

The Future of **Hydrogen & RNG** in Canada

*Part 2: The Role of Utilities in Accelerating
Hydrogen & RNG Adoption*



#H2RNG

September 29, 2020



Opening remarks

Karen Tam Wu

B.C. Director

Pembina Institute

Leading Canada's transition to clean energy

The Pembina Institute is a non-profit think-tank that advances a prosperous clean energy future for Canada through credible policy solutions.



Presenting partner



CANADIAN GAS ASSOCIATION
ASSOCIATION CANADIENNE DU GAZ

Supporting partners





Moderator

Tahra Jutt

Director, Clean Economy (B.C.)
Pembina Institute



Speaker

Scott Gramm

Manager, Renewable Natural Gas
FortisBC



Speaker

Greg Caldwell

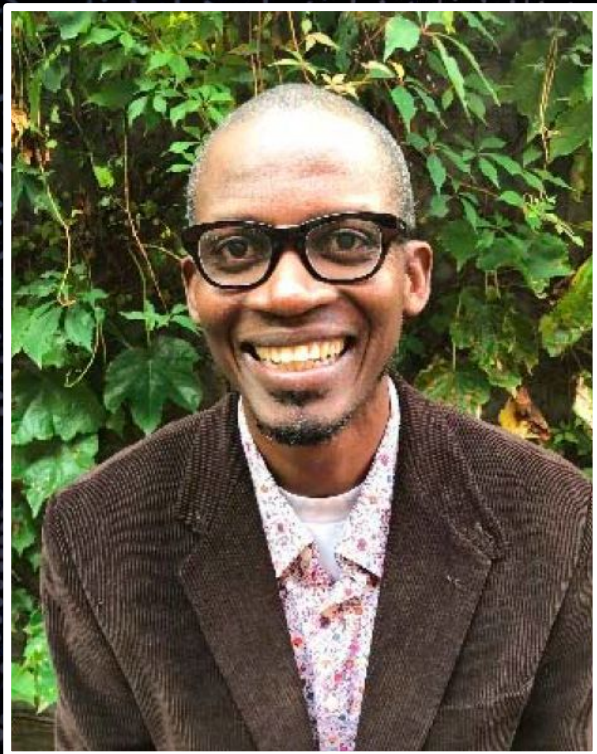
Director, Energy Systems Innovation
ATCO



Speaker

Vincent Regnault

Director, Gas Supply and Renewable
Gases Development
Énergir



Speaker

Samuel McDermott

Technical Manager, Renewable Hydrogen
Enbridge

Renewable Gas in BC

Pembina Webinar

Scott Gramm, Manager of RNG

September, 2020

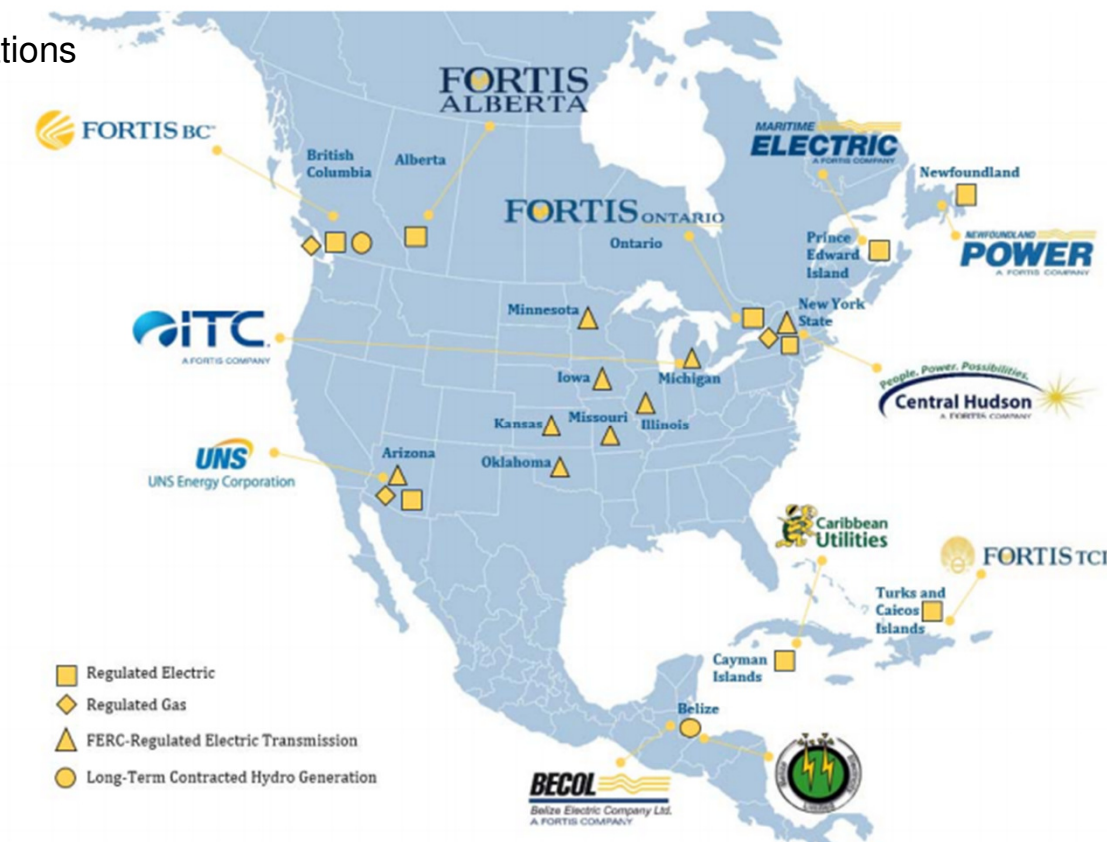
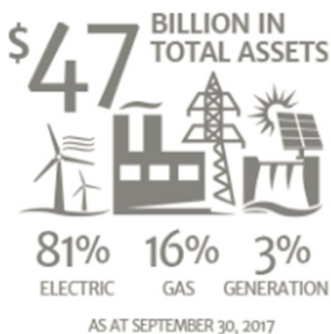
Energy at work



FORTIS BC™

Fortis Inc. – A North American Gas & Electric utility business

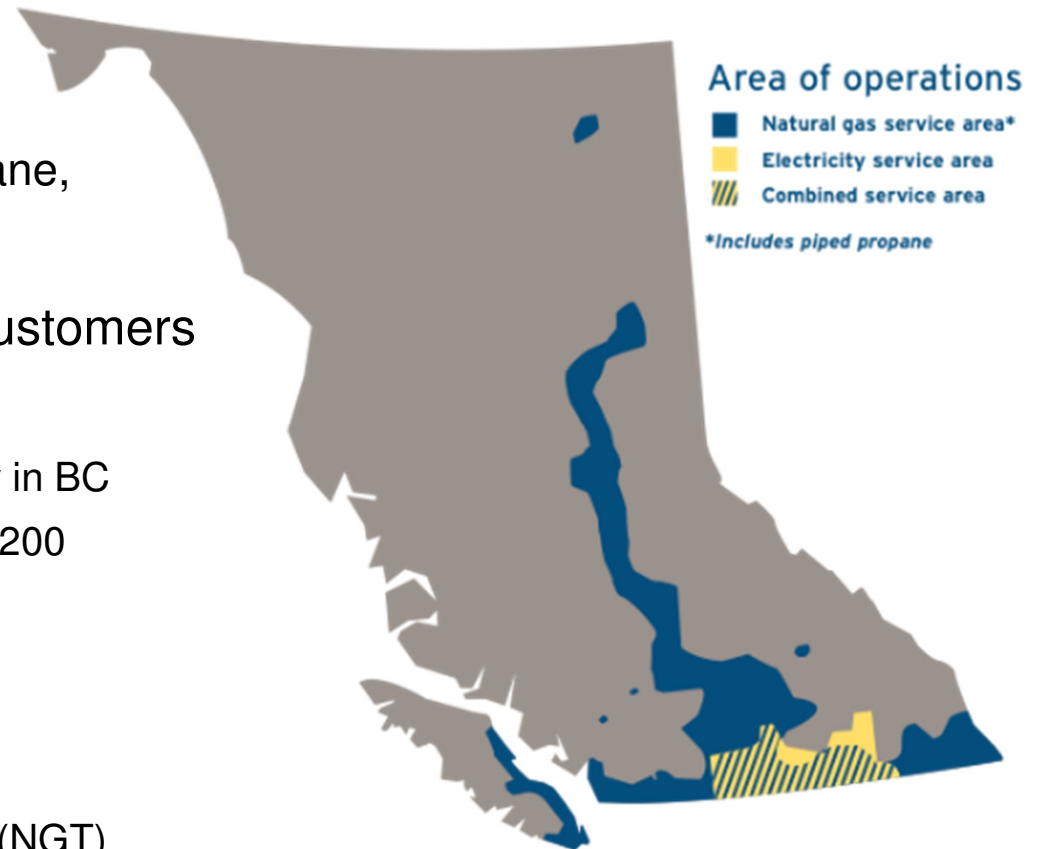
- Regulated Utility w/ 10 utility operations
 - 9 U.S. states
 - 5 Canadian provinces
 - 3 Caribbean countries
- 8,000 employees
- Rate base of \$25.4B
- Listed on TSX and NYSE



Energy at work  FORTIS BC™

About FortisBC

- Energy Provider
 - Natural gas, electricity, propane, district energy
- We serve about 1.1 Million customers
 - Operate in 135 communities
 - Deliver 21 percent of all energy in BC
 - Employ a workforce of about 2,200
- Integrated portfolio:
 - 48,000 km of pipeline in BC
 - Two LNG facilities
 - Natural Gas for Transportation (NGT)
 - Renewable Gas (RG)



FortisBC's Clean Growth Pathway and 30BY30 target

FortisBC's **Clean Growth Pathway** to 2050 is a diversified and flexible approach that supports BC's energy needs.

30BY30 represents an interim target to reduce GHG emissions across our customer base and lead the way to a lower carbon economy.

The Renewable Gas pillar will contribute significantly to achieving this target and including **In-province RNG, Out-of-province RNG and other potential renewable gas pathways.**

Four pillars of our Clean Growth Pathway



Energy Efficiency



Renewable Gas

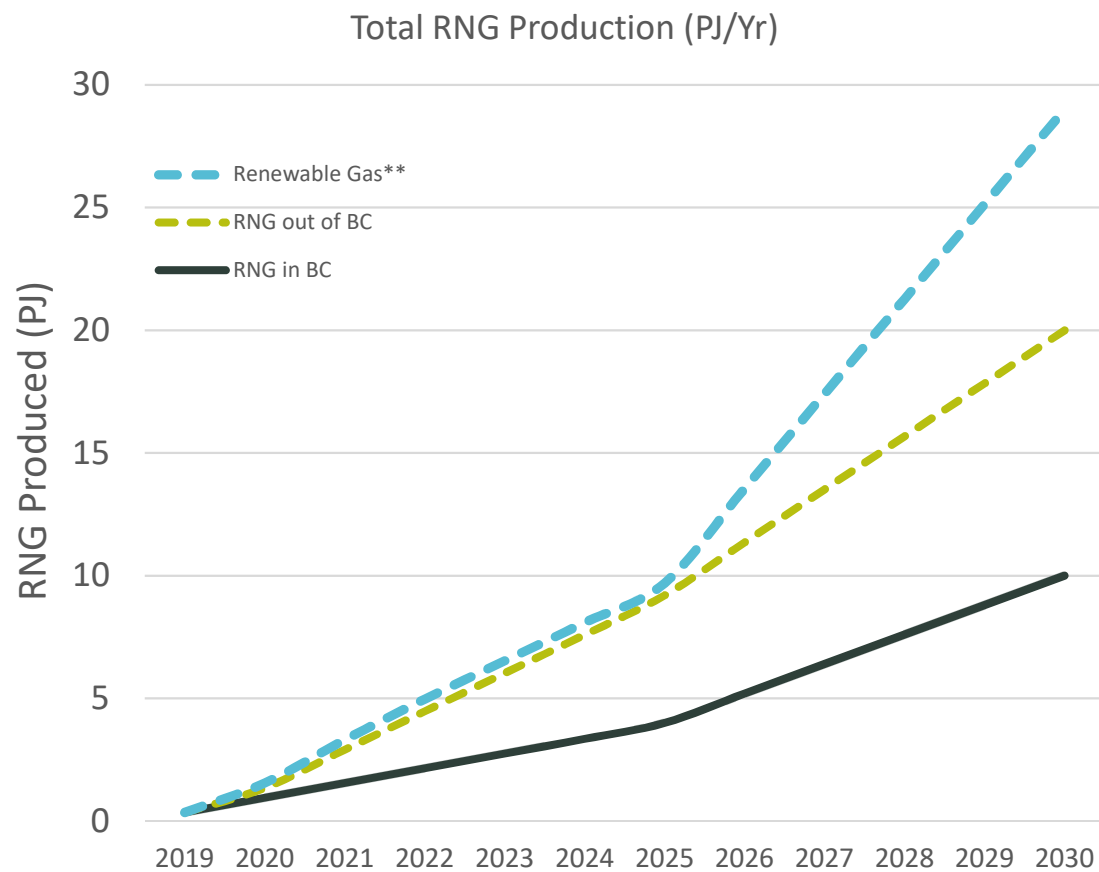


Global LNG



Zero and low carbon transportation

Renewable Gas important for 30BY30



Potential GHG reduction
1.5 MtCO₂e*

Technology advancement
required**:
Wood->RNG, H₂, Syngas

Existing Technology,
Regulatory Change needed:
RNG from organics out of BC

Existing Technology,
feedstock and regulatory
framework:
RNG from organic waste
within BC

*Assumes Renewable gas is approximately carbon neutral, resulting in reduction of GHG emissions by 50kgCO₂e per GJ

FortisBC RG Program History

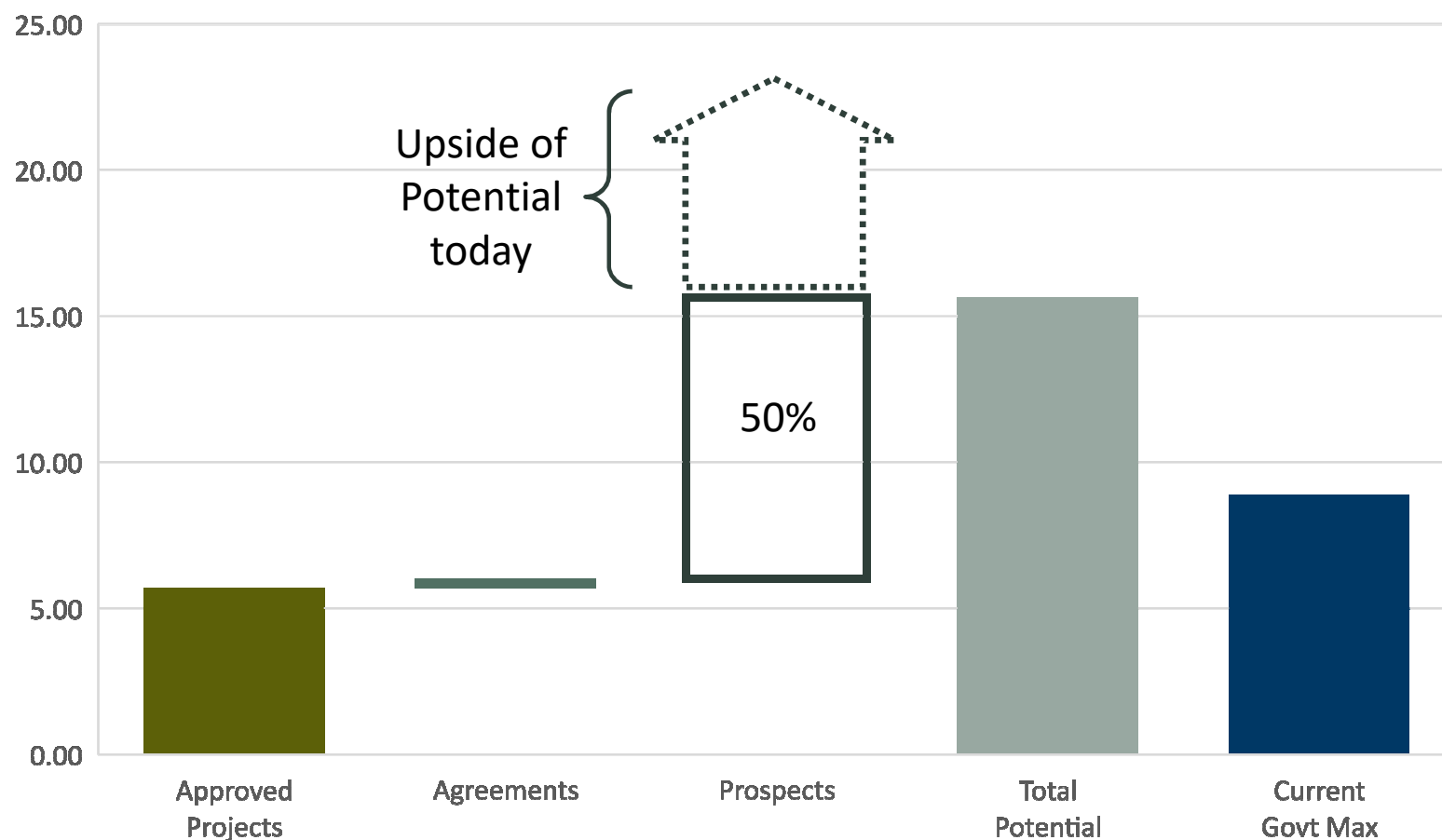


A Few FortisBC Renewable Gas Milestones

- **2010:** First RNG accepted in system at Fraser Valley Biogas
- **2011:** FortisBC established 1st RNG customer Program Canada
- **2012:** First FortisBC-owned project at Salmon Arm Landfill
- **2013:** FortisBC gets BCUC approval for a permanent RNG Program and expands offering to a wider group of customers
- **2016:** New RNG rate leads to increased demand
- **2017:** BC Climate Policy results in a regulation that allows a 5% volume of RNG in existing pipelines
- **2018:** Clean BC Policy states 15% Renewable Gas Objective
- **2019:** BCUC Approval for RNG project at Vancouver Landfill
- **2020:** First out-of-province RNG Supply approved creating opportunity for expanded opportunity

Renewable Gas Supply Portfolio

RG Volume vs Current Regulated Maximum (PJ/Yr)



Key Developments in 2020

FEI now reaching 5% regulation limit

- CleanBC sets target of 15%
- No formal legislation (in GGRR)

Out-of-province RNG

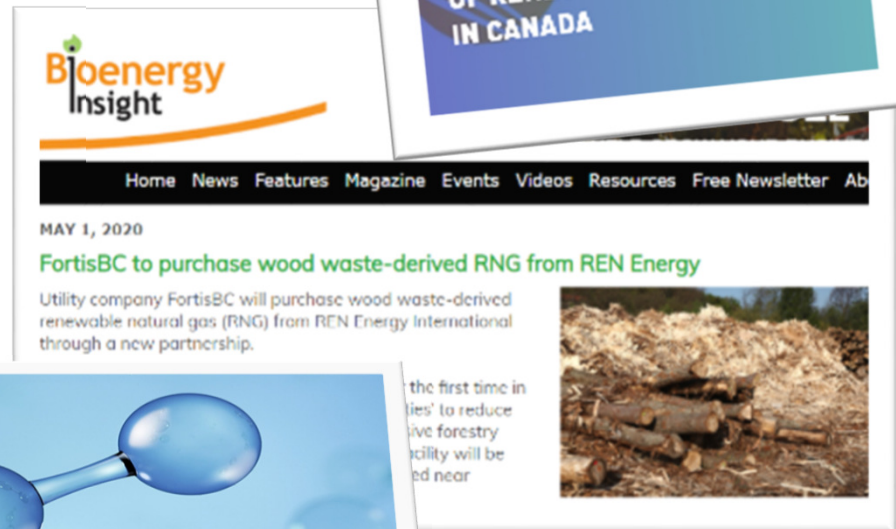
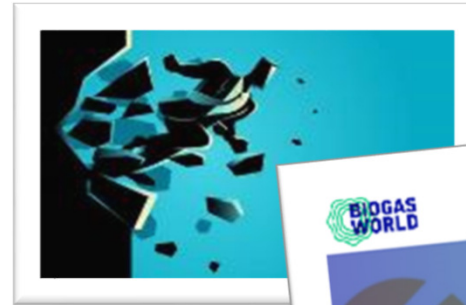
- Received approval for first Agreement in 2020
- Expands concept of displacement

Wood-RNG

- REN Energy
- First-of-its-kind commercial Wood-RNG
- Expected online in 2022

Hydrogen

- Phase 1 of 3-phase plan
- System readiness
- Codes, Standards, Safety



FortisBC Innovation Fund

First of its kind among Canadian Utilities

- Focus on decarbonisation, performance breakthroughs, cost reductions, new clean energy end-uses and sources
- Renewable Gas seen as critical area for innovation investment

Over \$20M between now and 2024

- Governance includes external advisory council
- Established criteria will look at estimated CO₂e and contaminant reduction in BC
- First portfolio approvals expected this fall



Priorities for Success

- Need clarity over legislation and regulation supporting 15% renewable content

Policy



- Need the GGRR definition to include hydrogen and synthesis gas (Syngas) along with price and volume increases

Legislation



- Need access to lower cost electricity for grid-connected projects (electricity is approximately 75% of operating cost)

Provincial Grid



- Need clarity over technical approval pathways

Regulations



Innovate:

Focus on implementation

Evolve:

Technology needs to change and improve to increase opportunity

Develop:

Multi-product sources of supply

Partner:

Significant capital required to build up new infrastructure for production and end-use



ATCO

UTILITIES & HYDROGEN ADOPTION

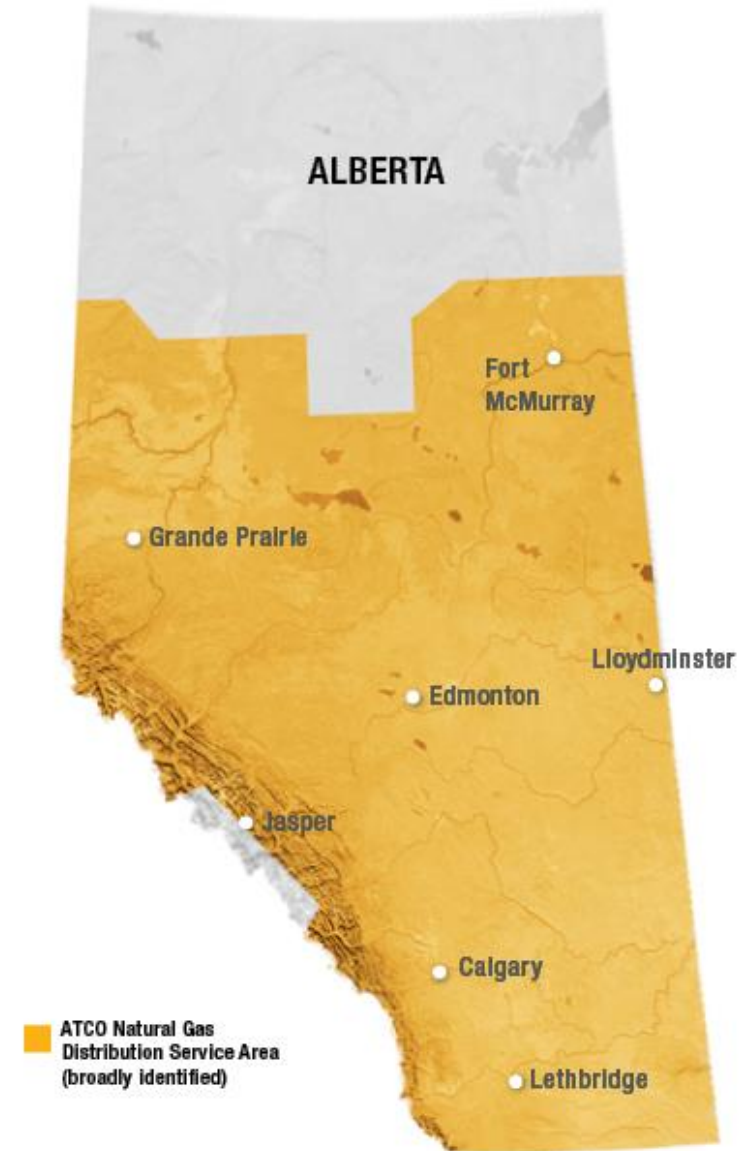
Pembina Institute H2 & RNG Webinar

September 29, 2020

ATCO NATURAL GAS – ALBERTA

We deliver safe, reliable and cost-effective natural gas to homes and businesses throughout Alberta

- Alberta's largest natural gas distribution company
- Serve more than 1.2 million customers in nearly 300 Alberta communities
- Builds, maintains and operates more than 40,000 km of natural gas distribution pipelines



NATURAL GAS TRANSMISSION- ALBERTA

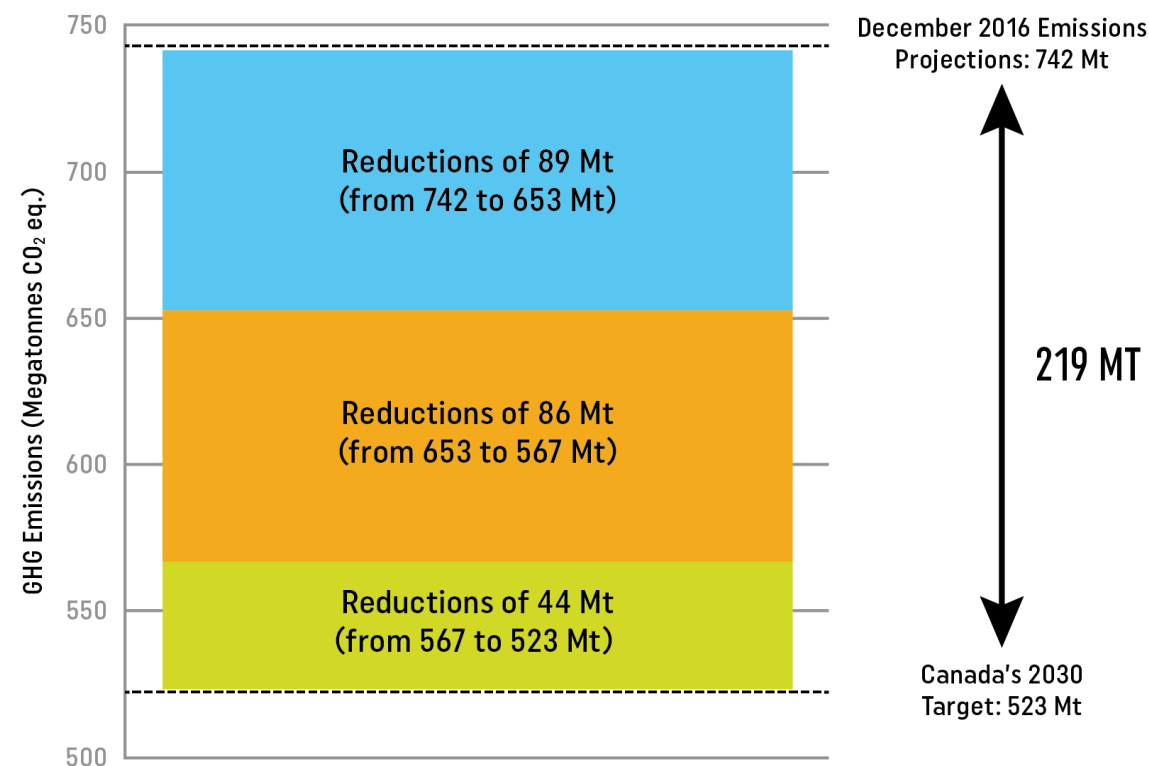
We own and operate key high-pressure natural gas transmission facilities in Alberta

- Own and operate approximately 9,100 km of natural gas transmission pipelines in Alberta
- Deliver a peak of 3.7 billion cubic feet of natural gas per day to customers
- Nearly 3,500 receipt and delivery points

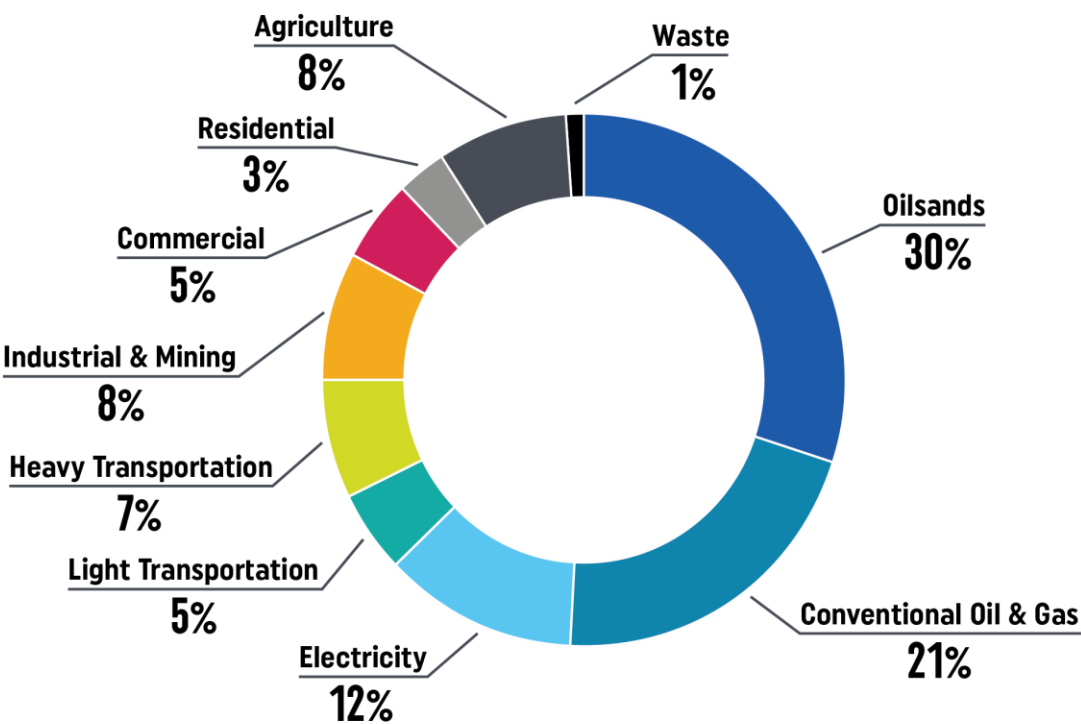


EMISSIONS CHALLENGE – ALBERTA & CANADA

PATHWAY TO MEETING CANADA'S 2030 TARGET

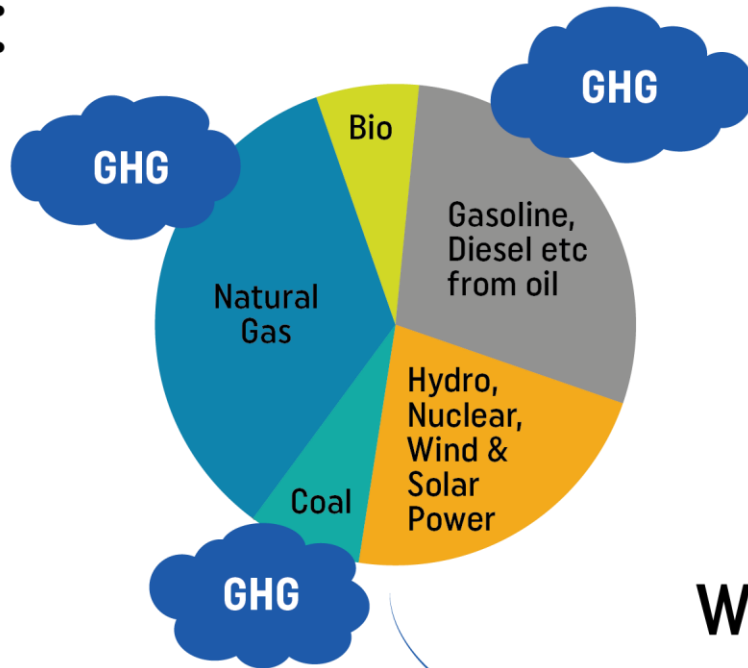


ALBERTA GHG EMISSIONS (~277 MT CO₂e)

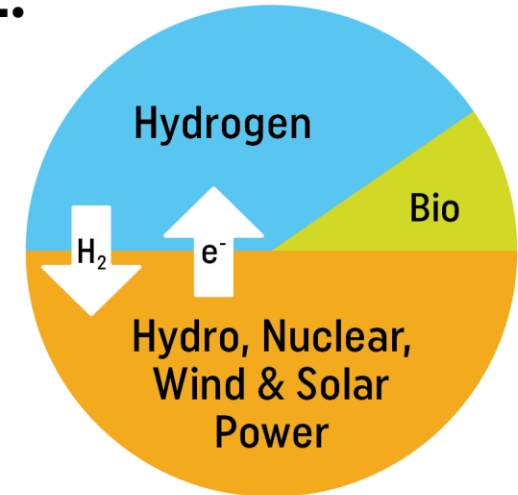


HYDROGEN ENABLES MORE RENEWABLES & DECARBONIZATION

TODAY'S ENERGY SYSTEMS:

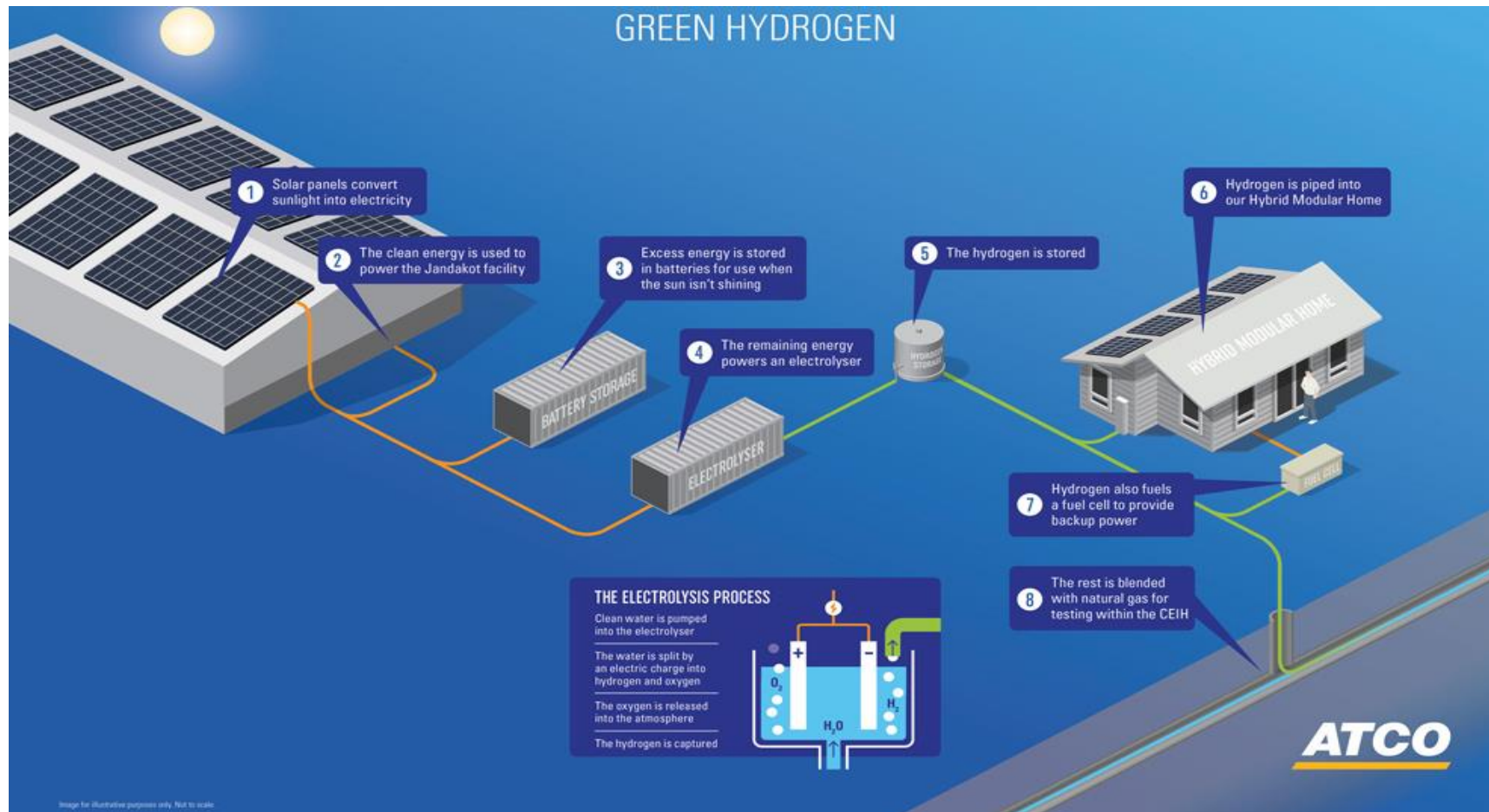


THE ENERGY SYSTEM OF THE FUTURE:



What is the Transition Pathway?

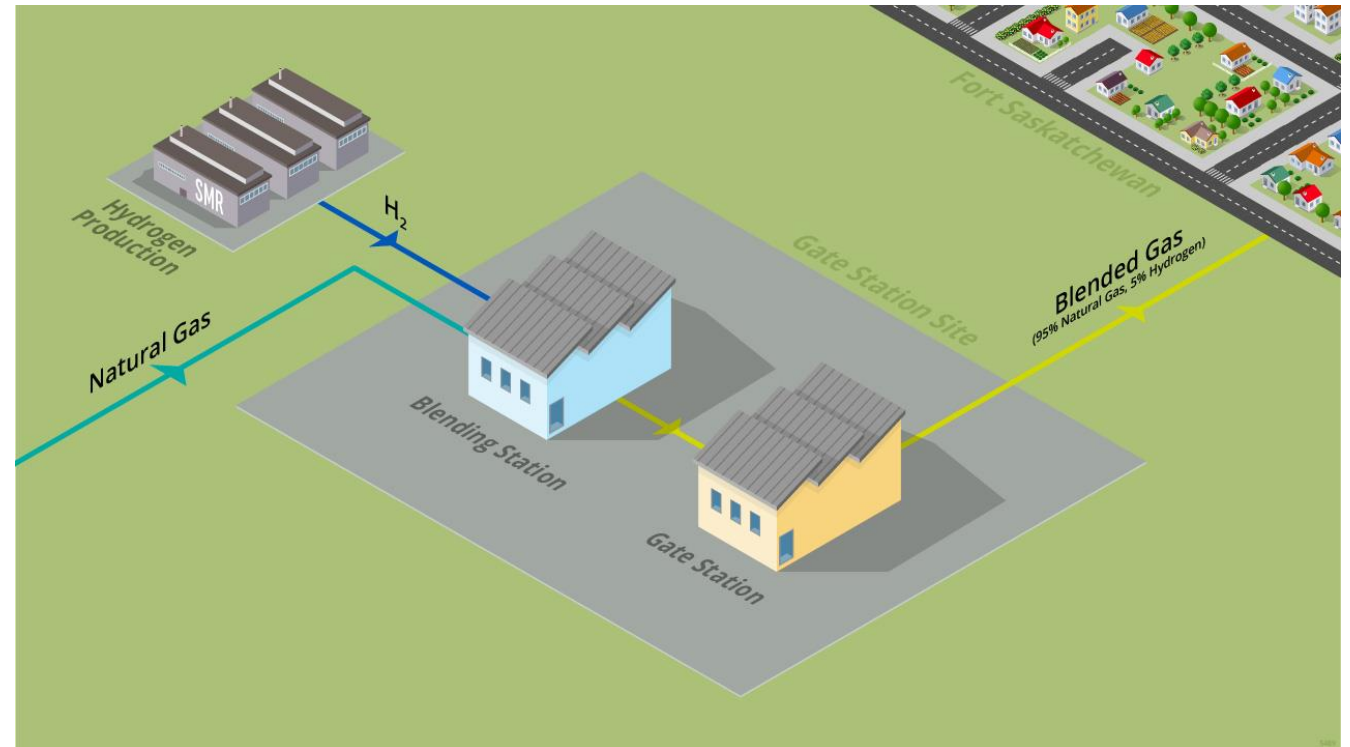
ATCO'S CLEAN ENERGY INNOVATION HUB



FORT SASKATCHEWAN BLENDING PROJECT

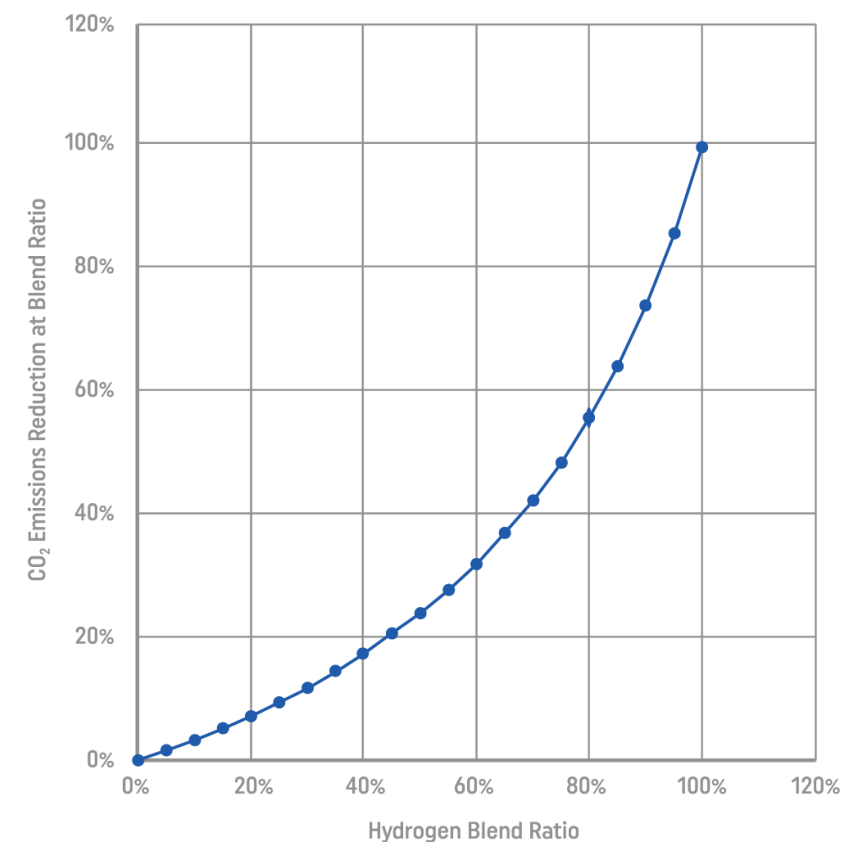
Foundational step towards building a hydrogen economy for Canada

- Accelerate business model development
- Overcome obstacles (regulatory, technical, public awareness & acceptance)
- First-of-its-kind project leveraging world class natural gas industry in Canada
- Total estimated cost \$5.7M
- Emissions Reduction Alberta to fund \$2.8M



GREENHOUSE GAS EMISSIONS REDUCTIONS

	5%	10%	15%	20%	100%
Proposed Project*	600	1,200	1,900	2,600	35,300
Large Scale Edmonton Blending Project	27,000	55,300	86,300	120,000	1.6M
Entire ATCO Distribution System	202,000	418,000	651,000	902,500	12.4M
Oilsands	1.3M	2.8M	4.3M	6M	82M
Industrial Heartland & East Edmonton	260,000	530,000	830,000	1.2M	15.9M



PROPOSED ALBERTA 100% HYDROGEN INITIATIVE

80% of ATCO network to get 100% hydrogen under consideration

Includes

- **Transmission and Distribution Pipelines**
- **Production**
- **Storage**
- **C02 Pipe / Storage**
- **Appliance Conversion**

BARRIERS TO ADOPTION

- General awareness of Hydrogen as a decarbonization pathway
- Codes & standards (safety)
- Appliance evolution (for 100% H₂)
- Most critically, business models & policy frameworks to enable:
 - Utility investment & cost recovery in regulated rates
 - Legislative change
 - Abundant low-carbon supply
 - Low-cost production
 - Carbon capture

WHY HYDROGEN?

Essential component to achieve Net Zero by 2050
(In conjunction with other renewables)

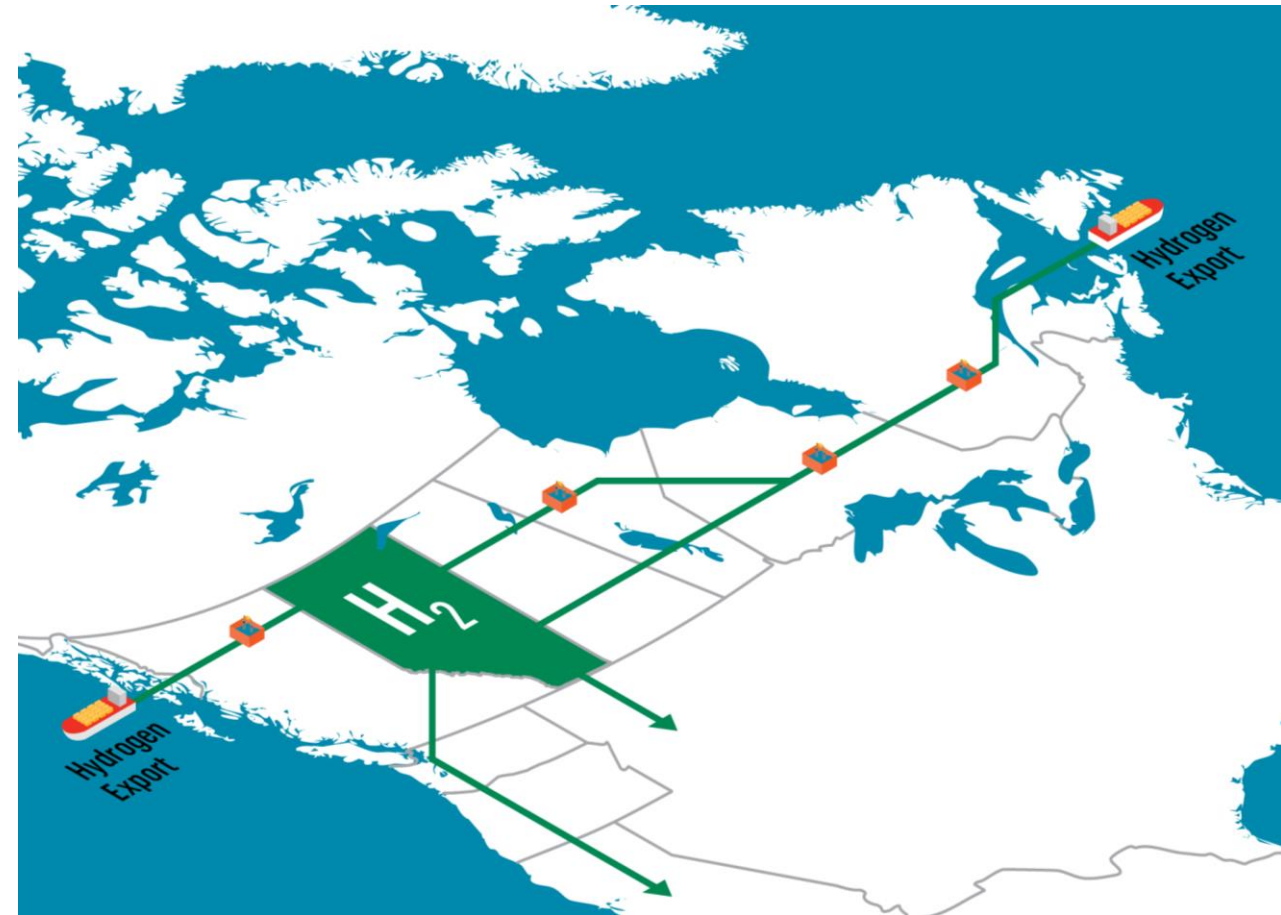
Scalable GHG reduction compliance mechanism

Re-use existing infrastructure to support a long-term transition to clean heat

Alberta is a logical hydrogen hub for Canada

- Lowest cost H₂ production and built CCS assets
- Abundant supply of natural gas
- Large industrial demand

Maintain and create energy jobs in Alberta, delivering clean heat to our energy customers, ensuring pipelines growth and relevance in a zero-emission world.





QUESTIONS







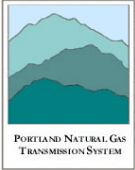










The Future of Hydrogen and Renewable Natural Gas in Canada

Pembina's webinar

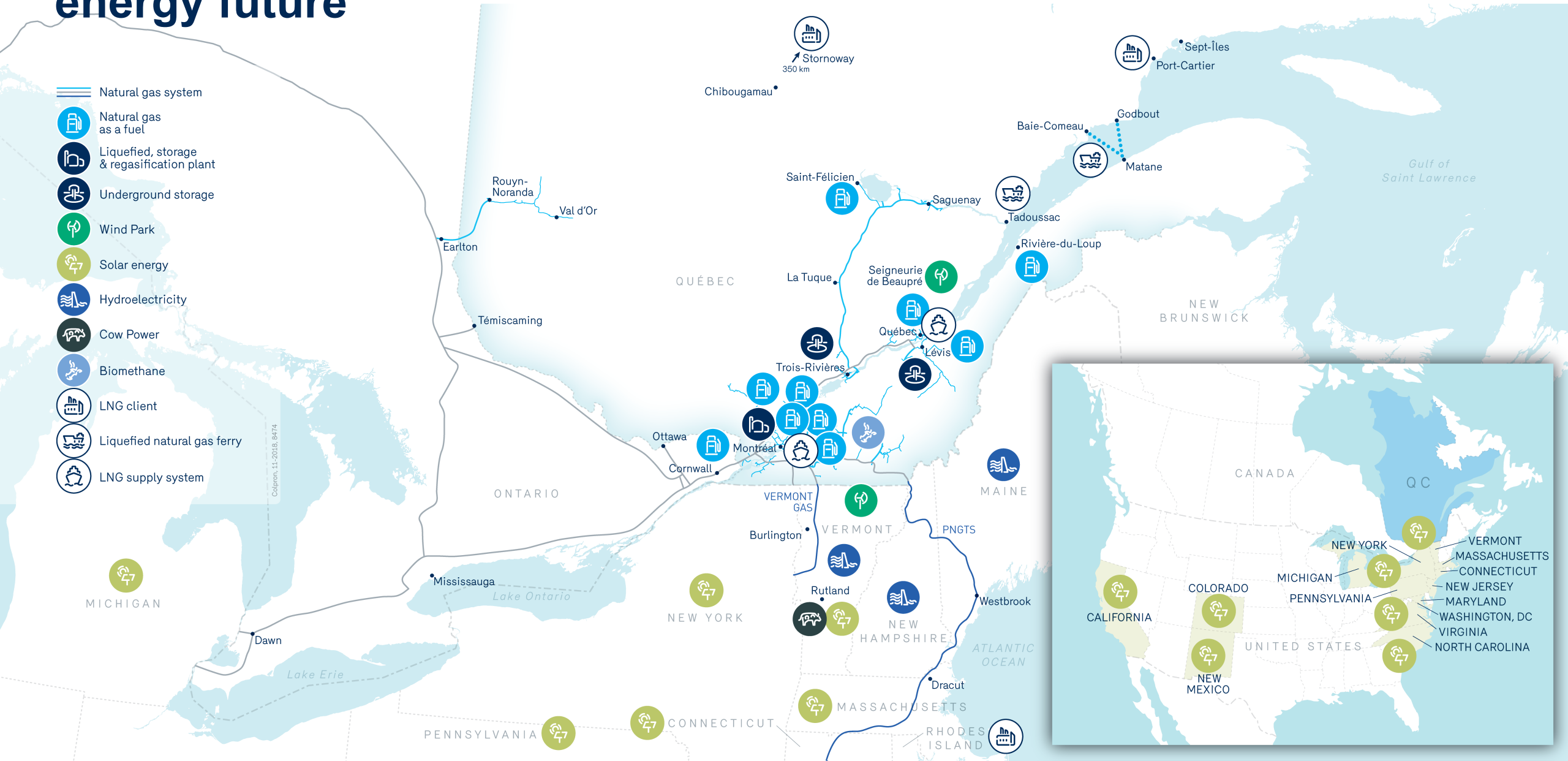
Vincent Regnault
Director Gas Supply and Renewable Gases Development
September 2020

Table of Contents

- **About Énergir**
- **Renewable Gases**

Energy distribution	Energy transportation	Energy production	Energy, storage and other services
<div> 100%</div> <div> 100%</div> <div> 100%</div>	<div> 50%</div> <div> 38.3%</div> <div> 100%</div>	<div> 25.5%</div> <div> 100%</div> <div> 100%</div>	<div> 100%</div> <div> 100%</div> <div> 100%</div> <div> 58%</div> <div> 100%</div> <div> ~ 40% to 60%</div>

Énergir and its subsidiaries are actively committed to a better energy future



Énergir's Natural Gas Distribution Network in Québec



11,000 km



6,000,000 Mm³ distributed



Over 325 municipalities



1,500 employees



205,000 customers¹



97% natural gas distributed



Public utility regulated

- Énergir - Transmission
- Énergir - Supply
- Champion Pipeline
- TQM Pipeline
- TCPL Pipeline
- Gazifère

Colpiron, 11-2017, 7937

GAZIFÈRE
Gatineau • Ottawa

QUÉBEC

NEW YORK

VERMONT

N. H.

MAINE

1) Data based on September 30, 2018

The contribution of Energize: reduce, replace, integrate



1. Reduce...

helping our customers and communities to consume less with energy efficiency



2. Replace...

petroleum products in heavy transportation and certain industrial processes



3. Integrate...

more and more renewable gas, a local energy that contributes to the circular economy of the regions

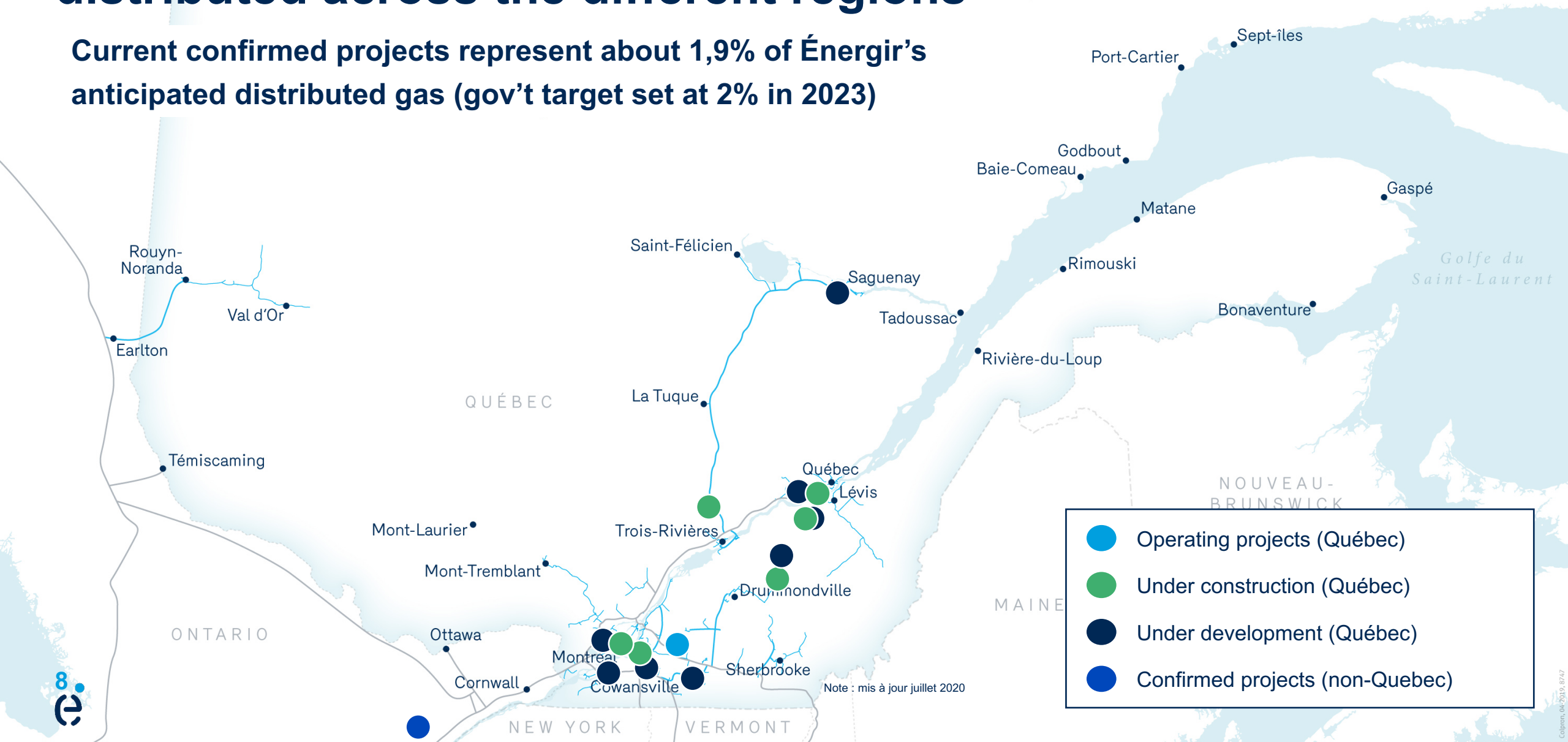
Renewable gases



The pipeline of RNG projects in Quebec is well distributed across the different regions



Current confirmed projects represent about 1,9% of Énergir’s anticipated distributed gas (gov’t target set at 2% in 2023)



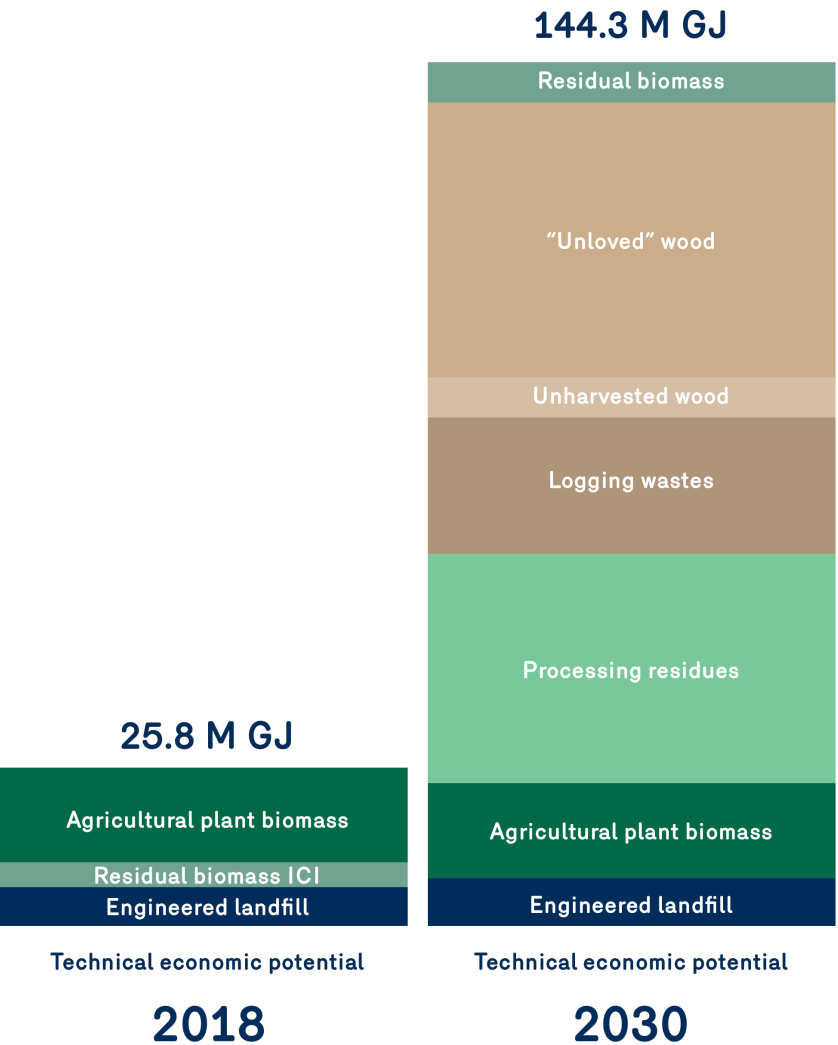
Québec has the potential of having 2/3 of its natural gas, representing 144 M GJ, come from a renewable source by 2030



With the objective of measuring the renewable natural gas (RNG) production potential in Québec, WSP Canada and Deloitte conducted a study to evaluate the technical-economic production potential from today to 2030

Promising results:

- The technical-economic RNG production potential in 2018 equates to **12% of the volume of natural gas currently distributed by Énergir** in Québec
- All regions in Québec have RNG production potential by 2030
- The use of 2/3 of RNG in the gas network by 2030 would eliminate **7.2 Mt of GHG emissions annually**, comparable to removing 1.5 M cars from the road



Quebec has also identified RNG as a lever for energy transition

Quebec's 2030 energy policy...

Quebec has clarified its intention to decarbonize its energy environment with the publication of the new Energy Policy 2030;

An ambitious GHG reduction target of 37.5% compared to 1990 levels;

Renewable natural gas is an important part of the Policy, with an emphasis on :



Increase the **production of RNG** in Quebec



Increase the **availability of RNG** to customers

... and its action plan

A regulation adopted in 2017 establishes at 5% the minimum proportion of renewable natural gas that Quebec natural gas distributors must inject into their distribution system for Quebec customers;

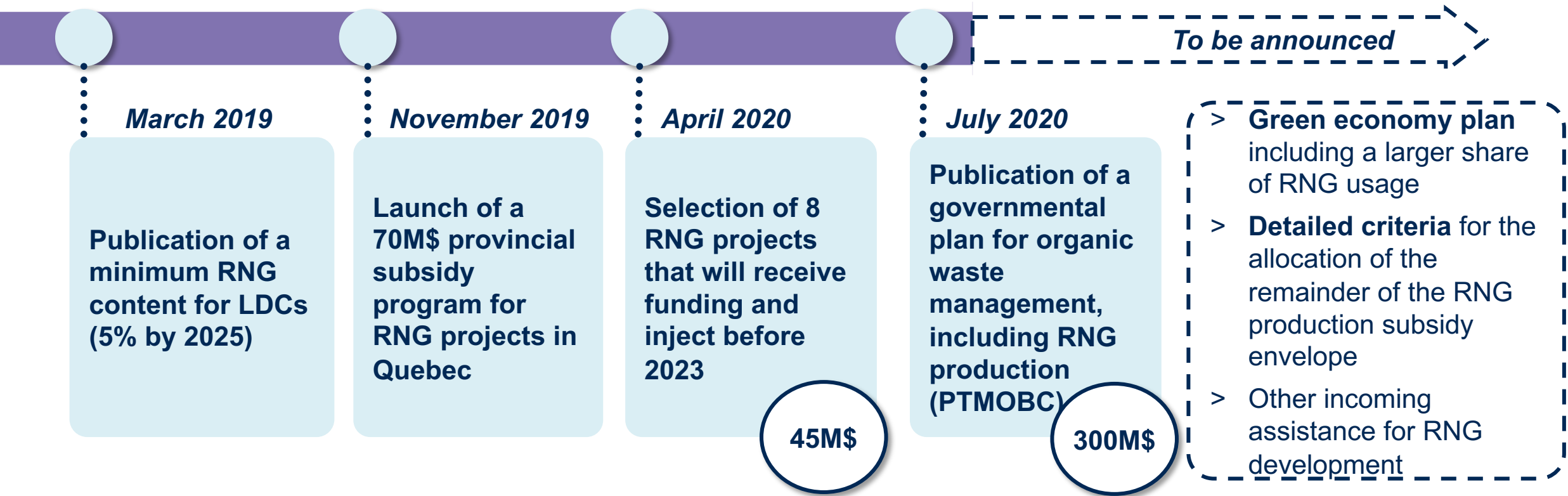
Contribute to the financing of the construction of biofuel demonstration plants.

... and its regulations

By-law concerning the quantity of renewable natural gas to be delivered by a distributor.

1 % in 2020 | 2 % in 2023 | 5 % in 2025

The Quebec government confirmed its intention to make RNG a central tool of its multi-energy decarbonisation plan



The government support sends a strong signal that positions RNG as a perennial solution for decarbonisation, therefore increasing producer and customer confidence



Decarbonizing the natural gas distribution system can be done in different ways depending on the available resources

RNG

- **1st generation:** Landfill, WWTP, AD, etc.
- **2nd generation:** Pyrogasification
- **3rd generation:** Power-to-gas

Hydrogen

- **Blending** into the natural gas network
- **Dedicated pipelines**

The 2nd and 3rd generation RNG will contain residual H₂ (up to 2%). Therefore, in order to decarbonize the gas distribution systems, there is a need to quickly determine the H₂ injection limits

Hurdles remains before low-emission hydrogen can be viably injected into the natural gas network

Commercial

- **High costs across the entire value chain**, including **production technologies** and **distribution**.
- The **scale of public investment is small** (\$700 million in 2018) compared to the investments required to reduce production costs (\$70 billion worldwide by 2030).
- **Low-emission hydrogen production remains underdeveloped worldwide** and requires a combination of factors in order to be commercially viable (scale-up)

Social

- Demystification **efforts to improve social acceptability** (e.g., flammability).
- **Overall knowledge** on hydrogen use (increase demand) and the implementation of **measures to encourage its adoption**
- Define role of hydrogen in the **energy transition**

Technical



Safety : explosion limit, explosivity, emergency operation protocol



Leaks and integrity: penetration losses, embrittlement of the network by hydrogen



Capacity, metering and storage: energy capacity of the network, compression and liquefaction capacity, turbine flowmeter, storage capacity



Clients : flame speed, flame temperature, combustion

Regulatory

- **Coherent legal and regulatory framework** and incentives to mobilize investors (de-risking)
- **Legislative framework for clean fuels** (taxation / carbon market)
- **Accelerate network upscaling and adaptation** for new renewable gases (Codes and Standards)

Merci!



Hydrogen and RNG Outlook

29 September 2020

For: The Pembina Institute

By: Samuel McDermott, M. Eng., P. Eng.

Technical Manager Hydrogen

Agenda

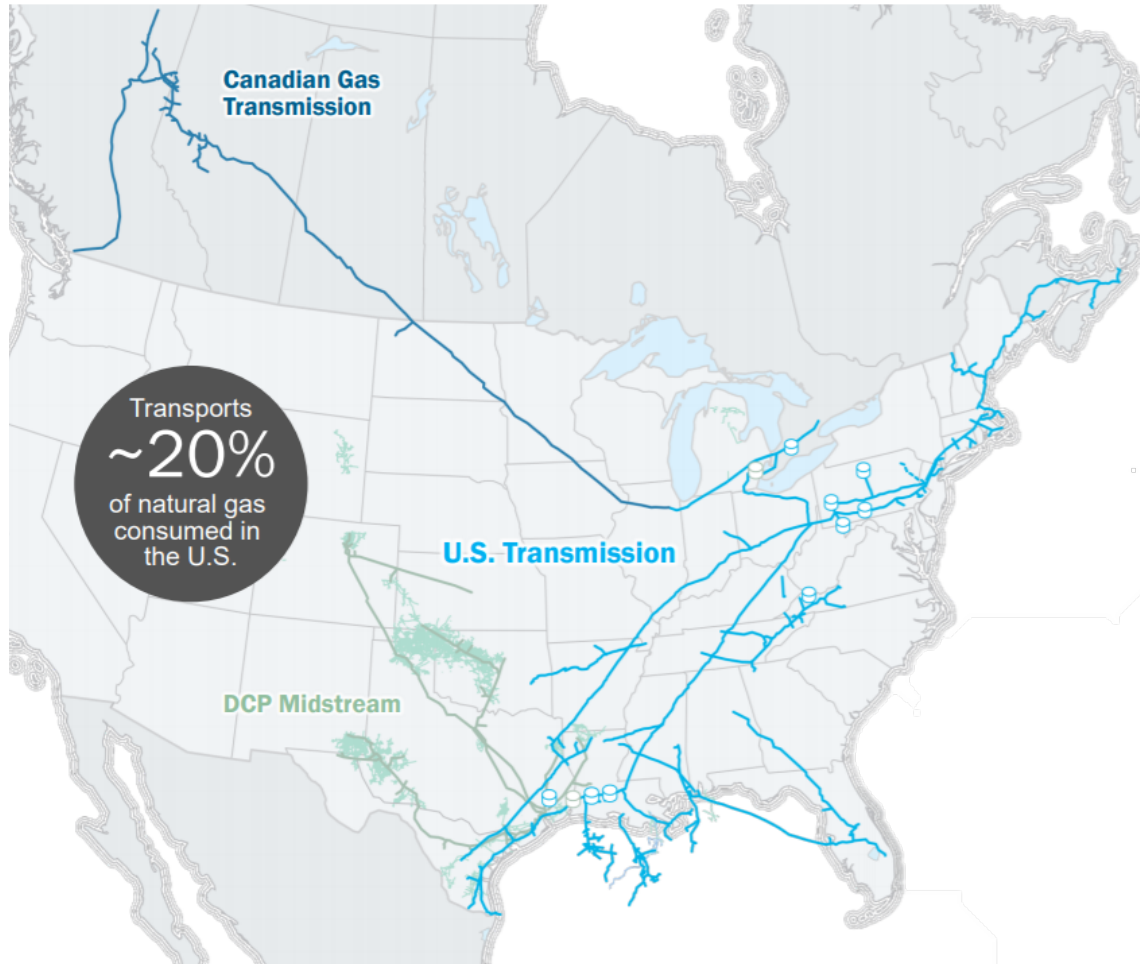


1. General Characteristics of Natural Gas Distribution Network
2. General Characteristics of Natural Gas Market in Ontario
3. Sectoral GHG Emissions Reduction Target and Initiatives
4. Outlook on H2 and RNG Blending Potential
5. Barriers to Adoption
6. Conclusion

Enbridge Inc. – Proven Asset Owners & Managers



A Very Big Battery: Existing Natural Transmission & Midstream

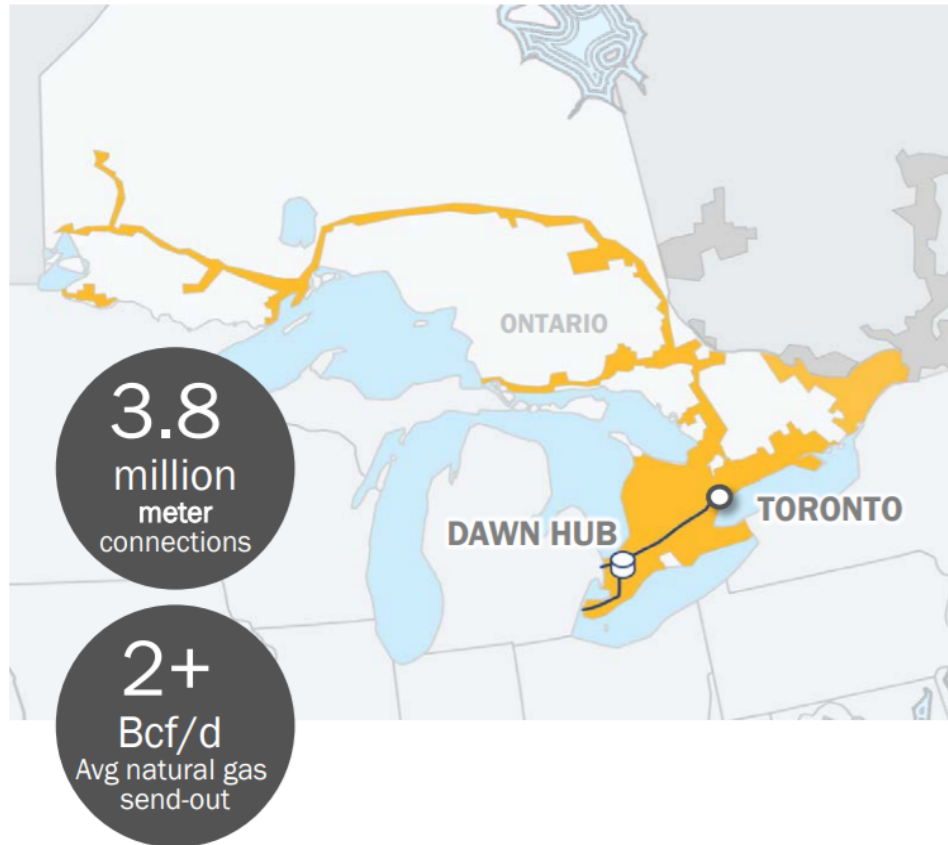


- Enbridge's pipelines cover about 38,000 km
- Transport about 18.3 Bcf (billions of cubic feet per day) of natural gas
- BC Pipeline transports ~60% of natural gas produced in BC

Enbridge Gas Inc. – Proven Asset Owners & Managers



A Very Big Battery: Existing Ontario Natural Gas Distribution Network

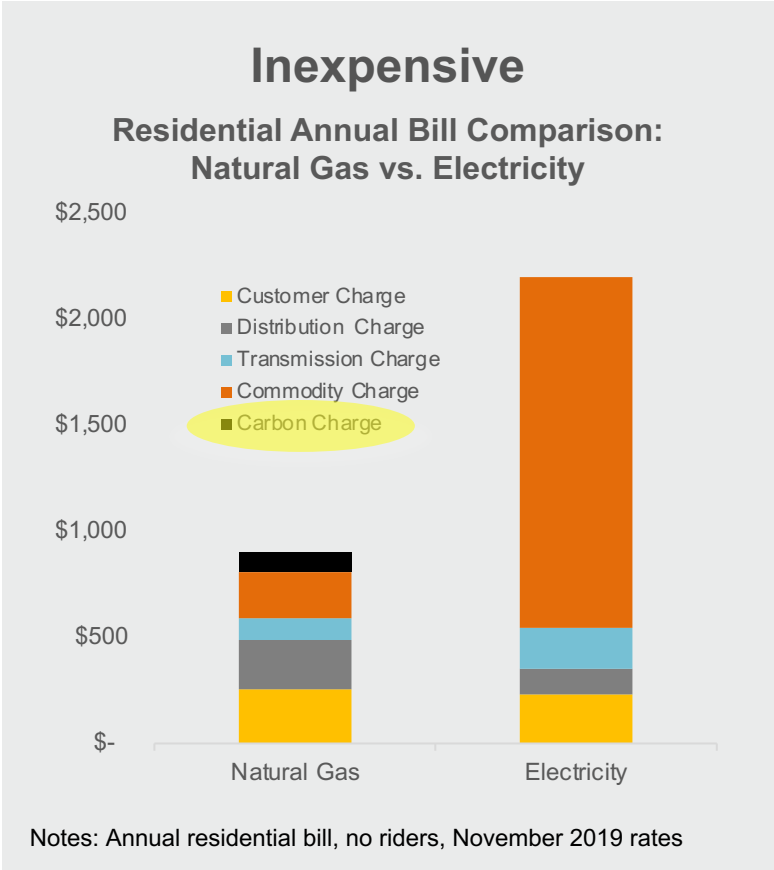
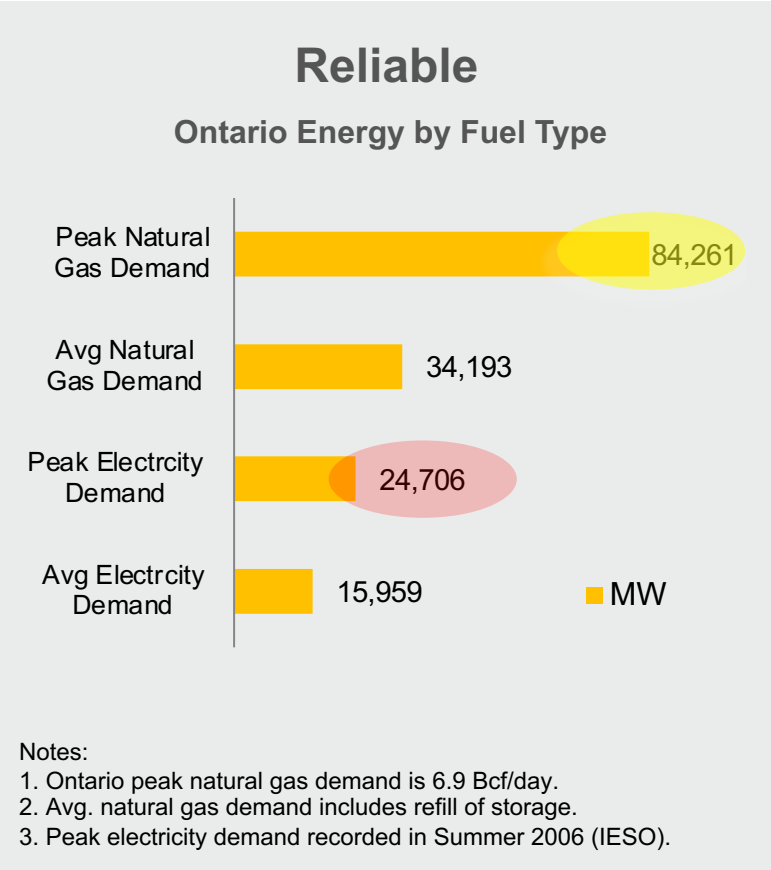
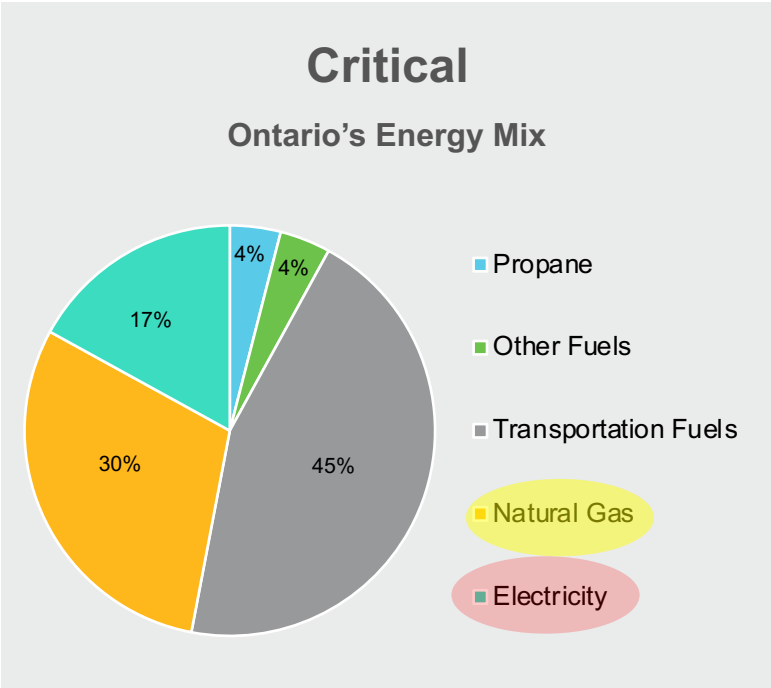


- North America's largest natural gas utility by volume and third largest by customer count
- Delivers 40% of Ontario's energy needs & heats more than 75% of homes in Ontario
- Ontario network includes:
 - +145,000km of distribution mains and service lines
 - ~280 Bcf (billion cubic feet) of net storage
- Hydrogen enables Gas Network to be tied to the electrical grid
- Gas grid has the potential to store large amounts of electricity as hydrogen while lowering NG grid's GHG.
- Ontario would need 16 Nuclear plants @ ~5Twh to replace 81Twh of energy needs on peak days supplied by gas

The Energy Landscape in Ontario



Natural gas is affordable, reliable and a critical part of Ontario's energy mix



Enbridge delivers energy efficiency
Enbridge's energy efficiency programs drive energy, water and GHG savings with \$1 invested resulting in \$2.67 of net benefits.*

Ontario's energy system reality Electrifying Ontario's residential heating would require a \$30B investment in Ontario's electric distribution infrastructure.**

* Environmental Commissioner's Annual Energy Conservation Report 2016-2017 (Volume 2) ** Enbridge's 2017 Ontario LTEP Submission.









Enbridge Inc. Renewable Energy Mix



Multi Pronged Approach to Climate Change and Energy Transition



Asset portfolio:

-  21 Wind farms - onshore & offshore
-  4 Solar energy operations
-  5 Waste heat recovery facilities
-  1 Hydro facility
-  1 Geothermal facility
-  1 RNG facility
-  3 CNG fueling stations
-  1 Power to Gas Hydrogen facility

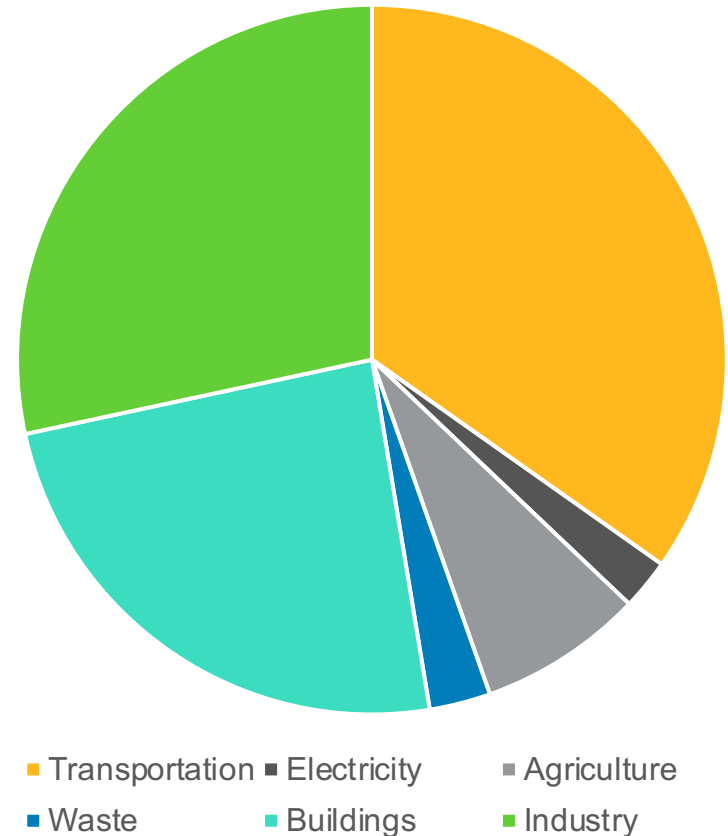
- \$8B invested in renewable power generation since 2002
- 1.8 GW of long-term contracted renewable power, enough to power 900,000 homes¹
- 2005 – 2016, Reduced emissions to 21% below 1990 levels
- Reduced emissions equivalent to removing ~12.2M cars off the road annually since 1995 (through Demand Side Management programs in Ontario)

All forms of energy will be needed to fuel quality of life and prosperity globally, but it must be accomplished in a way that addresses climate change

GHG Emissions in Ontario

- 2018 - Ontario's GHG emissions – 165 MT
- 2030 - Ontario's GHG target – 143 MT
- Made in Ontario Environment Plan outlines pathway to reach target
 - Low carbon vehicle uptake (16%)
 - Industry performance standards (15%)
 - Clean fuels (19%)
 - Federal Clean Fuel Standard (7%)
 - Natural gas conservation (18%)
 - Ontario Carbon Trust (4%)
 - Innovation (15%)
 - Other policies (organic waste, transit) (6%)

2018 GHG Emissions by Sector



Enbridge's Power to Gas Plant

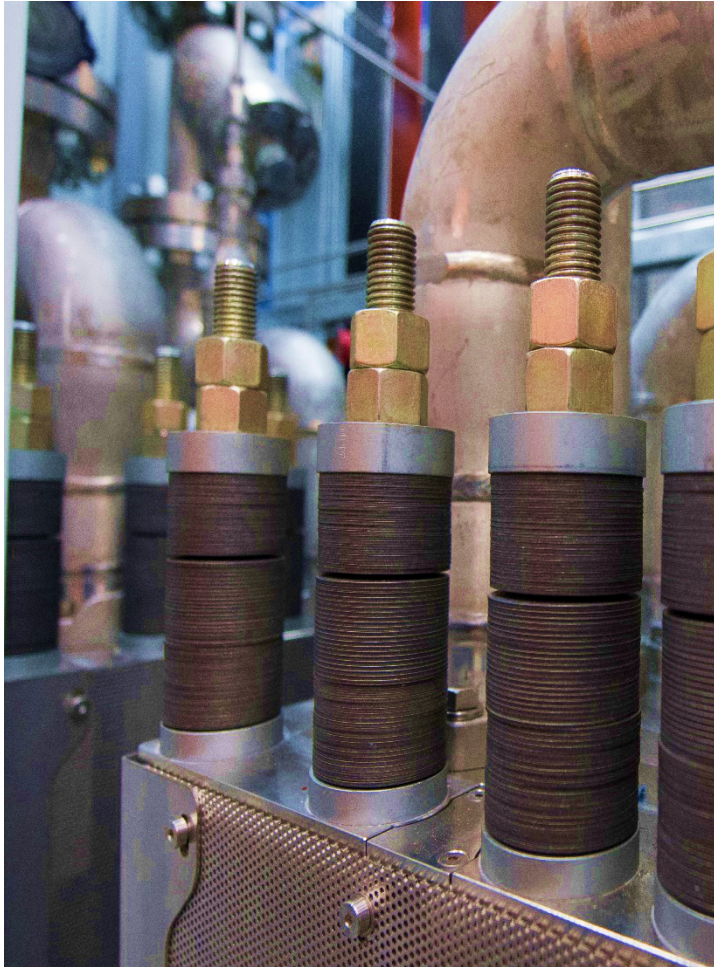
What is Power-to-Gas?



The process of taking **(low carbon, clean)** electrical energy, and through the electrolysis of water, **converting that energy into gas.** **(Hydrogen and Oxygen).**

The Power-to-Gas Plant

Fully commissioned as of Q2 - 2018



- An Enbridge/Hydrogenics Joint Venture
- 2.5 MW – 5 MW Energy Storage Project
- Footprint – 126sqm (1350sqft)
- Max theoretical hydrogen output:
 - 1000kg/day
 - 12,000m³/hydrogen per day
- Provides Frequency Regulation Service to IESO
- Purity of hydrogen – 99.99%
- Capability: SAEJ2719 grade H₂ at 99.9999% purity

Enbridge's Plant Progress Update & Accomplishments



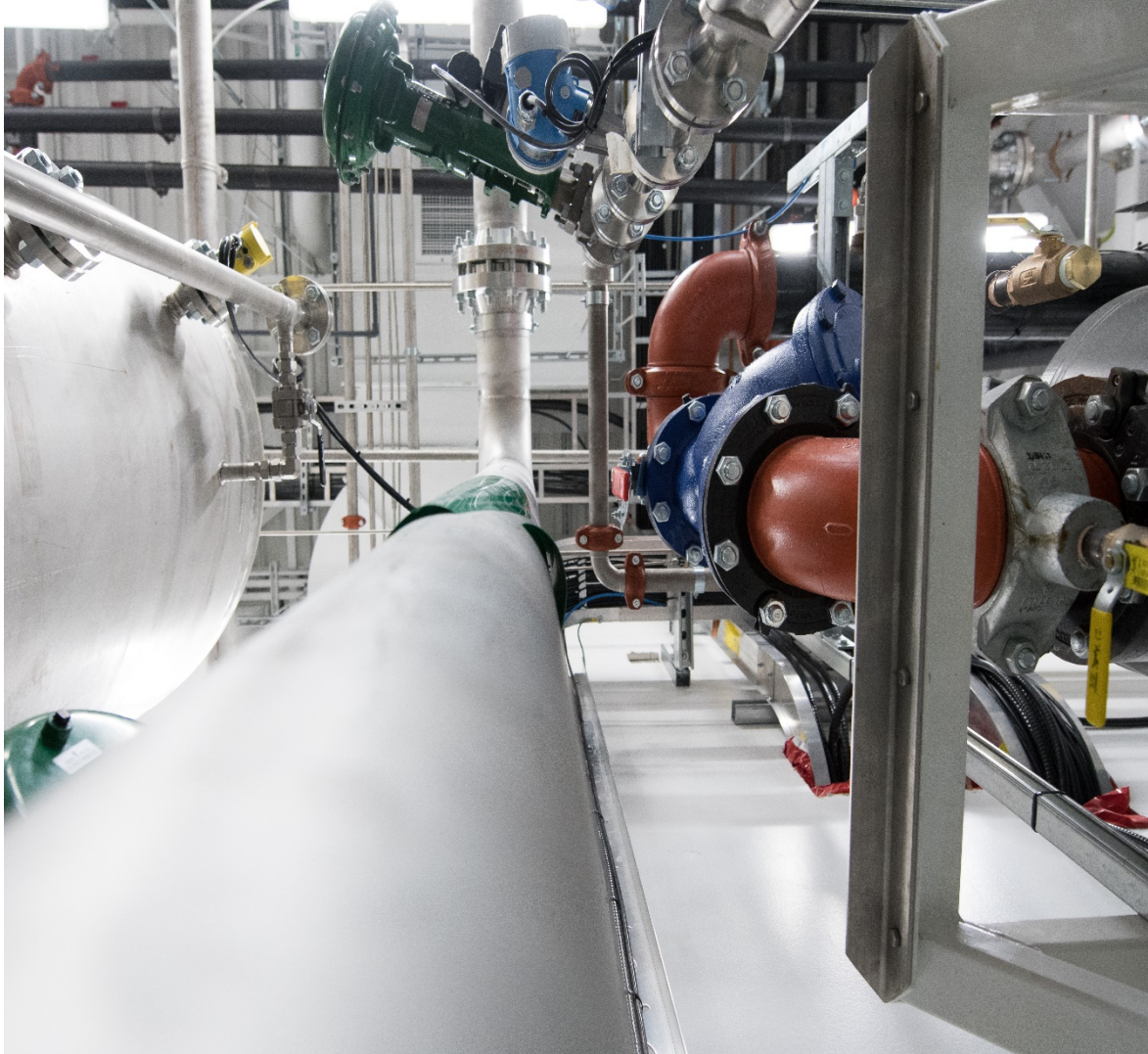
Successfully:

- ✓ Demonstrated Hydrogen Production
- ✓ Demonstrated Hydrogen Storage
- ✓ Demonstrated the plants ability to provide frequency regulation as per the IESO specifications
- ✓ Converted Hydrogen back to electricity

Enbridge Gas Inc.



Current, Pending & Future Use of the Plant



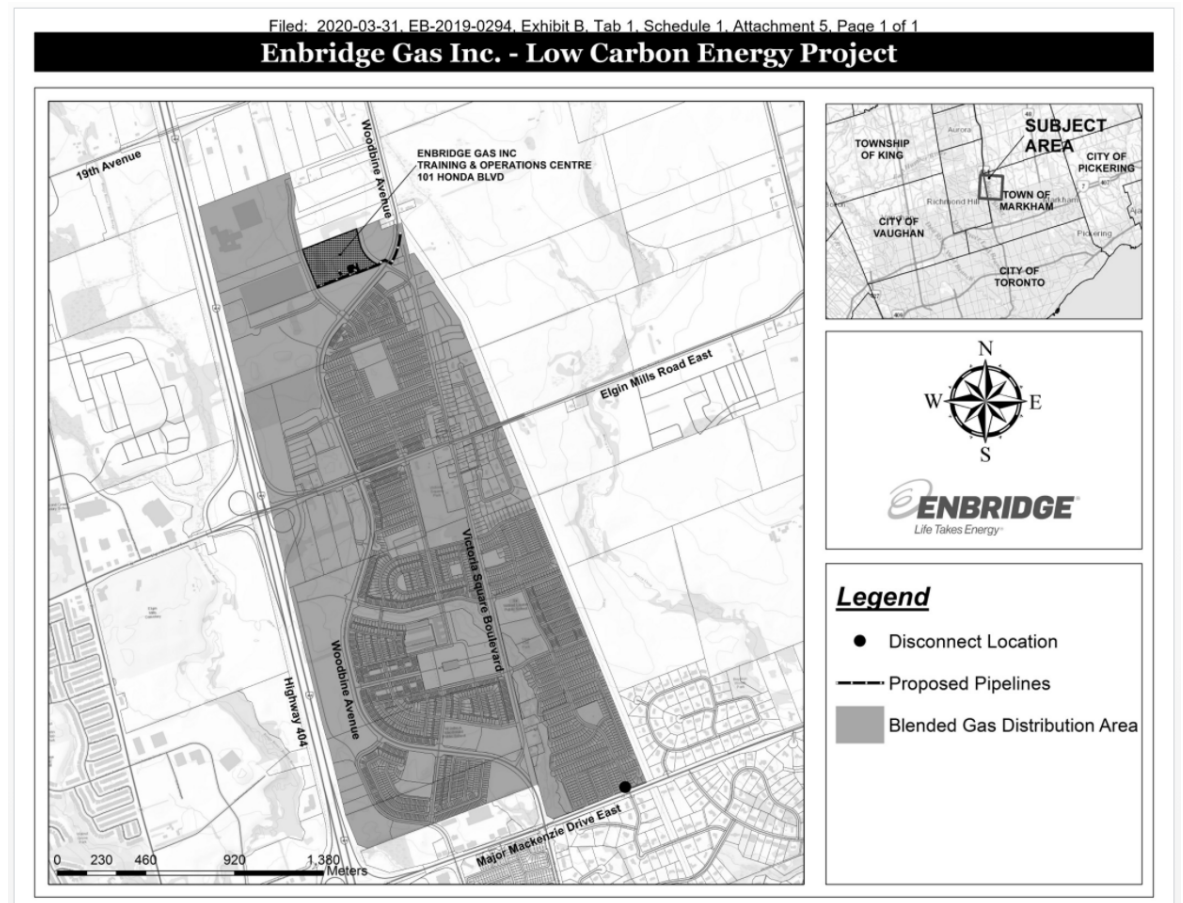
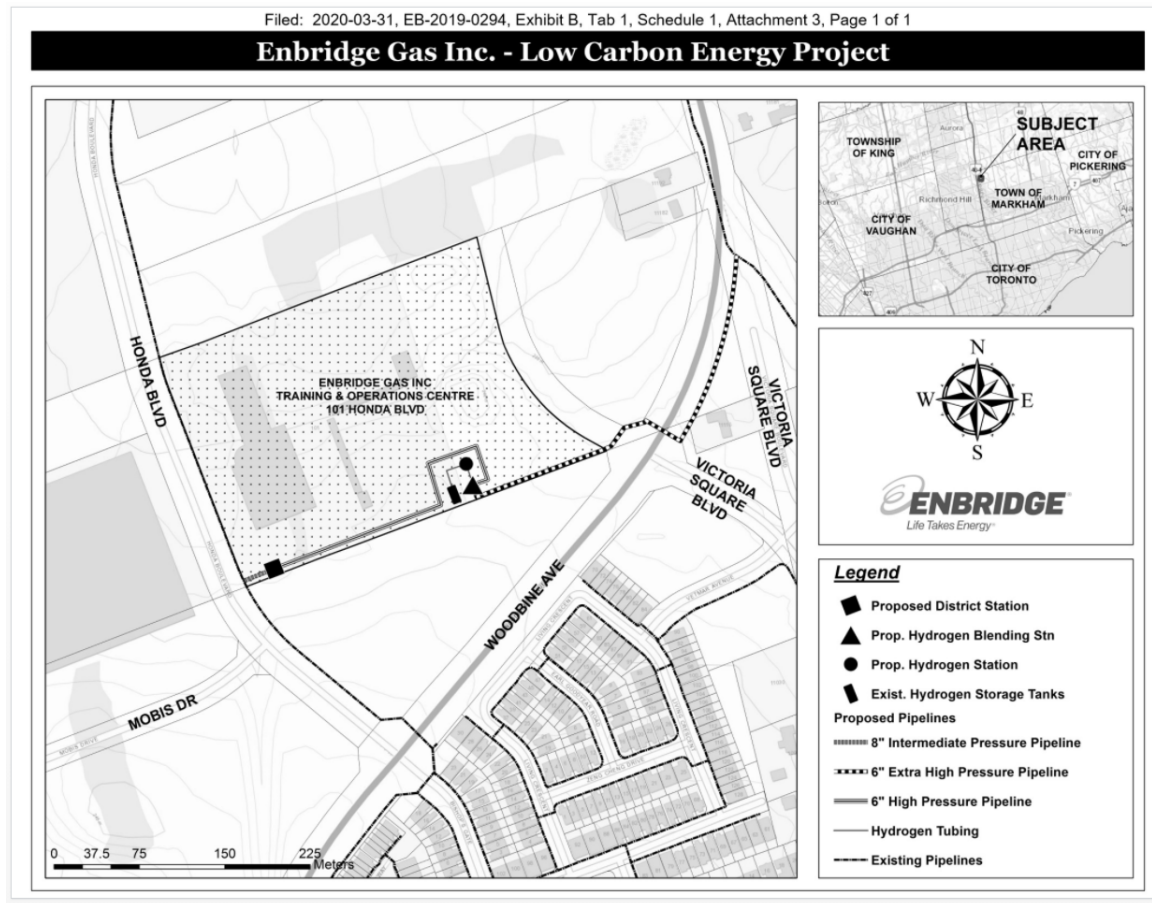
1. Ancillary services
 - Controllable variable load
 - Rapid response frequency
 - Regulation up – supply shortfall
 - Regulation down – excess supply
2. **Renewable hydrogen feedstock**
3. **Transportation Fuel**
4. ***Blending renewable hydrogen in the gas grid to reduce carbon footprint***

Hydrogen Blending EGI's Low Carbon Energy Project (LCEP) EB-2019-0294

OEB Application Update – LCEP Blending Project



- Subject Area – 3,600 Customers
- Up to 2% H2 blend by volume – 109 Tons of CO2 Abatement



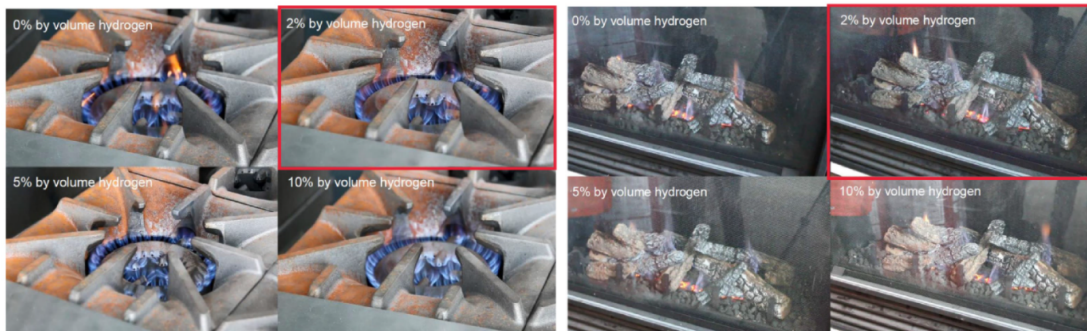
OEB Application Update – LCEP Blending Project



- Subject Area – 3,600 Customers
- Prudence, Safety, Resiliency

How Will Up to 2% Hydrogen Blending Affect My Appliances?

- > Your appliances would continue to operate as they have been.
- > Appliances would not require testing as a result of the blending project.
- > It is always recommended that customers have gas appliances inspected annually to ensure they are operating safely and efficiently.
- > Always follow manufacturer recommendations for maintenance.



LOW-CARBON ENERGY PROJECT - PUBLIC OPEN HOUSE



Prudence to Verify Safety



Enbridge completed a detailed engineering assessment covering many aspects of hydrogen blending including:



- > Research & Development from similar projects around the world.



- > Assessment of components within the natural gas network.
- > Assessment of end-user equipment including field survey.



- > Developing design guidelines.
- > Undertaking risk assessments.
- > In-House validation testing.



OEB Application Update – LCEP Blending Project - EB-2019-0294

Schedule

Table 7: Proposed Construction Schedule

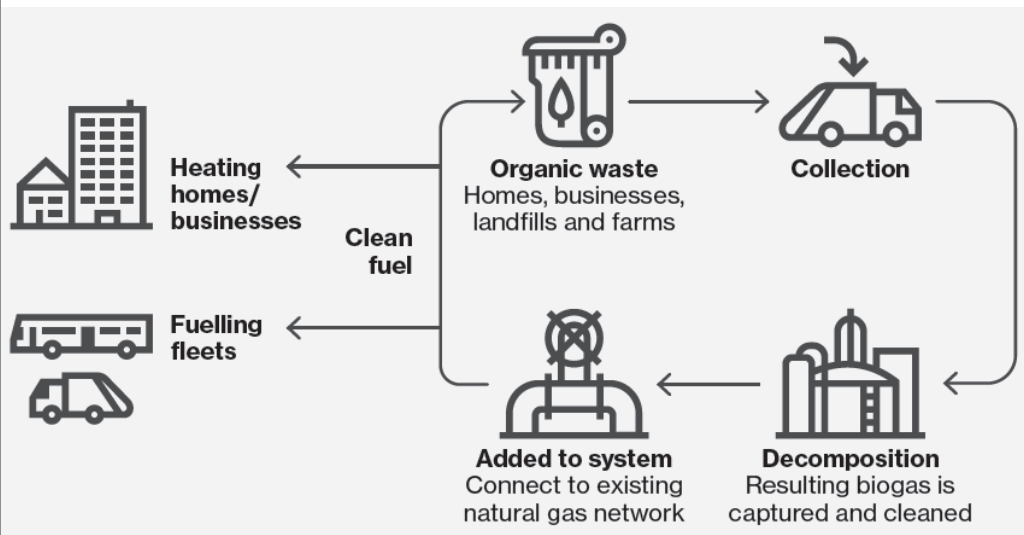
Receipt of Permits and Approvals	November, 2020
Expected LTC Approval	November, 2020
Commence Construction	April, 2021
Completion of Construction	July, 2021
Expected In-Service	August, 2021
Completion of Reinstatement	December, 2021
Final Inspection	May, 2022

- ✓ Filed with the OEB December 2019
- ✓ Refiled with the OEB March 2020
- IR's Issued and due back to the board on June 15
- A favourable outcome from the OEB establishes this as the first in North America
- Precedent Setting
- Paves the way for a wider investigation into system wide blending

EGI's-Renewable Natural Gas

Renewable Natural Gas

RNG is created by capturing methane emissions from organic waste, landfills and wastewater treatment plants. A renewable source of energy, it can be injected into our natural gas network and used for residential and commercial energy needs as well as transportation fuel.



Strategy

- Enbridge provides expertise in the design, construction, and maintenance of RNG facilities
- Enbridge provides its customer energy choice to help meet aggressive climate change goals



Opportunity

- RNG will play an important role in Ontario's clean energy future
- Enbridge is partnering with municipalities, agribusinesses, and commercial/industrial facilities to reduce their carbon footprints



Milestones

- In August 2018, EGI received OEB approval to build and connect RNG facilities to the NG distribution network.
- In September 2020, EGI received OEB approval to offer its customer RNG supply on a voluntary basis



Barriers to Adoption

Hydrogen & RNG



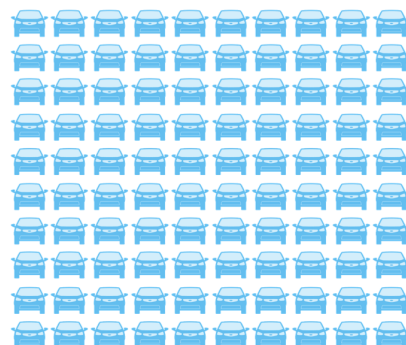
- Electricity Cost
- Codes and Standards that are adopted nationally and Internationally
- Enabling government policies
- Establishment of a clear regulatory framework
- Public Education/Awareness
 - Choice
 - Canada leads the world in Hydrogen Technology
 - \$100B/year – Potential H2 industry
- National Hydrogen Strategy with commensurate funding to enable the industry

Thank You

Samuel McDermott – Enbridge Gas Inc.

WHAT ELSE COULD YOU DO WITH 1000KG/D OF HYDROGEN?

100 FC Cars x 1000 km/day



50 FC Buses x 250 km/day

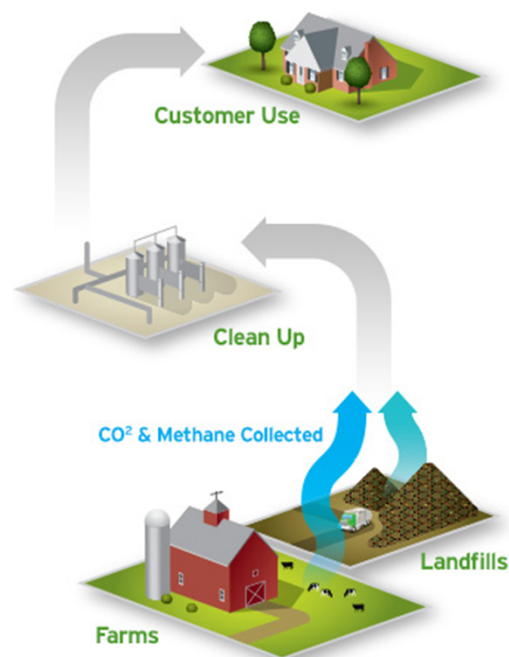


5 Alstom Coradia iLint FC Trains x 1000 km/day



Source: Hydrogenics

HYDROGENICS
SHIFT POWER | ENERGIZE YOUR WORLD



Source: Enbridge Gas Inc.

Poll

Questions

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