 5: "The OEB finds that Union appropriately followed the OEB's E.B.O. 134 test for transmission projects."

and that 100% of those electric configurations would consist of high-efficiency end-use equipment (electric air-source heat pumps and electric heat pump water heaters).[4] Dr. McDiarmid provides no support for this assumption. Furthermore, the assumption is inconsistent with the results from the Company's 2021 Residential Single Family End Use Study (completed in Q4 2021 approximately 1-year prior to the date of this Reply Evidence).[5] The study observed that, without consideration of any energy system limitations or constraints, most customers (77%) prefer natural gas for home heating in a new home.

iv. *Dr. McDiarmid does not consider the cost of incremental electricity infrastructure*

15. While Dr. McDiarmid assumes that as of 2024 all general service customers would choose all-electric configurations instead of attaching to the natural gas system, Dr. McDiarmid does not consider any corresponding electricity infrastructure costs. /u

v. *Dr. McDiarmid ignores the importance of energy system diversification and resiliency*

16. Within Dr. McDiarmid's selective modifications of the E.B.O. 134 economic test, Dr. McDiarmid does not account for net benefits related to energy security and resiliency from different fuel types, and from maintaining a diversity of energy systems. Associated with Section C below, energy security and resiliency are critically important to the Project area due to its impact on

[4] ED Evidence, Attachment 1.
[5] Sponsor-identified telephone interviews were completed by Leger between November 23-December 17, 2021. 2,404 interviews were completed with customers who reside in single family dwellings and are (mainly) responsible for making energy-related decisions about their home.

large-scale greenhouse operations whose seasonal production could be irreparably harmed by significant system outages and who rely upon natural gas not only for space heating but also as a feedstock input.

vi. <u>*Dr. McDiarmid provides cost-effectiveness results for electric air-source heat pumps based on a climate not relevant to that of the Project area*</u>

17. On page 4 of the ED Evidence, Dr. McDiarmid states that "an average homeowner in the Panhandle area can save $4,012 (NPV) over the 15-year /u lifetime of space and water heating systems by choosing electric heat pumps over conventional gas systems". In Attachment 2 to the ED Evidence, Dr. McDiarmid provides the assumed efficiency rating (HSPF 10 region 5, or 293% efficiency) and the upfront cost ($11,100) of the electric air-source heat pump used in the analysis.[6] Dr. McDiarmid's source for the claim that an HSPF 10 region 5 electric air-source heat pump costs $11,100 is Enbridge Gas's evidence from the Multi-Year Demand Side Management Plan (2022 to 2027) (EB-2021-0002).[7]

18. The definition of and context for "HSPF" and "regions" is provided in the NRCan source referenced by Dr. McDiarmid in the ED Evidence *[emphasis added]:* [8]

> "<u>HSPF is a ratio of how much energy the heat pump delivers to the building over the full heating season (in Btu), to the total energy (in Watthours) it uses over the same period</u>.
>
> Weather data characteristics of long-term climate conditions are used to represent the heating season in calculating the HSPF.

[6] ED Evidence, Attachment 2.
[7] ED Evidence, Attachment 2.
[8] https://www.nrcan.gc.ca/energy-efficiency/energy-star-canada/about/energy-star-announcements/publications/heating-and-cooling-heat-pump/6817

> However, this calculation is typically limited to a single region, and may not fully represent performance across Canada.
>
> Some manufacturers can provide an HSPF for another climate region upon request; however typically HSPFs are reported for Region 4, representing climates similar to the Midwestern US. Region 5 would cover most of the southern half of the provinces in Canada, from the B.C interior through New Brunswick"

19. For additional clarity, region 4 refers to a warmer climate than region 5. Region 4 represents "climates similar to the Midwestern US" while region 5 "would cover most of the southern half of the provinces in Canada". The Project area is understood to reside in region 5.

20. Enbridge Gas did not claim that the upfront cost of an HSPF 10 region 5 electric air-source heat pump is $11,100. Enbridge Gas's understanding of its own information is that the upfront cost of $11,100 is relevant to an HSPF 10 region 4 electric air-source heat pump. This aligns with NRCan's statement that "typically HSPFs are reported for Region 4". As such, Dr. McDiarmid's cost-effectiveness assessment for electric air-source heat pumps is based on a climate that is warmer than that of the Project area, and is therefore overstated.

vii. *Dr. McDiarmid makes other inappropriate assumptions*

21. Rather than using an average natural gas commodity cost over a defined period (e.g., previous 12 months, or previous calendar year), Dr. McDiarmid states on page 3 of the initial ED Evidence filed on October 28, 2022 that, "I /u
adjusted fuel costs to reflect the full October 2022 costs". This approach is problematic, because it does not account for the potential short-term price volatility of the natural gas commodity, as is currently being experienced in 2022 due to various economic fundamentals and unique geo-political issues (e.g., war in Ukraine). Dr. McDiarmid's economic assessment overstates the /u

Stage 2 cost of natural gas by approximately $32 million on an NPV basis over 20 years when compared to a more appropriate approach of using the calendar year 2022 average effective price for natural gas.[9] Within the updated ED Evidence dated October 18, 2023, Dr. McDiarmid updates fuel costs to reflect October 2023 costs, which results in a 49% lower natural gas cost per heat ouput figure for residential customers when compared to the initial ED Evidence filed October 28, 2022 which relied on October 2022 fuel costs.[10]

22. Dr. McDiarmid also uses a heating value of 38.00 GJ/10^3m^3 for the conversion of electricity to equivalent natural gas.[11] The appropriate heating value for natural gas in the Union South rate zone is 39.12 GJ/10^3m^3.[12] As such, Dr. McDiarmid's economic assessment within the initial ED Evidence filed on October 28, 2022 understates the Stage 2 cost of electricity by approximately $5 million on a NPV basis over 20 years.[13] /u

C. <u>Dr. McDiarmid's Analysis of Natural Gas Alternatives for New Construction Greenhouses in Ontario</u>

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[9] https://www.oeb.ca/consumer-information-and-protection/natural-gas-rates/historical-natural-gas-rates, Average effective price of natural gas ($/m3) from January 2022, April 2022, July 2022, and October 2022.
[10] On page 3 of the initial ED Evidence filed October 28, 2022, Dr. McDiarmid displays a $25.3/GJ natural gas cost per heat ouput figure for residential customers. On page 3 of the updated ED Evidence dated October 18, 2023, Dr. McDiarmid displays a $12.8/GJ natural gas cost per heat ouput figure for residential customers (i.e., a 49% decrease).
[11] ED Evidence, Attachment 2.
[12] From Enridge Gas's October 2022 QRAM.
[13] Within the updated ED Evidence filed October 18, 2023, Dr. McDiarmid corrects the heating value within its Stage 2 analysis (i.e., ED Evidence, Attachment 1) from 38.00 GJ/10^3m^3 to 39.12 GJ/10^3m^3. However, Dr. McDiarmid maintains the incorrect heating value within its electric heat pump cost-effectiveness analysis (i.e., ED Evidence, Attachment 2) at 38.00 GJ/10^3m^3 (for example, see the formula in cell B183 of the "outputs" tab at Attachment 2). As such, Dr. McDiarmid's electric heat pump cost-effectiveness analysis overstates the NPV for an average homeowner by $268 (i.e., the corrected figure is $3,744 not $4,012) and the 20-year and 40-year NPVs by -$2.5 million and -$3.9 million, respectively (i.e., the corrected figures are -$41.8 million and -$68.0 million, respectively, not -$44.3 million and -$71.9 million, respectively).

23. This section of Reply Evidence is in response to Section 2 of the ED Evidence, titled *Analysis of Alternatives to Natural Gas for New Construction Greenhouses in Ontario*.

24. Throughout the ED Evidence, Dr. McDiarmid makes references to various greenhouse operations but does not distinguish between (i) small-scale commercial greenhouses, and (ii) large-scale greenhouse operations, and gives no consideration to the technical feasibility or viability of the alternatives referenced in this regard. The distinction is critically relevant, as the proposed Project is designed specifically to support the energy needs of several large-scale greenhouse operations, not small-scale commercial greenhouses.

25. Small-scale commercial greenhouses are fundamentally different than large-scale greenhouse operations. **Small-scale commercial greenhouses** are generally used as retail nurseries, school greenhouses, or recreational facilities, and are generally smaller than 1-acre in size. **Large-scale greenhouse operations** are mass-market vegetable farming facilities that span many acres. Examples of large-scale greenhouse operations constructed recently within the Project area include:

- Pure Flavor – Recently began construction of a **40-acre (or 1.7 million square foot)** greenhouse facility in Leamington, Ontario.[14]
- Pomas Farms – Recently constructed a **77-acre (or 3.4 million square foot)** greenhouse facility in Leamington, Ontario.[15]

26. Dr. McDiarmid makes numerous references to greenhouse operations throughout the ED Evidence but provides limited context as to the nature and scale of those operations.

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[14] https://www.pure-flavor.com/leamington-phase-4-expansion-distribution-center/
[15] https://www.hortidaily.com/article/9307584/construction-completed-on-pomas-farms/

27. On page 6 of the ED Evidence, Dr. McDiarmid states that ground-source heat pump technology is "commercially available for greenhouse applications" and that "there are examples of greenhouses with this technology in the United States" by referencing the Ceres EcoLoop geothermal HVAC system. As per the Ceres website provided by Dr. McDiarmid, "the Ceres EcoLoop™ is designed solely for Ceres greenhouses and has been specifically designed to work with the Ceres SunChamber™".[16]

28. The Ceres SunChamber greenhouse facility options are described on the Ceres website as "commercial modular greenhouse kits" with individual sizes between 30 and 60 feet in width.[17] Marketing material available on the Ceres website provides only one case study that describes actual use of the Ceres EcoLoop geothermal HVAC system. The case study describes Green Lynx farm which consists of four greenhouse structures totaling 1/4 of an acre in aggregate, or 11,250 square feet,[18] which is not relevant to large-scale greenhouse operations.

29. Also on page 6 of the ED Evidence, Dr. McDiarmid states "Summerstreet Industries in Nova Scotia is in the process of building a year-round greenhouse that will be heated using ground-source heat pumps" to support the claim that the technology is commercially available.

30. While Dr. McDiarmid's evidence does not provide information or a reference that can be used to confirm the size and scope of the greenhouse operation, it appears as though Summer Street is a charitable foundation which aims to "support and empower people with intellectual disabilities to lead the quality of life they choose".[19] Material from the Summer Street website provides

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[16] https://ceresgs.com/environmental-controls/ecoloop-sunchamber/
[17] https://ceresgs.com/greenhouses/commercial-modular/
[18] https://ceresgs.com/wp-content/uploads/2022/01/catalog.pdf, p. 9
[19] https://canadian-charities.com/charity/summer-street-industries

information on the types of programs[20] and services[21] the organization provides, which suggests the greenhouse build may be used for recreational and/or therapeutic purposes, rather than as a large-scale greenhouse operation for mass-market vegetable farming.

31. Also on page 6 of the ED Evidence, Dr. McDiarmid references a Greenhouse Canada article regarding the potential to store heat in the ground in the summer using solar collectors, and then leveraging the heat during the winter as a secondary heat source. The article however does not provide information on the use of this technology in actual greenhouse operations.

32. Dr. McDiarmid also references a study titled *Drake Landing Solar Community: 10 Years of Operation* in relation to the use of solar collection/storage technology. However, the study examined residential applications (featuring 52 detached homes)[22] and does not reference the use of this technology in greenhouse operations.

33. While the Greenhouse Canada article referenced by Dr. McDiarmid does not reference the use of solar collection/storage technology in actual greenhouse operations, it does provide information on the technical feasibility of geothermal energy in general.[23] The article states that geothermal energy refers to “a range of technologies, each with differing capabilities and costs”, with one extreme consisting of “deep geothermal” or “conventional geothermal”, and on the other extreme a form of “shallow” geo-exchange.

34. Regarding deep geothermal or conventional geothermal, the article states that while it can be appropriate in some regions of Canada such as Alberta,

[20] https://summerstreet.ca/assets/4bf72d4a57/Summer-Street-Participation-Agreement-2019.pdf, pp. 1-2
[21] https://summerstreet.ca/assets/4bf72d4a57/Summer-Street-Participation-Agreement-2019.pdf, p. 2
[22] https://www.dlsc.ca/reports/swc2017-0033-Mesquita.pdf, p. 1
[23] https://www.greenhousecanada.com/power-from-the-ground-up-the-geothermal-spectrum/

Saskatchewan, and northeastern B.C., it is "geologically constrained", and in Ontario specifically "the geothermal gradient is not nearly as high, making it less commercially feasible for deep geothermal".

35. Regarding shallow geo-exchange technology, while the article states it can be largely deployed anywhere across the country, the article also states "whether geoexchange makes sense for a greenhouse, however, depends on the operation's needs." As such, the technical feasibility of geothermal energy for large-scale greenhouse operations is not definitively supported by the reference.

36. Also on page 6 of the ED Evidence, Dr. McDiarmid states that ground-air heat transfer ("GAHT") is another alternative technology that is commercially available and technically viable for greenhouses in Ontario (with supplementary heating) by referencing another Ceres product, the "GAHT System".

37. As per the Ceres website, the GAHT system is described in the context of either residential (between $2,000 and $5,000 in cost) or larger commercial and school applications (between $5,000 and $15,000 in cost).[24] The size for the residential application is listed as under 1,000 square feet (or 1/45 of an acre). The size for the larger commercial and school application is not provided, however one case study is provided, which is referenced by Dr. McDiarmid in support of the claim that the technology is viable in Ontario. The case study is a 30 by 70-foot greenhouse (2,100 square feet or 1/20 of an acre) in Almonte, Ontario.[25] This greenhouse application is not fundamentally comparable to the large-scale greenhouse operations driving the need for the proposed Project.

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[24] https://ceresgs.com/environmental-controls/gaht/#1470868392507-588bc317-73b9
[25] https://ceresgs.com/greenhouse-for-cold-climates/

38. On page 7 of the ED Evidence, Dr. McDiarmid references a Canadian Biomass Magazine article to support the claim that many new construction greenhouses may choose to "seek waste heat and carbon dioxide … to reduce total dependence on natural gas".

39. The article describes one scenario where an ethanol production facility in Chatham, Ontario, ships waste heat and carbon dioxide to a greenhouse directly "across the road". The proximity of the two facilities in this instance provides a technically feasible option; however, most large-scale greenhouse operations in the Project area do not reside near a large industrial facility. Regarding the specific scenario referenced in the article (i.e., an ethanol production facility delivering waste heat and carbon dioxide to a greenhouse), there are only six operational ethanol plants in Ontario,[26] and none of them reside within the Project area.[27] In addition, it should be noted that the Chatham, Ontario, greenhouse facility referenced in the article maintains an active connection to Enbridge Gas's natural gas system.

40. Also on page 7 of the ED Evidence, Dr. McDiarmid states that a tomato grown in an Ontario greenhouse is responsible for several times more greenhouse gas emissions than a field tomato trucked from Mexico to Canada, by referencing Dr. Michael Bomford, a professor of sustainable agriculture at Kwantlen Polytechnic University, in an article from the National Observer.

41. Within the article, Dr. Bomford also "warned that focusing on greenhouse gas emissions alone doesn't paint a complete picture of a vegetable's ecological footprint". In addition to water use efficiency (which in the case of hydroponics, can use up to 10 times less water than field-grown crops

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[26] https://ethanolproducer.com/plants/listplants/Canada/Operational/All
[27] Chatham, ON; Mooretown, ON; Tiverton, ON; Aylmer, ON; Havelock, ON; and Prescott, ON.

according to the U.S. National Park Service),[28] "fertilizer and pesticide pollution, the impact of crop-filled fields on biodiversity and key habitats, and the working conditions of farmhands all impact a product's overall sustainability".[29]

D. Conclusion

42. The analysis provided by Dr. McDiarmid in the ED Evidence cannot be used to assess the economic feasibility of the Project as it selectively modifies and misuses the E.B.O. 134 economic test, resulting in an inherent inconsistency among the stages of the E.B.O. 134 cumulative three-stage economic assessment. Furthermore, the analysis relies on inappropriate simplifying assumptions.

43. In addition, the information provided by Dr. McDiarmid in the ED Evidence related to the technical viability of natural gas alternatives for greenhouses is not applicable to large-scale greenhouse operations driving the need for the proposed Project.

[28] https://www.nps.gov/articles/hydroponics.htm
[29] https://www.nationalobserver.com/2021/05/03/news/why-mexican-tomatoes-can-be-more-sustainable-canadian