GAS WHOLESALE CONSULTATIVE FORUM

Subject:	Distributed Gas Resources (Hydrogen and Biogas)
Agenda item:	9
Paper #:	5
Contact:	Yvonne Tan, AEMO
Date:	THURSDAY, 15 APRIL 2021

1. EXECUTIVE SUMMARY

Item raised by:	AEMO
Rule requirement:	Not Applicable
Link to National Objectives:	To promote efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of natural gas.
Previous forum discussion(s):	N/A
Item impact:	Investigate the impact of hydrogen and biogas distribution connected facilities on the east coast gas markets (STTM & DWGM)
Impacted parties:	Registered participants in DWGM and STTM
Purpose:	This paper informs the GWCF of issues relating to hydrogen blending in the distribution networks and AEMO's proposed approach in considering gas facilities other than natural gas in the distribution network.
Desired outcome:	Seeking feedback on the issues raised, any other issues to consider and proposed approach.

2. BACKGROUND

The National Hydrogen Strategy outlines how Hydrogen will be produced from renewable energy drawing power from the grid in a controllable fashion to counteract the uncontrolled nature of renewable energy and DER.

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When renewable energy is abundant hydrogen can be produced and stored for vehicle refuelling and/or injection into gas pipelines. When renewable energy is scarce, the stored hydrogen can be used and does not place a load on the grid. Biogas is produced from landfill, agriculture or forestry waste to produce a net-zero emissions fuel and can be injected into natural gas pipelines, typically into lower pressure gas distribution networks.

Blending hydrogen into the natural gas stream is seen as a way to decarbonise natural gas and eventually hydrogen could replace natural gas to provide inter-seasonal energy storage.

Victoria uses 10 PJ of natural gas per month in summer and up to 30 PJ per month in winter – Victoria uses more gas as energy than electricity during the winter. Therefore electrifying the Victorian heating load with renewables and hydro-storage (the only other inter-seasonal energy storage option) could be difficult to achieve without hydrogen.

The UK has a similar issue with winter heating load – in that it would be extremely difficult and expensive to electrify the heating load. Hydrogen is thought to be part of the solution in the colder part of the UK. California are also investigating the inter-seasonal storage role of hydrogen to support summer peak electricity / cooling demand.

Hydrogen is still an expensive alternative to natural gas but costs are expected to reduce as technology develops and mass production of electrolysers starts – noting that solar has reduced in cost by 99% and the Commonwealth / global target of getting the price of hydrogen down to $2 per kg.

In April 2019, ARENA opened the $70 million Renewable Hydrogen Deployment Funding Round to help fast track the development of renewable hydrogen in Australia. ARENA has announced that seven companies have been shortlisted and invited to submit a full application for the next stage of the Agency's $70 million hydrogen funding round. Among the shortlisted applicants, there are four projects based in Western Australia, and one each in Queensland, Tasmania and Victoria. ARENA aims to support two or three of the shortlisted large scale renewable hydrogen projects.

AEMO has several responsibilities for the DWGM and Retail Gas Market including demand forecasting, scheduling, heating value determination, metering, and gas quality management; that will be materially impacted by hydrogen and biogas blending into natural gas.

3. DISCUSSION

AEMO has conducted an initial investigation into some of the potential issues that should be resolved over the next few years to improve the integration of hydrogen and biogas into the markets. AEMO is seeking feedback on the identified issues and industry input into any other potential issues they can see which AEMO should consider.

3.1 Metering and billing

Natural Gas is typically metered by volume (standard cubic metres), but is billed on an energy delivered basis. To calculate this delivered energy value, the volumetric flow is multiplied by a Heating Value which effectively represents an energy density.

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The Heating Value is determined by measuring the composition of the natural gas (mainly methane, ethane, propane, plus inerts – carbon dioxide and nitrogen) using known energy values for each of the components to calculate the Heating Value of the gas blend.

Hydrogen has different properties to natural gas. Hydrogen produces over 2.5 times the energy per kg combusted vs. the energy per kg of natural gas (Higher Heating Value of 142 MJ/kg vs. 52 MJ/kg for natural gas), however hydrogen has a lower density so a greater volume of hydrogen is needed to deliver the same energy. Biogas also has a lower heating value than many natural gas streams (due to there being no heavier hydrocarbons present).

3.1.1 Victorian Retail Market

The Victorian Retail Market design currently uses an averaged uniform "State-wide Heating Value" to bill customers for their gas use. This is because the Retail Market Procedures and the Gas Distribution System (GDS) Code specifies that state-wide average heating values must be used for basic meter billing.

In 2009, Envestra submitted a proposal to change the state-wide average heating value used in the basic meter energy calculation to a zonal average heating value. In the final decision by the Essential Services Commission (ESC) of Victoria, it was decided that the Victorian Gas Distribution System Code will not be amended and the industry will continue to use the state-wide average heating value and requested that AEMO considers referring the issue to its industry reference group for discussion.

The ESC did not consider that a change was justified given the uncertainties in calculating heating values and measuring gas consumption using basic meters. In 2017, AEMO developed the Victorian real-time Heating Value Allocation (HVA) system which can accurately calculate Heating Values for the wholesale market for wholesale billing. AEMO's HVA system accurately calculates the gas composition at the 160+ withdrawal points into distribution networks, using measurements from 17 key sites and SCADA flow data. Field testing demonstrated that 97% of sites have a measurement accuracy of +/- 0.2%.

The ESC also noted at the time that the industries in Victoria were currently mid-way through the current access arrangement. The next access arrangement starts from 1 January 2023 and submissions are due on 1 January 2022. If a change was to occur now, distribution businesses could incorporate the changes into their next access arrangement.

There are several projects proposed in Victoria to supply either biogas or hydrogen to end use customers. The most notable of these is the Hyp Murray Valley[1] project, an electrolyser proposed by Australian Gas Infrastructure Group (AGIG) which would produce hydrogen for injection into the Albury-Wodonga gas distribution network.

The Albury – Wodonga project involves 40,000-50,000 customer meters, which makes it difficult to manually adjust the pressure correction factor or otherwise manually adjust the heating value. The current state-wide heating value in Victoria averages around 38.8 MJ/m^3 monthly[2]. A hydrogen blending trial will materially lower the Heating Value of gas in the distribution

[1] https://www.agig.com.au/media-release---hydrogen-proposal-in-albury-wodonga

[2] https://aemo.com.au/energy-systems/gas/declared-wholesale-gas-market-dwgm/data-dwgm/daily-dwgm-reports (INT139 – Declared Daily State Heating Value)

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network, resulting in inaccurate billing if nothing is done. A blend of 10% hydrogen is expected to lower the heating value to 35.96 MJ/m^3 in Victoria[3].

As more projects seek to connect, Victoria will require a solution that can adjust to the new connections which could be scattered across the distribution networks creating areas of low heating value and areas of high heating value. AEMO's proposed solution is to replace the Victorian Retail Market "State-wide Heating Value" with a locational / zonal model. A data feed from the distribution connected facility to the AEMO's Heating Value Allocation (HVA) system can then be used to calculate an accurate heating value for the blend to then be attributed to all customers within that zone. This will require a change to the Victorian Retail Market Procedures and the Gas Distribution System (GDS) Code.

3.1.2 Retail Markets (SA, QLD and NSW/ACT)

While different terminology is used within the different retail procedures (gas zone for SA, heating value zone for Queensland, network section for NSW/ACT), most other retail procedures allow for different heating values throughout the state. The procedures typically require a zone or section to be specified by the network operator and the heating value is then attributed to that zone or section. As more distribution connected facilities connect, more zones may be specified by the network operators.

3.2 Market Design

There are several market design components to contemplate, the connection of biogas facilities, the connection of hydrogen facilities and distribution facilities in general.

3.2.1 NGL

The NGL defines natural gas as a substance that—

(a) is in a gaseous state at standard temperature and pressure; and

(b) consists of naturally occurring hydrocarbons, or a naturally occurring mixture of hydrocarbons and non-hydrocarbons, the principal constituent of which is methane; and

(c) is suitable for consumption;

AEMO is of the opinion that while this definition could potentially cover biogas and their production facilities, it does not cover hydrogen or its production facilities. Once the hydrogen has been injected into the natural gas however it effectively is still natural gas as the blend is still predominately a mixture of hydrocarbons with the principal constituent being methane. Hydrogen could be a small artificial component within this mixture, however that does not change the fundamental definition of natural gas, as this artificial addition is akin to the addition of odorant.

The only other issue identified with the definition for natural gas is whether a blend which includes hydrogen is suitable for consumption under all circumstances. The Future Fuels CRC is currently collaborating with several universities and the Gas Appliances Manufacturers Association of Australia (GAMAA) to test appliances with a hydrogen blend to confirm the

[3] www.coagenergycouncil.gov.au/sites/prod.energycouncil/files/publications/documents/Hydrogen%20in%20the%20gas%20distribution%20networks%20report%202019.pdf

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suitability[4]. AEMO is of the opinion that the suitability for consumption would be within the remit of each jurisdiction's technical regulator.

An Energy Networks Australia legal review[5] of legislation concluded that nothing prohibits hydrogen or biogas being blended into natural gas, it is just not comprehended or covered effectively by the NGL. The National Hydrogen Project Team[6] are currently initiating a review into how to update the NGL to allow these facilities to participate within the East Australian gas markets.

3.2.2 STTM

The Short Term Trading Market (STTM) design and rules already contemplate distribution connected production facilities as a facility existed in Sydney when the market was designed. Therefore, it is AEMO's belief that the STTM design and rules do not fundamentally need to change to facilitate hydrogen or biogas injections. One minor area identified which may need change is the matched allocation agreements and what type of facility can participate in them.

3.2.3 DWGM

The current Victorian DWGM design does not contemplate distribution connected production facilities.

If hydrogen and biogas producers wish to sell their gas into the market, then the market design would have to contemplate distribution network connected facilities. For example, consideration would have to be given on whether they would have their own biddable injection meters or whether they could be recognised as a negative demand like NEM DER. The biddable injection meter initially appears to be the simpler solution as very little else would need changing while a negative demand could require a fundamental redesign of the wholesale and retail markets.

Depending on which market design is chosen, the market system will need to be updated to reflect this market design.

By allowing distributed connected facilities to register in the DWGM, this removes one of the market design inconsistencies between the STTM and DWGM. When registering these projects, they could be registered as a producer per the existing NGR definition or a new type of facility with a new definition.

AEMO's proposed solution is to investigate options with the Victorian Government including a potential DWGM rule change for the market design to contemplate distribution connected production facilities. Any potential rule change proposal would also likely contain updates to the rules regarding gas quality and metering.

4. TIMING AND NEXT STEPS

AEMO is seeking feedback on the following:

- The issues raised and proposed approach in Section 3.

[4] https://www.futurefuelscrc.com/wp-content/uploads/RP1.4-01SummaryGasApplianceTest.pdf

[5] https://www.energynetworks.com.au/resources/reports/a-report-on-the-injection-of-hydrogen-and-biogas-into-gas-distribution-networks/

[6] https://www.industry.gov.au/news/national-hydrogen-strategy-priorities-and-delivery

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- Any other potential issues or potential solutions participants can provide.

Please send all feedback to GWCF_Correspondence@aemo.com.au prior to 21 May 2021.

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