Submission to the community consultation on gas infrastructure in a zero emissions economy - Victoria

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Introduction

Thank you for the opportunity to submit some brief comments for consideration as part of the consultation process.

I have made a submission to the Victorian Gas Roadmap community consultation. As this consultation covers much of the same territory I won't be commenting in detail on all of the alternatives proposed. I may repeat or expand upon some of the issues covered in the other submission.

Some Specific Comments

Please review the statement on page 33 of the report: Towards 2050: Gas infrastructure in a zero emissions economy - Interim report (the Interim Report) – 3rd paragraph, regarding the relative costs increase of electricity and gas. This should be looked at again and brought up to date – to 2021. Prices in the two markets are moving quickly relative to each other and no reliance should be placed on data from 5 years ago. The statement also does not take into account the benefits of electric heat pumps and the impact of the gas connection charge on the total cost of energy supply (including heat) to a house.

In Table 3 (page 30) of the Interim Report, the "Cost to achieve net zero" row. If this only includes a consideration of the capital costs of new and converted infrastructure, and not the actual cost of the natural gas substitute to the consumer, then its usefulness as a comparator of the options is questioned. It also surprised me that the cost comparator for Scenario C was listed as the cheapest option when it would involve extensive rebuilding of the gas distribution network to be able to handle hydrogen plus modification of all domestic and commercial gas appliances, plus the building of the hydrogen generation equipment. However that may be so. It is also unclear how it handles the issue of hydrogen being clear and odourless thus posing a risk for residents from in house hydrogen leakage. This issue was mentioned elsewhere in the Interim Report. Green hydrogen is likely to be considerably more expensive than natural gas for a number of decades – also mentioned in the Interim Report.

As I said in the Roadmap submission ultimately what fuel is chosen by the household will depend on cost. If heat from electricity is cheaper than heat from a gas then the householder will move to the cheaper source. So it would be a waste to spend a large amount on a gaseous substitute for natural gas for domestic and commercial use but then have the majority of people drift away from it due to cost. Cost impacts on consumer choice must be considered in the analysis, and not just the cost of infrastructure.

Preferred Option for domestic and commercial energy supply

Due to energy/heat delivery price and cost, and environmental considerations it is recommended that the preferred option for domestic and commercial low temperature heating should be **electrification** and the extensive use of heat pumps.

Role of Hydrogen

Hydrogen may play a part in our energy future. All hydrogen produced should be "Green" hydrogen (hydrogen produced by water electrolysis with renewable energy), as defined in the Interim Report. There should be no role for "Blue" or "Brown" hydrogen.

Hydrogen can have number of roles:

- For industrial uses for production of high heat – though much industrial heat can be provided by heat pumps, electrical resistance or electromagnetic current induction;
- For restaurant cooking;
- For vehicle fuel. While most cars and light and medium commercial vehicles will be battery powered some of the long haul vehicles may be powered by hydrogen. One of the advantages of hydrogen power is the speed of refuelling compared to battery powered vehicles. There may also be a role for hydrogen as a fuel for airplanes and country/interstate trains.
- As a chemical feedstock; and
- As a store of energy when there is an abundance of renewable electricity available on the grid.

Hydrogen can be used to run generators or fuel cells to supply electricity in times of low renewable electricity generator and/or higher demand. Hydrogen may also become a key export commodity.

Rooftop Photovoltaic Systems (RPV)

RPV should be encouraged and perhaps even made mandatory for new houses. In new estates the electricity transmission lines should be designed and sized with this in mind.

High PV electricity generation from large scale RPV could create an issue for local area grids at times. There is currently talk about grid operators being able to turn off rooftop PV in periods of high generation with insufficient demand. This is to prevent grid instability. However ideally the better way to handle this issue is to use or store the excess.

For increased use there could be a number of industries that are willing to only ramp up their use when the electricity price is cheap – that is in a time of excess electricity.

For storage in home and neighbourhood batteries will play a big part.

In my Roadmap submission I floated the idea that the main distributor gas pipelines would be retained and converted to hydrogen. This would enable distribution of the hydrogen for the uses listed in the section headed the "Role of Hydrogen". If this was done it would enable the building of local hydrogen electrolysis plants which could soak up the excess RPV power and put the generated hydrogen back into the hydrogen distribution pipelines. They may be able to use stormwater runoff

in the electrolysis process rather than desalinated drinking water. Having distributed hydrogen electrolysis plants will allow full utilisation of RPV power.

The main issue will be the feasibility of converting the main distributor pipelines to be able to handle hydrogen without steel embrittlement. If the pipes have to be physically dug up and replaced the cost may be too high. In-situ lining may be possible - though I don't know if this is currently able to be done. It is suggested as one of the options to be investigated.

Role of Natural Gas

Of course natural gas will not be turned off overnight. Under the domestic and commercial electrification scenario new gas appliances should be banned fairly early – it would lack logic to be installing new gas appliances when they would have to be replaced within say ten years. Similarly the current rule of having to have gas reticulation in new subdivisions would be abandoned as soon as possible. In the first 7 to 10 years* replacement of gas appliances would be for appliance breakdowns, the State Government's low income heating appliance replacement scheme and from government advertisements encouraging people to replace their own appliances on the basis that it will save them money and is environmentally preferred. As soon as the grid got to say 40% renewable electricity the main gas appliance replacement program would have to commence across the whole community.

(*How quickly closure should occur depends on the actual fugitive emissions from natural gas production, distribution and use. If it is very high and the total emissions from natural gas use are approaching the emissions – or even half the emissions - from the use of Victoria's grid electricity – still predominantly generated from brown coal - then replacement of gas appliances and the closing of the natural gas distribution system should be brought forward. It is a matter of determining the timetable that gives the lowest overall emissions.)

I note that Victoria has a number of gas powered electricity generators. These should be the last of the fossil fuel generators to be closed. As renewable electricity and storage increases the gas plants will be more and more used as peaking plants – some may need to be upgraded for this use. Some may be able to be converted to use hydrogen as a fuel for ongoing use. This needs to be investigated.

Natural gas is currently used as a feedstock for some industry. Not being a chemist I do not know whether this feedstock can be substituted with say hydrogen and carbon dioxide. If it can't be and natural gas continues to be used all emissions will have to be offset.

Energy from Waste

The Interim Report seems to suggest that emissions from Energy from Waste plants would be part of the natural carbon cycle. I would question that assumption. Victoria's 4 bin municipal waste collection system (yet to be rolled out) will separate most of the organic waste from the other waste stream. The organic waste stream will be composted, not burnt, at least that is what they are telling us so far. It also separates out most other materials (paper, glass, hard plastics) that can be recycled. What is proposed to be burnt is the waste that is left over. If there is any fossil fuel derived waste in the waste stream to be burnt e.g. plastics and some synthetic materials – and there will be – then fossil fuel based carbon emissions will be generated. These emissions would have to be either offset

or captured and stored – see suggestion in next section. If this is not the intention it may be better to bury the waste in landfill.

Suggestion for Investigation - OFCCCS / BECCS

While carbon capture and storage (CCS) is currently problematic with few commercial operations in place, it is clear that CCS will be required in the future to extract excess carbon from the atmosphere. CCS should NOT be used to enable the fossil fuel industry to keep burning their non-renewable fuel.

There is one technology that I believe has great potential that I rarely hear talked about. They call it Oxy Fuel Combustion with CCS (OFCCCS). It is part of a group of technologies know as Bio Energy with CCS (BECCS).

The difficult part of normal CCS is capturing and concentrating the carbon dioxide from the combustion gases. When a fuel is burnt in air the flue gases contain some carbon dioxide but it also contains other gases the most notable one being nitrogen – as nitrogen makes up approx. 80% of air. The idea of OFCCCS is to get rid of that nitrogen before combustion, leaving the post combustion flue gases with a lot higher concentration of carbon dioxide – and a few other gases in lesser concentrations.

My understanding of it is that the fuel – any carbon based fuel - is burnt in a mixture of carbon dioxide and oxygen. So it might be 30% oxygen and 70% carbon dioxide – whatever concentration mix is found to work best. The oxygen is consumed in the combustion process creating more carbon dioxide, plus some other gases, such as water vapour and other by-products of burning, but mainly carbon dioxide. The flue gases, which would be captured, should now be mostly carbon dioxide. The flue gases are then largely suitable for geological storage. However a proportion of the flue gases will be recirculated back to the combustion chamber to be mixed with more oxygen at the appropriate concentration for burning more fuel. And the cycle goes round.

What makes this particularly attractive (to me at least) is that the country should have an abundance of pure oxygen from electrolysis of water in the process of creating hydrogen, once that industry is up and running. I have never heard anyone say if there is any the plan for the use of the oxygen by-product. Perhaps it is to be released, harmlessly, into the atmosphere. This OFCCCS process will provide a use for part of it. As an abundant by-product its use should be relatively cheap. Having a market for this by-product would also assist in lowering the cost of green hydrogen.

Here is a link to a paper written on the process:

https://www.sciencedirect.com/science/article/pii/S036054422030459X

It is interesting in the paper that it says one of the significant costs with the system is from sourcing pure oxygen. With electrolysis being used primarily to produce hydrogen, with oxygen as the by-product going into the future I can't see this as an impediment. It also says some further post combustion cleaning of the flue gas would occur prior to storage. However I would think it would not be an issue if gases other than pure carbon dioxide also went into geological storage, provided the proportion of those gases are not so great as to needlessly waste the geological storage space. Even if an amount of smoke (unburnt fuel) went down into the geological store I can't see that as an issue.

The paper also says that there are a number of plants around the world already operating under this process.

While this paper is suggesting its use for energy production from municipal waste – and it certainly could be used for that – it could also have wider use as part of the strategy to both generate clean electricity from, say, crop waste, and to remove carbon from the atmosphere. It will result in negative carbon emissions, a lowering of carbon dioxide in the atmosphere, which is what is required now and will become even more important in the future. Consequently if atmospheric carbon removal it is found to be very beneficial (which it will) perhaps in the future some crops may be specifically grown for burning in OFCCCS electricity generators, giving the dual benefit.

This process would of course benefit from a carbon credit or carbon price system. But even without that it will still be generating clean renewable electricity to be sold onto the market.

I suggest that this would be a good opportunity for government to provide grants for research and a pilot plant to further investigate OFCCCS as part of the renewable electricity generation from waste or crop incorporating carbon capture strategies. But please not to the fossil fuel industry for fossil fuel carbon capture and storage. It is about decreasing atmospheric carbon dioxide, not prolonging a dying industry.

(On rereading I realise that this last section is only indirectly about gas infrastructure. However it is about possible infrastructure in the energy market and could be part of Victoria's long term Roadmap to a renewable energy future.)