**ONTARIO ENERGY BOARD**

**EB-2019-0294**

**IN THE MATTER OF** the *Ontario Energy Board Act*, 1998, S. O. 1998, c. 15, Schedule B;

**AND IN THE MATTER OF** an application for leave to construct in relation to a hydrogen blending pilot project.

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# Submissions of Environmental Defence

# Re Enbridge's Hydrogen Blending Pilot Project

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**September 8, 2020**

**Elson Advocacy**
Professional Corporation
1062 College Street, Lower Suite
Toronto, Ontario
M4H 1A9

**Kent Elson, LSO# 57091I**
Tel.: (416) 906-7305
Fax: (416) 763-5435
kent@elsonadvocacy.ca

## Introduction

Enbridge is proposing a $5.75 million pilot project to blend hydrogen into a small portion of its system. The intent is to gain experience in order to "position Enbridge Gas to then expand hydrogen injection into other parts of its gas distribution system."[1] Enbridge hopes the project will lead to future expansions to cover more customers and increase hydrogen blending concentrations.[2]

Although Environmental Defence strongly supports decarbonization efforts, this particular project is not prudent and should not proceed. Due to user equipment and gas grid safety limits, hydrogen can only be injected into the gas grid at very low levels – up to 6%.[3] Even this meager level may be unattainable (Enbridge is only proposing a 0.6% blend by energy content in this pilot).[4] Furthermore, the cost of avoided carbon emissions is extreme, and far higher than alternatives – over $900/tCO$_2$e for the incremental commodity costs alone, plus approximately $4,000/tCO$_2$e for incremental capital costs.[5] As illustrated in the below table generated entirely

[1] EB-2019-0294, Exhibit A, Tab 2, Schedule 1, p. 1 [link, PDF p. 9].
[2] Exhibit I.ED.12, p. 4 (a) [link, PDF p. 5].
[3] Enbridge is proposing to blend 2% hydrogen by volume. Because hydrogen is less energy dense, this amounts to 0.6% by energy content. See Exhibit I.ED.12, p 14-15 (h)&(i), link, PDF p. 15-16. No studies have recommended blending beyond 20% by volume (per Exhibit I.ED.7, link, PDF p. 177), which equates to 6% by energy content.
[4] *Ibid*.
[5] Exhibit I.ED.11, p. 3 (a) & (b) [link, PDF p. 197-198].

from Enbridge's evidence and Ontario Energy Board reports, hydrogen blending is highly ineffective, expensive, and speculative in comparison to alternatives measures to decarbonize space and water heating.

**Table 1: Comparison of Decarbonization Measures**[6]

| | **Cost-effectiveness** ($/t$CO_2$e, combustion only) | **Decarbonization potential** (% of Ontario gas demand) | **Risks and Other Factors** |
|---|---|---|---|
| **Hydrogen** | >$900 (commodity cost) + ~$4,000 (capital cost) | 6% | Untested technology; Risk of stranded investments; High conversion losses; Diverts away from priority uses |
| **Cost-effective energy efficiency** | $0 to -$140 (i.e. savings) | 25% | Long track record; Consistent with all other options |
| **Heat pumps** | $130 to $200 (commodity & capital cost) | Near 100% | Widely available and tested; Achieves efficiency over 200% |
| **RNG** | $338 | 2.5% | |

This project will ultimately harm consumers and the environment. Hydrogen generated from discounted surplus power should be reserved for the hardest-to-decarbonize sectors such as air travel and certain industrial uses where decarbonization cannot be achieved through cost-effective alternatives such as efficiency and heat pumps. Hydrogen could play an important role in these sectors if it is not diverted into the gas grid for space and water heating.

Furthermore, blending hydrogen into the gas grid will likely frustrate efforts to decarbonize space and water hearing by diverting attention and resources away from the most promising and cost-effective options, such as energy efficiency and heat pumps.

We respectfully request that the Board decide not to approve this application.

## Hydrogen blending is not prudent

The entire purpose of this project is to take a step toward expanded blending of hydrogen into Enbridge's gas grid, which in turn is intended to assist in decarbonizing that grid. However, this is premised on the assumption that hydrogen blending is a promising option worthy of initial investments, which Enbridge has failed to establish. Indeed, all the available evidence supports the opposite conclusion, that hydrogen blending for use in space and water heating is not prudent and should not be pursued.

Environmental Defence is *not* saying that hydrogen should not be part of greater decarbonization efforts in other areas. Indeed, it could prove to be important in the hardest-to-decarbonize

[6] See the citations in the reproduction of this table on page 6 below for the sources of each figure.

sectors. Instead, Environmental Defence simply submits that Enbridge has not met its burden to establish that hydrogen blending into the gas grid is worth pursuing via its proposed $5.75 million pilot project in the face of the strong evidence to the contrary, as outlined below.

**Ineffective: carbon offset is meager**

Hydrogen blending cannot play a substantial role in decarbonizing buildings. At the most, hydrogen blending could offset **a mere 6%** of conventional fossil-based gas.[7] Even this level may not be possible.[8] Hydrogen blending is severely constrained by potential impacts on gas distribution infrastructure and customer equipment.[9] Hydrogen burns differently and at a higher temperature.[10] Too much blending is dangerous and can cause serious hazards such as fires, explosions, leaks, flashback (when the flame retreats back into the tip of the combustion nozzle), burner failure from overheating, and long-term burner and pipe integrity issues.[11]

Enbridge proposes to inject 2% hydrogen by volume in this pilot project. However, hydrogen is less energy dense and therefore this volume only corresponds to an offset of 0.6% by energy content.[12] Enbridge does not have a position on the highest possible hydrogen blending percentage, but it has not identified any projects worldwide that are exploring anything beyond a blend of 20% by volume.[13] Even 20% by volume corresponds to a mere 6% offset by energy content because of the lower energy density of hydrogen.[14]

This meager carbon offset is inconsistent with Canada's 2030 and 2050 carbon reduction targets. The 2030 target requires emissions to decline by approximately 16% from 2020 levels.[15] The 2050 target is net zero emissions.[16] Expending an extraordinary amount of resources on hydrogen blending to achieve up to a maximum of a 6% reduction is ineffective in the short-term. In the medium- and long-term, the expensive capital investments in hydrogen could become stranded assets as other options are pursued, such as electrification.

This is important. Conventional fossil-based natural gas combustion creates over 30% of Ontario's carbon emissions.[17] This very large source of carbon emissions cannot be out of step with the overall targets.

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[7] Enbridge is proposing to blend 2% hydrogen by volume. Because hydrogen is less energy dense, this amounts to 0.6% by energy content. See Exhibit I.ED.12, p 14-15 (h)&(i), link, PDF p. 15-16. No studies have recommended blending beyond 20% by volume (per Exhibit I.ED.7, link, PDF p. 177), which equates to 6% by energy content.
[8] *Ibid*.
[9] Exhibit B, Tab 1, Schedule 1, Attachment 1, p. 1 [link, PDF p. 9].
[10] Exhibit B, Tab 1, Schedule 1, Attachment 1, p. 14 [link, PDF p. 40].
[11] *Ibid*. Evidence of the Technical Standards and Safety Authority, July 8, 2020 [link].
[12] Exhibit I.ED.12, p. 15 (i) [link, PDF p. 16].
[13] Exhibit I.ED.7(e), p. 2 [link,, PDF p. 177].
[14] Exhibit I.ED.12, p. 14 (h) [link, PDF p. 15].
[15] Exhibit I.ED.1(h), p. 3 (The 2020 target is 607 Mt $CO_2$e. The 2030 target is 511 Mt $CO_2$e, a decline of 15.8% from 2020.) [link, PDF p. 160].
[16] *Ibid*.
[17] Exhibit I.ED.1(J), p. 4 (Ontario's GHG emission in 2018 were 159 Mt $CO_2$e overall and 50.4 Mt $CO_2$e from natural gas.) [link, PDF p. 161].

In contrast, as discussed below, alternatives such as heat pumps and energy efficiency can offset all of Ontario's fossil-based gas at a far lower cost.

**Expensive: fuel and capital costs are exorbitant**

Hydrogen is an extremely expensive way to decarbonize buildings. It is many, many times more expensive than alternatives. The cost is **between $925 and $1,151 per tonne of $CO_2$e** accounting only for the additional commodity cost of power-to-gas hydrogen versus fossil-based gas.[18] This alone is many times the all-in cost of alternatives such as energy efficiency and electric heat pumps. Hydrogen created through power-to-gas is more than 22 times the cost of fossil-based gas and much higher than the commodity cost of electricity.[19] But hydrogen also involves extensive capital investments to transport and inject hydrogen. Although Enbridge estimated the incremental capital costs to be **$4,058/t$CO_2$e,** the actual cost is unknown as Enbridge does not know whether separate dedicated hydrogen infrastructure would be required throughout the province to expand hydrogen supply.[20]

Although hydrogen can be created out of natural gas through natural gas steam reforming, Enbridge has no plans to introduce this kind of hydrogen, presumably because this would not achieve the carbon reductions driving the use of hydrogen in the first place.[21] In any event, hydrogen created via steam reforming would likely be more expensive than hydrogen created via power-to-gas in terms of $/$CO_2$e.[22]

For comparative purposes, the current carbon price in Canada is only $30/t$CO_2$e. It is highly unlikely that hydrogen blending would ever be the most cost-effective solution when it costs over $900/t$CO_2$e for the incremental commodity costs alone plus additional capital costs in the range of $4,000/t$CO_2$e.[23]

**Worst option: energy efficiency and heat pumps are far cheaper and more effective**

A comparison with other decarbonization measures helps to illustrate just how expensive, ineffective, and risky hydrogen blending is. This comparison is summarized in the below table

[18] Exhibit I.ED.11(a), p. 2-3 [link, PDF p. 197-198].
[19] Exhibit I.ED.11, Attachment 1, p. 1 [link, PDF p. 199] (Hydrogen commodity cost mid-point: $0.63/m3; fossil-based gas commodity cost: $0.0812; heating value differential of fossil-based gas versus hydrogen: 38.5/12.7=3.0315); Exhibit I.ED.6(g), p. 3 [link, PDF p. 173] (Hydrogen commodity cost mid-point = $50/GJ, corresponding to $0.18/kWh @ 1 GJ = 277.778 kWh.); IESO, *Monthly Market Report*, December 2019 [link] (2019 HOEP average: $0.01825/kWh; 2019 wholesale commodity cost average: $0.1258.).
[20] Exhibit I.ED.11(b), p. 3 [link, PDF p. 198]; Exhibit I.ED.8(g), p. 1-2 [link, PDF p. 196-197].
[21] Exhibit I.ED.4 [link, PDF p. 168].
[22] The current price of delivered hydrogen created through steam reforming is comparable to the commodity cost of hydrogen created through power-to-gas (see Exhibit I.ED.6(g),(i), & (k), link, PDF p. 173-174). But hydrogen created through steam reforming avoids few if any carbon emissions. Therefore, the cost per tonne of avoided $CO_2$e would be far higher. If technological advances eventually allow carbon capture at source, which appears very speculative at best at this stage, the cost will still likely be higher because (a) the carbon capture would be an additional step with additional costs, (b) the carbon capture will not eliminate all carbon, further increasing the cost per avoided tonne of $CO_2$e verses "green" hydrogen created via power-to-gas, and (c) the hydrogen would need to be transmitted over long distances and delivered to Ontario at a cost.
[23] Exhibit I.ED.11(a)&(b), p. 2-3 [link, PDF p. 197-198].

and detailed in the following text. This comparison is made entirely with figures from Enbridge's evidence and Ontario Energy Board reports. There is a huge gulf between the cost, effectiveness, and riskiness of hydrogen and other options. Enbridge has not discharged its burden to provide evidence as to why its $5.75 million investment is prudent in light of this.

**Table 1: Comparison of Decarbonization Measures**

| | **Cost-effectiveness** ($/t$CO_2$e, combustion only) | **Decarbonization potential** (% of Ontario gas demand) | **Risks and Other Factors** |
|---|---|---|---|
| **Hydrogen** | >$900 (commodity cost) + ~$4,000 (capital cost) [24] | 6%[25] | Untested technology; Risk of stranded investments; High conversion losses; Diverts away from priority uses |
| **Cost-effective energy efficiency** | $0 to -$140 (i.e. savings)[26] | 25%[27] | Long track record; Consistent with all other options |
| **Heat pumps** | $130 to $200[28] (commodity & capital cost) | Near 100%[29] | Widely available and tested; Achieves efficiency over 200% |
| **RNG** | $338[30] | 2.5%[31] | |

*Cost-effectiveness*

Hydrogen blending is extremely expensive in comparison to alternatives. Whereas hydrogen blending will *cost* in the range of $4,000 to $5,000 per tonne, energy efficiency *saves* money, often over $100 per tonne. If Ontario is seeking to reduce carbon emissions, investments will go farthest by increasing energy efficiency programs first. This is well-illustrated by the below

[24] Exhibit I.ED.11(a)&(b), p. 2-3 [link, PDF p. 197-198]; Per Exhibit JT1.7 in EB-2020-0066 [link, PDF p. 398], if upstream emissions are accounted for, the cost is over $700/tCO2e for commodity costs and over $3,000 for capital costs.

[25] Enbridge is proposing to blend 2% hydrogen by volume. Because hydrogen is less energy dense, this amounts to 0.6% by energy content. See Exhibit I.ED.12, p 14-15 (h)&(i), link, PDF p. 15-16. No studies have recommended blending beyond 20% by volume (per Exhibit I.ED.7, link, PDF p. 177), which equates to 6% by energy content.

[26] EB-2016-0359, ICF, *Marginal Abatement Cost Curve*, July 20, 2017, prepared for the OEB, p. 14 [link]; Per Exhibit JT1.7 in EB-2020-0066 [link, PDF p. 398], if upstream emissions are accounted for, the cost is $0 to -$108/tCO2e.

[27] Navigant, *2019 Integrated Ontario Electricity and Natural Gas Achievable Potential Study*, prepared for the IESO and OEB, December 18, 2019, p. ix [link].

[28] EB-2016-0359, ICF, *Marginal Abatement Cost Curve*, July 20, 2017, prepared for the OEB, p. A-4 to A-5 14 [link] (heat pumps are $130/t$CO_2$e for new homes and $200/t$CO_2$e for existing homes according to this study, but prices are declining significantly as cold climate heat pumps become more commonplace); Per Exhibit JT1.7 in EB-2020-0066 [link], if upstream emissions are accounted for, the cost is $101 to $155/tCO2e.

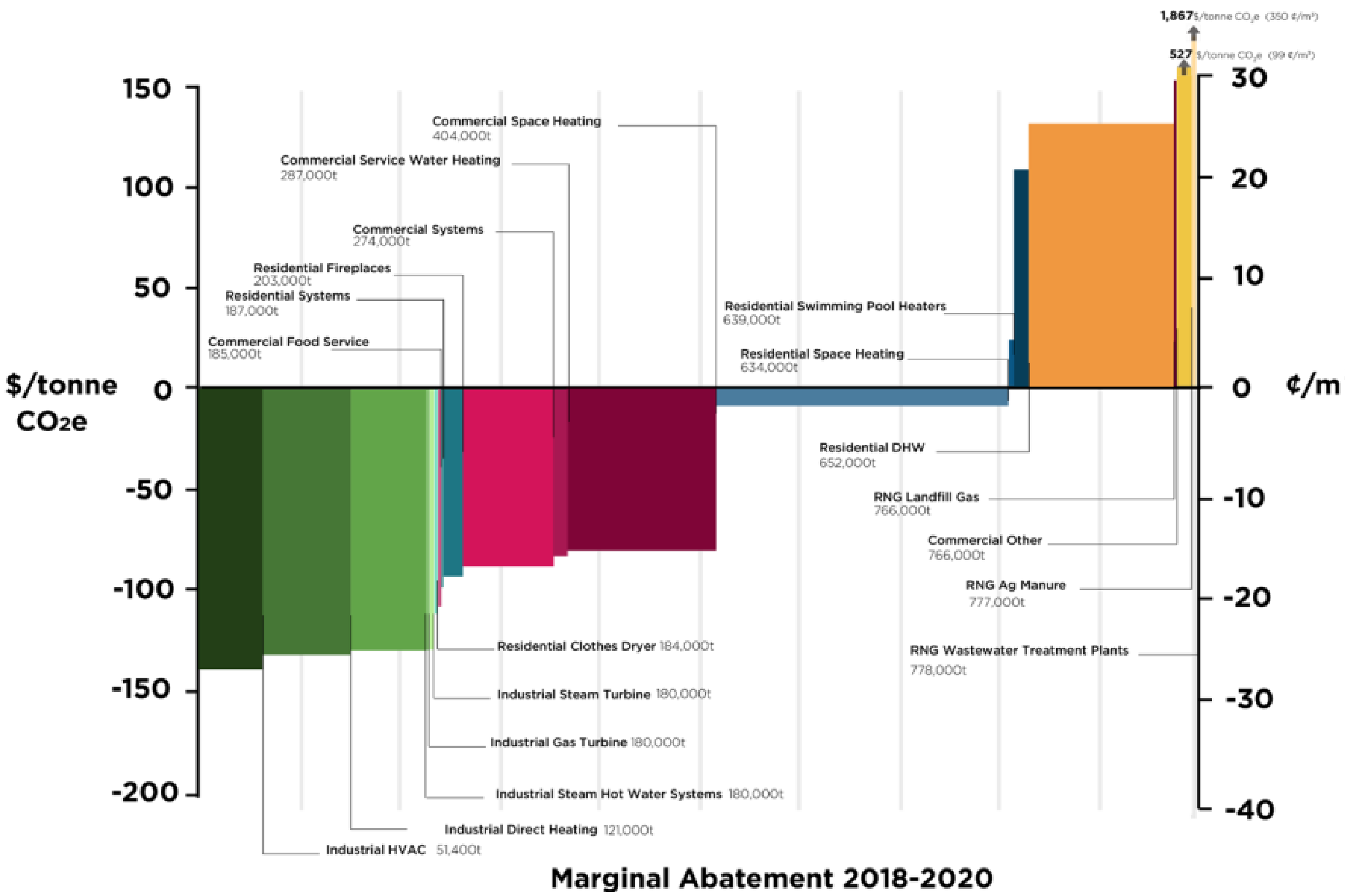
[29] EB-2016-0359, ICF, *Marginal Abatement Cost Curve*, July 20, 2017, prepared for the OEB, p. 25 [link].

[30] EB-2020-0066, Exhibit I.SEC.15 [link]; Per Exhibit JT1.7 in EB-2020-0066 [link, PDF p. 398], if upstream emissions are accounted for, the cost is $262/tCO2e.

[31] EB-2016-0359, ICF, *Marginal Abatement Cost Curve*, July 20, 2017, prepared for the OEB, p. 47 [link]; This report estimates a potential of 627 million $m^3$/yr, which is 2.41% of Ontario's consumption of 26 billion $m^3$/yr. This potential was considered achievable by 2028 based on a study conducted in 2013. In Exhibit JT1.5 [link], Enbridge estimates the potential as 402 million $m^3$/yr by 2025, which is 1.55% of Ontario's gas consumption of 26 billion $m^3$/yr.

figure from a 2017 report commissioned by the OEB to compare the relative cost-effectiveness of various carbon reduction measures.[32] The left side of the figure shows that gas energy efficiency results in up to $140 in *savings* per tonne of $CO_2e$ avoided. The right side shows that RNG results in significant *costs* per tonne of CO2e. Based on the evidence provided in this application, the cost of hydrogen blending would be literally off the chart. [33] Indeed, when the OEB commissioned this report looking into decarbonization measures, a decision was made that it was not even worth including hydrogen in the analysis.[34]

**The OEB's Marginal Abatement Cost Curve**




Furthermore, hydrogen blending is approximately 24 times more expensive than the cost of electric heat pumps and approximately 14 times more expensive than the cost of renewable natural gas ($/tCO_2e$).[35] In each case, this includes both the incremental commodity and capital costs.[36] This is a staggering difference.

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[32] EB-2016-0359, ICF, *Marginal Abatement Cost Curve*, July 20, 2017, prepared for the OEB, p. 14 [link].
[33] Exhibit I.ED.11(a)&(b), p. 2-3 [link, PDF p. 197-198].
[34] EB-2016-0359, ICF, *Marginal Abatement Cost Curve*, July 20, 2017, prepared for the OEB, p. 52 [link].
[35] See Table 1 above.
[36] But even if we include only the incremental commodity cost of hydrogen and compare that to both the incremental commodity and capital cost of the alternatives, hydrogen blending is *still* four times more expensive

*Efficiency and conversion losses*

Due to the immutable laws of physics, it is likely impossible that the kind of hydrogen blending proposed by Enbridge could ever be a better option for space and water heating in comparison to electric heat pumps. That is because converting electricity into hydrogen results in significant energy conversion losses. In other words, one kWh of electricity results in significantly less than one kWh of hydrogen. It is more efficient to use green electricity to run an electric heat pump and therein avoid the losses inherent in electrolysis.

In addition, electric heat pumps are able to create significantly more than one kWh of heat using one kWh of electricity. According to the Ontario Energy Board's *Marginal Abatement Cost Curve* report, the average annual heating efficiency for standard electric air source heat pumps is 2.1 (or 210%).[37] Newer cold climate heat pumps that are now available on the market can achieve even higher levels of efficiency.[38] In contrast, a standard gas furnace may be 95% efficient.

A study recently released by the Fraunhofer Institute for Energy Economics and Energy System Technology contains the following conclusion on this point:

> "[H]ydrogen is not a viable option when it comes to heating buildings. The amount of green electricity needed to produce green hydrogen for this purpose is 500 to 600 percent greater than the amount needed to power an equivalent number of heat pumps.
>
> 'The differences in efficiency are so large that it is unreasonable to propose the wide-spread use of hydrogen for heat in buildings'"[39]

Although the precise figures cited in that passage may need adjustment for the Ontario context, the conclusion holds true. The below table shows the difference in energy efficiency between hydrogen and electric heat pumps entirely using figures from Enbridge's evidence and the Ontario Energy Board's *Marginal Abatement Cost Curve* report. An input of 1 kWh of electricity is used to illustrate the greater efficiency of heat pumps in comparison to hydrogen. For space heating, a standard electric heat pump generates **295%** the heat output of a standard gas furnace. For water heating, a standard electric heat pump generates **465%** the heat output of a standard gas water heater.

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than heat pumps and twice as expensive as renewable natural gas. See Table 1 above. The mid-point incremental commodity cost for hydrogen blending is $1,020/tCO_2e$ per Exhibit I.ED.11(a), p. 2-3 [link, PDF p. 197-198].

[37] EB-2016-0359, ICF, *Marginal Abatement Cost Curve*, July 20, 2017, prepared for the OEB, p. A-3 [link]

[38] *Ibid*, p. A-1.

[39] Exhibit I.ED.12, p. 1 [link]; For the original reports, see: FIEE, *Green hydrogen or green electricity for building heating?*, July 14, 2020 [link]; FIEE, *Hydrogen in the Energy System of the Future: Focus on Heat in Buildings*, May 2020, p. 5 [link].

| Table 2: Energy Efficiency Comparison Between Hydrogen and Electric Heat Pumps<br>Residential Space and Water Heating | | | | |
|---|---|---|---|---|
| | **Space Heating** | | **Water Heating** | |
| | **Gas Furnace** | **Heat Pump** | **Gas Heater** | **Heat Pump** |
| Energy input | 1 kWh | 1 kWh | 1 kWh | 1 kWh |
| Hydrogen conversion loss[40] | 25% | n/a | 25% | n/a |
| Energy input minus loss[41] | 0.75 kWh | 1 kWh | 0.75 kWh | 1 kWh |
| Annual heating efficiency[42] | 95% | 210% | 67% | 234% |
| Heat output[43] | 0.7 kWh | 2.1 kWh | 0.5 kWh | 2.34 kWh |
| Output difference[44] | 295% | | 465% | |

The conversion loss and efficiency differential means Ontario would need at least 2-3 times more green electricity to decarbonize space/water heating via hydrogen versus electric heat pumps. Stated differently, the same amount of green electricity could decarbonize at least 2-3 times more homes with electric heat pumps versus hydrogen. Although gas-powered heat pumps could theoretically improve the efficiency of gas heating with substantial technological advancements and decreases in price, this would be offset by the ongoing efficiency improvements in electric heating via cold climate air-source heat pumps and geothermal.[45]

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[40] Enbridge acknowledges that electrolysis results in approximately 25% conversion loss. The amount of electricity to run the electrolysis equipment is about 4.7 kWh/m³ per Exhibit I.ED.6(g) [link, PDF p. 173]. One m³ of hydrogen equals 3.5278 kWh of hydrogen per the conversion factors in I.ED.3(c) [link, PDF p. 165]. An input of 4.7 kWh and output of 3.5278 kWh amounts to approximately 25% energy loss.
[41] Calculation: 1 kWh minus 25% loss for hydrogen conversion.
[42] EB-2016-0359, ICF, *Marginal Abatement Cost Curve*, July 20, 2017, prepared for the OEB, p. A-3 [link]. Note that this report uses annual heating efficiency percentages for standard heat pumps, not the more efficient cold climate heat pumps.
[43] Calculation: "Energy input minus loss" multiplied by "Annual heating efficiency."
[44] Calculation: heat output of heat pumps divided by heat output of the gas equipment.
[45] Gas heat pumps are expensive and only achieve annual heating efficiency in the range of 114% (per this study funded by Enbridge: TAF, *Gas Absorption Heat Pumps*, October 2018, link). Although they may be a positive interim transitional technology, they cannot make gas heating via hydrogen generated from electricity nearly as efficient as the direct use of electricity in an electric heat pump. Gas heat pumps are not widely available and were completely excluded from the OEB's study on decarbonization measures (EB-2016-0359, ICF, *Marginal Abatement Cost Curve*, July 20, 2017, prepared for the OEB [link]). In contrast, the same OEB study noted that electric air-source heat pump technology "has developed significantly over the last 5 years with more efficient and lower cost units and better cold climate solutions that can be 20-30% more efficient than resistance electric even at temperatures in the -20 °C range" (see p. A-1).

Furthermore, aside from the efficiency of various kinds of heat pumps, there is no dispute that electrolysis results in significant conversion losses. It is highly unlikely that heating via hydrogen made from electricity could ever match the efficiency and cost-effectiveness of heating via the direct use of electricity in electric heat pumps.

*Decarbonization potential*

As noted above, hydrogen can only be injected at very low levels – up to 6% – due to user equipment and gas grid safety limits.[46] In contrast, the Ontario Energy Board's report regarding energy efficiency potential found that increased investments in energy efficiency could reduce gas demand by 25%.[47] Heat pumps have the potential to eliminate almost all carbon emissions from space and water heating.[48]

**Speculative and risky: hydrogen requires uncertain technological advancements**

Using hydrogen for space and water heating is speculative and risky. First and foremost, the technology is largely untested and the long-term consequences are not known. Enbridge notes that this project "will be the first of its kind in North America."[49] That is not necessarily good.

In contrast, energy efficiency and heat pumps are tried and tested measures to decarbonize buildings. They can be adopted today with a high degree of confidence in their results.

Investments to inject hydrogen into the gas system face a real risk of becoming stranded assets. If hydrogen blending and RNG are unable to decarbonize space and water heating, which seems likely in light of their very limited potential, it may be that energy efficiency and electric heat pumps are pursued more aggressively. Electrification and hydrogen blending are "either or" solutions for the most part. If the province eventually pursues the former, investments in the latter will likely be stranded.

**Counterproductive: diverts hydrogen from hardest-to-decarbonize sectors**

Hydrogen could play an important role in meeting Canada's carbon targets with respect to the hardest-to-decarbonize sectors that do not have cost-effective alternatives. Aviation is one example, as are certain industrial processes. Whereas a home can be heated much more cost-effectively by electric heat pumps, the same is not true for the other sectors mentioned above. Hydrogen only makes any sense for those sectors and should be reserved for those sectors.

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[46] Enbridge is proposing to blend 2% hydrogen by volume. Because hydrogen is less energy dense, this amounts to 0.6% by energy content. See Exhibit I.ED.12, p 14-15 (h)&(i), link, PDF p. 15-16. No studies have recommended blending beyond 20% by volume (per Exhibit I.ED.7, link, PDF p. 177), which equates to 6% by energy content.

[47] Navigant, *2019 Integrated Ontario Electricity and Natural Gas Achievable Potential Study*, prepared for the IESO and OEB, December 18, 2019, p. ix [link].

[48] EB-2016-0359, ICF, *Marginal Abatement Cost Curve*, July 20, 2017, prepared for the OEB, p. 25 [link].

[49] Exhibit A, Tab 2, Schedule 1, p. 2 [link, PDF p. 5].

The proposed project uses hydrogen generated from surplus power purchased at a discounted rate, which surely should be reserved for the hardest-to-decarbonize sectors.[50] There is only so much surplus power available. Hydrogen generated from this discounted electricity should not be used for space and water heating, which could be decarbonized more cost-effectively with heat pumps. Therefore, this project would be counterproductive by directing this hydrogen away from where it is needed.

**Harmful: diverts resources & attention from better decarbonization options**

Finally, this project will likely frustrate efforts to decarbonize space and water heating by diverting attention and resources away from energy efficiency and heat pump expansion efforts. In the past, Enbridge has prioritized pipeline-based decarbonization solutions at the expense of better carbon reduction measures such as energy efficiency and has used the pipeline-based solutions as justification for not pursuing greater energy efficiency.[51] The worst outcome of this application and project is that hydrogen be treated as a viable solution to decarbonize space and water heating such that efforts to expand energy efficiency and heat pumps are lessened.

## Enbridge has not met its burden as the applicant

Enbridge has not met its burden to show that this project is prudent. Because the project is predicated on potential future expansion of hydrogen blending for space and water heating, Enbridge has the burden of showing at least a reasonable possibility that this expansion would be reasonable and prudent. It has completely failed to do so. Enbridge's evidence contains nothing robust in this regard. The details that can be gleaned from interrogatory responses strongly suggest that hydrogen blending into the gas grid should not be pursued at this stage.

The above submissions contain considerable analysis of hydrogen blending as a decarbonization solution. However, *Environmental Defence does not have the burden to conclusively prove whether hydrogen blending should or should not be pursued.* Nor is the Board required to conclusively rule on that wider topic. More narrowly, Enbridge has the evidentiary burden as the applicant, a burden it has not met, to establish that hydrogen blending is worth pursuing via its proposed $5.75 million pilot project at this stage, especially in the face of the negative factors described above.

Furthermore, Enbridge has not met its burden to establish that this specific pilot would be the appropriate next step with respect to the potential use of hydrogen for space and water heating. The pilot will explore whether a 0.6% hydrogen blend by energy content is technically feasible, but we already know that this low level of blending is technically feasible from studies conducted elsewhere. The pilot will completely sidestep all of the important questions around the

[50] Exhibit B, Tab 1, Schedule 1, p. 5 ("The PtG plant is part of a pilot project with the Independent Electricity System Operator (IESO). The PtG plant, under a contract with the IESO, provides regulation service, which assists the IESO with balancing electricity supply and demand on a second by second basis. The IESO dispatches the PtG plant when it requires regulation service and hydrogen and oxygen are produced when surplus electricity is run through the PtG plant.") [link, PDF p. 13].

[51] For example, see the 2017 and 2018 cap-and-trade plan proceedings (EB-2016-0296/0300/0330 & EB-2017-0224/0255/0275).

cost-effectiveness and prudence of using hydrogen for space and water heating, including those outlined above. It will put a foot in the door for hydrogen blending without substantially furthering our knowledge of whether that is a good idea or not.

## Enbridge has a conflict of interest

Enbridge has a strong incentive to oversell hydrogen blending and secure subsidies for it to be injected into the gas grid. Hydrogen would involve massive capital investments in the gas system, on which Enbridge would earn a robust return. Furthermore, hydrogen expansion could dampen or head off the adoption of alternatives that threaten Enbridge's core business model, such as electrification. As a pipeline-based solution to decarbonization, it can protect Enbridge's core business model from non-pipeline solutions. Therefore, any assertions and analysis completed by Enbridge should be viewed with this in mind. In short, Enbridge is strongly biased.

In many ways, hydrogen blending is akin to the now-debunked promises of "clean coal" technology made in the 1980s. Coal companies strongly advocated for and predicted technological breakthroughs that would allow coal to be burned without significant carbon emissions. These promised improvements never came to pass. The phasing out of coal in Ontario is likely the most significant step made in Canada towards its climate targets. This would not have occurred if the promises of clean coal had been believed and pursued. The same kind of situation exists in relation to the overselling of hydrogen as a solution to decarbonize space and water heating.

## Generic hearing on decarbonization is needed

Before any hydrogen investments are considered by the Board, Environmental Defence recommends holding a generic hearing on the decarbonization of buildings in Ontario. The main focus of this hearing would be to ensure that consumers' interests are safeguarded in the face of increasing changes to energy consumption patterns. A generic hearing would help to proactively address and mitigate the financial risks to consumers from climate change.

Conventional fossil-based natural gas combustion creates over 30% of Ontario's carbon emissions.[52] This figure accounts only for emissions from combustion; the lifecycle emissions are much higher due to fugitive emissions from hydraulic fracturing, leaks during transmission, and other factors.[53] Canada has committed to reduce its carbon emissions by approximately 16 percent by 2030 and is targeting net-zero emissions by 2050.[54] It is not clear how the emissions associated with gas will be reconciled with government commitments and the avoidance of catastrophic climate change.

The Ontario Energy Board is required by statute to "protect the interests of consumers with respect to prices and the reliability and quality of gas service."[55] The most important issue

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[52] Exhibit I.ED.1, Attachment 1 [link, PDF p. 161].
[53] EB-2020-0066, Exhibit JT1.7 [link].
[54] Exhibit I.ED.1 [link, PDF p. 160].
[55] *Ontario Energy Board Act, 1998*, S.O. 1998, c. 15, Sched. B, s. 2(2).

impacting the interests of gas consumers over the coming years is surely climate change. Climate change presents opportunities to drive greater efficiency but also poses a major risk to energy consumers if the transition to net zero emissions is not proactively addressed in the most cost-effective and careful way.

The financial risks associated with continued investments in fossil fuels are widely acknowledged by financial leaders. For example, Mark Carney recently warned that global warming could render the assets of many financial companies worthless because they have been too slow to cut investment in fossil fuels.[56] The point is this: decarbonization is not solely an environmental issue aimed at saving human lives from catastrophic climate change. It is also a massive financial and energy regulation issue worthy of proactive attention and regulation by the Ontario Energy Board.

This issue is currently being considered in a piecemeal fashion in a variety of separate proceedings, including this hydrogen blending proceeding, Enbridge's renewable natural gas proceeding, the integrated resource planning proceeding, and the DSM framework review. A generic proceeding on the financial issues associated with decarbonization would provide consistency and help to ensure that consumers are protected.

## Conclusion

In light of the above, Environmental Defence requests that this application be denied. This project would represent a significant foot in the door for hydrogen to be used in the gas grid for space and water hearing. Enbridge has not met its burden to establish that this is worth pursuing via its proposed $5.75 million pilot project in the face of the extremely high costs of this option, the limited potential to decarbonize buildings, the existence of far superior alternatives, and the harm that would be caused by diverting the readily available hydrogen from better uses and diverting attention and resources away from superior decarbonization options.

However, Environmental Defence would support a generic hearing aimed at proactively safeguarding the interests of consumers in relation to the coming decarbonization of buildings. This generic hearing could examine hydrogen blending in more detail as part of a wider process looking at all the risks and opportunities faced by ratepayers. In light of the importance of climate change and the shifts likely to result therefrom, holding a proactive generic hearing could be one of the most important steps the Ontario Energy Board could take to fulfill its mandate to protect the interests of energy consumers over the next decade.

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[56] Financial Post, *Global warming could render the assets of many financial companies worthless, Mark Carney warns*, December 30, 2019, [link].