# The Future of Hydrogen & RNG in Canada

Part 1: The Potential of Hydrogen & RNG to Decarbonize Canada's Energy Systems



September 22, 2020





# Opening remarks Linda Coady

Executive 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 Richard Carlson

Director, Energy Policy and Energy Exchange Pollution Probe





### Speaker Sabina Russell

Principal Zen Clean Energy Solutions





# Sarah Stadnyk

Speaker

Manager, Business Development and Communications Canadian Biogas Association





# POLLUTION PROBE

CLEAN AIR. CLEAN WATER.

# The Future of Natural Gas in Canada

Pembina Webinar

September 22, 2020



CLEAN AIR. CLEAN WATER.

# **About Pollution Probe**

- Pollution Probe is Canada's oldest "homegrown" environmental NGOs (50 years in 2019!)
- Future of Natural Gas study was completed in 2019
- Project was funded in part by the natural gas downstream industry

### Natural gas is a large part of our energy systems

#### Secondary energy consumption (2017)



#### GHG emissions by fuel source (2017)





# Natural gas use (2017)





# Industrial demand for gas (2017)





### Residential energy demand and GHG emissions (2017)











# Start with efficiency and electrification

Easier to replace when you are using less

Electrify where you can



#### Move to low-carbon gases

Renewable natural gas

Hydrogen



# Gas provides flexibility





# Peak ratio with all electric space heating



Source: Waite and Modi, "Electricity Load Implications of Space Heating Decarbonization Pathways," Joule, February 2020



# IEA Pathway to New Zero





# Switching to low-carbon gases

### **Renewable Natural Gas**

- Wet wastes: 5-10%
- Gasification: Unknown ~12-50%
- Part of solution

### Hydrogen

- Rainbow of hydrogen: Green v. blue v. pink (plus brown)
- Blending: 20% by volume is ~10% by energy content
- Trials: up 20% blending in Europe; 3-5% blending trials in Canada
- Synthetic methane



# Switching to low-carbon gas: Costs





# Overview of challenge

- Lots of pipe in the ground
- Lots of benefits:
  - Storage
  - Flexibility
  - Industrial processes
- Merging silos: Electrons and molecules in hybrid systems
- Timelines are critical: We need to start now
- Not a question of "can the gas system play a role?" but more of a "will the gas system play a role?"



# What Does the Future Hold for Natural Gas?

Considering the role of natural gas and the gas system in Canada's low-emissions future

November 2019



# Thank you!

Richard Carlson Director, Energy Policy <u>rcarlson@pollutionprobe.org</u> Twitter: @RichardKCarlson

- <u>https://www.pollutionprobe.org/future-hold-natural-gas-report/</u>
- Follow us on Twitter: @PollutionProbe

#### Hydrogen's Potential to Decarbonize Natural Gas

Pembina Hydrogen and RNG Webinar September 22, 2020

Presented by: Sabina Russell, Principal







- Specialty consulting firm in Vancouver, BC in 5th year of business
- Zen works with clients to commercially advance and deploy clean energy solutions
- >80% of business relates to hydrogen and zero emission transportation
- Have helped clients raise >\$100 million in non-dilutive funding to deploy clean energy solutions
- Combination of technical and business expertise, underpinned with project management skills, makes Zen uniquely positioned to guide complex projects from inception to implementation



# Outline

- Hydrogen basics
- Why Hydrogen?
- Hydrogen Production & Use
- Canada's Starting Point
- Decarbonization of natural gas
- Moving forward opportunities, challenges, enablers



# What is Hydrogen?

Benefits



#### Benefits



#### Versatile energy carrier

- Electrochemical conversion to produce power
- Combustion to produce heat
- Use directly as feedstock



# Carbon free at point of use Important decarbonizing vector



Can be produced from a variety of feedstocks



- Can be transported long distances, stored indefinitely
  - Produced when and where most convenient
  - shipped by pipeline, road, rail, or water



High energy density = well suited to intensive duty cycles



# Why Hydrogen?

Main drivers to transition are environmental

- Meeting decarbonization goals
  - > 2030 commitment: 511 Mt (218.5 Mt reduction)
  - > 2050 target: net-zero through emissions reduction & offset (729.5 Mt, 2018 ref.)
- Improving air quality

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#### **Canada's Positioning & Benefits**





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**Energy Resilience** 

**Economic Growth** 

5

# **Hydrogen Production & Use**



#### **Clean Hydrogen Sources**

- Clean electricity & water
- Fossil fuels
- Biomass
- Industrial by-product

#### Hydrogen Uses:

- Transportation fuel
- Fuel for power production
- Heat for buildings and industry
- Feedstock for industrial processes

Image courtesy of CHFCA

# **Hydrogen Production Pathways**



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All low CI pathways need to be pursued to meet 2050 demand in net zero scenario

#### **Cost and CI are Key Metrics**





Reference: BC Hydrogen Study

7

### **Broader view – ROW & Canada**





## **Use as a Heating Fuel**





## **Canada's Starting Point**



# **Hydrogen as Decarbonization Vector in NG Grid**

#### **Opportunities**

- Hydrogen can have an critical role in the future of the NG industry in Canada as work to GHG neutrality, utilities can play key role ٠
- Blending of 5-20% H2 in the gas network is technically feasible in near-term, given sufficient supply ٠
- Dedicated pipelines to enable 100% H2 distribution in regions will be important in longer term ٠
- By 2050, H2 could make up large portion of the fuel in the gas network by volume and serve, along with electricity, as the one of the main carriers in the energy system

#### Challenges



Safety and reliability must be successfully proven in pilot stage before technology can be fully adopted



NG is currently low cost in many parts of Canada, and while H2 can compete with RNG the higher cost is a challenge particularly for industry

#### $\checkmark$ = Levers for Success

- Blending pilot projects needed to explore blending limits & drive codes and standards development Canada is lagging
- Define plan & approach to safely increase H2 blending percentages, include regulators, AHJs and international organizations and standards bodies
- Increase awareness around hydrogen as option for low carbon heating, e.g. with municipalities & develop suite of public tools (e.g. TCO model) & resources to help end-users evaluate H2 options
- Expand pilots for H2-integrated mini-grids at industrial sites & along strategic transportation corridors to pool supply / demand
- Increase R&D into end-use equipment and applications including boilers, safety and monitoring equipment, and materials



Lower volumetric energy density & radiant heat and equipment limitations complicate the direct substitution of H2 into industrial processes



Lack of standards and research into defining blending limits in Canada

# Thank You



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### The Potential of RNG to Decarbonize Canada's Energy Systems

The Future of Hydrogen & RNG in Canada – September 22, 2020



## About The Canadian Biogas Association

**Building the Biogas Sector With You** 

### Who We Are

### The **Canadian Biogas Association** is the voice of the biogas/RNG industry.

Since 2008, our membership has grown to over 140, including farmers, municipalities, technology developers, consultants, utilities, finance and insurance firms, affiliate organizations.

www.biogasassociation.ca





### What We Do

We advocate for building the Canadian biogas/RNG industry with current industry and organizational objectives focused in the following areas:



### Advocacy

- . Increase biogas/RNG market opportunities
- II. Improve the biogas/RNG development cycle

### **Education**

- III. Sustain biogas/RNG project operational longevity and proficiency
- IV. Enhance industry awareness, research and knowledge





## What is Biogas and Renewable Natural Gas?





**RENEWABLE NATURAL GAS (RNG)** 

## Sources of Biogas/RNG





### **RNG Applications**







Blended in existing natural gas networks

Transportation fuel

On-site energy



# **RNG Environmental Benefits**

- RNG reduces GHGs and addresses climate change in two ways:
  - Captures methane which would have otherwise been released into the atmosphere untreated. Methane is 84 times more potent than carbon dioxide over a 20-year period
  - 2. The methane captured in the form of BIOGAS is used as a renewable fuel and displaces the consumption of fossil fuels.
- Digestate replaces commercial fertilizer and returns organic matter to the soil





### Renewable Natural Gas in Canada

### Biogas and RNG in Canada

#### **Operating Biogas and RNG Projects in Canada**

61 & Food Waste Digesters



Wastewater Treatment Facilities





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### Biogas and RNG in Canada



Canadian Biogas Association

www.biogasassociation.ca/about\_biogas/projects\_canada

### **RNG Development in Canada**





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### **RNG Projects in Canada**



Province	Operating	In Development
British Columbia	5	4
Alberta	0	2
Ontario	2	4
Quebec	4	11



Over 5 million GJs of RNG produced annually

Over 3 million GJs of RNG in development



Building the Biogas Sector With You

### **RNG Programs in Canada**

• British Columbia, Quebec, Ontario are leading the way with RNG policy and programs.

Province	Date of RNG Program	Cost per GJ	Number of Projects
British Columbia	2007	Up to \$30	5 (4 in development)
Quebec	2017	\$7-22	4 (11 in development)
Ontario	Proposed Voluntary RNG Program in development	TBD	2 (others expected soon)





# Challenges and Opportunities

# Challenges Limiting Future Development

- Approvals & Connection
  - Siting, grid access, public consultation, studies, NIMBY
- Market competition
  - Provincial and state incentives upwards of \$30/GJ
- Limits on feedstock
  - Cheaper disposal options
- Cost
  - Low commodity pricing of natural gas and high capital investments in technology





# Unlocking the Value of RNG

- What elements are needed to advance the biogas/RNG market:
  - − Tangible Target/Goal → A renewable content requirement
  - Strong Market Pull Reasonable and stable gov't policy and programs to support sustainable, long-term product demand
  - Clear Market Mechanisms → Well-defined approach that sends strong signal and enables broad participation by industry







### **CBA Resources**

- The CBA has developed biogas and RNG resources to enhance awareness and knowledge of the industry
- Available on our website biogasassociation.ca





## Biogas makes better gas.

- CBA launched a public awareness campaign to communicate biogas and RNG as a sustainability means for industry, municipalities and agribusinesses
- Visit <u>bettergas.ca</u> for resources and biogas messaging









### Thank You!

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# Questions



# The Future of Hydrogen & RNG in Canada

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



September 29, 2020



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