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EnergyAustralia
LIGHT THE WAY

Infrastructure Victoria
[redacted]

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Infrastructure Victoria — Towards 2050: Gas infrastructure in a zero emissions economy, Interim Report — July 2021

EnergyAustralia is one of Australia's largest energy companies with around 2.4 million electricity and gas accounts across eastern Australia. We also own, operate and contract a diversified energy generation portfolio across Australia, including coal, gas, battery storage, demand response, wind and solar assets, with control of over 4,500MW of generation capacity.

We support Infrastructure Victoria's work in helping to systematically examine the risks and opportunities for gas infrastructure arising from pursuing net zero emissions targets. As Infrastructure Victoria is looking to assist the Victorian Government in its Gas Substitution Roadmap, many of the policy considerations will overlap and hence we refer you to our recent submission as part of the Government's consultation process (see attached). Selected observations from that submission, and the implications for Infrastructure Victoria's review, are as follows.

Optimal pathways should be considered separately for industrial, commercial and residential users.

The Interim Report outlines implications for different gas users in some detail however we suggest further quantitative or comparative analysis on the costs and use of infrastructure (gas and electricity) over time across the scenarios, disaggregated for mass market and for industrial users. The role of pricing, particularly for regulated network assets that may be subject to accelerated depreciation, seem likely to have important feedback loops on customer behaviour, infrastructure utilisation and potential policy interventions, which again will likely be quite distinct between industrial and other users depending on their ability to substitute away from gas.

Scenarios A and B illustrate some of these issues in having what appear to be very high rates of gas infrastructure decommissioning from 2030.[1] Since this will not be replaced (as per Scenarios C and D) such rates seem likely to material affect pricing via accelerated depreciation, to be recovered from a shrinking customer base and with lower gas usage. This would amplify equity concerns where affected customers are unable to switch. It may be worth also considering whether decommissioning needs to occur ahead of 2030 in order to smooth out impacts and support for affected users.

[1] See Infrastructure Victoria Interim Report, table 3; and DORIS Engineering Study Report, pp. 54-55, 110.

Households and commercial sites are best positioned to move towards zero emissions through progressive electrification.

High-efficiency appliances are now readily available and include heat-pump hot water units, reverse-cycle air conditioners and induction cooktops. Electric hot water units can be deployed to absorb surplus solar electricity and act as grid batteries, without spurring material build out of electricity infrastructure. The Interim Report notes the high potential for mass market electrification across most of the scenarios, which we agree with, highlighting the need to address a range of behavioural, cost and attitudinal barriers. As also noted, alternative routes involving hydrogen blending and biogas seem to have much higher cost, scale and technical barriers than electrification for these customers.

We expect Infrastructure Victoria's further work to identify cost-effective energy efficiency investment and customer research on household level understanding to explore upfront cost barriers (for example in exchanging gas space heaters and hot water) and the impact of different usage profiles on customer bills e.g. relating to time of use tariffs or general network capacity requirements.

Demand patterns will be important from a technical and policy perspective.

The Interim Report highlights that switching away from gas will place additional demand on electricity infrastructure, suggesting that household and commercial maximum demand would increase by 40 per cent, and shift into winter, relative to current summer maximum demand.[2] It is unclear whether this is an assumption or a finding based on detailed analysis, but in any case should be explored further in public discussion. For example, there is likely to be significant redundant capacity in the current electricity network to accommodate higher winter demand. Following from the above point on customer behaviour and technologies, the ability of particular appliances, particularly heat pump hot water units, should be examined for their potential to counter rather than amplify higher cost usage profiles, on daily and seasonal bases.

Hydrogen as a growth industry should be considered as a separate driver.

Although the Interim Report appears to indicate Scenario D is less plausible, we see value in retaining it to illustrate the use case of gas infrastructure where hydrogen is commercialised, which again should be kept separate from drivers relating to decarbonising domestic and industrial sectors.

We note the total volume of CO_2 storage required in Scenario D appears to be far above the capacity of offshore storage resources in Victoria that could feasibly be developed by 2050. Similarly, the annual rates of capture, up to 698Mt per year by 2050, compares to the 1Mt (and up to 20Mt) anticipated for the CarbonNet project[3], and this should be tested against feasible rates of CO_2 injection, not just total storage capacity or number of capture projects.

It may also be worth exploring cost projections and deployment rates of green hydrogen as they rest on assumed high capacity factors. The rate of plant utilisation will depend on the availability of renewable electricity being diverted from, or surplus to, grid supply including for short and long-term storage.

[2] Infrastructure Victoria, p. 19.
[3] DORIS Engineering, p. 222.

Transitional arrangements must be considered and implemented to avoid shocks and community resistance.

In addition, affordability, equity, and energy efficiency must be factored into the transition. The Interim Report identifies these as pertinent factors which can be further explored with more disaggregated information on different customer segments. For example, upfront barriers to conversion will mean that vulnerable and low-income Victorians will need comprehensive support to transition. Such support may need to go beyond subsidies which require a co-contribution and extend to limited numbers of free installations. Some households will require meter and / or fuse upgrades and increased input phases to support electrification.

If you would like to discuss this submission, please contact me on [redacted] or [redacted].

Regards

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Regulatory Affairs Lead

20 July 2021

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EnergyAustralia's comments on Victoria's Gas Substitution Roadmap Consultation Paper

We welcome the opportunity to provide comments in support of the Victorian Government's Gas Substitution Roadmap Consultation Paper ("the Consultation Paper").

EnergyAustralia is one of Australia's largest energy companies. We are headquartered in Melbourne, and Victoria is a state of critical importance to us. In this state, we operate the Yallourn power station and mine, as well as two gas-fired power stations, one near Morwell and one in Newport. We also underpin two utility-scale lithium-ion battery storage projects, a windfarm, and a solar farm, and we have committed to the development of a further 250MW battery at Jeeralang. We have over 850,000 customer accounts within Victoria and make around 100,000 of these accounts carbon neutral by providing carbon offsets.

EnergyAustralia is committed to reducing the emissions of our customers. We have the largest Climate Active certified offset offering in the Australian energy sector, and the second largest in the country after Telstra. In addition to offering our customers product level carbon neutrality, our goal is to achieve net zero across our portfolio by 2050. You can find out more at: energyaustralia.com.au/Carbon-Neutral-by-2050.

Key points

We agree emissions from the energy sector must reduce over coming decades and congratulation the Victorian Government on its consideration of how the state can reduce emissions from natural gas extraction, transportation, and use.

In this submission, we suggest that:

- Optimal pathways should be considered separately for:
  - Industrial users of gas without foreseeable potential to electrify
  - Households and commercial sites with the potential to electrify
  - Growing the hydrogen economy to drive exports and new industries.
- Some industrial uses for gas, including high-heat processing, gas-fired power generation and gas feedstock applications, will continue to rely on gaseous fuel for the foreseeable future. Reliable supply will remain important to these industries.

Steps can be taken case by case to support biogas and hydrogen blending within the technical limits of industrial equipment and processes.

- Households and commercial sites are best positioned to move towards zero emissions through progressive electrification, with readily available and high-efficiency appliances, including heat-pump hot water units, reverse-cycle air conditioners and induction cooktops. Electric hot water units can be deployed to absorb surplus solar electricity and act as grid batteries, without spurring material build out of electricity infrastructure.
- We are less supportive of moves to invest in hydrogen blending for household and small commercial use where greater than approximately 10% hydrogen is understood to require simultaneous appliance replacement and the extensive upgrade of pipes, creating an impediment to full decarbonisation and high costs to users.
- Transitional arrangements must be considered and implemented to avoid shocks and community resistance. In addition, affordability, equity, and energy efficiency must be factored into the transition.

Separate strategies for households and industrial processes

Analysis of gas needs and the potential for fuel substitution should engage with the different considerations relevant to the industrial use of gas as distinct from gas used by households or commercial sites. As outlined below, these use-cases exhibit very different economic and decarbonisation potential and should not be conflated.

The growth of the hydrogen economy, including the stimulation of new industries and exports, is to be championed. It should be approached as a separate use-case that can be addressed at arm's length to the decarbonisation of Victoria's existing gas. The long path to commercialisation of hydrogen through demand stimulation should not result in measures that drive domestic household use and exposure to higher home energy costs.

Industrial use-cases, including peaking power generation

There are many industrial processes that rely on gas, with no credible electrification alternative. High heat processes, including gas-fired power stations, cannot be powered without a fuel source with a high heat rate, such as gas. Some chemical reactions are similarly dependent upon gas as a feedstock[4].

EnergyAustralia operates two gas-fired power stations in Victoria that provide important dispatchable electricity to the system when demand spikes, or during periods of 'dunkelflaute', when poor wind and solar conditions suppress renewable energy supply and dispatchable power is needed to avoid blackouts. Victoria experiences such winter wind droughts, sometimes lasting more than a week. Battery storage is advancing rapidly but will not yet span more than 1-4 hours before requiring recharge, leaving gas 'peakers' to play a critically important role. For these power stations, there is currently no alternative to operating on a gaseous fuel[5].

In the industrial and high-heat use-cases described here, where gas will still be required for the foreseeable future, the decarbonisation narrative naturally moves to the pursuit of green hydrogen and/or the introduction of biogas. In cases of natural gas substitution where biogas can be accessed as a by-product without growing the production of

[4] Some of these have technical constraints that prevent gas blending and some produce no emissions.
[5] No alternative without increasing greenhouse gas emissions through substitution for liquid fuels.

methane, it can make a helpful contribution to industrial gas emissions reduction by using methane that would otherwise have leaked to the atmosphere. Available sources of biogas are understood to be volume constrained. EnergyAustralia is supportive of efforts to decarbonise such use-cases through gas blending so long as infrastructure costs and gas prices are not raised without the explicit involvement and consent of end users on a case-by-case basis.

In May 2021, EnergyAustralia announced our commitment to build Australia's first net zero emissions hydrogen and gas-capable power plant in NSW. Direct carbon dioxide emissions from the 300+MW Tallawarra B plant will be offset over its operational life. Importantly, the emissions that we offset will decline through the introduction of hydrogen into the fuel mix, starting with a commitment to offer to buy 200,000kg of green hydrogen per year from 2025. As we deepen our knowledge of hydrogen supply chains and technology limits, we hope to be able to increase the amount of green hydrogen we can take. We have made the commitment to invest in green hydrogen as a responsible asset owner with no current alternative to the use of high-heat content gaseous fuel.

We have noted projections of gas scarcity in Victoria and other southern states, potentially as soon as 2024[6]. For industrial users with continuing reliance upon gas, the most constructive roadmap would have the effect of prioritising gas for their needs while other sectors of the community with potential to electrify are engaged more proactively in that pathway. In this way, industrial users could be spared some of the pressures on pricing that local supply constraints might otherwise bring forward. Case by case, these users can then manage the technical limits on the rate of hydrogen and / or biogas blending that their equipment and processes can tolerate.

Household electrification the clearest path to zero emissions energy

Households and small commercial gas users face lower switching barriers than industrial users and can contribute meaningful emissions reduction through the slow and coordinated electrification of home appliances over time. For these gas users, a gas blending pathway may present an impediment to emissions reduction beyond an initial percentage.

According to the Grattan Institute's November 2020 report, 'Flame Out', over 98% of the natural gas used in Victorian homes is for space heating and hot water[7] These are applications that have ready electric equivalents. Where heat-pump hot water units, reverse-cycle air conditioners are chosen, and even induction cooktops, the electric equivalents boast meaningful efficiency gains in addition to decarbonisation.

Taking a long-term view, we anticipate a cost and complexity impediment to the deeper decarbonisation of households and commercial sites through a gas blending pathway.

The CSIRO National Hydrogen Roadmap is quoted in the Consultation Paper as indicating that blending more than around 10% hydrogen into the gas supply may trigger a need to simultaneously replace all the appliances it powers. This view is reinforced by a report

[6] AEMO Gas Statement of Opportunities Figure 2 on p.6 shows a shortfall from 2026 if there an import facility such as Port Kembla is operational. The absence of such a facility would bring forward that shortfall, potentially as early as 2024 https://www.aemo.com.au/-/media/files/gas/national_planning_and_forecasting/gsoo/2021/2021-gas-statement-of-opportunities.pdf?la=en

[7] https://grattan.edu.au/wp-content/uploads/2020/11/Flame-out-Grattan-report.pdf, Table 5.1

prepared for the South Australian Government by GPA Engineering[8]. While the precise tipping point is not yet definitively known, these reports suggest that beyond a relatively low penetration of hydrogen, a simultaneous step change in assets and infrastructure would be required across the reticulated system to unlock further decarbonisation. This step-up in deployment complexity and cost constitutes a material impediment to full decarbonisation.

The appliances required to function at 100% hydrogen are not commercialised. Since hydrogen molecules are smaller than the methane molecules which largely comprise natural gas, we would expect a more stringent and costly design response to manage the higher propensity to leak, adding to end user costs including high hydrogen fuel costs for the foreseeable future. These factors further increase the risk of decarbonisation through a blending pathway stalling at around 10%.

In addition to household appliance replacement costs, hydrogen blending at rates above around 10% would require increased expenditure in gas delivery. An extensive proportion of gas pipes would likely require either internal lining or replacement as steel and aged pipes would be embrittled by exposure to hydrogen. This would trigger pipe works within the boundary of user properties, and across distribution and transmission networks.

Under a hydrogen blending pathway, avoiding the step change in appliance and pipe replacement costs would mean decarbonising to around 10% and then being unable to achieve deeper abatement.

Biogas is proposed as another pathway to decarbonising the reticulated gas system. Where biogas is readily available as a by-product of waste and other cycles, and the customer does not incur materially higher costs for its inclusion, it can make sense to add it to the mix. However, the limited supply of biogas and constraints on the physical location of available sources will limit the role it can play in decarbonisation.

In contrast, the slow, phased electrification of homes and small commercial sites can be achieved with existing, readily available technology, with low risk, and with a clear line of sight to full decarbonisation. These electric household and small commercial appliances can be phased in without the need for system-wide simultaneous conversion.

Many electric heating appliances are already more energy efficient than their gas equivalents. For example, heat-pump water heaters are more than 4 times as efficient as gas equivalents, reverse-cycle air-conditioners are 3 to 6 times as efficient as gas heaters, and induction cooktops are twice as efficient as gas cooktops[9] - and appliance efficiency continues to improve.

The decarbonisation of the electricity generation sector is well underway. The emissions intensity of the National Electricity Market has declined around 6% per year over the last three years and is continuing to decline, facilitating ongoing decarbonisation of all electric appliances powered from the grid.

Given that more than one in five[10] Victorian homes now has rooftop solar installed, the emissions abatement from converting to electric appliances is higher still for those households. Those with access to rooftop solar can also enjoy lower energy costs from use of their own electricity.

[8] https://energyministers.gov.au/sites/prod.energycouncil/files/publications/documents/Hydrogen%20Impacts%20on%20Downstream%20Installations%20Appliances%20Report%202019.docx#:~:text=Domestic%20appliances%20(Type%20A)%20are,stability%20and%20materials%20is%20completed

[9] https://grattan.edu.au/wp-content/uploads/2020/11/Flame-out-Grattan-report.pdf, p.44

[10] https://www.solar.vic.gov.au/victorians-embracing-solar-record-levels

Taking a long-term view of household emissions

As the Victorian Government considers the Gas Substitution Roadmap, we encourage policy leaders to think in terms of appliance lifetime emissions and to structure incentives and measures that ready our state for full decarbonisation.

Household appliances for hot water, space heating, cooking and pool heating are major investments that tend to be operational for well over a decade. Replacements are purchased only very infrequently, typically as units fail or where a renovation or new build creates a need. An investment in home equipment that operates on gas that is only partially decarbonised will continue to release greenhouse gas emissions while the electricity system decarbonises around it.

In contrast, electric household and small commercial appliances will deliver growing greenhouse gas abatement as the electricity system continues to decarbonise.

As noted above, while biogas presents none of the conversion barriers of high blends of hydrogen, its low availability would similarly prevent long-term complete decarbonisation.

If blended gaseous fuels are difficult to fully decarbonise, short-term emissions reductions from their use could lock in higher emissions over the useful lives of household and commercial appliances. Perversely, there is potential for immediate emissions reductions through low volume gas blending to come at the expense of higher total lifetime emissions reductions.

Where to place the next dollar

The exchange of gas space heaters, gas hot water and gas cooktops for electric alternatives will not come cheaply. In some cases, the electric equivalent appliance is more than twice the price. The upfront cost barriers will persist until economies of scale drive pricing down. While electrification can be approached slowly and with higher overall certainty, it is not a zero-cost strategy.

The impact of adding electric household space heating to Victoria's electricity load are hard to model. Some of the uptick in electricity use will be resolved by drawing on rooftop solar output and some will occur in periods of plentiful electricity supply with distribution systems that are unconstrained. There will, however, be times at which electric space heating and other appliances add to electricity demand during periods of supply constraint or where there are impacts to distribution infrastructure.

As electric appliance penetration grows, we expect that some level of infrastructure investment will be required. Incremental, progressive deployment can, however, smooth the transition, and heat-pump hot water units and household batteries can increasingly time shift some of the load. We suggest that household and small-site electrification be approached on a gradual and measured basis, with a pace of change that allows the energy system to adapt.

Importantly, the cost of gradual electrification cannot be assessed against a zero-cost baseline. Biogas and hydrogen pathways are subject to scarcity and higher fuel costs for the foreseeable future, with additional transmission and distribution costs and appliance conversion costs beyond the initial blending barrier. This pathway would appear to be higher cost when viewed from the perspective of individual households.

Electric heat pump hot water and space heaters offer wider benefits

The gradual replacement of gas hot water units with heat-pump electric hot water units can not only remove around a quarter of the emissions from gas used by Victorian homes, equivalent to 15% of the state's total gas use, but can do so with minimal impact to the electricity system. Heat-pump hot water units can be set to charge through the middle of the day when solar output is highest, absorbing surplus energy that can otherwise become problematic, and reducing export energy from household solar panels. The value of heat-pump hot water units as batteries alone may be significant.

The heat pump technology driving electric reverse cycle air conditioners is already up to 600% efficient, meaning that it can take one unit of electrical energy and turn it into 3 to 6 times as much heating or cooling energy[11]. This is mature technology that is being increasingly deployed into today's energy system, providing dual function heating and cooling.

We note that the higher efficiency of heat-pump technologies means that the growth in electricity load will be materially lower than the corresponding fall in gas usage, driving further decarbonisation benefits.

Affordability, equity and constituent satisfaction through electrification

Any effort to gradually electrify households and small commercial sites in Victoria would need to be approached with great sensitivity so that the transition is as widely supported as possible. Given that Victoria currently consumes more energy from gas than electricity, and that around 60% of that gas is used at residential and commercial sites, this transition will need time.

As already noted, high efficiency electric appliances are priced above gas-fired equivalents. Given these upfront barriers to conversion, vulnerable and low-income Victorians will need comprehensive support to transition. Such support may need to go beyond subsidies which require a co-contribution and extend to limited numbers of free installations. Some households will require meter and / or fuse upgrades and increased input phases to support electrification. The costs of these changes should be considered alongside upfront appliance costs in designing for equitable access.

There will also be a need for appropriate consultation, education and communication with consumers. The focus should be on hot water and space heating conversion rather than bringing forward engagement on more complex and emotive conversions, such as gas barbecues, that might be beneficial for complete electrification further into the future.

We observe gaps in customer literacy and readily available information on heat-pump appliances, most notably for heat-pump hot water units. It would be helpful to publish the relative efficiency, tank sizes, STC certificates and noise ratings of available units.

The Victorian Government agency Solar Victoria has commenced delivery of rebates for the installation of energy-efficient heating and cooling. 250,000 dwellings, starting with not-for-profit community housing organisations[12], will have access to $1,000 towards the cost of purchasing and installing a high-efficiency reverse cycle heating and cooling system, with a further $200 if they need to cap their old gas heater or $500 if they need to upgrade their switchboard.

[11] https://www.energy.gov.au/households/heating-and-cooling

[12] To be followed before the end of July by eligibility for holders of a concession card and households with a combined income of less than $90,000.

We expect that this program will deliver important insights that can enrich future policy design while delivering real quality-of-life, energy efficiency and safety improvements. We commend the Victorian Government on the Home Heating and Cooling Upgrades Program, and hope it is accompanied by efforts to build the knowledge and capability of those trades that will be central to the transition.

Over the long-term, gradual electrification might see fewer households contributing to network service charges, with network infrastructure businesses in turn facing less certain cost recovery and, potentially, costs falling more heavily on remaining gas users. The Victorian Government might consider measures, such as slightly accelerated network and distribution gas pipe depreciation and ultimately customer supports in key use-cases.

Energy efficiency and building standards remain relevant

Finally, we note that building insulation and energy efficiency remain relevant. Most Victorian homes "were built before energy efficiency regulations were introduced in 2005 and have a very low thermal efficiency[13]". Air leakage rates typically exceed two air changes per hour, meaning that internal air warmed by space heating is lost within half an hour[14]. Efforts to improve the efficiency of existing and new housing stock would complement gradual home electrification.

For further information please contact [redacted], or beyond 26 July, please contact [redacted], at [redacted]

Best regards,

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[13] Victorian Households Energy Report, 2014
[14] *Ibid*.,