APA submission – Towards 2050: Gas Infrastructure in a zero emissions economy

Interim Report

16 August 2021

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1 Executive Summary

Key points

- APA supports the transition to net zero emissions. We recently announced our own ambition of net zero operations emissions by 2050.
- As recent experience in South Australia and Victoria has shown, gas infrastructure plays a critical role in helping maintain system security and will help unlock low-cost renewable generation capacity.
- Continuing to utilise gas infrastructure to support Victoria's decarbonisation can reduce emissions at a lower cost to Victorian consumers than electrifying the services provided by gas. The significant cost of electrification appears to be understated in the scenarios presented in the Interim Report.
- In its advice to Government, it is important that Infrastructure Victoria adopts a technology neutral approach and allows for all possible infrastructure scenarios to eventuate. This will ensure that the transition to a lower carbon future occurs at least cost. As Infrastructure Victoria's engineering consultant pointed out, there may be other scenarios that deliver improved affordability and reliability outcomes whilst achieving net zero emissions.
- Decarbonisation of the Victorian economy should be considered as a whole, rather than on an industry-by-industry basis. Overseas jurisdictions with similar energy profiles to Victoria, such as the UK and the Netherlands, are prioritising the retirement of the more carbon intensive coal generation.

APA is a leading Australian Securities Exchange (ASX) listed energy infrastructure business. Consistent with our purpose to strengthen communities through responsible energy, our diverse portfolio of energy infrastructure delivers energy to customers in every state and territory on mainland Australia.

Our 15,000 kilometres of natural gas pipelines connect sources of supply and markets across mainland Australia. We operate and maintain networks connecting 1.4 million Australian homes and businesses to the benefits of natural gas. And we own or have interests in gas storage facilities, gas-fired power stations.

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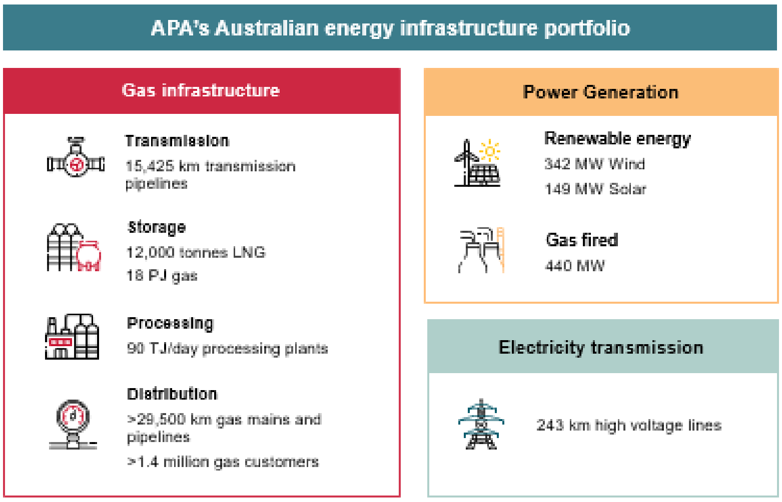
Our investments also include over $750 million in renewable generation, while our high voltage electricity transmission connects Victoria with South Australia and New South Wales with Queensland.

Figure 1



APA is supporting the transition to a lower carbon future. Our ambition is to achieve net zero operations emissions by 2050. Through our Pathfinder Program, we are investigating how hydrogen and other technologies such as batteries and microgrids, can support a lower carbon future.

In the Interim Report, Infrastructure Victoria considered that the opportunity to repurpose existing gas infrastructure over the long term (beyond 2040) is limited. An increasing number of projects around the world, however, are demonstrating the potential for re-use of gas infrastructure to transport renewable gases. For example, the Gasunie hydrogen pipeline in the Netherlands has been transporting hydrogen along a modified natural gas pipeline since 2018. On 30 June 2021, Gasunie announced a significant expansion of the Dutch hydrogen transmission network. The new Dutch national hydrogen network will consist of 85% reused natural gas pipelines, resulting in costs four times lower than if entirely new pipelines were laid.

Gas infrastructure has an essential role to play in helping Australia meet its net zero ambitions targets. As the penetration of variable renewable energy sources, such as wind and solar, increase, and aging coal power stations retire, Gas Powered Generation (GPG) will play a critical role in meeting electricity demand and maintaining the security of the system.

Electricity generation accounts for approximately 45% of Victoria's overall net emissions, with 96% of electricity generation emissions coming from three brown coal power stations. Not only does GPG's flexibility make it a perfect complement to variable renewable energy, it also has the advantage of emitting approximately half the carbon emissions of brown coal.

This advantage has been recognised in many international jurisdictions that have historically relied heavily on gas and coal. For example, as Infrastructure Australia's international comparisons points out, the United Kingdom and the Netherlands have both achieved significant emissions reductions by retiring coal in the first instance, with gas supporting the economy during that transition.

Determining a pathway to a lower carbon future requires a consideration of many complex and interrelated issues. To ensure that the transition to a low carbon economy occurs at least cost, Infrastructure Victoria should adopt a technology neutral approach in its advice to Government. 'Picking winners' or attempting to choose an optimal infrastructure scenario risks exposing Victorian customers to inefficient outcomes and higher costs on the long run. As Infrastructure Victoria's engineering consultant pointed out, there may be other scenarios that deliver affordability and reliability improvements over and above the four scenarios considered.

Our submission to the Interim Report is structured as follows:

- PART A contains the key issues we wish to raise, including the importance of gas in maintaining energy security and reliability.
- PART B contains answers to the questions for consideration in the Interim Report.

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2 PART A – Overview

2.1 Natural gas is essential for energy security

The National Electricity Market is going through a period of fundamental change, with large volumes of VRE displacing aging thermal generation, mostly coal power stations, at great speed. This transition is not without its challenges.

Recent experience has demonstrated the critical role that gas plays in supporting renewables and providing a critical backup when large renewable generation such as wind and solar is not available.

The gas network is also a flexible, affordable and safe store of energy, making it ideal to help support energy supply during extreme weather or periods of reduced supply. The ability to locate GPG close to major demand centres also reduces exposure to transmission capacity constraints often experienced by the overconcentration of renewable generation in common areas of the grid.

The build out of renewable generation will require substantial increases in electricity transmission and related infrastructure costs with a consequential impact on household and industry electricity bills. Gas, on the other hand, can be sited in suitable grid locations and will not materially add to such costs.

2.1.1 Gas's role in complementing VRE

As recent experience in South Australia has shown, periods of low wind and solar availability require significant volumes of dispatchable resources to be available to support the reliability and security of the system. Similar issues are likely to be experienced in other states, including Victoria, as coal power stations retire.

For example, in the recent period from 8 July to 12 July 2021, Gas Powered Generation (GPG) was critical in keeping the lights on, due to periods of low wind and solar generation. On four out of the five days, GPG provided:

- over 75% of peak electricity consumption
- over 50% of total daily consumption.

These four days are shown in Figure 2, with the critical role of gas during the 6pm daily peak highlighted. These four days are not a unique occurrence. While the days in which SA is powered exclusively by VRE are well publicised, the days in which gas provides reliable, dispatchable generation do not get so much attention.

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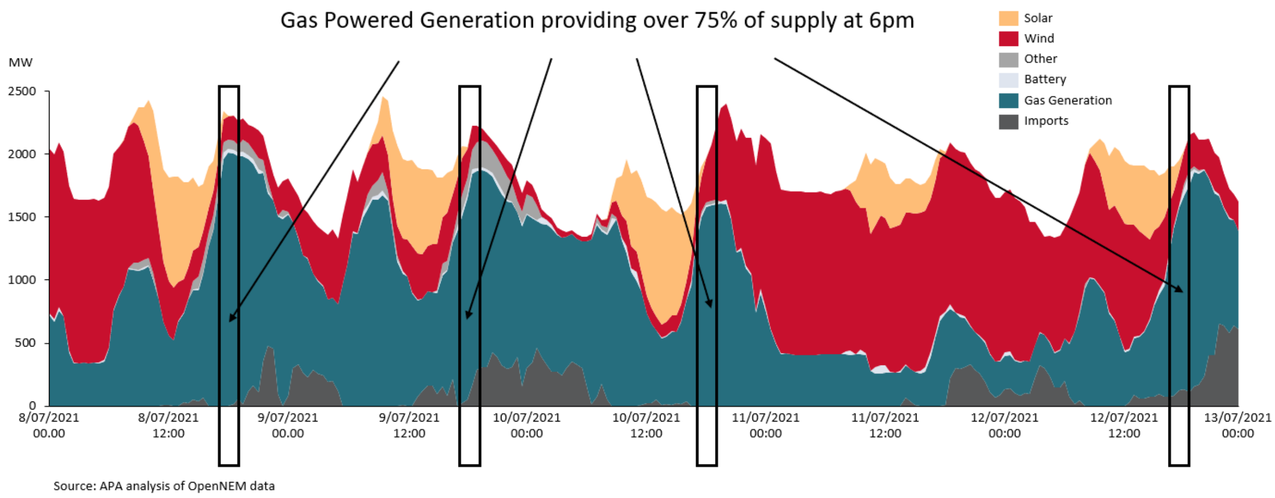
Figure 2: Case Study 8 to 12 July 2021 in South Australia



The important role played by gas was recognised in a recent speech by the new AEMO Chief Executive Officer, Daniel Westerman, on 14 July 2021. Mr Westerman recognised that gas firming is invaluable because it can be called on for short or long periods. Most importantly, Mr Westerman argued that gas is critical in supporting greater volumes of VRE:[1]

> *"… dispatchable generation like this unlocks many multiples of low-cost renewable generation capacity into the market, by providing the security for when the sun isn't shining, the wind isn't blowing, and other storage can't bridge the gap."*

The critical role that gas will continue to play into the future was also recognised by the Grattan Institute in its recent report *Go for net zero: A practical plan for reliable, affordable low-emissions electricity.*[2]

Grattan correctly identified that the economics of GPG make it ideal for providing backstop capacity in a system powered mostly by solar and wind. The main reasons for this include:

- in contrast to coal, gas turbines can ramp up and down quickly to balance fluctuations in demand;
- gas plants are cheaper to build;

1 AEMO, *A view from the control room*, CEDA keynote address, 14 July 2021
2 Grattan Institute, *Go for net zero*, April 2021, p30

- it is easier and cheaper to store gas and liquid fuels than electricity, which make them ideal for energy storage in case of a particularly challenging winter or summer; and
- Australia has substantial infrastructure for moving and storing gas.

The Victorian Government's Gas Substitution pathway must recognise the important role of GPG in providing Victorian customers with an affordable and reliable electricity supply.

2.1.2 Gas's role in supporting the NEM

Recent events in Queensland and Victoria have also demonstrated the flexibility and security offered by GPG:

- On 25 May 2021a failure of one of the generation units at Callide Power Station in Queensland caused 477,000 customers to lose power.
- In mid-June 2021, Yallourn Power Station in Victoria reduced electricity generation to approximately 20% capacity due to the threat of floodwater from the Morwell River. This was the second time Yallourn experienced a significant flooding event, with the Power Station shutting in 2012 when floodwaters entered the adjoining mine.

Following both these recent events, GPG stepped up to help provide crucial electricity generation in both Queensland and Victoria. GPG doubled its output while not increasing overall emissions. The ability of gas turbines to quickly ramp up and provide long term dispatchable generation shows they will be a critical part of the energy system for many years to come.

2.1.3 The gas network is a vital energy store

Due to their ability to compress and store gas, pipelines are ideally placed to help with energy supplies either during extreme weather or in the event of supply failure. In many respects they are just like big batteries capable of being turned on in minutes, and able to be sustained for days, offering a unique ability to deliver energy security when it's needed most. This was shown to be the case following the supply disruption at Longford.

In mid-July 2021, the Longford gas plant in Victoria suffered a reduction in production due to technical problems, significantly reducing the amount of gas being supplied to the Victorian market. This led to AEMO issuing a notice of threat to system security.[3]

In response to this event, it was the flexibility of APA's 7,500 kilometres of interconnected gas transmission pipelines that form East Coast Gas Grid that enabled

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3 AER, *Weekly Gas Market Report, Weekly Summary,* 20-26 June

us to get gas from the north to the south, helping to rapidly address these shortfalls. APA utilised its substantial inventory position (known as 'linepack') on the Moomba to Sydney Pipeline (MSP) to support shippers supply through this event. A recent capacity upgrade of compression prior to this winter ensured flows from the MSP into the Victorian Transmission System (VTS) via the Victorian Interconnect at Culcairn. Further additional capacity was available during this event should the market have required it.

APA's Dandenong Liquid Natural Gas (LNG) facility also played an important role in supporting the VTS by injecting LNG at the Dandenong city gate, directly into the Melbourne metro area. The Dandenong LNG Facility was also available to inject additional volumes of gas should the market have required it.

Following this rapid response, AEMO subsequently removed the threat to system security.

2.1.4 *The gas network provides energy resilience for customers*

Given that gas pipelines are underground, it is a very rare occurrence for network faults to disrupt customer supply. The fact that gas can be compressed and 'stored' in gas pipelines means that even during maintenance activities customers are rarely disrupted.

Gas transmission pipelines and distribution networks are not subject to formal reliability standards. One of the key reasons for this is that gas reliability is very good. The last gas distribution performance report published by the AER, for example, showed that the average Victorian gas customer had an outage once every 36 years.[4] This contrasts with electricity networks where customers often experience outages due to storms taking down power lines or outages to conduct maintenance.

The resilience of gas infrastructure and its complementary nature to electricity suggest that every possible avenue should be pursued to retain its use. Repurposed natural gas pipelines that deliver renewable gases will provide customers with an efficient and resilient energy supply for many generations to come.

2.2 Decarbonisation of the economy should be considered as a whole

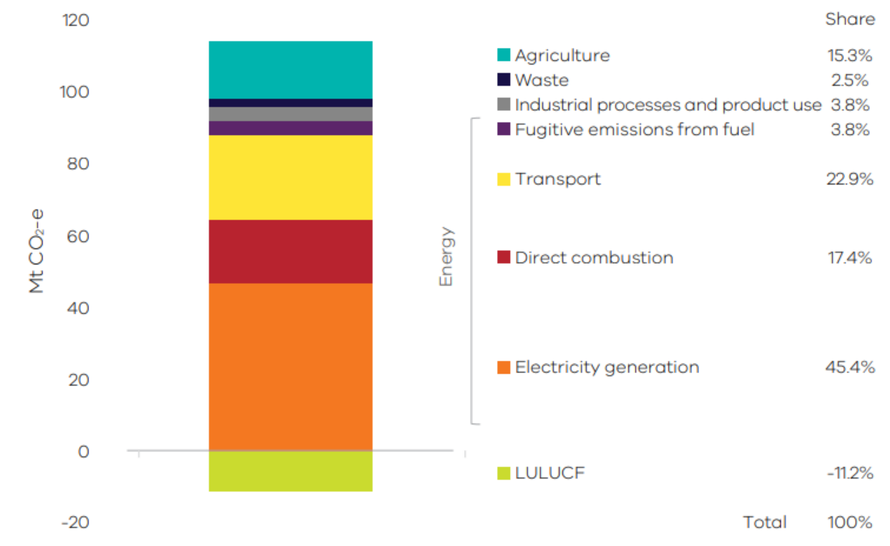
The Victorian Gas sector contributes 15.8% of Victoria's total emissions which is around a third of emissions produced by Victoria's heavy reliance on brown coal for electricity generation.[5]

4 AER, Victorian Gas Distribution Performance Report 2012, p. 13
5 Victorian Government, *Gas Substitution Roadmap Consultation Paper,* May 2021, p.10

The most recent *Victorian Greenhouse Gas Emissions Report*, published in 2020, provides a summary of where all of Victoria's carbon emissions come from (see Figure 3).

Electricity generation accounts for approximately 45% of overall net emissions, with 96% of electricity generation emissions coming from the three Victorian brown coal power stations.[6]

Figure 3: Victorian Emissions by sector 2018



Source: Victorian Government

One of the key risks associated with focussing attention on just the gas sector is that policy makers risk 'picking winners' or choosing a pathway that may not be the most optimal way to lower carbon emissions at least cost.

In the Interim Report, Infrastructure Victoria relies heavily on *Net Zero Emission Scenario Analysis Study Report* prepared by DORiS Engineering (the DORiS Report) when presenting infrastructure scenarios to achieve net zero emissions.[7] The DORiS Report conducted analysis of four possible decarbonisation scenarios and considered the strengths and costs of each. Based on the method adopted, the DORiS Report was not able to differentiate the three strongest scenarios.[8] More importantly, DORiS Engineering identified an alternative scenario that may deliver a more affordable and reliable energy scenario:[9]

6 Victorian Government Greenhouse and Energy Information by Designated Generation Facility, 2019-20

7 DORiS Engineering, *Net Zero Emission Scenario Analysis Study Report*, May 2021

8 DORiS Engineering, *Net Zero Emission Scenario Analysis Study Report*, May 2021, p.244

9 DORiS Engineering, *Net Zero Emission Scenario Analysis Study Report*, May 2021, p.7

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> *"…elements of a potential "hybrid scenario" were identified that may deliver improvements over the base scenarios in affordability and reliability of energy whilst achieving a Net Zero Emissions position by 2050."*

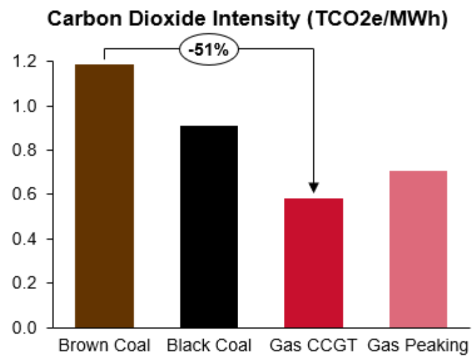
The DORiS Report demonstrates the difficulty in attempting to predict the future and forecast the optimal infrastructure scenario for Victoria. Attempting to do so risks higher costs and inefficient outcomes for customers in the long run.

In our view the decarbonisation of the energy system should be considered as a whole, rather than on an industry-by-industry basis. An emissions reductions pathway should take a technology neutral approach and focus on measures that achieve the maximum carbon reductions at lowest marginal abatement cost.

The existing electricity generation mix in the NEM, and in Victoria in particular, has a higher carbon profile than emissions associated with the combustion of natural gas. Brown coal, the primary source of electricity in Victoria, has approximately double the carbon emissions intensity of energy produced by a combined cycle gas turbine (CCGT) (see Figure 4).

While it is recognised that the ultimate aim is to reduce all forms of emissions, including from gas combustion, any short to medium term electrification of gas demand is likely to increase overall emissions, given the heavy reliance on brown coal to supply electricity. A rapid uptake of electric vehicles or grid connected batteries could exacerbate this issue if they are charging from the Victorian grid which is dominated by brown coal generation. Should either of these situations eventuate, meeting Victoria's interim emissions reductions targets would become harder to achieve.

Figure 4: Carbon intensity of natural gas compared to coal

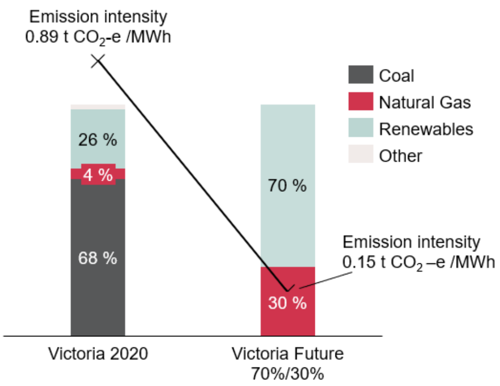


Source: APA analysis of OpenNEM emissions data from 16 May to 21 June 2021

The early retirement of brown coal is the biggest single emissions reduction initiative that Victoria could undertake and would increase the likelihood of Victoria not just meeting, but exceeding, its 2025 and 2030 emission reductions targets. This is clearly demonstrated below:

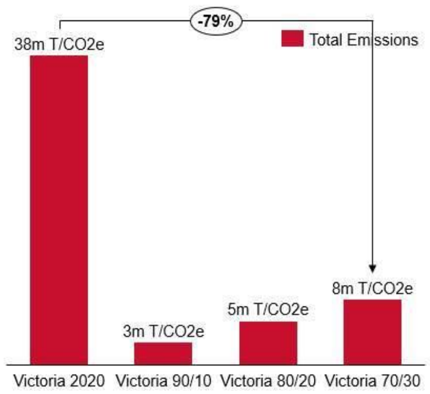
- Figure 5 shows that a future energy mix of 70% renewables supported by 30% gas could reduce the emissions intensity of Victoria's electricity generation by around 80%, from 0.89 TCO2e/MWh to 0.15 TCO2e/MWh.
- Figure 6 shows that this would result in annual emissions from electricity generation reducing by approximately 80% in the 70/30 energy mix. Given that electricity generation accounts for 45% of overall Victorian emissions, this would result in a large 36% reduction in overall Victorian emissions.

Figure 5: Emissions intensity of Victoria in 2020 compared with 70/30 scenario



Source: Carbon Dioxide Equivalent Intensity Index, AEMO
Table O, Australian Energy Statistics Update DISER

Figure 6: Annual energy generation emissions in Victoria in 2020 compared with 70/30 scenario



Source: APA analysis based on 50/50 peak/baseload mix and AEMO data

International jurisdictions have come to similar conclusions when considering options to meet emissions targets. In its *Gas infrastructure: international comparisons* prepared for Infrastructure Victoria, Accenture Strategy looked at several jurisdictions that also relied heavily on gas and coal and have taken measures to reduce coal consumption as a logical first step in moving to a low emissions economy:[10]

- **United Kingdom –** coal will soon be completely phased out of the UK economy, with the government recently announcing plans to bring forward the 2025 phase out of coal to October 2024 (see Figure 7). Major upgrades of the

10 Accenture Strategy, *Gas infrastructure: international comparisons,* April 2021

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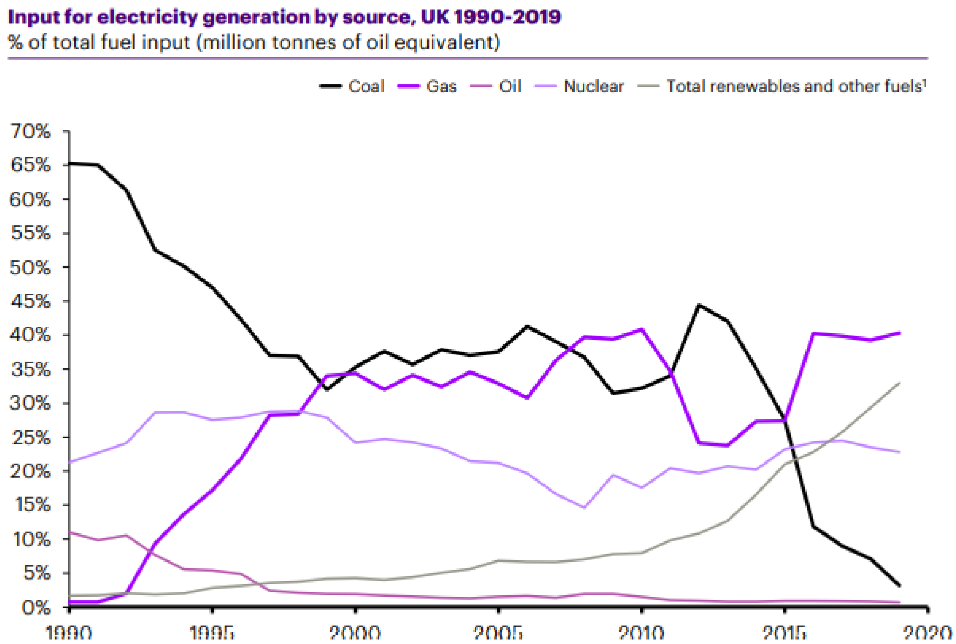
natural gas network will continue until 2032. This will reduce methane leakage and provide options to switch to hydrogen in the future.[11]

Figure 7: Input for UK electricity generation by source



Source: Accenture Strategy

- **Netherlands –** gas consumption in the Netherlands is similar to Victoria, driven by historical low gas prices and high local production and the dominant role of gas in heating. The abundant supply of gas has supported the transition from coal and the Netherlands is now considering various measures to decarbonise gas.[12]

2.3 The cost of electrification must be carefully evaluated

One of the key unknowns when developing the Roadmap is the potential cost of electrification. Using publicly available sources, it is possible to determine the magnitude of the task being considered.

In Victoria there is a significant difference between summer and winter energy use, as shown in Table 1.

11 Accenture Strategy, *Gas infrastructure: international comparisons,* April 2021, pp31-32.
12 Accenture Strategy, *Gas infrastructure: international comparisons,* April 2021, pp46-48.

Table 1: 2019 Maximum electricity and gas demand

2019	Winter	Summer
Electricity - maximum demand	7.6GW[13]	8.7GW[14]
Gas – Hourly peak day demand[15]	75 TJ/hr	25.4 TJ/h

It is possible to convert hourly gas demand into GW to compare how much energy the electricity and gas networks are delivering at their summer and winter peaks. This is achieved by multiplying the number of TJ/h by 0.27778 to determine the number of GW. For example:

75 TJ/h x 0.27778 = 20.8GW

The resulting electricity and gas winter and summer maximum demand, expressed in GW, are shown in Table 2.

Table 2: 2019 Maximum electricity and gas demand expressed in GW

2019	Winter	Summer
Electricity - Maximum demand	7.6GW	8.7GW
Gas – Forecast hourly peak day demand in MW	20.8GW	7.1GW

Source: APA analysis of AEMO data

Recognising this is a simplistic comparison, it demonstrates that while the electricity and gas networks had a comparable peak demand on a summer day in 2019 (i.e., 8.7GW compared to 7.1GW) on a peak winter day the gas network delivered more than twice the peak energy demand of the electricity network (20.8GW compared to 8.7GW).

The fact that the gas network delivers over twice the peak energy demand of the Victorian electricity network is one of the key hurdles associated with the Roadmap.

Electrification of gas use is one of the proposed decarbonisation pathways identified by the Interim Report (Scenario A). As the simple analysis above demonstrates, electrifying Victoria's winter gas load could require the electricity network to handle three times its current load. That is, instead of a peak demand of around 10GW, the

13 AER, Seasonal peak demand – regions: https://www.aer.gov.au/wholesale-markets/wholesale-statistics/seasonal-peak-demand-regions, Winter 2019, accessed 23 July 2021

14 AER, Network performance report 2020, TNSP operational performance data 2006-2019

15 AEMO, VGPR 2021, p.80

electricity network would need to be able to carry a peak demand of around 30GW (10GW plus the additional 20GW from gas).

APA is studying entry to US energy markets to inform possible decarbonisation scenarios. 'Cold-climate' states in the US exhibit similar characteristics to Victoria, in that seeking to electrify the winter heating load is cost-prohibitive. Electrification also concentrates supply interruption risks to the electricity grid, which is subject to winter storm events.

The Interim Report recognises that any shift towards electricity in place of gas will have a significant impact on Victoria's electricity network. Based on a Grattan Report, Infrastructure Victoria estimates that peak electricity use could increase by an estimated 40% compared with the current summer peak demand, if household and small business gas loads were to be electrified.[16] Grattan's analysis does not appear to be available on its website, but it is difficult to reconcile Grattan's 40% figure with the simple analysis above, and the fact that 60.5% of Victorian gas use is for cooking, space heating and hot water.[17] Given its significant influence on the cost of upgrading the electricity network, the impact of electrification on peak demand must be investigated as part of the Roadmap development.

Estimating the cost of upgrading the Victorian electricity distribution and transmission networks to cater for additional peak demand is a very complex exercise. However, two important points should be highlighted:

- Any electrification pathway needs to consider the parallel electrification of another key energy source: liquid fuels for transport. The uptake of EVs for domestic, commercial, and public use is increasing rapidly. In the absence of price signals to encourage efficient use of the electricity distribution network, EVs are likely to place extra demands on electricity networks and generation.
- Victorian distribution networks are the most well utilised in the NEM.[18] Utilisation is derived by comparing maximum demand to the total capacity of the distribution network, at the zone substation level. In 2019, for example, Powercor, one of Victoria's electricity distribution businesses, had a network utilisation of 0.78. This shows that there is not significant 'headroom' on the electricity distribution network for any electrification of gas use.

It is essential that Infrastructure Victoria attempts to estimate the actual cost (as opposed to the relative cost between scenarios) of upgrading both the electricity distribution and transmission system for its final advice to the Victorian Government.

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16 Infrastructure Victoria, *Interim Report*, p.19

17 Victorian Government, *Gas Substitution Roadmap Consultation Paper*, May 2021, p17.

18 AER, *Network performance report 2020, Electricity DNSP operational performance data 2006-2019*

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The DORiS Report appears to have significantly underestimated the cost of building new electricity infrastructure. For example, while the report clearly attempts to quantify the cost of new electricity transmission required to connect new solar and wind assets, the report appears to be silent on the cost or extent of electricity distribution investment.[19] Delivering renewable electricity from regional Victoria to urban centres will require significant investment in both transmission and distribution electricity networks.

The Victorian electricity distribution networks are well utilised and are the largest cost component in electricity delivery. In 2020-21 for example, the average residential electricity bill included $53 in transmission costs and $350 in distribution costs.[20] It is very important that the cost of distribution investment is included in Infrastructure Victoria's analysis. As experience in other jurisdictions has shown, rapid increases in capital expenditure can quickly flow through to network charges and therefore customer bills.

2.4 Infrastructure Victoria's scenarios contain very challenging timeframes

The Interim Report and DORiS Report foreshadow some very challenging timeframes for establishing new hydrogen and electricity infrastructure, as well as the potential decommissioning of gas infrastructure:

- **Electricity transmission upgrades** – the DORiS Report identifies that future scenarios require between 6,000 and 7,000km of new 220kv transmission lines by 2030 to connect new renewable generation across Victoria.[21] The length of new transmission increases significantly out to 2050 (see Figure 8).

Figure 8: Electricity powerlines installed under Infrastructure Victoria's scenarios

Scenario	2030		2040		2050	
Line Size	220kV	550kV	220kV	550kV	220kV	550kV
A	6,783 kms	100 kms	14,693 kms	100 kms	20,467 kms	100 kms
B	6,241 kms	100 kms	13,380 kms	100 kms	19,129 kms	100 kms
C	7,112 kms	100 kms	10,302 kms	100 kms	8,499 kms	100 kms
D	2,372 kms	100 kms	3,019 kms	100 kms	4,392 kms	100 kms

Source: DORiS Engineering

To put these figures into perspective, the Victorian Transmission Network Service Provider, AusNet Services, has an existing transmission network of approximately 6,700km.[22] and has taken many decades to plan and build.

19 DORiS Engineering, *Net Zero Emission Scenario Analysis Study Report*, May 2021, p.52-53

20 AEMC, *Residential Electricity Price Trends 2020 Final Report*, 21 December, p13

21 DORiS Engineering, *Net Zero Emission Scenario Analysis Study Report*, May 2021, p.55

22 AER, *AusNet Services Transmission Benchmarking RIN response 2019-20*

Scenarios A, B and C effectively duplicate the existing Victorian transmission system by 2030. There are many concerns across the National Electricity Market at present about the slow timeframes for building new electricity transmission to connect new renewable generation to the grid. There are also significant social licence issues associated with building new infrastructure. It is extremely unlikely that the transmission investment required in scenarios A, B and C can be provided in the timeframes indicated.

- **Potential decommissioning of gas assets –** the DORiS Report identifies scenarios that require 20% of the gas distribution network to have been decommissioned by 2030.[23] For the reasons outlined in this submission, we consider that the decommissioning of the gas network is not an efficient or optimal option for reaching net zero. Regardless of the merits of this option, however, decommissioning 20% of the gas distribution network by 2030 is an unrealistic milestone, given the myriad of issues that must be solved prior to any decommissioning and the significant impact that this would have on households, industry, and the whole Victorian economy.

2.5 Utilising existing assets is a more efficient option

Electrifying Victoria's gas usage will result in peak electricity demand increasing substantially and shifting from summer to winter. Not only would electrification of this shifting load be a very expensive exercise, but it could also take many decades to undertake the necessary investment. This approach also represents an inefficient option that is not in customers long term interests:

- The electricity transmission and distribution network investment associated with electrification will have to be paid for by customers for 365 days of the year, for many decades to come. This is an inefficient use of resources given that the heating load is concentrated in a few winter months and much of any new infrastructure will be idle for most of the year.
- Large quantities of mainly renewable generation would be required to help meet winter demand. Much of this generation could be excess to requirements during the summer when peak demand is much lower. Excess renewable energy entering the system may also lead to other network problems, which would need to be managed.

Frontier Economics has investigated the potential for gas infrastructure to decarbonise the economy. In its September 2020 report, Frontier concluded that making continued use of existing gas assets wherever possible, including for the transport of hydrogen or

23 DORiS Engineering, *Net Zero Emission Scenario Analysis Study Report,* May 2021, p.110

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biomethane, can help avoid the material costs of investing in new assets to deliver energy.[24]

The main reason Frontier came to this conclusion was due to the significant cost of the electrification pathway, particularly for industrial energy load. Frontier also recognised that gaseous fuels are essential as industrial feedstock, and if gaseous fuels are not available, the industries that rely on this feedstock will not be viable.

Frontier Economics' conclusion is not surprising given the cost of delivering energy in Victoria and the investment made in the electricity and gas networks to date. Using publicly available AER data, Table 3 outlines the value of the gas and electricity networks (referred to as the Regulated Asset Base) and the amount customers paid in network charges in 2019 to transport energy using the respective networks.

The data shows that revenues earned from operating the Victorian gas transmission and distribution network costs are around a quarter of those to run the electricity distribution and transmission network. These revenues are paid for by customers through their electricity and gas bills.

Table 3: Victorian RAB, Revenue and Energy Delivered 2019

	Regulated Asset Base ($m)	**Actual Revenue ($m)**
Electricity distribution and transmission networks	17,329[25]	2,825[11]
Gas transmission and distribution networks	5,631[26]	774[14]

The efficiency of the interconnected gas system at delivering energy is further demonstrated by looking at the cost of delivering a unit of energy across the gas and electricity networks. As Table 4 shows, Victorian gas pipelines deliver:

- a GWh equivalent of energy approximately 6 times cheaper than electricity networks
- A MW of peak demand load approximately 10 times cheaper than electricity networks.

24 Frontier Economics, *The Benefits of Gas Infrastructure to Decarbonise Australia,* September 2020, p.9

25 AER, *Electricity DNSP and TNSP network performance report 2020*

26 AER, *APA VTS, Multinet, AusNet Services, Australian Gas Networks 2019 RIN data*

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Table 4: Energy delivered and maximum demand

	Actual Energy Delivered (GWh)	Average annual cost to deliver a GWh ($)	Maximum demand (MW)	Average cost to deliver a MW of maximum demand ($)
Electricity distribution and transmission networks	41,480[11]	68,115	8,684[27]	325,362
Gas transmission and distribution networks	64,722[28]	11,965	20,834[29]	37,171

As the numbers in Table 3 and Table 4 show, delivering energy through electricity networks is significantly more expensive than doing so through gas networks. Increasing the proportion of energy delivered to customers through the electricity network risks is likely to increase overall energy costs for customers.

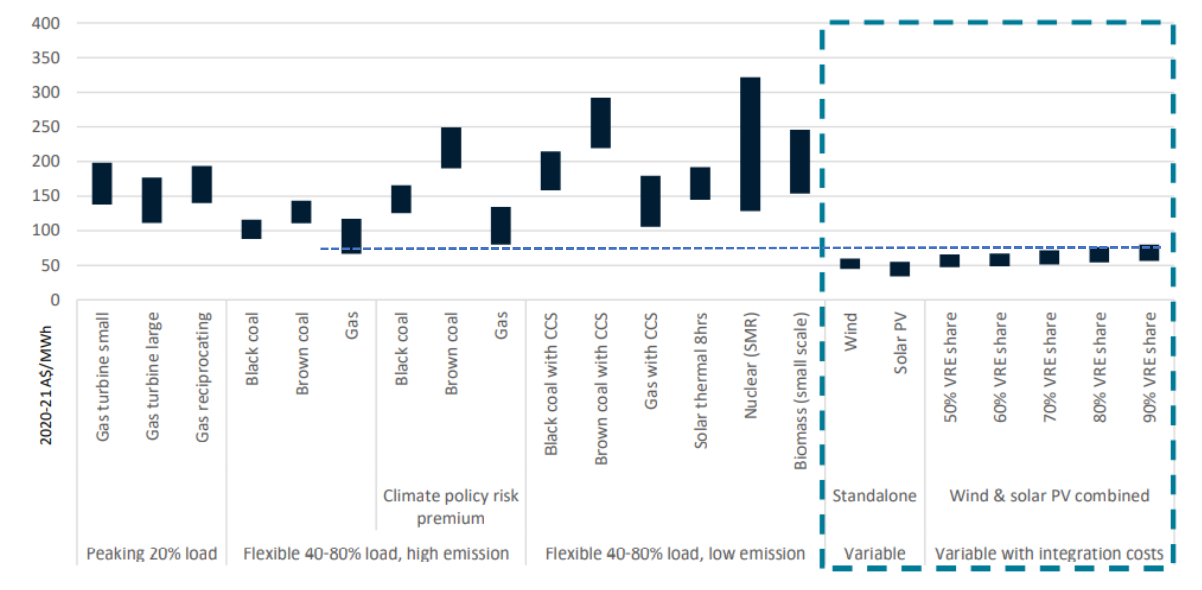
In its annual *GenCost* report, the CSIRO investigates the cost of various generation technologies. In its 2021 report, the CSIRO acknowledged that significant investment is required to incorporate VRE in the energy system, including new transmission to Renewable Energy Zones, additional transmission to strengthen the grid, and synchronous condensers to support system reliability.[30]

Recognising the significant additional costs associated with reaching 100% VRE, the 2021 GenCost report found that in 2030 the cost of gas electricity generation can match the cost of VRE up to a 70% or greater share of generation (shown in Figure 9 below).[31]

Continuing to use existing gas infrastructure to support VRE is a more efficient outcome than full electrification, which is likely to be an expensive proposition and have unforeseen impacts on customers and businesses.

27 AER, Network performance report 2020, TNSP operational performance data 2006-2019
28 AEMO, VGPR 2020 update, Table 1, 2019 Victorian Consumption of 233PJ converted into GWh
29 AEMO, VGPR 2021, p.80, Peak hourly demand of 75 TJ/hour converted into MW
30 CSIRO, *Annual GenCost Report,* June 2021, pviii
31 CSIRO, *Annual GenCost Report,* June 2021, p.ix

Figure 9: CSIRO Levelised Cost of Energy 2030



Source: CSIRO

2.6 Repurposing existing gas infrastructure

Australia has some of the world's best natural resources, such as wind and sunshine, for producing renewable energy. This is one of the key reasons why hydrogen has been identified as one of Australia's key comparative advantages and one of the logical options to help decarbonise the Australian economy.[32] The May 2021 Victorian Climate Change Strategy includes a five-point plan to cut emissions and developing a local renewable hydrogen industry is part of the innovation pathway.[33]

Complementing our natural advantage in renewable energy is the fact that Australia has one of the most extensive interconnected gas infrastructure networks in the world, with an expert workforce supporting it. It therefore makes strong sense for Australia to explore the opportunities to repurpose this existing infrastructure to support the transition to a low carbon economy.

In the Interim Report, Infrastructure Victoria considered that the opportunity to repurpose existing gas infrastructure over the long term (beyond 2040) is limited.[34] While it is not clear how Infrastructure Victoria reached this conclusion, it did imply that part of the rationale is that over half of all Victoria's onshore pipeline infrastructure is over 40 years old., It is important to remember that gas pipelines are generally designed with 50 to 80 year asset lives and many of Victoria's pipelines have many

32 Australian Government, *First Low Emissions Technology Statement – 2020*, p17.

33 *Victorian Climate Change Strategy, May 2021, p26.*

34 Infrastructure Victoria, *Interim Report,* July 2021, p5

decades left of service. Pipelines can also have their design life extended with modern integrity measures such as pigging and recoating.

While Australia has only recently begun the journey of decarbonising its gas infrastructure, other countries around the world, particularly in Europe, are further ahead. An increasing number of projects around the world are demonstrating the potential for re-use of gas infrastructure to transport renewable gases.

For example, the Gasunie hydrogen pipeline in the Netherlands has been transporting hydrogen along a modified natural gas pipeline since 2018. In June 2021 Gasunie announced a significant expansion of the Dutch hydrogen transmission network, with 85% of the new network reusing existing natural gas pipelines (see case study below).

Case study: Gasunie repurposing transmission pipelines in the Netherlands

Figure 8: Gasunie's hydrogen transmission pipeline

In November 2018, Gasunie, the Netherlands' gas transmission operator, started transporting hydrogen along a 12km long stretch of repurposed natural gas pipeline. The pipeline will transport more than 4,000 tons of hydrogen per year for industrial purposes, saving over 10,000 tons of carbon emissions each year.[35]

On 30 June 2021 the Netherlands Ministry of Economic Affairs and Climate Policy announced that it will commission Gasunie to develop the national infrastructure for the transport of hydrogen.[36] The project, with an estimated investment of €1.5 billion, is scheduled for completion in 2027. Most importantly, the new national hydrogen network will consist of 85% reused natural gas pipelines, resulting in costs four times lower than if entirely new pipelines were laid.

2.7 APA's gas substitution pathway

As the International Energy Agency acknowledged in its recent report Net Zero by 2050, the gas sector is very well placed to accelerate the deployment of low emissions

[35] https://www.gasunie.nl/en/news/gasunie-hydrogen-pipeline-from-dow-to-yara-brought-into-operation, accessed 11 August 2021

[36] https://www.gasunie.nl/en/news/dutch-german-cooperation-secures-european-future-of-hydrogen, accessed 11 August 2021

technologies, helping to steer the country's energy transition towards a net zero pathway.[37]

Much of APA's pipelines gas infrastructure is adjacent to some of the best geographical areas for hydrogen production in Australia. We are actively leading efforts to unlock the innovation and new technologies that will lead to the development of a new hydrogen industry in Australia.

As we look ahead to 2050 and beyond, consistent with the International Energy Agency's observations, the gas industry is well placed to diversify and deploy decades of knowledge, capability and critical infrastructure to play a leading role in developing the low emissions technologies of tomorrow, at scale, and to support our own ambitions for a net zero future.

We welcome commitments by Australian Governments to set hydrogen blending mandates, such as the Western Australian and NSW Government goals to blend 10 per cent hydrogen in gas pipelines by 2030, subject to ongoing assessment of technical feasibility. These are important steps to enable the commercialisation of hydrogen technologies and bring forward the work required to solve some of the regulatory challenges associated with the conversation of gas infrastructure.

2.7.1 Pathfinder Program

Our Pathfinder Program will be a key enabler in our pathway to our new ambition for net zero operations emissions by 2050. Through Pathfinder, we will help unlock energy solutions of the future and develop opportunities to extend our core business.

Pathfinder's initial focus will be on clean molecules, off-grid renewables and storage. Our first Pathfinder project is seeking to enable the conversion of around 43-kilometres of the Parmelia Gas Pipeline in Western Australian into Australia's first 100 per cent hydrogen-ready transmission pipeline and one of only a few existing gas transmission pipelines in the world, 100 per cent hydrogen-ready.

This project, which is being delivered in partnership with Future Fuels Cooperative Research Centre and Wollongong University, carries enormous significance for APA and the entire industry. It will create a significant opportunity for the development of a hydrogen hub in Western Australia, while the more broadly the results will support decision-making as to the potential for APA's other gas infrastructure assets to be hydrogen-ready.

2.7.2 Renewable methane pilot

APA and ARENA have jointly funded a project by Southern Green Gas to develop a renewable methane demonstration plant at APA's Wallumbilla gas plant in Queensland. This carbon neutral project is investigating whether it is possible to create

[37] International Energy Agency, *Net Zero by 2050*, May 2021

renewable methane from hydrogen that is produced using solar energy and water, converted to methane using CO2 extracted from the atmosphere.

Renewable methane is indistinguishable from the methane that currently fills our natural gas pipelines and therefore offers a potential low carbon alternative with the ability to use the existing gas infrastructure system.

The renewable methane created at Wallumbilla can be injected into the gas transmission network. The project will also generate cost and technical data to be used to assess the feasibility of a larger, commercial scale renewable methane concept.

2.8 Intergenerational and social equity issues

Gas infrastructure owners have invested billions of dollars in long-lived assets to bring gas into Victoria and deliver it to over two million customers across the state. These assets are paid for by customers over many decades through network charges in their gas bills.

The Victorian Government's Roadmap raises the prospect that some gas use will be electrified, thereby reducing the amount of gas used by customers. This raises both intergenerational and social equity issues:

- **Intergenerational equity** – existing gas networks have been built with a forecast number of customers in mind. Together, the customer base will pay for the cost of that investment, with today's customer base paying for their use of the network and future customers also paying a share. Any moves to limit the number of future gas customers will raise intergenerational equity issues as a smaller number of future customers will continue to pay for a disproportionate share of the network costs. This may impact low income and vulnerable households the hardest, particularly if they do not have the financial means to switch fuels.
- **Social equity issues** – the energy transition currently underway is allowing customers to take greater control of their energy use, as long as they can afford the solar PV, batteries, and home energy management systems that enable them to do that. If customers are required to electrify their gas use, energy inequality risks be exacerbated. This is because many customers will not have the opportunity, whether it be for financial or other reasons, to take control of their electricity use.

Furthermore, any moves to remove a customer's choice to connect to the gas network is essentially mandating electrification and will close off the opportunity to repurpose the gas network in the years ahead for hydrogen or other renewable gases. History has shown that once the opportunity to lay gas mains is foregone at the time of initial development it is highly unlikely to be economically nor socially viable to retro-fit later.

2.9 Fugitive emissions

The Interim Report claims that fugitive emissions from natural gas may be underestimated. This claim is based on research into fugitive emissions undertaken in the US. Methods used to estimate and industry practices to manage fugitive emissions in the US and Australia are different. APA reports fugitive emissions in accordance with Australia's NGER system. This is a robust system for estimating and reporting greenhouse gas emissions including emissions of methane.

There have been queries by some sources as to the accuracy of emissions methods in NGER reporting but this has been an area of continual investigation and improvement by the industry and Australian Government for over 10 years. For example, in 2017 the Department of Environment and Energy published a reported titled *Update on Recent Empirical Evidence on Fugitive Emissions From the Gas Industry*. Estimation methods used in Australia were updated in light of new evidence about fugitive emissions..

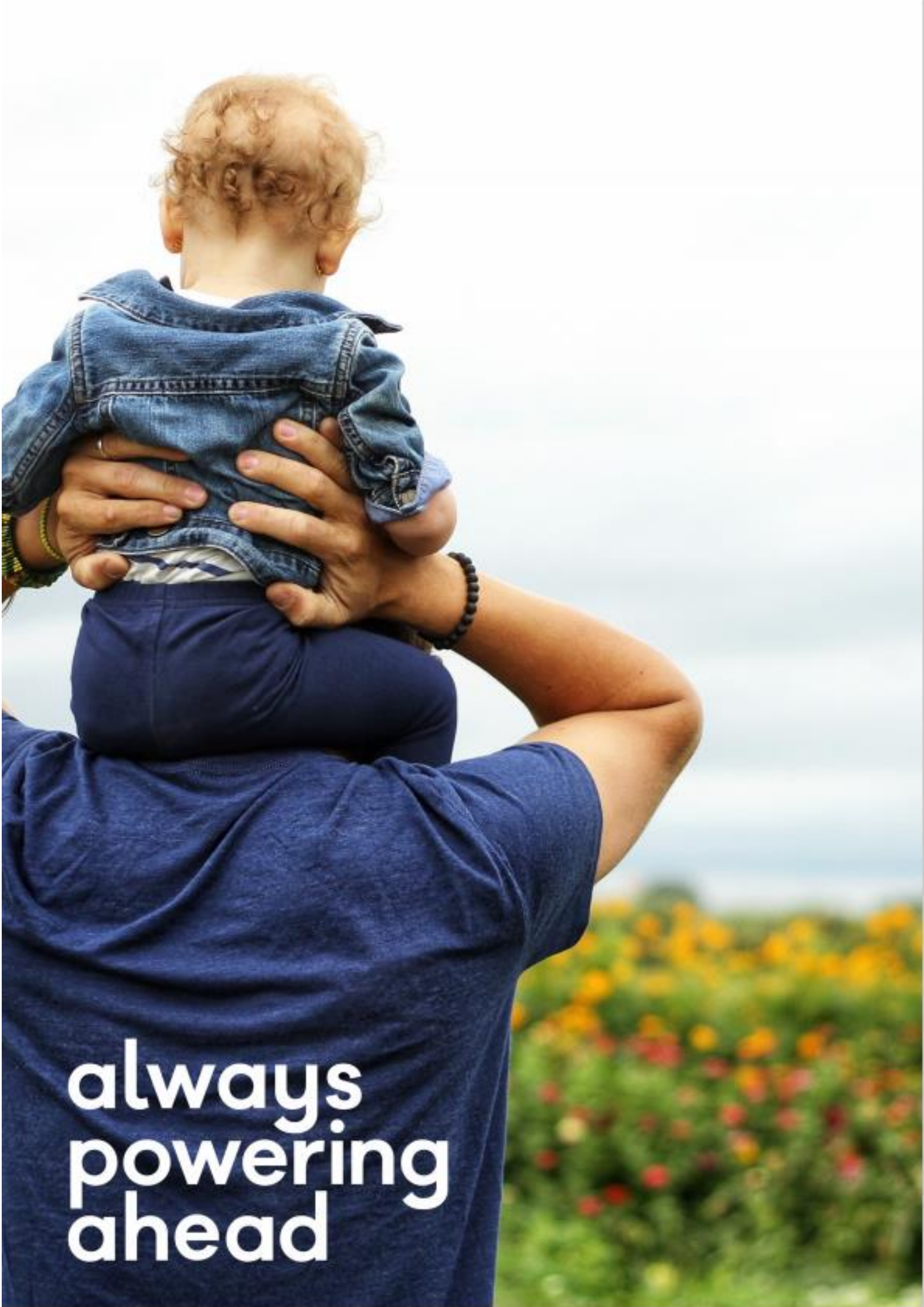
3 PART B –Responses to questions for consideration

The table below contains guidance on our responses to Infrastructure Victoria's questions for consideration

Question	APA response for each pathway
Do you have any further information, evidence or concerns that you wish to raise in relation to the scenario design and analysis?	• See section 2.2 for risks associated with the scenario options and methodology.
Do you have any further information or evidence that can help identify an optimum scenario for a net zero emissions gas sector in 2050?	• See section 2.2 for analysis which shows that Victoria can reduce emissions from electricity generation by 80% through the early retirement of coal. This would be a logical first step in reducing emissions and has been the approach adopted in other jurisdictions with similar energy profiles, such as the UK and the Netherlands.
What policies and/or regulations, if any, are needed to support the development of low carbon pathways such as biogas, green hydrogen, and carbon capture and storage?	• The first steps in creating a hydrogen industry are to establish, test and prove clean hydrogen supply chains, encourage global markets and develop cost-competitive production capability. Targeted support for pilot demonstration projects and develop industry expertise will help achieve these goals. • Following that, scaling up the industry will require policies to build widespread domestic hydrogen demand. The National Hydrogen Strategy outlines some of these initiatives, which include:

	◦ Using clean hydrogen for industrial feedstocks and heating ◦ Blending of hydrogen in gas pipelines ◦ Using hydrogen for long distance transport and development of refuelling infrastructure. APA supports continued policy development, that will help establish domestic and global hydrogen demand.
What is your view on the best ways to maintain the reliability and affordability of Victoria's gas supply if natural gas use declines?	• Repurposing natural gas pipelines will help maintain energy reliability and affordability for customers (see sections 2.1.4 and 2.6.
What else can you tell us about the implications of decarbonisation pathways for the electricity generation, transmission and distribution networks?	• See section 2.3 for information about the costs associated with electrification. • See section 2.4 about the challenging timeframes associated with electrification.
How can the use of Victoria's existing gas infrastructure be optimised during the transition to net zero emissions, over the short (10 years), medium (20 years) and long-term (30+ years)? How can the Victorian Government assist in this?	• See section 2.6 for an example of how Governments can support the repurposing of natural gas pipelines.
What principles should apply or what measures will be needed to manage the impacts of gas decarbonisation on households and businesses?	• No response

What policies, programs and/or regulations should the Victorian Government consider or expand to encourage households, commercial buildings and small businesses to reduce their gas use?	• No response
What policies, regulations or other support, if any, do you think are needed to support industrial users to switch from natural gas to lower emissions energy sources or chemical feedstocks?	• The National Hydrogen Strategy identifies 57 joint strategic actions to establish a hydrogen industry. Many of these actions will be applicable to other renewable gases. • APA supports the development of a guarantee of origin for hydrogen, which was one of the actions identified in the Hydrogen Strategy.


always
powering
ahead