# Elson Advocacy

November 28, 2022

**BY RESS**

**Nancy Marconi**
Registrar
Ontario Energy Board
2300 Yonge Street, Suite 2700, P.O. Box 2319
Toronto, Ontario M4P 1E4

Dear Ms. Marconi:

**Re: EB-2022-0157 – Enbridge Gas Inc. – Panhandle Regional Expansion Project**

Enclosed please find the responses to interrogatories on the evidence of Dr. Heather McDiarmid.

Yours truly,

Kent Elson

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# ED-IRR-2.0 Staff.1- Environmental Defence Intervenor Evidence

**Reference:** McDiarmid Climate Consulting, Evidence Regarding Stage 2 Analysis and Gas Alternatives for Greenhouses, page 3, paragraph 3

**Preamble:**

McDiarmid Climate Consulting notes the assumption that "the applicable residential and commercial customers (which are 95% to 98% new construction) would choose heat pump space heating systems and electric water heaters over heating oil and propane systems because their higher efficiencies mean significantly lower operational costs".

**Question:**

(a) Is McDiarmid Climate Consulting aware of any recent empirical data sources (e.g. data on installed space heating systems in new construction, builder/end user surveys, etc.) that could form an improved basis for input assumptions in the DCF test regarding expected customer space heating market share in residential new construction in Ontario (in the presence or absence of natural gas availability)? If so, please provide references or links.

**Response:**

McDiarmid Climate Consulting is not aware of a sufficiently up-to-date dataset regarding the fuel choices made in new construction where gas is not available. Most information is based on the existing housing stock or is too outdated, and therefore does not account for:

- The advent of cold-climate heat pumps, which allow the technology to be used as a primary heating source in our climate;
- The recent significant improvements in heat pump performance and efficiency, which make them more cost-effective to operate;
- The increases in carbon prices, which significantly impact the cost of heating with propane and oil;
- The increases in propane and oil prices over the past year; and
- The incentives for qualifying customers to install heat pumps under the Greener Homes Grant and the impact this has already made on heat pump knowledge and expertise among HVAC contractors.

Heating with heat pumps would be far cheaper than propane and oil. Heat pumps cost $17.50/MJ of heat output while oil and propane cost $89.80/MJ and $71.70/MJ respectively in the Ontario panhandle area. Also, there are many examples that demonstrate rising heat pump adoption, especially for homes where oil, propane and electric resistance heating are the alternatives[1].

[1] For examples, see https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/market-snapshots/2019/market-snapshot-growing-heat-pump-adoption-how-does-technology-work.html , https://www.iea.org/reports/heat-pumps , https://www.cbc.ca/news/canada/prince-edward-island/pei-heat-pumps-demand-grows-furnace-oil-1.6629248

Environmental Defence does not agree that stage 2 analysis should be or is required to be based on a forecast of what actual customers would install were gas not available. Stage 2 is meant to capture benefits arising to customers who are able to attach to the gas system versus alternatives. Those incremental savings (or costs) should be calculated based on the most cost-effective alternative. This avoids the need for forecasting data. It is also more methodically sound. If electric heat pumps are the cheapest option, followed by gas, and then propane/oil, one cannot say that a customer is "saving" money by installing gas in comparison to the available alternatives.

## ED-IRR-3-PP-ED-1

**Question:**

Table 3 in your evidence appears only to include heating costs. Please duplicate Table 3 an include incremental costs and savings if the residential customer also was able to avoid installation of an air-conditioning unit by leveraging the heat pump.

**Response:**

Table 3 includes air conditioning in the upfront and operational costs.

## ED-IRR-3-PP-ED-2

**Question:**

Please explain how your residential electric ASHP assumptions would differ for a residential home that currently has natural gas forced air heating that is at end of life and the customer switched to an electric heat pump instead of purchasing another gas furnace.

**Response:**

A model for installing an electric ASHP as a replacement for an end of life natural gas forced air heating system would be similar to the model used here for new construction homes. In these existing homes, I would additionally assume the application of the $5,000 Greener Homes Grant and assume that no upgrades to the electrical panel or ductwork would be required. The customer may also be eligible for an additional $1,500 incentive from Enbridge.

## ED-IRR-3-PP-ED-3

**Question:**

Efficiency Canada recently released the 2022 Canadian Energy Efficiency Scorecard (Scorecard 2022 - Canadian Provincial Energy Efficiency Scorecard (efficiencycanada.org) indicated that "to meet our net zero emission goals, space and hot water heating systems must all become at least 100% efficient" [Page 19].

a) Is the solution you propose at least 100% efficient?

b) Is the solution proposed by Enbridge at least 100% efficient?

**Response:**

a) The all electric heat pump systems that I propose are more than 100% efficient.

b) The solution proposed by Enbridge is assumed to be a 95% efficient gas furnace and 81% efficient gas water heater. These efficiencies are consistent with default values used in Enbridge's DSM proceeding (EB-2021-0002).

## ED-IRR-3-PP-ED-4

**Question:**

The OEB DSM Framework applies a 15% Non-Energy Benefit (NEB) adder to the Total Resource Cost Test for energy saving technologies such as heat pumps.

a) Was an OEB adder (i.e. 15%) used in your calculations?

b) If not, please indicate what the impact would be fon your modeling if the 15% adder is applied.

c) Energy efficiency and/or climate programs available to Ontario consumers in the Panhandle region provide incentives for electric heat pumps. Were ASHP incentives included in the calculations and if not what would be the impact if they were included?

**Response:**

a) An OEB adder was not used in my calculations.

b) It is not clear how this should be applied in this context. If it were applied, it would presumably result in a larger negative NPV for gas.

c) No ASHP incentives were included in the calculations.

Existing homeowners installing a qualifying ASHP in their primary residence would be eligible for a $5,000 rebate from the Greener Homes Grant. The Greener Homes Grant also has $1,000 rebates for qualifying HPWHs (maximum rebate is $5,000)[2]. Homeowners that meet the criteria for Enbridge's new program could also be eligible for up to $1,500 in rebates from Enbridge and for an overall increase in the maximum rebate (see EB-2021-0002 for details).

Inclusion of these rebates would mean a larger negative NPV value for gas savings. The specific impact is not possible to calculate as it is not clear how many of the new residential customers would qualify for the rebate. But note that Enbridge is forecasting 15,143 new residential customers.

[2] https://www.nrcan.gc.ca/energy-efficiency/homes/canada-greener-homes-grant/23441

## ED-IRR-3-PP-ED-5

**Question:**

Based on the Enbridge Reply Evidence are there any changes or updates required to your model to reflect best available information? If so, please provide the changes or updates. If not, please explain why not.

**Response:**

I do not agree with Enbridge's critiques to the model assumptions, with the exception of a minor change to the conversion factor between m3 and GJ, which in any event does not have a material impact on the conclusion of my evidence that gas is considerably less cost effective than electric heat pumps. I have addressed each of Enbridge's comments below under the headings used in Enbridge's reply evidence:

Enbridge comment: "Dr. McDiarmid calculates a negative Net Present Value ("NPV") in Stage 2"

> My evidence resulted in a large negative NPV. This shows that the cost-effectiveness calculations are not close and therefore changes to the assumptions likely will not change the overall conclusion.
>
> Enbridge notes that zero is the lowest result for Stage 2 in the assumed scenario for purposes of the E.B.O. 134. That may be true. However, as noted above, the negative NPV figure is helpful in indicating the magnitude of changes to the underlying assumptions that would be necessary to generate a positive NPV.

Enbridge comment: "Dr. McDiarmid inappropriately nullifies incremental Project revenues in Stage 2"

> My analysis calculates the actual customer cost impacts. I have done this in two ways. First, I focused only on the operational cost impacts using Enbridge's spreadsheet. I do not agree that variable costs arising from gas distribution should be removed, but even if they were (i.e. if I remove them from Attachment 1 to my evidence), the result is a negative NPV of $50 million over 20 years and $83 million over 40 years. In other words, gas is still less cost-effective after I remove the variable costs for gas distribution but include all electric variable costs that appear on customer bills.
>
> Second, I have calculated and compared the lifetime costs, including both operational and upfront capital costs. This requires accounting for the difference in all gas and electricity-related costs that customers would face as between the two options (a) gas space and water heating plus traditional air conditioning and (b) heating and cooling with an electric cold-climate air-source heat pump and a heat pump water heater. Without accounting for all the cost differences, including the cost of gas delivery, the analysis would be incomplete and would not provide an appropriate picture of the costs to customers.

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

> Enbridge claims that I stated that 100% of customers would choose heat pumps over natural gas heating. That is incorrect. I assumed that incremental customers would choose ASHPs over oil, propane and electric baseboard for space heating and HPWHs over oil, propane or electric resistance water heaters. That is because ASHP/HPWHs are much more cost-effective. Although not shown, the same is true for a home that chooses and electric resistance water heater paired with an ASHP. See also the response to the interrogatory from Board Staff above.

Enbridge comment: "Dr. McDiarmid does not consider the cost of incremental electricity infrastructure"

> I am not aware of the need for any incremental electricity infrastructure needed to install heat pumps in this area. In any event, the cold-climate heat pumps I modelled are considerably more energy efficient when compared to traditional air conditioning, and therefore could reduce the peak summer energy consumption. This could lessen the overall annual peak electricity system requirements.

Enbridge comment: "Dr. McDiarmid ignores the importance of energy system diversification and resiliency"

> This comment is baseless. Fossil fuel heating systems also require electricity to run fans, pumps, and electronics. Also, long term resiliency is dependent on our collective ability to limit climate change by reducing greenhouse gas emissions from natural gas and other fossil fuels.

Enbridge comment: "Dr. McDiarmid provides cost-effectiveness results for electric air-source heat pumps based on a climate not relevant to that of the Project area"

> My evidence is based on a heat pump with an efficiency rating of HSPF 10 (Region V). This region includes the project area. This region goes as far north as Thunder Bay. The project area is in the southern part of the region, and therefore performance would be expected to be better than average for the region.
>
> My evidence cites previous Enbridge evidence that used the same values. Enbridge is now saying that its previous evidence used values for Region IV, which is not applicable to Ontario. I cannot comment on whether or why Enbridge would have used values for the wrong region in its previous evidence.
>
> However, my assumption is valid regardless. As noted in an undertaking response for the DSM proceeding, there are many, many units available in Canada that are rated as HSPF 10 (Region v). That undertaking response is attached. In addition, Enbridge's own interrogatory responses confirmed that:
>
> (a) NRCan energy efficiency ratings for air source heat pumps include a very large number of models with an HSPF region 5 rating of 10 or higher.

(b) It is appropriate to use NRCan's energy efficiency HSPF region 5 ratings to assess the cost effectiveness of air source heat pumps.
(c) The numbers Enbridge uses to assess the cost-effectiveness of measures involving gas furnaces should be consistent with NRCan's Energy Efficiency ratings.

Enbridge comment: "Dr. McDiarmid makes other inappropriate assumptions"

Enbridge Gas provided a conversion factor for converting gas volumes to GJ of energy that is more appropriate for the Union South rate zone. This does not have a material impact on the conclusion of my evidence that gas is considerably less cost effective than electric heat pumps.

Enbridge also recommended using 2022 annual average gas prices rather than the price on October 1, 2022. Absent a gas price forecast, it appears reasonable to me to use the latest available prices.

To demonstrate the impact of Enbridge Gas's proposed changes, I redid the analysis with Enbridge's EB-2022-0157 reply evidence assumptions regarding heat pump efficiency levels, the m3 to GJ conversion factor, and energy prices. To remain conservative, the electricity prices were kept at October 1, 2022 values despite their being lower at the beginning and end of the year. Full variable energy costs were used because the analysis is designed to reflect the cost to the customer.

- Using the adjusted spreadsheet used by Enbridge Gas, the total NPV of gas fuel savings was negative $50 million over 20 years and negative $83 million over 40 years.
- Using my model, the NPV of gas fuel savings was negative $21 million over 20-years and negative $37 million over 40 years.

## ED-IRR-3-PP-ED-6

**Question:**

Enbridge suggests that "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." [Reply Evidence paragraph 7]. Please indicate if this assertion is correct and what adjustments (if any) are required to the evidence provided by Dr. McDiarmid.

**Response:**

My analysis aimed to quantify the economic costs and benefits to customers of supplying natural gas for space and water heating in residential and commercial buildings. From the OEB's E.B.O 134 Report of the Board (p46)[3] relating to stage 2 economic analysis:

> "The second stage should be designed to quantify other public interest factors not considered at stage one. All quantifiable other public interest information as to costs and benefits should be provided at this stage."

For detailed comments, see the response to Pollution Probe 5

[3] https://www.oeb.ca/sites/default/files/EBO134-Board-Report-review-of-natural-gas-system-19870601.pdf

## ED-IRR-3-Enbridge 1

**Reference:** N/A

**Preamble:** The OEB's Rules of Practice and Procedure require under Rule 13A.03(f) that an acknowledgement of the expert's duty to the OEB in Form A to the Rules, signed by the expert, be filed with the evidence of the expert.

**Question:**

Please file an executed copy of Form A referenced in Rule 13A.03

**Response:**

A copy has been filed on the record.

## ED-IRR-3-Enbridge 2

**Reference:** ED Evidence

**Preamble:** N/A

**Question:**

Please file the engagement letter or agreement between Environmental Defence and Dr. McDiarmid through which Dr. McDiarmid was engaged and under which she prepared her report.

**Response:**

The questions posed to Dr. McDiarmid are those set out in the evidence proposal submitted to the OEB on September 27, 2022. There is no separate engagement letter or agreement.

## ED-IRR-3-Enbridge 3

**Reference:** ED Evidence

**Preamble:** N/A

**Question:**

Please provide all documentation, data and information, including any and all information provided to Dr. McDiarmid by Environmental Defence, not already disclosed in Dr. McDiarmid's report, on which Dr. McDiarmid relied to complete her analysis and to reach any conclusion made by her in her report.

**Response:**

I have cited all the materials that I directly relied on in my report. I also interviewed researchers and professionals working in the greenhouse sector, but I did not obtain permission to include public attribution to those conversations in my report, nor did I feel that necessary as my report is cited to published sources. I reviewed a wide range of materials in my research on greenhouses, including but not limited to the following:

Nazim Gruda, Mehdi Bisbis, Josef Tanny, (2019). Impacts of protected vegetable cultivation on climate change and adaptation strategies for cleaner production – A review, Journal of Cleaner Production, 225: 324-39. https://doi.org/10.1016/j.jclepro.2019.03.295.

Veeramani, A., Dias, G. M., & Kirkpatrick, S. I. (2017). Carbon footprint of dietary patterns in Ontario, Canada: A case study based on actual food consumption. *Journal of Cleaner Production*, *162*(Complete), 1398–1406. https://doi.org/10.1016/j.jclepro.2017.06.025

Quinn, A., 2022. Some Dutch greenhouses fear bankruptcy as energy crisis deepens. Bloomberg Retrieved from https://www.bloomberg.com/news/articles/2022-10-10/some-dutch-greenhouses-fear-bankruptcy-as-energy-crisis-deepens

Vetter, D. (2021). How much does our food contribute to global warming: new research reveals all. Forbes. Retrieved from https://www.forbes.com/sites/davidrvetter/2021/03/10/how-much-does-our-food-contribute-to-global-warming-new-research-reveals-all/?sh=2f8789027d7e

Luo J, Xue W, Shao H. Thermo-economic comparison of coal-fired boiler-based and groundwater-heat-pump based heating and cooling solution – A case study on a greenhouse in Hubei, China. *Energy and buildings*. 2020;223:110214-. doi:10.1016/j.enbuild.2020.110214

Xu J, Li Y, Wang RZ, Liu W. Performance investigation of a solar heating system with underground seasonal energy storage for greenhouse application. *Energy (Oxford)*. 2014;67:63-73. doi:10.1016/j.energy.2014.01.049

Yildirim. 2017. Evaluation of a hybrid system for a nearly zero energy greenhouse. *Energy conversion and management*. 148:1278-1290. doi:info:doi/

Kinney, Dehghani-Sanij, Mahbaz, Dusseault, Nathwani, Fraser. Geothermal Energy for Sustainable Food Production in Canada's Remote Northern Communities. *Energies (Basel)*. 2019;12(21):4058-. doi:10.3390/en12214058

Mantini, R. (2020). Biofuel boiler puts the "green" in greenhouse. Canadian Biomass. Retrieved from https://www.canadianbiomassmagazine.ca/biofuel-boiler-puts-the-green-in-greenhouse/