Towards Net Zero – Blending Hydrogen in Natural Gas
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ABSTRACT
Enbridge sees an enormous opportunity for hydrogen production and blending within Natural Gas systems supported by comprehensive technical and economic assessments. These energy innovations will help Enbridge reduce emissions intensity by 35% by 2030 and reach the net-zero goal by 2050. Enbridge has become an industry leader in hydrogen through the development of the first-of-its-kind utility-scale hydrogen blending facility in North America. Using detailed research and development and engineering assessment, Enbridge Gas Inc concluded 2% hydrogen blend is a suitable threshold on a pilot basis in a closed distribution network located in Markham, Ontario. Hydrogen is produced from 2.5 MW electrolysis connected to Ontario’s 94% emission-free electrical grid. The pilot project is currently serving approximately 3,600 residential customers fed through the closed network, helping lower greenhouse gas (GHG) emissions by up to 117 tonnes of CO2e annually. Enbridge is building on the Markham pilot with ambitions to expand blending to a larger network at Gazifère—an Enbridge subsidiary in Québec—developing a 20 MW power-to-gas facility and blending into the whole network serving more than 43,000 customers.

KEY WORDS: Hydrogen Blending, Natural Gas Distribution, Hydrogen, Power-to-Gas.

INTRODUCTION
This paper summarizes the approach taken at Enbridge Gas Inc. (EGI) to enable hydrogen blending in an existing natural gas distribution network in Markham, Ontario, Canada. Elements of the full project cycle will be presented including planning, design, construction, commissioning, monitoring, and continuous improvement efforts.

Background
In May of 2018, a collaboration between EGI and Cummins successfully built and commissioned North America’s first and largest utility scale Power-to-Gas (PtG) plant in Markham, Ontario. The facility’s main function was to be “dispatched by the Independent Electricity System Operator (IESO) to help manage real-time supply and demand imbalances for Ontario’s electricity grid and ensures its reliable operation” (Cummins, 2020). The facility has at its core, a 2.5 MW Proton Exchange Membrane (PEM) electrolyzer, which is expandable to 5 MW within its current footprint. The PtG facility utilizes electricity and water to produce high purity hydrogen (at 99.99%) and oxygen. The produced hydrogen (at a pressure of 30 bar) is stored on site in storage vessels, while the oxygen can either be further captured or released into the atmosphere. This enables electrical energy storage in the form of hydrogen gas.

The working principle of PEM electrolysis is shown in Fig. 1, where voltage applied across electrodes results in oxidation at the anode producing oxygen gas and reduction at the cathode producing hydrogen gas. Stored hydrogen gas can be utilized in several applications such as re-generation of electricity at peak time demands, clean fuel for vehicles, feedstock for chemical processes and blending into the natural gas grid.

![Figure 1: PEM Electrolyzer operations (Cummins, n.d.)](image-url)