Exentian

Exentian Pty Ltd
www.exentian.com
Melbourne, Australia

Wednesday, July 28, 2021

RE: Submission to DELWP response to Victorian Gas Substitution Roadmap

Dear Sir/Madam,

Exentian are a Project Management and Engineering advisory business working predominantly in the energy sectors. We thank the State Government for the opportunity to participate in forming the future of the energy industry in Victoria.

Exentian team expertise spans traditional oil and gas production (especially in the Bass Strait) and, more recently, new energy developments and consulting.

Exentian are responding to the Victorian Gas Substitution Roadmap for the following reasons;

1. To provide technical input and advice to Government on issues to do with energy production, transmission and climate change.
2. To provide a broader (national) perspective on the issues to be addressed, as absence of overall National or bipartisan approach to GHG reduction is causing significant uncertainty.

The key areas addressed are: Electrification, Substituting natural gas with hydrogen, Substituting natural gas with biogas.

Summary of key points;

1. Decarbonization of coal electricity generation and decarbonization of transport (EV) should take precedence to using electricity for substitution of natural gas (hydrogen).
2. An overarching national roadmap is required, including all the steps required to achieve the end goal. Is gas system retirement the end goal?
3. The roadmap should account for the significant investment required to at least double the current electricity generation to substitute gas (and coal) usage.
4. Point source hydrogen generation should be prioritized rather than injection into the natural gas grid due to transport and regulation inefficiencies and future proofing against gas system retirement.
5. Gas importation will likely be required. Government policy should consider aligning policies with countries like Japan that encourage low carbon LNG imports.

1. **Clarity on objectives:**
   Electrification is the most effective way to reduce the use of gas in Victoria and decarbonize the gas system.

Processes that use electricity to produce a gas substitute are inherently less efficient than direct electrification, be it hydrogen or biomass planted where solar panels could be installed[i].

In order of priority for the decarbonization of Victoria the following may be an appropriate hierarchy:

1. Substitute coal with cleaner forms of power generation, renewables, or gas.
2. Decarbonize transport (gasoline and diesel) fuel burning activities with EV or hydrogen.
3. Electrify domestic and commercial energy usage.
4. Modify industrial processes to supplement or reduce gas usage.

Use of electricity to produce a gas substitute (such as hydrogen) would only be practical and economic when there is excess stranded renewable energy and a local market for hydrogen. In this context, hydrogen may have a part to play in electricity grid management.

Localized hydrogen production for industrial purposes that displace natural gas usage would be a more sustainable way to support hydrogen production projects, rather than gas blending. Such opportunities should be included in the overall list of options that is available for decarbonization. The analysis and support for electrification is repeated in many publications[ii] [iii].

It is acknowledged that there are many programs, incentives and policy directions to assist decarbonization. Some examples of policy areas to consider to decarbonize by electrification, reduce gas usage and displace gas usage are;

a. Reusing of glass bottles. Currently glass production is a major user of gas. Allowing bottle reuse would be a gas reduction opportunity.
b. Providing policy settings that require use of waste material in firing major kilns, eg in cement industry. Using waste to displace and to decarbonize industrial uses would be a better outcome than using waste for power.
c. Phasing out of gas hot water systems including gas pool heaters.
d. Providing targeted incentives on electrical appliances with electrification of existing gas appliances being the ultimate end goal.
e. Updating building codes and planning requirements to discourage and ultimately prevent gas appliances.

All opportunities will come at a cost to consumers, given gas has developed as the lowest cost energy source. Management of the societal and political implication of cost increases and burden should be part of the agreed policy objectives and directions that are based on a long term, bi-partisan and national vision for energy policy.

The need for a long-term vision on energy and environmental policy is highlighted when considering the investment required to deliver the energy currently provided from gas in Victoria with electricity.

Case Study:

The power equivalent required to displace gas usage in Victoria is an average of 6.8GW (589TJ/d, equivalent to 215PJ/Annum[iv]), with a peak winter load of 12.7GW (1100TJ/d) [v].

In the FY 2019 it was estimated Victoria power generation capacity was 10GW, with over half the capacity from coal and gas fired power generation. Simplistically, on a cold winter's day Victoria will need to over double its electricity capacity to substitute gas.

From a CO_2 perspective it would be better to use that electricity to substitute coal first as coal is 50% more polluting than gas (refer to need for hierarchy of opportunities).

For example, Macarthur wind farm in Western Victoria was the largest wind farm in the southern hemisphere. It comprises of 140 turbines and has a nominal capacity of 420MW with a load factor of 35% with a total delivered capacity of 147MW. When installed it cost ~AU$1B.

Using Macarthur as measurement unit, to replace gas an additional 12,125 turbines (or ~86 Macarthur wind farms) would need to be installed. This would suggest an investment in the order of AU$80B and the relevant land and transmission upgrades.

Mega scale projects are possible in Victoria, and investigation and support of high impact electricity projects to decarbonize production, such as offshore wind, should be a focus (refer to hierarchy of opportunities). These projects would have the added benefit of being economic, compared to hydrogen production for gas substitution. Providing jobs and investment to facilitate decarbonization.

2. **Establish priorities for use of electricity:**
   Meaningful substitution of methane with hydrogen is inefficient and uneconomic when compared to other decarbonization options.

Hydrogen has a low energy density and substitution of hydrogen into the natural gas system effectively dilutes the energy being delivered to customers. It will take more volume of gas to boil water in a stove if it has hydrogen in it than if it does not (see chart below[vi]).

Hydrogen introduction to the gas system has been demonstrated up to 5% in South Australia. Additional public spending to demonstrate feasibility is of limited technical value. From a decarbonization perspective it would be more effective to use the electricity used to make the green hydrogen to directly power appliances that would have previously used natural gas. Some examples;

1. Gas cook tops to induction.
2. Gas water heating (domestic and pools) to heat pumps, or alternates.
3. Gas central heating to electric or efficient reverse cycle.

Biomethane to supplement the gas network while desirable, is not effective[vii]. While theoretically feasible, land used for the production of biomass could more effectively be used for the production of renewable energy. Biomethane from anaerobic digesters will only be a fraction of the gas supply. The amount of treatment needed to clean and compress biomethane makes it uncompetitive compared to natural gas. Biomethane is better focused as a power source in small ecosystems of waste management or for standalone uses such as boilers.

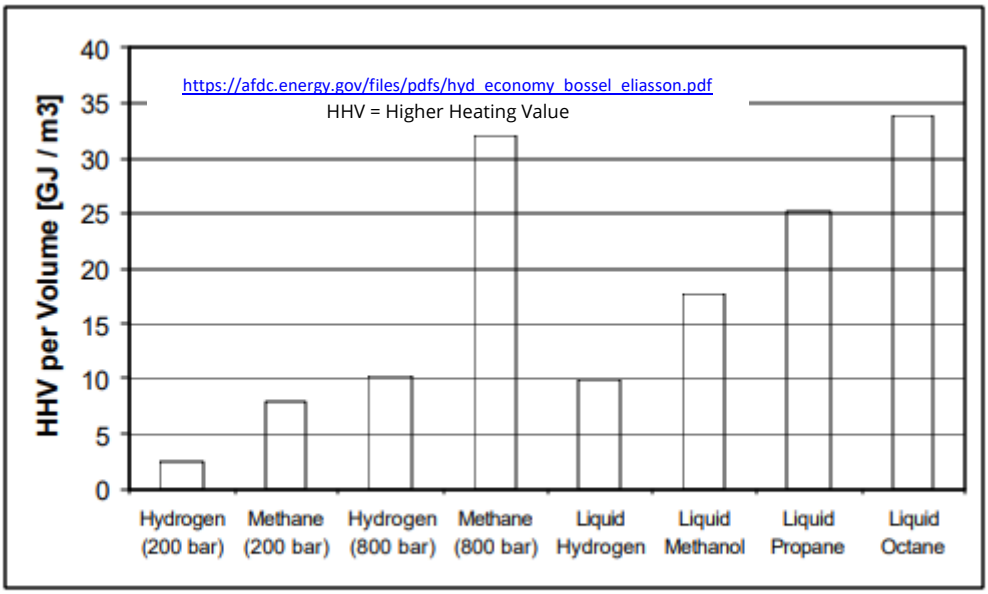

Figure 2 Volumetric HHV energy density of different fuels

Hydrogen pricing is not competitive with methane and is unlikely to be in the life of the current gas network [viii]. An overall gas network strategy is required, then the objective of the gas substitution roadmap can be defined.

3. Develop a regulatory framework for hydrogen injection into the gas system.

Regulation of the small-scale injection of hydrogen or (bio-methane) into the gas network is analogous to the integration of renewables into the grid. Hydrogen injection in the gas grid has been demonstrated in South Australia and the UK, however the scenario in Victoria is more complex. There is a need to manage hydrogen injection to account for pipeline limitations and overall swings in supply. Demand will significantly increase the complexity of managing the network.

The upgrade of systems and processes to manage hydrogen or biomethane injection into the existing network needs to be considered carefully. If the intention is to eventually retire the gas network, it will be uneconomic to upgrade or maintain the network to run on reticulated hydrogen due to metallurgical issues. Having hydrogen injection into the existing system locks in a certain amount of gas usage, if gas system retirement is an objective then the extent of hydrogen injection that is approved needs to be carefully considered as the metallurgy issues above 20% hydrogen are well documented and significant.

An overall plan for the gas system including clarity on the potential for gas system retirement is necessary to assess the overall viability of gas substitution.

4. **Align on decarbonization requirements for imported gas.**

Gas importation into Eastern Australia will be required as Bass Strait declines. This presents an opportunity to align with global best practice in relation to carbon neutrality of gas imported and support the global trend in LNG carbon neutrality.

Japan is major importer of LNG and is leading the decarbonization of the LNG industry by forming a Carbon Neutral LNG Buyers Alliance and putting in place a regulatory framework that requires imported LNG to have a degree of carbon neutrality. Aligning with this process would be a simple way to decarbonize part of the gas system. The benefits are;

- That the onus is on the suppliers to deliver solutions and encourages investment.
- The investment is made where the gas is, which is inherently more economic than trying to create gas.
- Leverage the leading position of major companies in Asia and Europe to tackle the problem of climate change, rather doing it locally where it would displace other opportunities to decarbonize.

This does highlight the difficulty of a state by state approach. For example, if NSW did not have the carbon neutrality requirement they would be the import location of choice. There needs to be a national approach or a united approach with operators.

The importance of having verified offsets to prevent greenwashing may limit the appeal of this approach or call into question whether it is a true decarbonization option, however, aligning with major LNG importers and encouraging suppliers to decarbonize is worth consideration.

5. **Provide a forecast.**
   Forecasting period needs to be extended to allow policy to be appropriately applied.

It is noted that the forecasting by the regulator extends to 2025. At that point DEWLP documentation[ix] has an inflection in gas usage. This future outlook is critical to planning a gas network. An explanation as to how policy settings will allow for a gas usage increase in a low carbon environment need to be critically assessed. The opportunities to decarbonize are well documented and mapping out the impact that these will have on reducing gas usage is supported.

Exentian thanks the Government for the opportunity to provide input into the gas substitution roadmap.

Yours sincerely,

The Exentian Team

contact@exentian.com

Endnotes

All endnotes correct as of 27 July 2021.

i https://www.pnas.org/content/pnas/104/12/4828.full.pdf

ii https://australiainstitute.org.au/wp-content/uploads/2020/12/UoMEI-Switching-off-gas-FINAL.pdf

iii https://www.linkedin.com/pulse/hydrogen-replace-natural-gas-numbers-paul-martin/

iv http://convert-to.com/conversion/power/convert-j-per-day-to-gw.html

v P 23 https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.vic-engage.files/5916/0247/2394/187._EJA_-_AEMO_Victorian_Gas_Planning_Report_Update.pdf

vi https://afdc.energy.gov/files/pdfs/hyd_economy_bossel_eliasson.pdf

vii refer summary of findings; https://arena.gov.au/assets/2019/06/biogas-opportunities-for-australia.pdf

viii https://www.cefc.com.au/media/nkmljvkc/australian-hydrogen-market-study.pdf - page 38 shows $2 H2 where gas is well under $2.

ix https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.vic-engage.files/1716/2544/4975/Victorias_Gas_Substitution_Roadmap_Consultation_Paper.pdf