Volume 34, number 1, June 2020

Evaluation of techno-economic potential of producing renewable natural gas in Québec

Climate change has already had an impact on our modern lives. Developing energies and technologies that will reduce greenhouse gas (GHG) emissions will help limit the detrimental effects of climate change.

In this respect, renewable natural gas (RNG) represents an advantageous solution since this energy is not only renewable, it is perfectly interchangeable with conventional natural gas, which means that a customer who already consumes natural gas will not have to change appliances.

The first part of this article will define the different variations of RNG. Then the potential of producing RNG in Québec will be presented, taking into account the technical and economic constraints. Lastly, GHG reductions linked to the principal RNG production processes will be discussed.

Different renewable natural gas (RNG) production processes

First generation

Anaerobic digestion (absence of oxygen) is the best-known process for producing biogas, which principally consists of methane (CH_4) and carbon dioxide (CO_2). After refining and compression, the gas can be injected into a conventional natural gas distribution network, where it then becomes renewable natural gas or biomethane. Engineered landfills are the simplest source for RNG production: the biogas has only to be captured and refined to make RNG. Also, wastes from the agrifood, residential, agricultural and industrial sectors offer good potential and attractive opportunities for producing RNG. These types of production are called first-generation RNG.

Second generation

Forest or agricultural biomass can be burned at an extremely high temperature to produce a synthesis gas (syngas) through what is called gasification. Syngas is a mixture of hydrogen, monoxide and carbon dioxide. It can then be purified, and the hydrogen produced can be injected directly into a natural gas distribution network, which serves as an energy reservoir. However, since the minimum or maximum amount of hydrogen that a natural gas distribution network can absorb has not yet been defined, or regulated, there are few demonstration projects. Also, with the help of a catalyzer, methane (CH_4) can be created from the syngas through what is called methanation. This type of renewable natural gas is often described as second generation RNG in relevant documentation.

Third generation

Lastly, surplus renewable electricity can be used to produce hydrogen. To overcome the logistical issues (transportation and handling) inherent in hydrogen, it could be injected into a natural gas distribution network. As in syngas production, hydrogen can also be combined through a CO or CO_2 catalyzer to produce methane. This is also methanation, more specifically, Power-to-gas (P2G). The CO_2 may be captured in a biomethanation plant or from an industrial process that consumes natural gas. This production of renewable natural gas is often called third generation.

The techno-economic potential of RNG in Québec

The evaluation of energy production potential takes several factors into account, as shown below.

Steps in the analysis	Description
Determination of brakes and drivers	▪ Political, regulatory, environmental, social, economic and regional context
Evaluation of resources and technologies	▪ Accessibility of resources and estimation of growth ▪ Availability and maturity of production technologies ▪ Costs of investments and operations
Evaluation of potential	▪ Conversion of resources into technical potential ▪ Modelling of costs ▪ Quantification of potential for reducing GHGs

Table 1 – Principal steps in evaluating the potential for RNG production in Québec (Adapted from WSP Deloitte Report of October 2018 – See footnote)

Based on the initial evaluation of RNG production, various filters were applied to calculate the techno-economic potential. However, the techno-economic potential of P2G was not evaluated since it essentially depends on the availability of surplus electricity (political, environmental, economic, etc. context). An RNG worth $15/GJ was set as the purchase price in modelling the costs.

Given the above, the techno-economic potential of first-generation RNG production was evaluated at 25.8 million GJs, equivalent to 12% of the volume of natural gas distributed by Énergir. By 2030, adding in second generation RNG, the potential rises to 144.3 million GJs, which is equivalent to 66% of the volume of natural gas distributed by Énergir.

Potential reduction of GHGs

Substituting renewable natural gas (RNG) for conventional gas is a simple approach to reducing greenhouse gas emissions since it does not involve any investment in special gas-burning appliances for the consumer (interchangeability). Of course, an analysis of the life cycle for each RNG production process would help evaluate the potential for reducing GHGs more precisely.

In the preliminary analysis for 2030, the potential substitution of 144 million GJs would help avoid 7.2 million tonnes of GHGs or remove 1.5 million gas-powered vehicles from circulation. Given that overall GHG emissions in Québec in 2017 were more than 78 million tonnes, producing and consuming RNG as a replacement for hydrocarbons would represent an inexpensive approach.

In Québec, the targets for reducing GHGs by 2030 are -37.5% compared with 1990. Between 2017 and 2030, we must therefore collectively reduce GHG emissions by more than 23 million tonnes. So, renewable natural gas, in all its variations, can be part of the energy mix that will contribute to achieving our ambitious objectives.

Marie-Joëlle Lainé, Eng. CEM, Énergir

Source: Cordier, M. et al. “Renewable natural gas production in Québec: A key driver in the energy transition. Assessment of technical and economic potential in Québec (2018–2030).” October 2018.

Informa-TECH is a publication of DATECH Group of Énergir offered free of charge. For further information on these topics, contact DATECH Group at DATECH@energir.com.