

ENBRIDGE GAS INC.

Answer to Undertaking from
Energy Probe Research Foundation (EP)

Undertaking

Tr: 100

To file the requested document about hydrogen in pipeline systems.

Response:

Studies indicate that pipelines in low-pressure distribution systems at up to 700 kPa (100 psi) remain leak-tight when used with hydrogen, just as they do with natural gas. The presence of hydrogen does not increase the likelihood of leakage in these gas systems, as supported by the following sources:

1. The *Canadian Gas Association* (CGA) released a paper which indicates that “a natural gas distribution system that is ‘leak tight’ will remain ‘leak tight’ with hydrogen”¹ and that “‘selective leaking’ of only hydrogen from hydrogen blended systems is not a phenomenon found within natural gas distribution systems.”²
2. One of the key findings from the United Kingdom’s H21 project³ is “tests showed that assets that were gas tight on methane were also gas tight on hydrogen. Assets that leaked on hydrogen also leaked on methane, including repaired assets.”⁴ Another key finding is that “all of the repairs that sealed methane leaks also were effective when tested with hydrogen.”⁵ The scope of this report included a range of assets representing distribution networks up to the meter. Types of materials included polyethylene, steel, and cast, ductile and spun iron. Testing included operating pressures of 1.9 kPa to 700 kPa.

¹ Enabling Higher-Hydrogen Blending in the Natural Gas Distribution System; Global Technology and Market Scan Summary Report for Distributing Hydrogen at >5% into Natural Gas Energy Distribution Systems, October 2022, p. 5, <https://www.cga.ca/wp-content/uploads/2022/10/CGA-Hydrogen-Blending-Greater-than-5.pdf>

² Ibid.

³ H21 is a program led by Northern Gas Networks in partnership with Cadent Gas, West and West Utilities, SGN, National Grid, Leeds Beckett University, DNV and the Health and Safety Executive. H21 is a suite of gas industry projects to prove that the gas network can safely transport hydrogen in the future.

⁴ H21 Phase 1 Technical Summary Report, May 2021, p. 8, https://h21.green/app/uploads/2018/11/H21-Phase-1-Technical-Summary-Report_v6.pdf

⁵ Ibid.

3. A journal paper published in the *International Journal of Hydrogen Energy* titled “Hydrogen leaks at the same rate as natural gas in typical low-pressure gas infrastructure” investigated the leakage of hydrogen, natural gas, and hydrogen blended natural gas, both theoretically and experimentally. The authors present evidence that 100% hydrogen gas leaks at the same rate as hydrogen/natural gas mixtures and 100% natural gas in existing low-pressure (1-3 kPa) natural gas piping infrastructure on the customer side of the meter. The study uses a two-step leakage mechanism theory to explain the similar observed leakage rates between hydrogen and natural gas in low-pressure gas applications.⁶

⁶ A publicly accessible link is provided to this report. The summary provides sufficient information about the nature of the study and its conclusions. As the report is protected under copyright and Enbridge Gas does not have the author's permission to disclose, a copy of the full report is available for purchase via the provided link from the *International Journal of Hydrogen Energy*.
<https://www.sciencedirect.com/science/article/abs/pii/S0360319919347275>

ENBRIDGE GAS INC.

Answer to Undertaking from
Environmental Defence (ED)

Undertaking

Tr: 97

To provide figures for the current import/export balance for RNG for Ontario.

Response:

Enbridge Gas cannot provide the import/export balance of renewable natural gas (RNG) in Ontario as transactions are between RNG producers and buyers.

Where gas (RNG or natural gas) is transported into Ontario or to the Dawn hub for sale, Enbridge Gas does not have information related to the specific point of gas origination where it is produced outside of Enbridge Gas's system or whether the gas molecule is RNG or natural gas. Enbridge Gas is also not informed of the final consumption destination of RNG produced in Ontario that is injected into its system and transported to Dawn for sale. Ontario RNG transported to Dawn may be delivered to buyers located in Ontario, across Canada or the United States.

Buyers in Ontario looking to purchase RNG are not limited to supply produced within the province and instead are able to access supply from across North America. According to the RNG Coalition¹, there are currently 281 operational RNG facilities in North America, with an additional 180 under construction and 296 planned. Wood Mackenzie has further commented on the steady increase of RNG production experienced to date and expected, noting that in 2022, 60 MMcf/d of new RNG production was added, with the number of projects doubling in the last five years². Currently, utilities and other purchasers of RNG are understood to be importing RNG from across North America to their respective jurisdictions. As filed in their 2023-2024 Rate Case³, the largest natural gas utility in Quebec (Énergir), imports 74% of their RNG from outside of their territory. As of 2021, FortisBC Energy Inc. (natural gas utility) located in British Columbia

¹ The Coalition for Renewable Natural Gas. Renewable Natural Gas Infographics. RNG Facilities. <https://www.rngcoalition.com/infographic>.

² Natural Gas Institute. (2023 Jul 20). North American RNG Production Forecast to Steadily Increase to 2050, Says Wood Mackenzie. <https://www.naturalgasintel.com/north-american-rng-production-forecast-to-steadily-increase-to-2050-says-wood-mackenzie/>.

³ Énergir, s.e.c. R-4213-2022. p1. https://www.regie-energie.qc.ca/fr/participants/dossiers/R-4213-2022/doc/R-4213-2022-B-0187-DemAmend-PieceRev-2023_06_22.pdf.

indicated that they expected to import 74% of their RNG supply from across North America, of which 18% is expected to be supplied from Ontario.⁴ Similar to Énergir and FortisBC, Enbridge Gas also has the ability to purchase RNG produced outside of Ontario in the same manner that it procures natural gas produced outside of Ontario and is therefore not limited to Ontario RNG supplies.

In alignment with the existing conventional natural gas market in North America, as RNG production continues to increase, tools to facilitate North American-wide transactions, such as registries and pricing indices, are developing and further accelerating the RNG market's development.

⁴ FortisBC Energy Inc. (2021 Dec 17). Comprehensive Review and Application for Approval of a Revised Renewable Gas Program. https://docs.bccub.com/Documents/Proceedings/2021/DOC_65216_B-11-FEI-Stage-2-Comprehensive-Review-Application-of-Revised-Renewable-Gas-Program.pdf.

ENBRIDGE GAS INC.

Answer to Undertaking from
Environmental Defence (ED)

Undertaking

Tr: 175

For the table in JT1.19 at page 326: (1) to add two rows to the table for figures for blue and green hydrogen in the common value of dollars per kilogram; (2) to add a column for the cumulative amount of each kind of hydrogen in the diversified scenario; (3) add some additional clarifying descriptors to the table.

Response:

The following response was provided by Guidehouse Canada Ltd.:

The following information has been added to Table 1 from Exhibit JT1.19. The Pathways to Net Zero (P2NZ) model values for domestic production of green and blue hydrogen presented in this undertaking are after-the-fact ad hoc transformations of interim model outputs calculated based on the production cost (CAPEX and OPEX) and the production volume of each type of hydrogen. Caution should be used in interpreting them or comparing them to other industry values. As discussed at TC Tr. Vol 1 178 to 182, these values are not direct outputs of Guidehouse's analysis and may not align with other industry values, given methodology differences; thus, these values likely have limited usefulness in comparison with other sources for such costs. Please note the following caveats:

- 1) Cost estimates for the P2NZ Study were developed to inform a "total price tag" comparison of two net-zero scenarios.
- 2) Costs presented here do include cost of feedstock (methane for blue hydrogen, electricity for green hydrogen), cost of equipment, and cost of emissions (for blue hydrogen).
- 3) Costs presented here do not include the cost of financing, taxes, profits, ROE, etc. As such, these figures are not comparable to commodity costs, market prices, or customer rates.

Table 1

Type of Value	Reference	Fuel Description	2020 \$/kg (real 2020\$CAD)	2030 \$/kg (real 2020\$CAD)	2040 \$/kg (real 2020\$CAD)	2050 \$/kg (real 2020\$CAD)	Cumulative Supply / Production from P2NZ Model (million kgs) (2020-2050)
P2NZ ³	KT1.3, page 4	Hydrogen Imports from Quebec		2.0	1.6	1.5	44
	KT1.3, page 4	Hydrogen Imports from Western Canada		2.4	2.1	1.8	142
		Ontario Green Hydrogen (Diversified Scenario) ⁴	N/A	N/A	2.14	2.00	1,943
		Ontario Blue Hydrogen (Diversified Scenario) ⁵	N/A	1.64	0.88	0.64	3,998
Estimate, EB-2019-0294, Exhibit 1.ED.6	Exhibit 1.4.2-ED-131	Estimated production cost of Hydrogen from P2G in Ontario	6.24 to 7.80 ⁶	4.37 to 5.46 ⁷			
	Exhibit 1.4.2-ED-131	Retail Hydrogen price in Ontario	8.23 to 8.87 ⁸				
	Exhibit 1.4.2-ED-131	Retail hydrogen price in California	16.01 to 21.11 ⁹				
	Exhibit 1.4.2-ED-131	Retail hydrogen price in Quebec	18.04 ¹⁰				

³ All model values converted using a lower heating value of 119.88 MJ/kg. The model values are derived from the values provided at exhibit JT9.22 and Exhibit JT9.22 Attachment 1.

⁴ Derived from Model Output: This is the derived supply cost that best represents a proxy for commodity cost. Annual electrolyzer costs (average annual CAPEX by decade and annual O&M) plus cost of electricity needed, divided by annual hydrogen production via electrolyzers.

⁵ Derived from Model Output: This is the derived supply cost that best represents a proxy for commodity cost. Annual SMR costs (average annual CAPEX by decade and annual O&M) divided by annual hydrogen production via SMR.

⁶ Based on assumptions as specified in EB-2019-0294, Exhibit 1.ED.6 (g) and converted to kg using a higher heating value of 141.88 MJ/kg.

⁷ Assumed a net reduction of 30%, as specified in EB-2019-0294 (h), and converted to kg using a higher heating value of 141.88 MJ/kg.

⁸ Based on information provided in EB-2019-0294, Exhibit 1.ED.6 (l), and converted to kg using a higher heating value of 141.88 MJ/kg.

⁹ Based on information provided in EB-2019-0294, Exhibit 1.ED.6 (k) and converted to kg using a higher heating value of 141.88 MJ/kg.

¹⁰ Based on information provided in EB-2019-0294, Exhibit 1.ED.6 (m) and converted to kg using a higher heating value of 141.88 MJ/kg.

ENBRIDGE GAS INC.

Answer to Undertaking from
Environmental Defence (ED)

Undertaking

Tr: 183

(1) to provide a time estimate for post-outage checks in individual homes; (b) for the three most recent significant or substantial outages, to provide information including total customers impacted, the cost to do in-home checks.

Response:

Table 1 presents the data for the latest three significant outages that resulted in post-outage checks in individual properties.

Table 1

Line No.	Date	# of Customers	Cost
		(a)	(b)
1	6/11/2023	101	\$15,085
2	6/5/2023	104	\$11,031
3	5/8/2023	118	\$18,025

The costs shown include turning off the gas, remaining on-site for damage to be repaired and completing the service relight. Reasonable time expectancy for post-outage checks is 60 minutes per property.

The above costs and duration are reflective of unplanned outages and should not be used to infer the cost or time requirements for a planned activity. The work required for converting a pipeline network (such as a transition from natural gas to 100% hydrogen) would be a planned and coordinated effort that would include optimized scheduling, advanced customer communications and dedicated resources.

ENBRIDGE GAS INC.

Answer to Undertaking from
Environmental Defence (ED)

Undertaking

Tr: 191

To confirm a hydrogen blending range of between 5 to 20 percent

Response:

Confirmed. A hydrogen blend of between 5% and 20% by volume (1.6% to 7.3% by energy)¹ is the expected blending range over the near term. This range may expand over time as Enbridge Gas assesses its system's capabilities to accept more hydrogen.

¹ Based on a hydrogen high heating value of 12.1 MJ/m³ and a natural gas high heating value of 38.8 MJ/m³.

ENBRIDGE GAS INC.

Answer to Undertaking from
Industrial Gas Users Association (IGUA)

Undertaking

Tr: 84

To file the Minister of Energy's letter dated June 26, 2023 to the President of Enbridge, as well as Ms. Harradence's which preceded.

Response:

The letter to Enbridge Gas from the Minister of Energy dated June 26, 2023 is provided at Attachment 1.

The letter to the Minister of Energy from Enbridge Gas dated February 2, 2023 is provided at Attachment 2.

Ministry of Energy

Office of the Minister

77 Grenville Street, 10th Floor
Toronto ON M7A 2C1
Tel.: 416-327-6758

Ministère de l'Énergie

Bureau du ministre

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Toronto ON M7A 2C1
Tél. : 416-327-6758



MC-994-2023-84

June 26, 2023

Ms Michele Harradence
President
Enbridge Gas Inc.
michele.harradence@enbridge.com

Dear Ms Harradence:

Thank you for your letter regarding governance arrangements during Ontario's energy transition. I am pleased to respond on the respective roles and responsibilities across the province's energy regulatory landscape.

Ontario has a robust and clear set of governance arrangements laid out in legislation and regulation. Under my direction, the Ministry of Energy is focused on developing electricity, natural gas, and fuel policies that maintain safe, reliable, and affordable energy supply, transmission and distribution systems across the province – ensuring we continue to power our growing economy.

The Ontario Energy Board (OEB) is a Crown agency whose powers and responsibilities are laid out in the *Ontario Energy Board Act, 1998* (OEBA) and other statutes. The OEB also has powers and responsibilities under a number of other Ontario statutes including, but not limited to, the *Electricity Act, 1998*, the *Municipal Franchises Act* and the *Statutory Powers Procedure Act*. The objectives of the OEB, as set out in sections 1, 2 and 2.1 of the OEBA, include facilitating “rational expansion of (gas) transmission and distribution systems” and “the maintenance of a financially viable gas industry for the transmission, distribution and storage of gas.”

The Independent Electricity System Operator (IESO) is responsible for directing the operation and maintaining the reliability of the IESO-controlled electricity grid in Ontario. The mandate of the IESO is embodied in Part II of the *Electricity Act, 1998*, and the regulations made under the act. It is also subject to the requirements set out in its licence issued by the OEB, and applicable provisions of the OEBA, the regulations made under the OEBA and any applicable OEB codes or orders. The objects of the IESO, as set out in section 6 of the *Electricity Act, 1998*, include “promoting the use of cleaner energy sources and technologies.”

The government, as represented by me as the Minister of Energy, is responsible for the legislative, regulatory, and public policy frameworks under which the OEB and the IESO operate, while respecting the status of the OEB as an independent regulator and the IESO's statutory role as an independent market operator.

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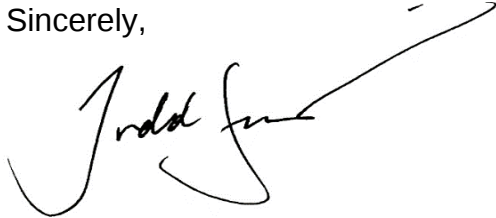
-2-

As you are aware, the government has established the Electrification and Energy Transition Panel to provide strategic advice on the highest value short, medium, and long-term opportunities for the energy sector to help Ontario's economy prepare for electrification and the energy transition, including long-term, integrated energy planning. As we embark on this energy transition journey, Ontario will need to rely on its diversified energy system that serves the needs of customers safely, reliably, and affordably. It will also need to maintain a system that is economically competitive to attract investment, support industry and grow jobs. That is why, on my direction, the Ministry of Energy has commissioned an independent Cost-Effective Energy Pathways Study to better understand how Ontario's energy sector can best support electrification and the energy transition. Together, the Panel and the Pathways Study will help the government make the best strategic decisions to reform our long-term energy planning process to serve Ontarians and prepare our province for the energy system of the future.

While this work is undertaken, I am confident in the ability of the OEB and the IESO to discharge their responsibilities to the sector and the public by focusing on their respective mandates and statutory obligations and delivering outcomes that promote the interests of consumers as well as the stability and sustainability of the energy sector.

Thank you again for writing and please accept my best wishes.

Sincerely,

A handwritten signature in black ink, appearing to read 'Todd Smith', with a long, sweeping horizontal stroke extending to the right.

Todd Smith
Minister

c: Jason Fitzsimmons, Deputy Minister of Energy
Steen Hume, Assistant Deputy Minister, Energy Supply Policy Division
Karen Moore, Assistant Deputy Minister, Strategic, Network and Agency
Policy Division
Susanna Zagar, Chief Executive Officer, Ontario Energy Board
Lesley Gallinger, President and CEO, Independent Electricity System Operator
David Collie, Chair, Electrification and Energy Transition Panel



Michele Harradence
President
Enbridge Gas Inc.

Enbridge Gas Inc.
500 Consumers Rd.
North York, ON M2J 1P8

February 2, 2023

The Honourable Todd Smith
Minister of Energy
10th Floor, 77 Grenville Street
Toronto, Ontario
M7A 2C1

Re. Clarifying the Governance Arrangements through Ontario's Energy Transition

Dear Minister,

On behalf of the team at Enbridge Gas Inc., we wanted to convey our excitement for the year ahead and applaud the work that your government has put in motion to help build an energy system that is clean, affordable, sustainable, reliable, and respectful of residential and business customer choice.

Many wheels have been put into motion to support electrification and energy transition in Ontario and we remain committed to supporting this work as a partner and collaborator in delivering the energy system of the future. We note the Energy Transition and Electrification Panel, established to provide the Minister of Energy with expert advice on various issues related to integrated long-term energy planning in Ontario, will launch stakeholder consultations in the weeks ahead. Esmia and Dunsky's Cost-Effective Pathways Study is underway. So too are the OEB's Innovation Taskforce consultations on the 4 D's which include electrification and moving off fossil fuels as well as the OEB's work to respond to your October 21, 2022 letter of direction. We are also eagerly anticipating consultations with the province on the "no regret decisions" recommended in the IESO's recent Pathways to Decarbonization Report.

Enbridge is committed to active engagement and supporting the province and its agencies in these undertakings. We have consistently advocated for long-term collaborative and integrated gas and electric planning to enable the most cost-effective and resilient decarbonization pathway possible for the economy as a whole. The Company also commissioned a *Pathways to Net-Zero Emissions for Ontario* report to support our strategic planning, which we have made public.

What has become evident through our engagement with various market players is a lack of clear understanding of roles and responsibilities across the Ontario energy agencies. Strong governance arrangements are required to provide clarity about strategic direction, roles and responsibilities and accountability for outcomes.

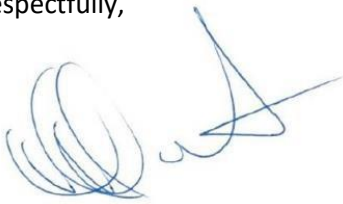
Minister, finding the optimal pathway to a net-zero economy will require us to leverage the expertise of all market players. It will also require a clear understanding of roles and responsibilities across the agencies. Without such clear delineation there is a real risk of a disjointed and less efficient and less cost-effective approach that is not in the best interest of Ontarians.

For example, based on our engagement with intervenors prior to filing with the OEB for our 2024 rates, we know that some will be advocating through the proceeding for an OEB decision that signals the retirement of all gas infrastructure and economy wide electrification. It has been argued that this is what the OEB's Innovation Task Force intends through its 4 D's of energy transition. But this is not established public policy, and we strongly contend that such policy direction is solely the domain of the provincial government.

To this end, Enbridge remains focused on meeting the evidentiary burden for 2024 rates and believes policy setting recommendations should best be directed to the Electrification and Energy Transition Panel. We believe a clear signal from you on the respective roles and responsibilities across the agencies would help ensure that stakeholders are directing their engagement efforts in the right places.

Please let us know how we can leverage the expertise and insights of our team to help you achieve our shared objectives.

Respectfully,



Michele Harradence
President
Enbridge Gas Inc.

cc:

Mr. Jason Fitzsimmons, Deputy Minister of Energy
Mr. Steen Hume, Assistant Deputy Minister, Energy Supply Division
Ms. Karen Moore, Assistant Deputy Minister, Strategic Networks and Partnerships Division
Ms. Susanna Zagar, President and CEO, Ontario Energy Board
Ms. Lesley Gallinger, President and CEO, Independent Electricity System Operator
Mr. David Collie, Chair, Electrification and Energy Transition Panel
Dr. Monica Gattinger, Electrification and Energy Transition Panel
Chief Emily Whetung, Electrification and Energy Transition Panel
Honourable Howard Wetston K.C., Electrification and Energy Transition Panel