AIRD BERLIS

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March 22, 2023

BY EMAIL AND FILED VIA RESS

Nancy Marconi
Registrar
Ontario Energy Board
2300 Yonge Street
Suite 2700
Toronto, ON M4P 1E4

Dear Ms. Marconi:

Re: Enbridge Gas Inc. ("Enbridge Gas")
EB-2022-0200 – 2024 Rates Application
Documents from Guidehouse re Low-Carbon Pathways (LCP) model

We act as counsel to Enbridge Gas in this matter.

As we explained in our March 20, 2023 letter, Guidehouse agreed to provide certain intervenors with a detailed overview of how the LCP model works, on a confidential basis. Guidehouse also agreed to provide a "workbook" of inputs used specific to Enbridge Gas, also on a confidential basis.

Yesterday (March 21st), Enbridge Gas provided these materials to representatives of Environmental Defence, Green Energy Coalition and School Energy Coalition. Each of these parties (who have already signed the OEB's Declaration and Undertaking) agreed to treat the documents as confidential, subject to any later OEB determination.

After the documents were provided, a meeting was held between Guidehouse, Enbridge Gas and the intervenor representatives on March 21st to provide further details and explanation about the LCP model to assist intervenor understanding of how the model operates. From the perspective of Enbridge Gas, the meeting was successful. Guidehouse provided extensive information and explanation and agreed to provide model inputs and outputs (to be confirmed in an undertaking at the Technical Conference). Guidehouse also explained the infeasibility of providing "the model" to parties (along with the very strong concerns about risks and adverse consequences of disclosure). It is Enbridge Gas's strong hope that there will be no continuing need / insistence on production of the Guidehouse LCP model.

Enbridge Gas and Guidehouse have agreed with the intervenor representatives that the documents shared on March 21st will be filed in this proceeding, and intervenors acknowledged that confidentiality requests will be made in relation to portions of the documents.

Attached to this letter are two documents: (i) a detailed overview of the LCP model; and (ii) an Excel spreadsheet including inputs used for the Enbridge Gas LCP model.

On behalf of Guidehouse, Enbridge Gas requests confidential treatment for portions of the documents. The specific request and rationale are set out in the attached letter from Guidehouse.

As required by the Practice Direction on Confidential Filings, Enbridge Gas has filed confidential un-redacted versions of each of the applicable documents, identifying all portions of the document for which confidential treatment (or non-relevance) is claimed, as well as non-confidential redacted versions of each such document.

Yours truly,

AIRD & BERLIS LLP

David Stevens
DS/

c: All parties registered in EB-2022-0200
Guidehouse, attn. Max Brady, Associate General Counsel
Reena Goyal, McCarthy Tetrault LLP, counsel to Guidehouse

Attachments, Documents from Guidehouse and March 22, 2023 Letter from Guidehouse.

47705292.1

Guidehouse

March 22, 2023

Via Email: dstevens@airdberlis.com
David Stevens
Aird & Berlis LLP
Brookfield Place,
181 Bay Street, Suite 1800,
Toronto, Ontario M5J 2T9

Re: Enbridge Gas Inc. 2024 to 2028 Rates Application EB-2022-0200 – Request for Confidential Treatment of Guidehouse Model Guide and Model Inputs

Dear Mr. Stevens:

As stated in the Guidehouse Inc. ("Guidehouse") letter delivered to you on March 19, 2023, and attached to the Enbridge Gas Inc. ("Enbridge Gas") letter delivered to the Ontario Energy Board ("OEB") on March 20, 2023, Guidehouse met virtually with ED and SEC on March 31, 2023 and provided detailed explanation of exactly how the Model works and answered questions regarding the Guide and Model Inputs (the "Conference"). . After further correspondence by Enbridge Gas on Guidehouse's behalf with Environmental Defence ("ED") and School Energy Coalition ("SEC"), Guidehouse provided *The Guidehouse Low Carbon Pathways Model Methodology* (the "Guide") and the model inputs used in the pathways report ("Model Inputs") to Enbridge Gas for purposes of sharing with ED and SEC. On March 21, 2023,.

Certain portions of the Guide and Model Inputs are confidential to Guidehouse and, as such, we ask that you submit this letter to the OEB on our behalf respectfully requesting that, in accordance with the OEB's revised Practice Direction on Confidential Filings effective December 17, 2021 (the "Practice Direction"), the confidential portions of the Guide and Model Inputs be given confidential treatment by the OEB. Schedule 1 sets out details of the request being made for each document.

For purposes of the filings required by the Practice Direction, Guidehouse has provided a separate attachment containing un-redacted version of the Guide and Model Inputs, which identifies all portions of the respective documents for which confidential treatment is claimed in yellow highlight. Non-confidential redacted versions of the Guide and Model Inputs to be filed are attached hereto as Exhibit A and Exhibit B, respectively.

Lastly, Guidehouse wishes to note its concern with sharing further proprietary Guidehouse information with the OEB or intervenors. Declarations and Undertakings are given to and only enforceable by the OEB and not Guidehouse. As such, Guidehouse has no direct way to be kept whole for any breaches resulting in a leak of Guidehouse's proprietary information and we are aware that breaches of Declarations and Undertakings have occurred in the past. Even if Guidehouse were to have a direct claim against a participant, the participants in the proceedings are not large entities with the means to provide compensation equivalent to the losses that Guidehouse would suffer from a breach of confidentiality involving its proprietary information.

Guidehouse

Very truly yours,

Guidehouse Inc.

Max J Brady

By: Max J. Brady, Associate General Counsel

Date: March 22, 2023

Enclosure

Schedule 1

Confidentiality Requests

	Document	Description of Document	Confidential Information Location	Brief Description	Basis for Confidentiality Claim
1.	Guide	Detailed discussion of the Guidehouse model methodology	Pages 8-11	The redacted information consists of specific model constraints used and developed by Guidehouse.	The redacted information provides details on the inner workings of Guidehouse's model that could be used by a competitor to improve their own capacity expansion or pathways models in direct competition to Guidehouse, and potentially result in a significant loss of revenue to Guidehouse. This fits with item a) in the OEB's Considerations in Determining Requests for Confidentiality ("the potential harm that could result from the disclosure of the information, including … (i) prejudice to any person's competitive position … (iv) whether the disclosure would be likely to produce significant loss or gain to any person.").[1] Because the redacted information relates to the inner workings of Guidehouse's model, this also fits item 7) in the OEB's Categories of Information that Will Presumptively Be Considered Confidential ("Underlying dataset and/or model of a consultant retained by a party").[2]
2.	Model Inputs	Inputs used in the pathways report	Page 11	The redacted information is existing generation capacity developed from confidential	The redacted existing generation capacity is commercial information from confidential Guidehouse developed forecasts that Guidehouse provides to clients as a paid service. Disclosure of the information would prejudice Guidehouse's

[1] Appendix A to the OEB's Practice Direction on Confidential Filings
[2] Appendix B to the OEB's Practice Direction on Confidential Filings

	Document	Description of Document	Confidential Information Location	Brief Description	Basis for Confidentiality Claim
				forecasts that Guidehouse requires clients to pay for access to.	competitive position by providing competitors with our proprietary research that could be used in their own service offerings to clients, and potentially result in a significant loss of revenue to Guidehouse. This fits with item a) in the OEB's Considerations in Determining Requests for Confidentiality ("the potential harm that could result from the disclosure of the information, including … (i) prejudice to any person's competitive position … (iv) whether the disclosure would be likely to produce significant loss or gain to any person.").[3] This also fits item 7) in the OEB's Categories of Information that Will Presumptively Be Considered Confidential ("Underlying dataset and/or model of a consultant retained by a party").[4]
3.	Model Inputs	Inputs used in the pathways report	Page 12	The redacted information is planned capacity retirements developed from confidential forecasts that Guidehouse requires clients to pay for access to.	The redacted planned capacity retirements are commercial information from confidential Guidehouse developed forecasts that Guidehouse provides to clients as a paid service. Disclosure of the information would prejudice Guidehouse's competitive position by providing competitors with our proprietary research that could be used in their own service offerings to clients, and potentially result in a significant loss of revenue to Guidehouse. This fits with item a) in the OEB's Considerations in Determining Requests for Confidentiality ("the potential harm that could result from the disclosure of the information, including … (i) prejudice to any person's competitive position … (iv) whether the disclosure would be likely to produce

[3] Appendix A to the OEB's Practice Direction on Confidential Filings
[4] Appendix B to the OEB's Practice Direction on Confidential Filings

	Document	Description of Document	Confidential Information Location	Brief Description	Basis for Confidentiality Claim
					significant loss or gain to any person.”).[5] This also fits item 7) in the OEB’s Categories of Information that Will Presumptively Be Considered Confidential (“Underlying dataset and/or model of a consultant retained by a party”).[6]

[5] Appendix A to the OEB’s Practice Direction on Confidential Filings
[6] Appendix B to the OEB’s Practice Direction on Confidential Filings

<u>Exhibit A</u>

Redacted Guide

[attached]

Appendix A. The Guidehouse Low Carbon Pathways Model Methodology

Governments, utilities, and commercial entities around the world are setting ambitious climate and energy targets, towards achieving a decarbonized future. However, due to the myriad decisions involved in this energy system transition, the best pathways to achieve goals are often unclear. Guidehouse's proprietary Low Carbon Pathways (LCP) model focuses on investigating different ways that regions may decarbonize energy systems, using an integrated capacity expansion and dispatch optimization model. The model facilitates critical decision-making by facilitating analysis of different potential pathways.

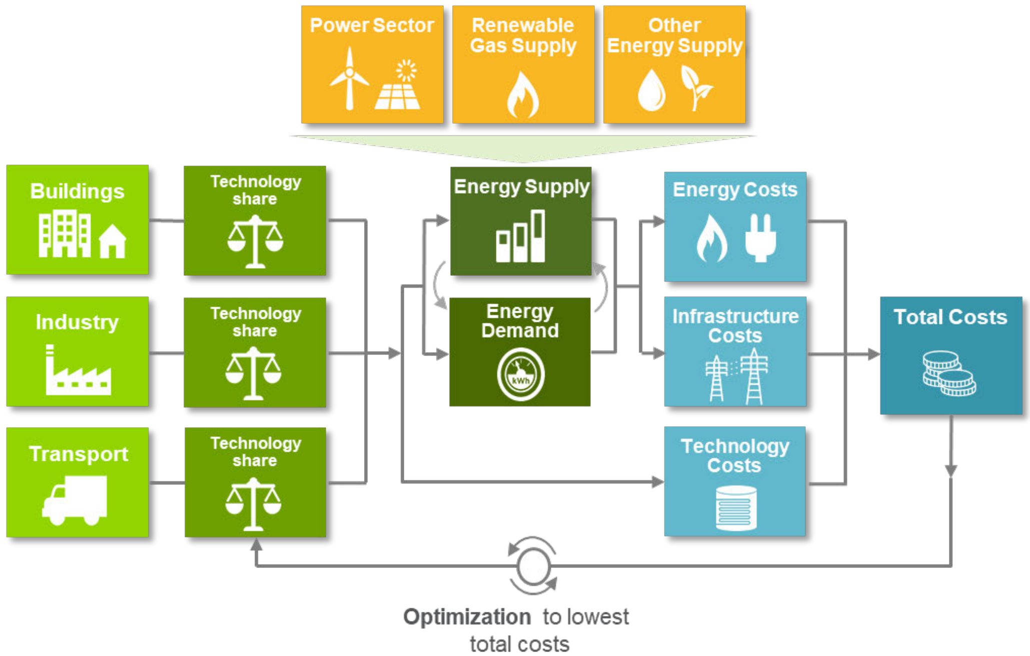
LCP leverages optimization techniques to identify the lowest total system cost pathway to achieve decarbonization targets in different scenarios:

- Within a specified time frame;
- Using a given set of technologies; and
- Under a set of constraints, both at the energy system level (e.g., the buildout and availability of supply, the development of interconnections) as well as operational, individual technology level (e.g., the operation of power generation plants).

The LCP model illustrated in Figure A-1, uses an integrated approach across different energy carriers to determine the lowest cost pathway to achieve a given scenario. Important features include:

1. Integrates decisions regarding both how much of a technology to deploy each year and how to dispatch that technology on an hourly basis.
2. Captures interactions between energy sub-systems, such as interactions between the electricity, natural gas, and hydrogen systems.
3. Uses representative days and peak days to reflect the seasonal variability of electricity and gas demand loads and supply resources.
4. Simulates a given energy system, subdivided into one or more primary regions, as well as one or more secondary neighboring regions.

Figure A-1. Low Carbon Pathways Model Overview



A.1 Model Inputs

Defined scenarios drive runs of the LCP model. A scenario consists of scope and resolution of geography, time period, and defined decarbonization targets (e.g., achieving net-zero for specific regions over 2030-2050). The scenario also represents a particular pathway to achieve targets, based on parameters such as:

- Existing and planned generation, storage, and transmission capacities over the time period
- Potential supply technologies that could be deployed, including technological characteristics and associated costs
- Forecasted demand for hydrogen, electricity, and natural gas (e.g., in different sectors) – this is accomplished exogenously to the LCP model itself.
- Potentials for renewable energy resources
- Fuel and emissions price assumptions

Example scenarios could compare achieving targets using a full-electrification pathway with an integrated pathway involving a mix of electricity, hydrogen, and renewable natural gas. Table A-1 describes the inputs that define a scenario. Scenarios may be defined by a subset of these inputs depending on the requirements of a particular study.

Table A-1. Example Input Data and Assumptions Required for LCP Modelling

Category	Input Data
General	**Economic parameters** (e.g., WACC)
Model Dimensions	**Temporal** (Season, representative days, temporal granularity) **Geographic** (Primary and neighbouring regions)
Emissions	Emissions target, carbon prices, offset prices and availability, emissions intensities for supply technologies
Demand	**Reference Case forecast of demand (e.g., 2020-2050)** • Electricity, methane, and hydrogen demand
Demand	**Hourly demand profiles by sector & network load profiles** • Hourly profiles for each representative day (e.g., each season and a winter and/or summer-peak)
Supply	**Existing supply capacity** • Current electricity supply mix and gas supply mix (e.g., imports, domestic biogas production via anaerobic digestion, etc.)
Supply	**Planned changes to system capacity (e.g., in 2030, 2040, and 2050)** • Planned capacity additions and planned capacity retirements
Supply	**Input fuel types and prices**
Supply	**Maximum fuel type supply potentials (or minimum supply), e.g.:** • Define max limit on RNG supply via anaerobic digestion and biomass gasification • Define max limit on blue and green hydrogen supply • Define max limit on gas storage capacity (salt caverns, aquifers, etc.)
Supply	**Techno-economic parameters for supply technologies considered, e.g.,** • Electricity: Solar, wind, hydrogen- and natural gas-fired CCGT / OCGT, battery storage, etc. • Hydrogen: Blue H2 (SMR + CCS) and green H2 (dedicated vs. curtailed renewables), H2 storage (salt caverns, aquifers, etc.) • Methane: Anaerobic digestion, biomass gasification
Infrastructure	**Existing (e.g., 2020) and planned (e.g., 2030, 2040, 2050) interconnection capacities** • Capacities for energy exchange between the primary region and connected neighboring regions
Infrastructure	**Cost parameters for new electric transmission lines** • Overhead AC, Underground/Overhead HVDC
Infrastructure	**Cost parameters for new and repurposed methane and hydrogen** transmission pipelines
End Users	**Cost of end user retrofits and equipment replacement, e.g.,** • Cost of weatherization and deep building retrofits • Total installed cost of heating equipment (e.g., whole-building electric heat pumps, dual fuel systems, and gas heat pumps) • Total installed cost of other relevant appliances (water heaters, cooktops, etc.)

A.2 Model Optimization

Fundamentally, LCP is an optimization model, comprising an objective function, decision variables (DVs), and constraints. Figure A-2 provides an illustrative example of a generic optimization for two decision variables and three constraints, where the model attempts to determine a single point in the feasible region that minimizes the objective function.

Figure A-2. Illustrative Depiction of Optimization

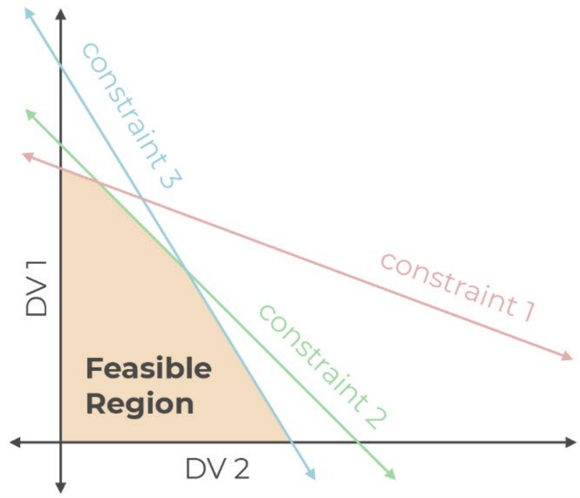
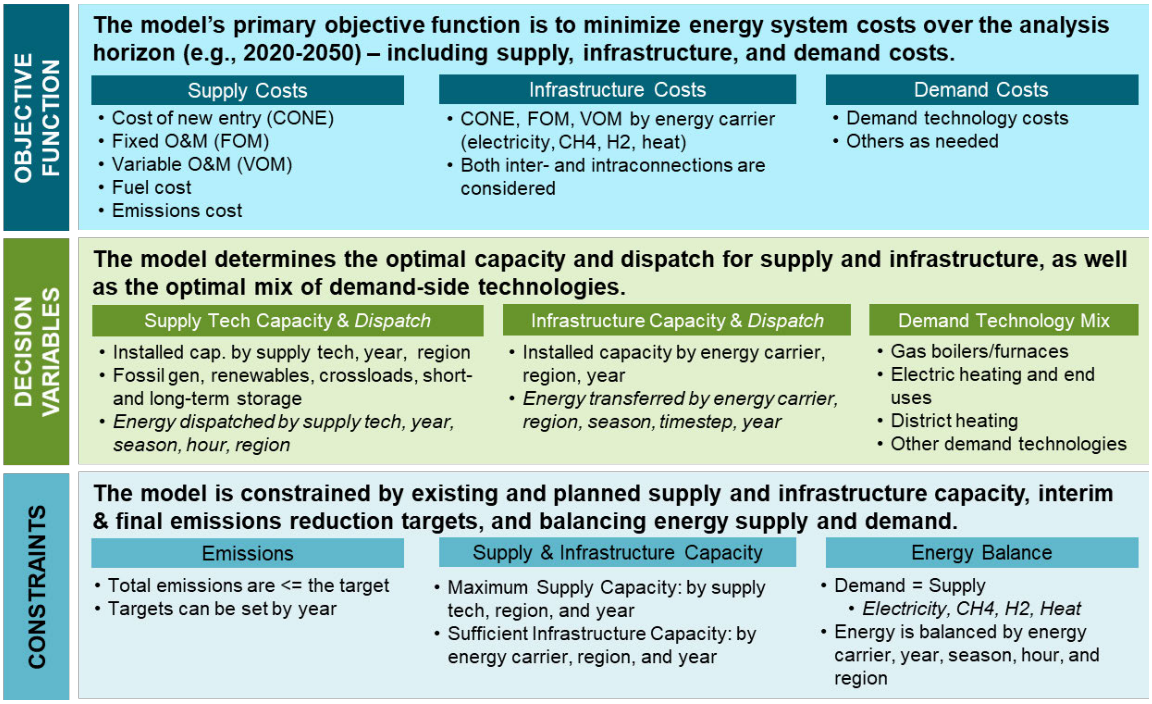


Figure A-3 describes the objective function, DVs, and constraints for the LCP model in more detail. From a whole-system, central planning perspective, LCP minimizes the net present value of total system cost – capital expenditures (CAPEX) as well as fixed and variable operational expenditures (OPEX) – over the specified time period (e.g., 2030-2050).

Figure A-3. LCP Model Objective Function, Decision Variables, and Constraints



A.2.1 Dimensionality

The model currently uses the following dimensions:

- **Simulation Year:** Calendar years considered, e.g., 2020, 2030, 2040, 2050
- **Season:** Seasons to represent in the model, e.g., Summer, Summer Peak, Winter, Winter Peak, Fall, Spring
- **Timestep:** The temporal resolution of demand in the model, e.g., hourly, at hours 1, 2, 3, …, and 24
- **Subregion:** Regions to model e.g., an entire province/state or subregions therein as well as neighbouring provinces/states.
- **Supply Technology:** energy supply technologies considered, e.g., electric generation from nuclear, coal, and solar resources, and hydrogen generation from SMR and electrolyzer resources
- **Infrastructure Technology:** Means of transporting energy considered, e.g., Wire, Pipe, Trucked Hydrogen
- **Fuel Type:** Energy carriers considered e.g., Electricity, Heat, Hydrogen, Methane

A.2.2 Supply Technology Definitions

This section provides some definitions regarding supply technologies within the LCP model.

Generation Technologies

Technologies defined as "Generation" use imported fuels with defined costs and availability, if applicable, and capacity factors to account for total limits on resource availability and seasonal variation in that availability. For example, an onshore wind power plant has no associated fuel costs, but has a capacity factor that depends on both Timestep and Season to account for patterns in wind direction and speed.

Crossload Technologies

Technologies defined as "Crossload" use a modeled Fuel Type to produce a different modeled Fuel Type. For example, electrolyzers may use electricity (produced by other technologies in the model) to produce hydrogen (which is then used to meet end use demand). Natural gas and hydrogen turbines use a gaseous fuel to produce electricity, depending on the amount of gaseous fuel that can be produced in or imported to the region.

Storage Technologies

Storage technologies have the same input fuel and output fuel and are able to store energy hourly and/or seasonally. The capacity of a storage technology refers to the amount of energy the technology can charge or discharge in a single timestep. For example, an electric battery that can dispatch 20 kW and has a 3 hour storage duration would have a capacity of 20 kW and a storage capacity of 60 kWh.

Some storage technologies are eligible for carryover storage, which allows them to use energy stored in the previous seasons for other seasons. For example, natural gas storage which typically fills in the summer and empties in the winter.

Technology Groups

Supply technology groups model supply technologies that are dependent on the capacity or dispatch of another supply technology, such as H2 enriched natural gas or an open cycle gas turbine that can use hydrogen or natural gas as an input fuel. Within a technology group, one is considered a primary technology (the one mainly used) and the other is considered secondary.

Import Technologies

These technologies represent imported energy separately from defined infrastructure connections between neighbouring Subregions (i.e. they are a different way of characterizing imported energy). When defining import technologies, the cost can be characterized as a fuel cost per unit of energy and/or a CAPEX and OPEX of building and operating the infrastructure needed to deliver the energy. For example, methane imports can be defined as an import technology using the price of natural gas at the point of reception in the associated Subregion.

Retrofitted Technologies

Supply technologies and infrastructure technologies can both be modeled as "retrofits" of existing original technologies. The "original tech" is the technology that's being replaced and the "replacement tech" is the new technology that's being brought online. CAPEX of retrofit technologies may be substantially lower than the installation of new resources, depending on the retrofit. Similar to new installs, the total cost of production for retrofit resources accounts for the capital cost of installing the resource and the operating cost of using the resource to produce energy. The capacity of the replacement technology is limited by the existing capacity of the original technology subject to a defined limit.

A.2.3 Decision Variables

DVs represent the unknowns the optimizer will solve, for example, the amount of energy dispatched from a specific nuclear plant in the summer of 2050. In the model, all decisions are combined into a vector of variables for which the model ultimately finds a cost-optimized solution, $DV_1, DV_2, \ldots, DV_n$. The full decision vector represents how an energy system would change (e.g., what is constructed) and how it is dispatched over the analysis timeframe.

The number of DVs will vary based on how the model is configured, but comprise the following categories:

1. **Dispatch**
   The modeled energy dispatched by each Supply Technology in each Timestep, Season, Simulation Year, and Subregion. This decision variable captures the dispatch of generation facilities, storage technologies, crossload technologies, import, and export technologies.
2. **Storage**
   The modeled amount of energy charging for both short and long-term storage technologies (i.e., batteries, natural gas storage, hydrogen storage) in each Timestep, Season, Simulation Year, and Subregion.
3. **Carryover**
   For relevant technologies, the modeled amount of stored energy to carry over from one Season or Simulation Year to the next by Subregion. Specifically, this decision variable represents the level of storage that the simulation starts with in each Season and Simulation Year. This is particularly relevant to long-term seasonal storage such as underground gas storage or a hydro reservoir.
4. **Supply Capacity**
   The modeled new capacity of each Supply Technology installed in each Simulation Year and Subregion. This sets the maximum energy output in each timestep (constraint described below). Includes generation facilities, storage technologies, and crossload technologies.
5. **Intra/Interconnection Capacity**
   The modeled new capacity installed of each Infrastructure Technology connecting two Subregions together ("interconnection") and within a Subregion ("intraconnection") for each Simulation year and Subregion. This sets the maximum amount of energy that can be transmitted across that infrastructure in each Timestep.
6. **Intra/Interconnection Dispatch**
   The modeled amount of energy transmitted from one Subregion to another ("inter-") or distributed within a Subregion ("intra-") in each Timestep, Season, and Simulation Year.
7. **Carbon Offset**
   The modeled quantity of offsets used to reach emission targets, specified system-wide (across all Subregions) for each Simulation Year.
8. **Supply Retrofits**
   The modeled retrofitted capacity of each Supply Technology (if eligible to be retrofitted) in each Simulation Year and Subregion. This keeps track of how much of the original supply technology capacity has been replaced by a replacement technology.

A.2.4 Objective Function

LCP's core objective is to minimize the present value of total system costs over the analysis horizon. To setup the objective function, the model generates a cost for each DV. That is, for a given a decision vector, $DV_1, DV_2, \ldots, DV_n$, the model generates an associated cost objective vector, $Cost_1, Cost_2, \ldots, Cost_n$, such that the objective function becomes:

$$Cost_1 DV_1 + Cost_2 DV_2 + \cdots + Cost_n DV_n = Total\ Cost$$

The model seeks to minimize Total Cost and leverages a commercially available solver, Gurobi. Since there are many dimensions to the model including time, the cost function for each decision variable must account for factors such as the time value of money, technology lifetimes, and the salvage value of resources at the end of the study period.

A.2.5 Constraints

The LCP model imposes limitations on the optimization of decision variables when determining the solution for a given scenario. In other words, the model determines the set of decision variables that minimizes the objective function subject to a set of constraints. The constraints defined in the model comprise the following categories:

1. **Energy Balance** – energy balance is split into two distinct balances (one at generation and one at end use) to enable flexibility such as modeling multiple intraconnection technologies (e.g., trucks vs. pipeline) and multiple crossloads at the end use (e.g., heat pump converting electricity into heat vs. furnace converting natural gas into heat)

   [redacted]

   [redacted]

2. **Dispatch** – constraints on dispatch could require that dispatch is less than capacity (supply technologies), meet minimum dispatch, be less than capacity (infrastructure), have regional constraints on percent of energy imported, constrain firm capacity, or limit one-way capacity.

   [redacted]

[redacted]

3. Capacity -

[redacted]

[redacted]

[redacted]

[redacted]

4. **Emissions** – Emissions constraints involve overall emissions targets in each year, as well as limits on carbon offsets.

[redacted]

[redacted]

5. **Storage** – The storage constraints pertain to storage technologies (e.g., batteries, natural gas storage, hydrogen storage), and are constrained in terms of their charge and dispatch levels

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

6. **Ramping** – Supply technologies can be constrained in terms of how fast they can be ramped up or down.

[redacted]

[redacted]

7. **Technology Groups** –The model includes some possible constraints regarding how technology groups are treated, including that their capacities must be equal to maintain linearity in the optimization problem, and that the secondary technology must be dispatched at a specified proportion of the primary technology. For example, this constraint may be used to model hydrogen blended into natural gas at 6% energy content.

[redacted]

[redacted]

[redacted]

8. **Annual Fuel Usage** – Annual usage of input fuels can be individually constrained at a maximum or minimum.

[redacted]

[redacted]

A.3 Model Outputs

Successful execution of the model (i.e., finding a feasible solution) produces a solution vector (i.e., optimal values for the decision vector, $DV_1, DV_2, \dots, DV_n$). The model processes the solution to output important details, such as:

- **Required investments in new generation and storage capacity** – e.g., solar, wind, electrolyzers, and hydrogen storage
- **System operation** – e.g., system dispatch, energy flows between regions, storage levels, and curtailment
- **System costs** – e.g., CAPEX, OPEX, fuel costs, and CO_2 emissions costs
- **CO_2 emissions incurred throughout the study period** – e.g. emissions resulting from the dispatch of natural gas plants, or losses in transport

A.4 Model Limitations

The LCP model has been designed with the intent of being as comprehensive as is practical within the scope of its intended use as a tool to explore different scenarios of a decarbonized future. The model does currently have limitations in its capabilities and application, and some important ones include:

- While the model calculates total supply of energy from different sources (e.g., MWh from onshore wind) and total production cost for supply technologies (e.g., total CAPEX and OPEX of onshore wind), the model does not attempt to calculate retail or wholesale cost of energy of different energy sources (e.g., $/kWh). This is a deliberate design choice. The future cost of energy will depend on factors that are not forecast by the model, such as cost of financing, tax rates, depreciation schedules and other factors. Additionally, energy rates could depend on future policy initiatives to incentivize particular technologies or to promote cost socialization. The goal of the model is to determine the approach to energy supply that will result in the least cost outcome from an economy-wide perspective.
- The LCP model optimizes supply-side resources but does not currently optimize demand-side technologies. For scenario-based analyses, demand-side technologies (e.g., heat electrification, efficiency improvements, fuel substitutions, etc.) are set by the scenario definitions. The impact of demand-side technologies on the annual and hourly demand for different energy types is calculated exogenously to the LCP model. For example, a scenario may define the adoption curve and future saturations of different heat pump technologies (e.g., air-source, ground-source, and gas heat pumps) and the LCP model's optimization function is not designed to alter these scenario-defining characteristics.
- The LCP model does not currently deploy demand response technologies as a supply resource. The model takes hourly demand profiles as an input and does not include technologies that could in effect shift the hourly demand profiles specified for individual scenarios. If demand response approaches are to be considered in a scenario, they must be specified in the upstream calculations that produce the hourly demand profiles that are taken as an input to the LCP model.
- The LCP model is not configured to model exact transmission and distribution systems (i.e. every substation). These systems are typically simplified to represent capacity connections between and within Subregions.

Exhibit B

Redacted Model Inputs

[attached]

Region	Region Key
ON	Ontario
QC	Quebec
WC	Western Canada
NY	New York State
MI	Michigan
PJ	Pennsylvania (PJM)

Season	Representative Number of Days
Winter	91
Winter Peak	1
Spring	91
Summer	91
Fall	91

Fuel	Unit (real 2020$ CAD)	2020	2030	2040	2050	Notes
Uranium	$/MWh	7	7	7	7	*Guidehouse nternal analysis.*
Biomass	$/MWh	51	51	51	51	*Gas for Cl mate (2019). Link: https://gasforclimate2050.eu/sdm_downloads/2019-gas-for-cl mate-study/*
Methane Imports	cents/m3	9	14	16	16	*Source: Enbridge ETSA Report*
Hydrogen Imports from Quebec	$/kg	-	2.0	1.6	1.5	*Assumes 100% green hydrogen produced from hydro. Source of hydrogen costs: European Hydrogen Backbone 2020. Link: https://ehb.eu/files/downloads/2020_European-Hydrogen-Backbone_Report.pdf*
Hydrogen Imports from Western Canada	$/kg	-	2.4	2.1	1.8	*Assumes 50% green hydrogen in 2030 through 2040 and 75% green hydrogen by 2050. Rema nder is assumed to be blue hydrogen. Source of hydrogen costs: European Hydrogen Backbone.*

Annual Ontario province-wide demand for each energy carrier

Electrification Scenario

	2020	2030	2040	2050
Electricity (TWh)	135	209	348	435
Methane (PJ)	922	798	442	182
Hydrogen (PJ)	0	55	152	262

Diversified Scenario

	2020	2030	2040	2050
Electricity (TWh)	135	186	232	277
Methane (PJ)	922	882	618	305
Hydrogen (PJ)	0	145	463	844

Hourly hydrogen demand for Ontario (MW). Note that hydrogen demand was not modelled for other regions.

Electrification Scenario

Season	Region	Hour	2020	2030	2040	2050
Winter	ON	1	-	2 264	6 776	12 088
Winter	ON	2	-	2 150	6 483	11 645
Winter	ON	3	-	2 035	6 194	11 212
Winter	ON	4	-	1 920	5 902	10 771
Winter	ON	5	-	1 920	5 907	10 786
Winter	ON	6	-	1 920	5 911	10 798
Winter	ON	7	-	1 920	5 913	10 803
Winter	ON	8	-	1 920	5 917	10 814
Winter	ON	9	-	1 920	5 911	10 796
Winter	ON	10	-	2 035	6 182	11 177
Winter	ON	11	-	2 173	6 501	11 618
Winter	ON	12	-	2 264	6 704	11 883
Winter	ON	13	-	2 379	6 976	12 266
Winter	ON	14	-	2 494	7 257	12 676
Winter	ON	15	-	2 517	7 308	12 743
Winter	ON	16	-	2 425	7 067	12 369
Winter	ON	17	-	2 333	6 839	12 033
Winter	ON	18	-	2 264	6 681	11 817
Winter	ON	19	-	2 333	6 881	12 151
Winter	ON	20	-	2 425	7 134	12 560
Winter	ON	21	-	2 494	7 324	12 868
Winter	ON	22	-	2 494	7 337	12 903
Winter	ON	23	-	2 494	7 348	12 937
Winter	ON	24	-	2 494	7 358	12 966
Winter Peak	ON	1	-	3 126	9 436	16 734
Winter Peak	ON	2	-	2 949	9 003	16 103
Winter Peak	ON	3	-	2 773	8 560	15 442
Winter Peak	ON	4	-	2 597	8 123	14 796
Winter Peak	ON	5	-	2 597	8 180	14 958
Winter Peak	ON	6	-	2 597	8 267	15 208
Winter Peak	ON	7	-	2 597	8 247	15 149
Winter Peak	ON	8	-	2 597	8 262	15 193
Winter Peak	ON	9	-	2 597	8 210	15 046
Winter Peak	ON	10	-	2 773	8 648	15 692
Winter Peak	ON	11	-	2 985	9 105	16 273
Winter Peak	ON	12	-	3 126	9 369	16 543
Winter Peak	ON	13	-	3 302	9 765	17 071
Winter Peak	ON	14	-	3 478	10 146	17 556
Winter Peak	ON	15	-	3 513	10 207	17 608
Winter Peak	ON	16	-	3 372	9 799	16 927
Winter Peak	ON	17	-	3 231	9 401	16 274
Winter Peak	ON	18	-	3 125	9 209	16 087
Winter Peak	ON	19	-	3 231	9 515	16 598
Winter Peak	ON	20	-	3 372	9 881	17 162
Winter Peak	ON	21	-	3 478	10 161	17 600
Winter Peak	ON	22	-	3 478	10 187	17 673
Winter Peak	ON	23	-	3 478	10 352	18 144
Winter Peak	ON	24	-	3 478	10 321	18 056
Spring	ON	1	-	1 863	5 308	9 271
Spring	ON	2	-	1 777	5 096	8 960
Spring	ON	3	-	1 691	4 886	8 655
Spring	ON	4	-	1 604	4 675	8 349
Spring	ON	5	-	1 604	4 685	8 378
Spring	ON	6	-	1 605	4 696	8 408
Spring	ON	7	-	1 604	4 685	8 376
Spring	ON	8	-	1 604	4 645	8 262
Spring	ON	9	-	1 604	4 594	8 116
Spring	ON	10	-	1 690	4 760	8 297
Spring	ON	11	-	1 794	4 985	8 586
Spring	ON	12	-	1 863	5 137	8 783
Spring	ON	13	-	1 949	5 338	9 062
Spring	ON	14	-	2 035	5 545	9 359
Spring	ON	15	-	2 052	5 581	9 404
Spring	ON	16	-	1 983	5 399	9 118
Spring	ON	17	-	1 914	5 223	8 852
Spring	ON	18	-	1 863	5 109	8 704
Spring	ON	19	-	1 914	5 275	9 001
Spring	ON	20	-	1 983	5 494	9 392
Spring	ON	21	-	2 035	5 660	9 689
Spring	ON	22	-	2 035	5 683	9 754
Spring	ON	23	-	2 035	5 708	9 825
Spring	ON	24	-	2 035	5 727	9 879
Summer	ON	1	-	1 461	3 584	5 724
Summer	ON	2	-	1 403	3 435	5 495
Summer	ON	3	-	1 346	3 286	5 265
Summer	ON	4	-	1 289	3 136	5 036
Summer	ON	5	-	1 289	3 136	5 036
Summer	ON	6	-	1 289	3 136	5 036
Summer	ON	7	-	1 289	3 136	5 036
Summer	ON	8	-	1 289	3 136	5 036
Summer	ON	9	-	1 289	3 136	5 036
Summer	ON	10	-	1 346	3 286	5 265
Summer	ON	11	-	1 415	3 465	5 541
Summer	ON	12	-	1 461	3 584	5 724
Summer	ON	13	-	1 518	3 733	5 954
Summer	ON	14	-	1 575	3 882	6 183
Summer	ON	15	-	1 587	3 912	6 229
Summer	ON	16	-	1 541	3 793	6 046
Summer	ON	17	-	1 495	3 673	5 862
Summer	ON	18	-	1 461	3 584	5 724
Summer	ON	19	-	1 495	3 673	5 862
Summer	ON	20	-	1 541	3 793	6 046
Summer	ON	21	-	1 575	3 882	6 183
Summer	ON	22	-	1 575	3 882	6 183
Summer	ON	23	-	1 575	3 882	6 183
Summer	ON	24	-	1 575	3 882	6 183
Fall	ON	1	-	1 461	4 058	7 077
Fall	ON	2	-	1 404	3 923	6 889
Fall	ON	3	-	1 346	3 789	6 701
Fall	ON	4	-	1 289	3 655	6 518
Fall	ON	5	-	1 289	3 663	6 539
Fall	ON	6	-	1 289	3 665	6 544
Fall	ON	7	-	1 289	3 668	6 553
Fall	ON	8	-	1 289	3 659	6 527
Fall	ON	9	-	1 289	3 598	6 352
Fall	ON	10	-	1 346	3 687	6 412
Fall	ON	11	-	1 415	3 819	6 551
Fall	ON	12	-	1 461	3 905	6 642
Fall	ON	13	-	1 518	4 027	6 794
Fall	ON	14	-	1 576	4 164	6 988
Fall	ON	15	-	1 587	4 183	7 003
Fall	ON	16	-	1 541	4 070	6 836
Fall	ON	17	-	1 495	3 966	6 697
Fall	ON	18	-	1 461	3 899	6 624
Fall	ON	19	-	1 495	4 022	6 858
Fall	ON	20	-	1 541	4 171	7 126
Fall	ON	21	-	1 576	4 287	7 337
Fall	ON	22	-	1 576	4 311	7 406
Fall	ON	23	-	1 576	4 331	7 464
Fall	ON	24	-	1 576	4 350	7 520

Diversified Scenario

Season	Region	Hour	2020	2030	2040	2050
Winter	ON	1	-	5 486	21 022	39 131
Winter	ON	2	-	5 346	20 610	38 259
Winter	ON	3	-	5 207	20 222	37 433
Winter	ON	4	-	5 066	19 814	36 567
Winter	ON	5	-	5 068	19 852	36 639
Winter	ON	6	-	5 070	19 882	36 696
Winter	ON	7	-	5 071	19 896	36 721
Winter	ON	8	-	5 072	19 924	36 774
Winter	ON	9	-	5 070	19 878	36 688
Winter	ON	10	-	5 202	20 133	37 265
Winter	ON	11	-	5 358	20 397	37 879
Winter	ON	12	-	5 458	20 499	38 148
Winter	ON	13	-	5 590	20 758	38 733
Winter	ON	14	-	5 726	21 087	39 450
Winter	ON	15	-	5 751	21 114	39 518
Winter	ON	16	-	5 636	20 735	38 729
Winter	ON	17	-	5 526	20 451	38 116
Winter	ON	18	-	5 449	20 331	37 832
Winter	ON	19	-	5 543	20 753	38 685
Winter	ON	20	-	5 663	21 222	39 645
Winter	ON	21	-	5 753	21 576	40 368
Winter	ON	22	-	5 758	21 667	40 539
Winter	ON	23	-	5 763	21 752	40 700
Winter	ON	24	-	5 767	21 826	40 838
Winter Peak	ON	1	-	6 726	27 489	52 022
Winter Peak	ON	2	-	6 517	26 980	50 916
Winter Peak	ON	3	-	6 304	26 396	49 669
Winter Peak	ON	4	-	6 092	25 850	48 492
Winter Peak	ON	5	-	6 115	26 262	49 267
Winter Peak	ON	6	-	6 150	26 900	50 466
Winter Peak	ON	7	-	6 142	26 750	50 184
Winter Peak	ON	8	-	6 148	26 862	50 396
Winter Peak	ON	9	-	6 127	26 487	49 690
Winter Peak	ON	10	-	6 339	27 034	50 867
Winter Peak	ON	11	-	6 565	27 194	51 349
Winter Peak	ON	12	-	6 699	27 001	51 106
Winter Peak	ON	13	-	6 894	27 247	51 718
Winter Peak	ON	14	-	7 083	27 381	52 120
Winter Peak	ON	15	-	7 115	27 295	51 988
Winter Peak	ON	16	-	6 923	26 438	50 257
Winter Peak	ON	17	-	6 735	25 656	48 667
Winter Peak	ON	18	-	6 636	25 839	48 920
Winter Peak	ON	19	-	6 780	26 481	50 218
Winter Peak	ON	20	-	6 955	27 038	51 385
Winter Peak	ON	21	-	7 089	27 494	52 331
Winter Peak	ON	22	-	7 099	27 681	52 684
Winter Peak	ON	23	-	7 165	28 881	54 940
Winter Peak	ON	24	-	7 153	28 656	54 517
Spring	ON	1	-	4 818	16 348	30 002
Spring	ON	2	-	4 715	16 093	29 450
Spring	ON	3	-	4 613	15 854	28 927
Spring	ON	4	-	4 512	15 610	28 395
Spring	ON	5	-	4 516	15 683	28 533
Spring	ON	6	-	4 520	15 761	28 680
Spring	ON	7	-	4 515	15 679	28 525
Spring	ON	8	-	4 499	15 388	27 978
Spring	ON	9	-	4 479	15 017	27 279
Spring	ON	10	-	4 563	14 940	27 208
Spring	ON	11	-	4 675	15 032	27 470
Spring	ON	12	-	4 750	15 104	27 663
Spring	ON	13	-	4 848	15 277	28 061
Spring	ON	14	-	4 948	15 498	28 551
Spring	ON	15	-	4 966	15 504	28 575
Spring	ON	16	-	4 879	15 206	27 956
Spring	ON	17	-	4 795	14 958	27 432
Spring	ON	18	-	4 739	14 903	27 286
Spring	ON	19	-	4 815	15 337	28 145
Spring	ON	20	-	4 917	15 904	29 269
Spring	ON	21	-	4 994	16 338	30 131
Spring	ON	22	-	5 003	16 504	30 442
Spring	ON	23	-	5 013	16 685	30 781
Spring	ON	24	-	5 021	16 823	31 042
Summer	ON	1	-	4 047	9 814	17 376
Summer	ON	2	-	3 976	9 588	16 901
Summer	ON	3	-	3 904	9 361	16 426
Summer	ON	4	-	3 833	9 134	15 951
Summer	ON	5	-	3 833	9 134	15 951
Summer	ON	6	-	3 833	9 134	15 951
Summer	ON	7	-	3 833	9 134	15 951
Summer	ON	8	-	3 833	9 134	15 951
Summer	ON	9	-	3 833	9 134	15 951
Summer	ON	10	-	3 904	9 361	16 426
Summer	ON	11	-	3 990	9 633	16 996
Summer	ON	12	-	4 047	9 814	17 376
Summer	ON	13	-	4 118	10 041	17 851
Summer	ON	14	-	4 190	10 267	18 325
Summer	ON	15	-	4 204	10 313	18 420
Summer	ON	16	-	4 147	10 131	18 040
Summer	ON	17	-	4 090	9 950	17 661
Summer	ON	18	-	4 047	9 814	17 376
Summer	ON	19	-	4 090	9 950	17 661
Summer	ON	20	-	4 147	10 131	18 040
Summer	ON	21	-	4 190	10 267	18 325
Summer	ON	22	-	4 190	10 267	18 325
Summer	ON	23	-	4 190	10 267	18 325
Summer	ON	24	-	4 190	10 267	18 325
Fall	ON	1	-	4 236	13 263	23 860
Fall	ON	2	-	4 170	13 141	23 583
Fall	ON	3	-	4 104	13 022	23 310
Fall	ON	4	-	4 039	12 912	23 054
Fall	ON	5	-	4 042	12 966	23 156
Fall	ON	6	-	4 043	12 980	23 183
Fall	ON	7	-	4 044	13 001	23 222
Fall	ON	8	-	4 041	12 936	23 100
Fall	ON	9	-	4 016	12 491	22 262
Fall	ON	10	-	4 064	12 285	21 923
Fall	ON	11	-	4 131	12 209	21 840
Fall	ON	12	-	4 175	12 153	21 773
Fall	ON	13	-	4 236	12 182	21 877
Fall	ON	14	-	4 302	12 320	22 185
Fall	ON	15	-	4 312	12 287	22 132
Fall	ON	16	-	4 257	12 146	21 829
Fall	ON	17	-	4 206	12 078	21 661
Fall	ON	18	-	4 172	12 107	21 688
Fall	ON	19	-	4 229	12 490	22 437
Fall	ON	20	-	4 298	12 886	23 220
Fall	ON	21	-	4 351	13 210	23 859
Fall	ON	22	-	4 360	13 385	24 187
Fall	ON	23	-	4 369	13 534	24 467
Fall	ON	24	-	4 376	13 675	24 732

Hourly methane demand for Ontario (MW). Note that methane demand was not modelled for other regions.
NOTE: Figure 10 of the P2NZ report presents 2020 peak gas demand based on the Enbridge ETSA Report not the figures presented here.

Electrification Scenario

Season	Region	Hour	2020	2030	2040	2050
Winter	ON	1	54 389	46 570	24 556	9 217
Winter	ON	2	53 321	45 507	23 746	8 725
Winter	ON	3	52 364	44 533	22 972	8 239
Winter	ON	4	51 313	43 484	22 167	7 748
Winter	ON	5	51 488	43 624	22 226	7 758
Winter	ON	6	51 627	43 736	22 272	7 767
Winter	ON	7	51 688	43 785	22 293	7 770
Winter	ON	8	51 817	43 889	22 336	7 778
Winter	ON	9	51 606	43 719	22 265	7 765
Winter	ON	10	51 955	44 205	22 835	8 215
Winter	ON	11	52 184	44 634	23 456	8 743
Winter	ON	12	51 995	44 646	23 755	9 075
Winter	ON	13	52 363	45 146	24 331	9 526
Winter	ON	14	53 054	45 906	25 015	9 996
Winter	ON	15	53 010	45 912	25 091	10 079
Winter	ON	16	51 933	44 883	24 368	9 672
Winter	ON	17	51 283	44 197	23 788	9 291
Winter	ON	18	51 225	44 027	23 497	9 030
Winter	ON	19	52 668	45 310	24 252	9 372
Winter	ON	20	54 162	46 674	25 114	9 804
Winter	ON	21	55 289	47 703	25 764	10 128
Winter	ON	22	55 705	48 037	25 903	10 152
Winter	ON	23	56 097	48 352	26 034	10 175
Winter	ON	24	56 433	48 622	26 147	10 195
Winter Pe	ON	1	77 859	66 966	35 816	13 821
Winter Pe	ON	2	76 787	65 789	34 761	13 099
Winter Pe	ON	3	75 371	64 337	33 591	12 356
Winter Pe	ON	4	74 127	63 023	32 478	11 624
Winter Pe	ON	5	76 015	64 540	33 111	11 736
Winter Pe	ON	6	78 934	66 886	34 088	11 908
Winter Pe	ON	7	78 247	66 334	33 858	11 867
Winter Pe	ON	8	78 763	66 748	34 031	11 898
Winter Pe	ON	9	77 046	65 368	33 456	11 796
Winter Pe	ON	10	78 290	66 682	34 568	12 529
Winter Pe	ON	11	77 516	66 438	35 144	13 274
Winter Pe	ON	12	75 627	65 172	35 068	13 689
Winter Pe	ON	13	75 498	65 383	35 720	14 341
Winter Pe	ON	14	74 853	65 179	36 200	14 961
Winter Pe	ON	15	74 209	64 725	36 124	15 055
Winter Pe	ON	16	71 291	62 128	34 590	14 356
Winter Pe	ON	17	68 716	59 807	33 171	13 677
Winter Pe	ON	18	70 304	60 895	33 285	13 375
Winter Pe	ON	19	72 493	62 842	34 436	13 900
Winter Pe	ON	20	74 038	64 335	35 510	14 518
Winter Pe	ON	21	75 368	65 593	36 373	14 992
Winter Pe	ON	22	76 227	66 283	36 660	15 042
Winter Pe	ON	23	81 722	70 698	38 500	15 367
Winter Pe	ON	24	80 691	69 870	38 155	15 306
Spring	ON	1	35 853	30 959	16 763	6 621
Spring	ON	2	35 300	30 361	16 238	6 266
Spring	ON	3	34 818	29 820	15 737	5 916
Spring	ON	4	34 315	29 263	15 229	5 565
Spring	ON	5	34 651	29 533	15 342	5 585
Spring	ON	6	35 008	29 819	15 461	5 606
Spring	ON	7	34 631	29 516	15 335	5 584
Spring	ON	8	33 300	28 447	14 889	5 505
Spring	ON	9	31 598	27 079	14 319	5 404
Spring	ON	10	30 633	26 458	14 336	5 669
Spring	ON	11	30 320	26 390	14 639	6 037
Spring	ON	12	30 158	26 383	14 856	6 285
Spring	ON	13	30 334	26 678	15 255	6 617
Spring	ON	14	30 736	27 154	15 729	6 962
Spring	ON	15	30 637	27 106	15 764	7 021
Spring	ON	16	29 763	26 281	15 199	6 712
Spring	ON	17	29 119	25 640	14 712	6 416
Spring	ON	18	29 238	25 644	14 548	6 230
Spring	ON	19	30 855	27 035	15 293	6 519
Spring	ON	20	32 960	28 850	16 270	6 900
Spring	ON	21	34 582	30 245	17 017	7 189
Spring	ON	22	35 340	30 854	17 271	7 234
Spring	ON	23	36 167	31 518	17 548	7 283
Spring	ON	24	36 801	32 028	17 760	7 320
Summer	ON	1	8 800	8 505	6 118	3 522
Summer	ON	2	8 172	7 897	5 681	3 271
Summer	ON	3	7 543	7 290	5 244	3 019
Summer	ON	4	6 915	6 682	4 807	2 767
Summer	ON	5	6 915	6 682	4 807	2 767
Summer	ON	6	6 915	6 682	4 807	2 767
Summer	ON	7	6 915	6 682	4 807	2 767
Summer	ON	8	6 915	6 682	4 807	2 767
Summer	ON	9	6 915	6 682	4 807	2 767
Summer	ON	10	7 543	7 290	5 244	3 019
Summer	ON	11	8 298	8 019	5 768	3 321
Summer	ON	12	8 800	8 505	6 118	3 522
Summer	ON	13	9 429	9 112	6 555	3 774
Summer	ON	14	10 058	9 720	6 992	4 025
Summer	ON	15	10 183	9 841	7 079	4 076
Summer	ON	16	9 681	9 355	6 730	3 874
Summer	ON	17	9 178	8 869	6 380	3 673
Summer	ON	18	8 800	8 505	6 118	3 522
Summer	ON	19	9 178	8 869	6 380	3 673
Summer	ON	20	9 681	9 355	6 730	3 874
Summer	ON	21	10 058	9 720	6 992	4 025
Summer	ON	22	10 058	9 720	6 992	4 025
Summer	ON	23	10 058	9 720	6 992	4 025
Summer	ON	24	10 058	9 720	6 992	4 025
Fall	ON	1	24 592	21 193	11 406	4 455
Fall	ON	2	24 444	20 973	11 131	4 231
Fall	ON	3	24 308	20 761	10 858	4 009
Fall	ON	4	24 211	20 581	10 600	3 789
Fall	ON	5	24 461	20 781	10 683	3 803
Fall	ON	6	24 525	20 832	10 705	3 807
Fall	ON	7	24 621	20 910	10 737	3 813
Fall	ON	8	24 323	20 670	10 637	3 795
Fall	ON	9	22 283	19 031	9 954	3 675
Fall	ON	10	20 930	18 047	9 727	3 809
Fall	ON	11	20 094	17 498	9 719	4 017
Fall	ON	12	19 508	17 109	9 704	4 154
Fall	ON	13	19 233	16 990	9 838	4 353
Fall	ON	14	19 456	17 272	10 140	4 580
Fall	ON	15	19 221	17 104	10 106	4 609
Fall	ON	16	18 905	16 768	9 819	4 419
Fall	ON	17	18 919	16 697	9 643	4 248
Fall	ON	18	19 301	16 942	9 635	4 142
Fall	ON	19	20 808	18 215	10 275	4 360
Fall	ON	20	22 294	19 491	10 954	4 619
Fall	ON	21	23 532	20 547	11 504	4 821
Fall	ON	22	24 332	21 189	11 772	4 868
Fall	ON	23	25 013	21 737	12 001	4 908
Fall	ON	24	25 658	22 255	12 217	4 946

Diversified Scenario

Season	Region	Hour	2020	2030	2040	2050
Winter	ON	1	54 389	50 201	32 863	14 546
Winter	ON	2	53 321	49 114	31 807	13 909
Winter	ON	3	52 364	48 126	30 799	13 283
Winter	ON	4	51 313	47 054	29 751	12 647
Winter	ON	5	51 488	47 208	29 826	12 664
Winter	ON	6	51 627	47 329	29 885	12 677
Winter	ON	7	51 688	47 382	29 912	12 683
Winter	ON	8	51 817	47 495	29 967	12 696
Winter	ON	9	51 606	47 310	29 876	12 675
Winter	ON	10	51 955	47 768	30 623	13 243
Winter	ON	11	52 184	48 151	31 438	13 906
Winter	ON	12	51 995	48 108	31 834	14 315
Winter	ON	13	52 363	48 582	32 589	14 885
Winter	ON	14	53 054	49 338	33 483	15 486
Winter	ON	15	53 010	49 330	33 583	15 589
Winter	ON	16	51 933	48 267	32 643	15 057
Winter	ON	17	51 283	47 577	31 886	14 567
Winter	ON	18	51 225	47 434	31 503	14 241
Winter	ON	19	52 668	48 788	32 481	14 701
Winter	ON	20	54 162	50 215	33 601	15 272
Winter	ON	21	55 289	51 292	34 443	15 702
Winter	ON	22	55 705	51 656	34 622	15 742
Winter	ON	23	56 097	51 999	34 791	15 780
Winter	ON	24	56 433	52 292	34 935	15 812
Winter Pe	ON	1	77 859	71 862	47 429	20 819
Winter Pe	ON	2	76 787	70 690	46 051	19 895
Winter Pe	ON	3	75 371	69 218	44 526	18 938
Winter Pe	ON	4	74 127	67 897	43 075	17 998
Winter Pe	ON	5	76 015	69 548	43 886	18 180
Winter Pe	ON	6	78 934	72 100	45 141	18 461
Winter Pe	ON	7	78 247	71 499	44 846	18 395
Winter Pe	ON	8	78 763	71 950	45 067	18 445
Winter Pe	ON	9	77 046	70 449	44 329	18 279
Winter Pe	ON	10	78 290	71 770	45 781	19 220
Winter Pe	ON	11	77 516	71 375	46 548	20 130
Winter Pe	ON	12	75 627	69 911	46 469	20 604
Winter Pe	ON	13	75 498	70 031	47 330	21 412
Winter Pe	ON	14	74 853	69 702	47 970	22 170
Winter Pe	ON	15	74 209	69 186	47 877	22 272
Winter Pe	ON	16	71 291	66 447	45 889	21 334
Winter Pe	ON	17	68 716	64 009	44 049	20 430
Winter Pe	ON	18	70 304	65 257	44 182	20 091
Winter Pe	ON	19	72 493	67 311	45 672	20 794
Winter Pe	ON	20	74 038	68 849	47 070	21 599
Winter Pe	ON	21	75 368	70 152	48 192	22 220
Winter Pe	ON	22	76 227	70 903	48 561	22 303
Winter Pe	ON	23	81 722	75 706	50 922	22 833
Winter Pe	ON	24	80 691	74 806	50 479	22 734
Spring	ON	1	35 853	33 463	22 807	10 888
Spring	ON	2	35 300	32 865	22 122	10 434
Spring	ON	3	34 818	32 330	21 467	9 987
Spring	ON	4	34 315	31 776	20 804	9 538
Spring	ON	5	34 651	32 070	20 948	9 571
Spring	ON	6	35 008	32 381	21 101	9 605
Spring	ON	7	34 631	32 052	20 939	9 569
Spring	ON	8	33 300	30 888	20 367	9 440
Spring	ON	9	31 598	29 400	19 636	9 276
Spring	ON	10	30 633	28 672	19 669	9 584
Spring	ON	11	30 320	28 535	20 071	10 034
Spring	ON	12	30 158	28 484	20 360	10 339
Spring	ON	13	30 334	28 753	20 883	10 757
Spring	ON	14	30 736	29 218	21 503	11 196
Spring	ON	15	30 637	29 154	21 550	11 267
Spring	ON	16	29 763	28 299	20 817	10 862
Spring	ON	17	29 119	27 645	20 182	10 479
Spring	ON	18	29 238	27 680	19 964	10 250
Spring	ON	19	30 855	29 162	20 928	10 647
Spring	ON	20	32 960	31 094	22 191	11 170
Spring	ON	21	34 582	32 581	23 156	11 567
Spring	ON	22	35 340	33 243	23 482	11 640
Spring	ON	23	36 167	33 966	23 838	11 720
Spring	ON	24	36 801	34 521	24 110	11 781
Summer	ON	1	8 800	9 280	9 091	6 409
Summer	ON	2	8 172	8 654	8 523	6 081
Summer	ON	3	7 543	8 029	7 954	5 754
Summer	ON	4	6 915	7 403	7 386	5 426
Summer	ON	5	6 915	7 403	7 386	5 426
Summer	ON	6	6 915	7 403	7 386	5 426
Summer	ON	7	6 915	7 403	7 386	5 426
Summer	ON	8	6 915	7 403	7 386	5 426
Summer	ON	9	6 915	7 403	7 386	5 426
Summer	ON	10	7 543	8 029	7 954	5 754
Summer	ON	11	8 298	8 780	8 637	6 147
Summer	ON	12	8 800	9 280	9 091	6 409
Summer	ON	13	9 429	9 906	9 660	6 737
Summer	ON	14	10 058	10 532	10 229	7 065
Summer	ON	15	10 183	10 657	10 342	7 130
Summer	ON	16	9 681	10 156	9 887	6 868
Summer	ON	17	9 178	9 656	9 433	6 606
Summer	ON	18	8 800	9 280	9 091	6 409
Summer	ON	19	9 178	9 656	9 433	6 606
Summer	ON	20	9 681	10 156	9 887	6 868
Summer	ON	21	10 058	10 532	10 229	7 065
Summer	ON	22	10 058	10 532	10 229	7 065
Summer	ON	23	10 058	10 532	10 229	7 065
Summer	ON	24	10 058	10 532	10 229	7 065
Fall	ON	1	24 592	23 085	15 879	7 932
Fall	ON	2	24 444	22 880	15 517	7 651
Fall	ON	3	24 308	22 685	15 160	7 371
Fall	ON	4	24 211	22 524	14 820	7 094
Fall	ON	5	24 461	22 742	14 927	7 118
Fall	ON	6	24 525	22 798	14 955	7 125
Fall	ON	7	24 621	22 882	14 996	7 134
Fall	ON	8	24 323	22 621	14 868	7 105
Fall	ON	9	22 283	20 838	13 991	6 908
Fall	ON	10	20 930	19 732	13 708	7 045
Fall	ON	11	20 094	19 092	13 707	7 285
Fall	ON	12	19 508	18 641	13 694	7 442
Fall	ON	13	19 233	18 477	13 874	7 683
Fall	ON	14	19 456	18 748	14 268	7 971
Fall	ON	15	19 221	18 558	14 227	8 002
Fall	ON	16	18 905	18 221	13 852	7 758
Fall	ON	17	18 919	18 172	13 620	7 546
Fall	ON	18	19 301	18 460	13 605	7 422
Fall	ON	19	20 808	19 823	14 431	7 728
Fall	ON	20	22 294	21 183	15 309	8 085
Fall	ON	21	23 532	22 311	16 020	8 364
Fall	ON	22	24 332	23 010	16 364	8 442
Fall	ON	23	25 013	23 606	16 656	8 507
Fall	ON	24	25 658	24 170	16 934	8 570

SupplyTechnology	InputFuel	OutputFuel	Lifetime	TechEfficiency	Source / Note
Wind Onshore	Wind	Electricity	25	*Varies by season and hour see "Supply Tech Efficiencies by Szn" tab*	
Wind Offshore	Wind	Electricity	25	*Varies by season and hour see "Supply Tech Efficiencies by Szn" tab*	
Solar PV	Solar	Electricity	25	*Varies by season and hour see "Supply Tech Efficiencies by Szn" tab*	
Hydro	Water	Electricity	50	*Varies by season and hour see "Supply Tech Efficiencies by Szn" tab*	
Hydro Pumped Storage	Electricity	Electricity	50	80%	*U.S. Energy Information Administration - EIA - ndependent Statistics and Analysis*
Nuclear	Uranium	Electricity	50	35%	*Nuc ear power p ant - Energy Education*
O/CCGT - CH4	Methane	Electricity	25	42%	*Our Energy Sources Natural Gas — The National Academ es (nas.edu)*
O/CCGT - H2	Hydrogen	Electricity	25	42%	*Our Energy Sources Natural Gas — The National Academ es (nas.edu)*
Biomass	Biomass	Electricity	25	28%	*Biomass for Heat and Power Technology Brief (irena.org)*
CH4 Salt Cavern Storage	Methane	Methane	50	99%	
H2 Salt Cavern Storage	Hydrogen	Hydrogen	50	99%	
Battery Storage	Electricity	Electricity	15	85%	*Fact Sheet | Energy Storage (2019) | White Papers | EESI*
Electrolyser 2030	Electricity	Hydrogen	25	71%	*Eff ciency chosen to match cost of electrolyzer. Source: European Hydrogen Backbone 2020. Link: https://ehb.eu/fi es/down oads/2020_European-Hydrogen-Backbone_Report.pdf*
Electrolyser 2040	Electricity	Hydrogen	25	76%	*Eff ciency chosen to match cost of electrolyzer. Source: European Hydrogen Backbone 2020. Link: https://ehb.eu/fi es/down oads/2020_European-Hydrogen-Backbone_Report.pdf*
Electrolyser 2050	Electricity	Hydrogen	25	80%	*Eff ciency chosen to match cost of electrolyzer. Source: European Hydrogen Backbone 2020. Link: https://ehb.eu/fi es/down oads/2020_European-Hydrogen-Backbone_Report.pdf*
Anaerobic Digestion	AD Feedstock	Methane	25	N/A	*Feedstock price is included in the unit energy cost (and therefore the effic ency value is not specified).*
SMR CCS	Methane	Hydrogen	25	69%	
Biomass CCS	Biomass	Electricity	25	28%	*Biomass for Heat and Power Technology Brief (irena.org)*
Nuclear SMR	Uranium	Electricity	50	35%	*Assumed to be the same as conventional nuclear.*

SupplyTechnology	**Existing Generation Capacity (MW)**	**Source**
Wind Onshore	5,534	Canadian Wind Energy Association
Wind Offshore	-	
Solar PV	478	Transmission-Connected Generation (ieso.ca)
Hydro	[redacted]	*Guidehouse Internal Source (Confidential & Proprietary)*
Hydro Pumped Storage	[redacted]	*Guidehouse Internal Markets Modeling Team (confidential forecast)*
Nuclear	13,089	Transmission-Connected Generation (ieso.ca)
Fossil Fuel Thermal (Coal, Peat, Oil)	[redacted]	*Guidehouse Internal Markets Modeling Team (confidential forecast)*
O/CCGT - CH4	[redacted]	*Guidehouse Internal Markets Modeling Team (confidential forecast)*
O/CCGT - H2	-	
Biomass	[redacted]	*Guidehouse Internal Markets Modeling Team (confidential forecast)*
Battery Storage	-	
CH4 Salt Cavern Storage	36,000	*Based on 281 bcf storage volume. Source: https://www.enbridge.com/about-us/natural-gas-transmission-and-midstream/natural-gas-storage*
H2 Salt Cavern Storage	-	
Electrolyser 2030	-	
Electrolyser 2040	-	
Electrolyser 2050	-	
Anaerobic Digestion	-	
SMR CCS	-	
Biomass + CCS	-	
Nuclear SMR	-	

Planned Capacity Retirements (MW)

SupplyTechnology	**2020**	**2030**	**2040**	**2050**	**Source**
Wind Onshore	0	0	0	0	
Wind Offshore	0	0	0	0	
Solar PV	0	0	0	0	
Hydro	0	0	0	0	
Hydro Pumped Storage	0	0	0	0	
Nuclear	[redacted]	[redacted]	[redacted]	[redacted]	*Guidehouse Internal Markets Modeling Team (confidential forecast)*
Fossil Fuel Thermal (Coal, Peat, Oil)	[redacted]	[redacted]	[redacted]	[redacted]	*Guidehouse Internal Markets Modeling Team (confidential forecast)*
O/CCGT - CH4 Existing	[redacted]	[redacted]	[redacted]	[redacted]	*Guidehouse Internal Markets Modeling Team (confidential forecast)*
O/CCGT - CH4 New	[redacted]	[redacted]	[redacted]	[redacted]	*Guidehouse Internal Markets Modeling Team (confidential forecast)*
O/CCGT - H2 New	[redacted]	[redacted]	[redacted]	[redacted]	*Guidehouse Internal Markets Modeling Team (confidential forecast)*
Biomass	[redacted]	[redacted]	[redacted]	[redacted]	*Guidehouse Internal Markets Modeling Team (confidential forecast)*
Battery Storage	0	0	0	0	
CH4 Salt Cavern Storage	0	0	0	0	
H2 Salt Cavern Storage	0	0	0	0	
Electrolyser 2030	0	0	0	0	
Electrolyser 2040	0	0	0	0	
Electrolyser 2050	0	0	0	0	
Anaerobic Digestion	0	0	0	0	
SMR CCS	0	0	0	0	
Biomass + CCS	0	0	0	0	
Nuclear SMR	0	0	0	0	

n aTechno ogy	Region1	Reg on2	uel	osses	ength km)	i etime yea s)	Notes
Elect ici y T ansmission ne	ON	ON	Elect ici y	6%	1	70	A 6% loss ac o is assumed o all nt a- egional elect ici y t ansmiss on No e that the ength s 1 because losses a e not calculated n te ms o length
Elect ici y T ansmission ne	QC	QC	Elect ici y	6%	1	70	A 6% loss ac o is assumed o all nt a- egional elect ici y t ansmiss on No e that the ength s 1 because losses a e not calculated n te ms o length
Elect ici y T ansmission ne	WC	WC	Elect ici y	6%	1	70	A 6% loss ac o is assumed o all nt a- egional elect ici y t ansmiss on No e that the ength s 1 because losses a e not calculated n te ms o length
Elect ici y T ansmission ne	NY	NY	Elect ici y	6%	1	70	A 6% loss ac o is assumed o all nt a- egional elect ici y t ansmiss on No e that the ength s 1 because losses a e not calculated n te ms o length
Elect ici y T ansmission ne	MI	MI	Elect ici y	6%	1	70	A 6% loss ac o is assumed o all nt a- egional elect ici y t ansmiss on No e that the ength s 1 because losses a e not calculated n te ms o length
Elect ici y T ansmission ne	PJ	PJ	Elect ici y	6%	1	70	A 6% loss ac o is assumed o all nt a- egional elect ici y t ansmiss on No e that the ength s 1 because losses a e not calculated n te ms o length
Elect ici y T ansmission ne	ON	QC	Elect ici y	0 011%	700	70	A 0 011% oss acto is assumed o all inte - eg onal elect city t ansmiss ons based on the s anda d 1 1% 100-km
Elect ici y T ansmission ne	ON	WC	Elect ici y	0 011%	2000	70	A 0 011% oss acto is assumed o all inte - eg onal elect city t ansmiss ons based on the s anda d 1 1% 100-km
Elect ici y T ansmission ne	ON	NY	Elect ici y	0 011%	500	70	A 0 011% oss acto is assumed o all inte - eg onal elect city t ansmiss ons based on the s anda d 1 1% 100-km
Elect ici y T ansmission ne	ON	MI	Elect ici y	0 011%	500	70	A 0 011% oss acto is assumed o all inte - eg onal elect city t ansmiss ons based on the s anda d 1 1% 100-km
Elect ici y T ansmission ne	ON	PJ	Elect ici y	0 011%	200	70	A 0 011% oss acto is assumed o all inte - eg onal elect city t ansmiss ons based on the s anda d 1 1% 100-km
Elect ici y T ansmission ne	QC	NY	Elect ici y	0 011%	500	70	A 0 011% oss acto is assumed o all inte - eg onal elect city t ansmiss ons based on the s anda d 1 1% 100-km
Elect ici y T ansmission ne	WC	MI	Elect ici y	0 011%	500	70	A 0 011% oss acto is assumed o all inte - eg onal elect city t ansmiss ons based on the s anda d 1 1% 100-km
New Ded cated H2 T ansmiss on P pe ine	ON	ON	Hyd ogen	0 4%	1	70	Sou ce Enb idge Link h tps www ds oeb ca CMWebD awe Reco d 728474 ile document
New Ded cated H2 T ansmiss on P pe ine	QC	QC	Hyd ogen	3%	1	70	App ying high- evel assump ion o 3% based on n the PHMSA database which li ts mo e han 1 400 gas companies 72 companies epo ed lost and unaccounted o ates o 10 pe cent o highe Two-hund ed-and-seven y- ive companies had a a e be ween 3 and 9 9 pe cent Sou ce h tps www cienti icame ican com a icle how-much-natu al gas- eaks
New Ded cated H2 T ansmiss on P pe ine	WC	WC	Hyd ogen	3%	1	70	App ying high- evel assump ion o 3% based on n the PHMSA database which li ts mo e han 1 400 gas companies 72 companies epo ed lost and unaccounted o ates o 10 pe cent o highe Two-hund ed-and-seven y- ive companies had a a e be ween 3 and 9 9 pe cent Sou ce h tps www cienti icame ican com a icle how-much-natu al gas- eaks
New Ded cated H2 T ansmiss on P pe ine	NY	NY	Hyd ogen	3%	1	70	App ying high- evel assump ion o 3% based on n the PHMSA database which li ts mo e han 1 400 gas companies 72 companies epo ed lost and unaccounted o ates o 10 pe cent o highe Two-hund ed-and-seven y- ive companies had a a e be ween 3 and 9 9 pe cent Sou ce h tps www cienti icame ican com a icle how-much-natu al gas- eaks
New Ded cated H2 T ansmiss on P pe ine	MI	MI	Hyd ogen	3%	1	70	App ying high- evel assump ion o 3% based on n the PHMSA database which li ts mo e han 1 400 gas companies 72 companies epo ed lost and unaccounted o ates o 10 pe cent o highe Two-hund ed-and-seven y- ive companies had a a e be ween 3 and 9 9 pe cent Sou ce h tps www cienti icame ican com a icle how-much-natu al gas- eaks
New Ded cated H2 T ansmiss on P pe ine	PJ	PJ	Hyd ogen	3%	1	70	App ying high- evel assump ion o 3% based on n the PHMSA database which li ts mo e han 1 400 gas companies 72 companies epo ed lost and unaccounted o ates o 10 pe cent o highe Two-hund ed-and-seven y- ive companies had a a e be ween 3 and 9 9 pe cent Sou ce h tps www cienti icame ican com a icle how-much-natu al gas- eaks
New Ded cated H2 T ansmiss on P pe ine	ON	QC	Hyd ogen	0 005%	100	70	Assuming 0 005% km losses based on compa ison w th elect ici y losses o elect city n e onnection osses a e 0 011% km whe e losses in nt a- egion a e 6% gas osses a e 3% equiva ent to ~50% o e ect ic ty osses assume a so 50% x 0 011% km 0 005% km o gas
New Ded cated H2 T ansmiss on P pe ine	ON	WC	Hyd ogen	0 005%	1400	70	Assuming 0 005% km losses based on compa ison w th elect ici y losses o elect city n e onnection osses a e 0 011% km whe e losses in nt a- egion a e 6% gas osses a e 3% equiva ent to ~50% o e ect ic ty osses assume a so 50% x 0 011% km 0 005% km o gas
New Ded cated H2 T ansmiss on P pe ine	ON	NY	Hyd ogen	0 005%	500	70	Assuming 0 005% km losses based on compa ison w th elect ici y losses o elect city n e onnection osses a e 0 011% km whe e losses in nt a- egion a e 6% gas osses a e 3% equiva ent to ~50% o e ect ic ty osses assume a so 50% x 0 011% km 0 005% km o gas
New Ded cated H2 T ansmiss on P pe ine	ON	MI	Hyd ogen	0 005%	500	70	Assuming 0 005% km losses based on compa ison w th elect ici y losses o elect city n e onnection osses a e 0 011% km whe e losses in nt a- egion a e 6% gas osses a e 3% equiva ent to ~50% o e ect ic ty osses assume a so 50% x 0 011% km 0 005% km o gas
New Ded cated H2 T ansmiss on P pe ine	ON	PJ	Hyd ogen	0 005%	200	70	Assuming 0 005% km losses based on compa ison w th elect ici y losses o elect city n e onnection osses a e 0 011% km whe e losses in nt a- egion a e 6% gas osses a e 3% equiva ent to ~50% o e ect ic ty osses assume a so 50% x 0 011% km 0 005% km o gas
Repu posed Dedicated H2 T ansm ssion Pipeline	ON	ON	Hyd ogen	0 4%	1	70	Sou ce Enb idge Link h tps www ds oeb ca CMWebD awe Reco d 728474 ile document
Repu posed Dedicated H2 T ansm ssion Pipeline	QC	QC	Hyd ogen	3%	1	70	App ying high- evel assump ion o 3% based on n the PHMSA database which li ts mo e han 1 400 gas companies 72 companies epo ed lost and unaccounted o ates o 10 pe cent o highe Two-hund ed-and-seven y- ive companies had a a e be ween 3 and 9 9 pe cent Sou ce h tps www cienti icame ican com a icle how-much-natu al gas- eaks
Repu posed Dedicated H2 T ansm ssion Pipeline	WC	WC	Hyd ogen	3%	1	70	App ying high- evel assump ion o 3% based on n the PHMSA database which li ts mo e han 1 400 gas companies 72 companies epo ed lost and unaccounted o ates o 10 pe cent o highe Two-hund ed-and-seven y- ive companies had a a e be ween 3 and 9 9 pe cent Sou ce h tps www cienti icame ican com a icle how-much-natu al gas- eaks
Repu posed Dedicated H2 T ansm ssion Pipeline	NY	NY	Hyd ogen	3%	1	70	App ying high- evel assump ion o 3% based on n the PHMSA database which li ts mo e han 1 400 gas companies 72 companies epo ed lost and unaccounted o ates o 10 pe cent o highe Two-hund ed-and-seven y- ive companies had a a e be ween 3 and 9 9 pe cent Sou ce h tps www cienti icame ican com a icle how-much-natu al gas- eaks
Repu posed Dedicated H2 T ansm ssion Pipeline	MI	MI	Hyd ogen	3%	1	70	App ying high- evel assump ion o 3% based on n the PHMSA database which li ts mo e han 1 400 gas companies 72 companies epo ed lost and unaccounted o ates o 10 pe cent o highe Two-hund ed-and-seven y- ive companies had a a e be ween 3 and 9 9 pe cent Sou ce h tps www cienti icame ican com a icle how-much-natu al gas- eaks
Repu posed Dedicated H2 T ansm ssion Pipeline	PJ	PJ	Hyd ogen	3%	1	70	App ying high- evel assump ion o 3% based on n the PHMSA database which li ts mo e han 1 400 gas companies 72 companies epo ed lost and unaccounted o ates o 10 pe cent o highe Two-hund ed-and-seven y- ive companies had a a e be ween 3 and 9 9 pe cent Sou ce h tps www cienti icame ican com a icle how-much-natu al gas- eaks
Repu posed Dedicated H2 T ansm ssion Pipeline	ON	QC	Hyd ogen	0 005%	100	70	Assuming 0 005% km losses based on compa ison w th elect ici y losses o elect city n e onnection osses a e 0 011% km whe e losses in nt a- egion a e 6% gas osses a e 3% equiva ent to ~50% o e ect ic ty osses assume a so 50% x 0 011% km 0 005% km o gas
Repu posed Dedicated H2 T ansm ssion Pipeline	ON	WC	Hyd ogen	0 005%	1400	70	Assuming 0 005% km losses based on compa ison w th elect ici y losses o elect city n e onnection osses a e 0 011% km whe e losses in nt a- egion a e 6% gas osses a e 3% equiva ent to ~50% o e ect ic ty osses assume a so 50% x 0 011% km 0 005% km o gas
Repu posed Dedicated H2 T ansm ssion Pipeline	ON	NY	Hyd ogen	0 005%	500	70	Assuming 0 005% km losses based on compa ison w th elect ici y losses o elect city n e onnection osses a e 0 011% km whe e losses in nt a- egion a e 6% gas osses a e 3% equiva ent to ~50% o e ect ic ty osses assume a so 50% x 0 011% km 0 005% km o gas
Repu posed Dedicated H2 T ansm ssion Pipeline	ON	MI	Hyd ogen	0 005%	500	70	Assuming 0 005% km losses based on compa ison w th elect ici y losses o elect city n e onnection osses a e 0 011% km whe e losses in nt a- egion a e 6% gas osses a e 3% equiva ent to ~50% o e ect ic ty osses assume a so 50% x 0 011% km 0 005% km o gas
Repu posed Dedicated H2 T ansm ssion Pipeline	ON	PJ	Hyd ogen	0 005%	200	70	Assuming 0 005% km losses based on compa ison w th elect ici y losses o elect city n e onnection osses a e 0 011% km whe e losses in nt a- egion a e 6% gas osses a e 3% equiva ent to ~50% o e ect ic ty osses assume a so 50% x 0 011% km 0 005% km o gas
Methane T ansm ssion Pipe ine	ON	ON	Methane	0 4%	1	70	Sou ce Enb idge Link h tps www ds oeb ca CMWebD awe Reco d 728474 ile document
Methane T ansm ssion Pipe ine	QC	QC	Methane	3%	1	70	App ying high- evel assump ion o 3% based on n the PHMSA database which li ts mo e han 1 400 gas companies 72 companies epo ed lost and unaccounted o ates o 10 pe cent o highe Two-hund ed-and-seven y- ive companies had a a e be ween 3 and 9 9 pe cent Sou ce h tps www cienti icame ican com a icle how-much-natu al gas- eaks
Methane T ansm ssion Pipe ine	WC	WC	Methane	3%	1	70	App ying high- evel assump ion o 3% based on n the PHMSA database which li ts mo e han 1 400 gas companies 72 companies epo ed lost and unaccounted o ates o 10 pe cent o highe Two-hund ed-and-seven y- ive companies had a a e be ween 3 and 9 9 pe cent Sou ce h tps www cienti icame ican com a icle how-much-natu al gas- eaks
Methane T ansm ssion Pipe ine	NY	NY	Methane	3%	1	70	App ying high- evel assump ion o 3% based on n the PHMSA database which li ts mo e han 1 400 gas companies 72 companies epo ed lost and unaccounted o ates o 10 pe cent o highe Two-hund ed-and-seven y- ive companies had a a e be ween 3 and 9 9 pe cent Sou ce h tps www cienti icame ican com a icle how-much-natu al gas- eaks
Methane T ansm ssion Pipe ine	MI	MI	Methane	3%	1	70	App ying high- evel assump ion o 3% based on n the PHMSA database which li ts mo e han 1 400 gas companies 72 companies epo ed lost and unaccounted o ates o 10 pe cent o highe Two-hund ed-and-seven y- ive companies had a a e be ween 3 and 9 9 pe cent Sou ce h tps www cienti icame ican com a icle how-much-natu al gas- eaks
Methane T ansm ssion Pipe ine	PJ	PJ	Methane	3%	1	70	App ying high- evel assump ion o 3% based on n the PHMSA database which li ts mo e han 1 400 gas companies 72 companies epo ed lost and unaccounted o ates o 10 pe cent o highe Two-hund ed-and-seven y- ive companies had a a e be ween 3 and 9 9 pe cent Sou ce h tps www cienti icame ican com a icle how-much-natu al gas- eaks
Methane T ansm ssion Pipe ine	ON	QC	Methane	0 005%	700	70	Assuming 0 005% km losses based on compa ison w th elect ici y losses o elect city n e onnection osses a e 0 011% km whe e losses in nt a- egion a e 6% gas osses a e 3% equiva ent to ~50% o e ect ic ty osses assume a so 50% x 0 011% km 0 005% km o gas
Methane T ansm ssion Pipe ine	ON	WC	Methane	0 005%	2000	70	Assuming 0 005% km losses based on compa ison w th elect ici y losses o elect city n e onnection osses a e 0 011% km whe e losses in nt a- egion a e 6% gas osses a e 3% equiva ent to ~50% o e ect ic ty osses assume a so 50% x 0 011% km 0 005% km o gas
Methane T ansm ssion Pipe ine	ON	NY	Methane	0 005%	500	70	Assuming 0 005% km losses based on compa ison w th elect ici y losses o elect city n e onnection osses a e 0 011% km whe e losses in nt a- egion a e 6% gas osses a e 3% equiva ent to ~50% o e ect ic ty osses assume a so 50% x 0 011% km 0 005% km o gas
Methane T ansm ssion Pipe ine	ON	MI	Methane	0 005%	500	70	Assuming 0 005% km losses based on compa ison w th elect ici y losses o elect city n e onnection osses a e 0 011% km whe e losses in nt a- egion a e 6% gas osses a e 3% equiva ent to ~50% o e ect ic ty osses assume a so 50% x 0 011% km 0 005% km o gas
Methane T ansm ssion Pipe ine	ON	PJ	Methane	0 005%	200	70	Assuming 0 005% km losses based on compa ison w th elect ici y losses o elect city n e onnection osses a e 0 011% km whe e losses in nt a- egion a e 6% gas osses a e 3% equiva ent to ~50% o e ect ic ty osses assume a so 50% x 0 011% km 0 005% km o gas

Existing Transmiss on Infrastructure (MW)

InfraTechnology	Region1	Region2	Fuel	Capacity (MW)	Notes
Electricity Transmission Line	ON	ON	Electricity	23000	*Source: IESO Fall 2021 Reliability Outlook l nk: https://www. eso.ca/en/Sector-Participants/P anning-and-Forecasting/Re iabi ity-Out ook*
Electricity Transmission Line	ON	QC	Electricity	2350	*Source: IESO Fall 2021 Reliability Outlook l nk: https://www. eso.ca/en/Sector-Participants/P anning-and-Forecasting/Re iabi ity-Out ook*
Electricity Transmission Line	ON	WC	Electricity	300	*Source: IESO Fall 2021 Reliability Outlook l nk: https://www. eso.ca/en/Sector-Participants/P anning-and-Forecasting/Re iabi ity-Out ook*
Electricity Transmission Line	ON	NY	Electricity	2100	*Source: IESO Fall 2021 Reliability Outlook l nk: https://www. eso.ca/en/Sector-Participants/P anning-and-Forecasting/Re iabi ity-Out ook*
Electricity Transmission Line	ON	MI	Electricity	1700	*Source: IESO Fall 2021 Reliability Outlook l nk: https://www. eso.ca/en/Sector-Participants/P anning-and-Forecasting/Re iabi ity-Out ook*
Electricity Transmission Line	ON	PJ	Electricity	0	*Source: IESO Fall 2021 Reliability Outlook l nk: https://www. eso.ca/en/Sector-Participants/P anning-and-Forecasting/Re iabi ity-Out ook*
Electricity Transmission Line	QC	NY	Electricity	2500	*Source: IESO Fall 2021 Reliability Outlook l nk: https://www. eso.ca/en/Sector-Participants/P anning-and-Forecasting/Re iabi ity-Out ook*
Electricity Transmission Line	WC	MI	Electricity	1000	*Source: IESO Fall 2021 Reliability Outlook l nk: https://www. eso.ca/en/Sector-Participants/P anning-and-Forecasting/Re iabi ity-Out ook*
New Dedicated H2 Transmission Pipe ine	ON	ON	Hydrogen	0	
New Dedicated H2 Transmission Pipe ine	ON	QC	Hydrogen	0	
New Dedicated H2 Transmission Pipe ine	ON	WC	Hydrogen	0	
New Dedicated H2 Transmission Pipe ine	ON	NY	Hydrogen	0	
New Dedicated H2 Transmission Pipe ine	ON	MI	Hydrogen	0	
New Dedicated H2 Transmission Pipe ine	ON	PJ	Hydrogen	0	
Repurposed Dedicated H2 Transmission Pipeline	ON	ON	Hydrogen	0	
Repurposed Dedicated H2 Transmission Pipeline	ON	QC	Hydrogen	0	
Repurposed Dedicated H2 Transmission Pipeline	ON	WC	Hydrogen	0	
Repurposed Dedicated H2 Transmission Pipeline	ON	NY	Hydrogen	0	
Repurposed Dedicated H2 Transmission Pipeline	ON	MI	Hydrogen	0	
Repurposed Dedicated H2 Transmission Pipeline	ON	PJ	Hydrogen	0	
Methane Transmission Pipeline	ON	ON	Methane	120 000	*Based on a 20-22 MCM/day peak demand in 2020 from Enbridge ETSA Report and rounded up to 120 GW.*
Methane Transmission Pipeline	ON	QC	Methane	14 000	*Based on a capacity of approx mately 1.21 bcf/day. Source: CER link: https://www.cer-rec.gc ca/en/data-analysis/facilities-we-regu ate/pipe ine-profi es/index.html*
Methane Transmission Pipeline	ON	WC	Methane	61 500	*Based on the Northern Ontario Line and the Vector Pipe ine with a combined capac ty of approximately 5.3 bcf/day. Source: CER link: https://www.cer-rec.gc.ca/en/data-ana ysis/facilities-we-regulate/pipeline-profiles/index.html*
Methane Transmission Pipeline	ON	NY	Methane	12 000	*Based on the Niagara and Chippawa interconnect on pipelines with a combined utilization of approximate y 1 bcf/day. Source: CER.*
Methane Transmission Pipeline	ON	MI	Methane	0	
Methane Transmission Pipeline	ON	PJ	Methane	0	