HELP BUILD VICTORIA'S

Gas Substitution Roadmap

CONSULTATION PAPER

VICTORIA State Government

Help build Victoria's Gas Substitution Roadmap

CONSULTATION PAPER

Have your say

Make a submission at
engage.vic.gov.au

You are encouraged to make a submission on any or all the matters raised in this consultation paper. Submissions will be published online and will be used to inform the development of the Roadmap. If you do not wish to have your submission published, please advise us at the time of submission.

Please email enquiries to
Gas.Roadmap@delwp.vic.gov.au

Traditional Owners acknowledgment

We acknowledge and respect Victorian Traditional Owners as the original custodians of Victoria's land and waters, their unique ability to care for Country and deep spiritual connection to it. We honour Elders past and present whose knowledge and wisdom has ensured the continuation of culture and traditional practices. We are committed to genuinely partner, and meaningfully engage, with Victoria's Traditional Owners and Aboriginal communities to support the protection of Country, the maintenance of spiritual and cultural practices and their broader aspirations in the 21st century and beyond.

Contents

Victoria is accelerating the development and deployment of all opportunities to decarbonise gas supply, promote economic growth and create clean energy jobs

MINISTER'S FOREWORD

The Hon. Lily D'Ambrosio MP

Minister for Energy, Environment and Climate Change
Minister for Solar Homes

Victoria has set ambitious but achievable targets to reduce our greenhouse gas emissions by 28 to 33 per cent by 2025 and 45 to 50 per cent by 2030, as part of our commitment to achieve net zero emissions by 2050. We are well on the path to a renewable energy future, with the share of renewable power generation increasing each year. To achieve Victoria's emission reduction goals, we will need to find sustainable alternatives to decarbonise gas use and embrace new technologies as we transition to a net zero emission economy.

Fortunately, there are a range of pathways available to help us get there, each of which is likely to have its role to play and present new opportunities and clean energy jobs for Victoria.

Over two million Victorian households currently use natural gas to heat their homes, for cooking and hot water. At the same time, gas continues to be an important input for Victorian industry and essential services, such as hospitals.

There are a range of pathways available to help us get to a net zero emission economy, each with new opportunities and clean energy jobs for Victoria

But the energy landscape is changing, in Victoria and globally. Rapidly increasing investment in low cost wind and solar power generation, backed by grid-scale battery storage, is driving down energy costs for consumers and reducing emissions.

Households are looking for ways to drive down their bills with more efficient appliances, and the government's Victorian Energy Upgrades program is already helping Victorians to improve their homes and businesses' energy efficiency.

The Victorian Government is exploring all pathways for the gas sector to reach net zero emissions and we recognise the significant opportunity that the State has to lead the way to a clean energy future. Switching gas appliances to electrical options and shifting to alternative gases such as hydrogen and biogas will all likely play a role in achieving net zero emissions, while promoting a sustainable, resilient and prosperous Victoria.

Later this year, we will release our Gas Substitution Roadmap, which will detail the Government's actions to promote the decarbonisation of the gas sector while ensuring that throughout the transition Victorians continue to have access to a secure, reliable, affordable and safe supply of energy.

In the meantime, we encourage all Victorians, through this consultation paper, to have their say on the advantages and disadvantages, barriers and opportunities on all the transition pathways to achieve Victoria's emission reduction targets.

We want you to help us build Victoria's Gas Substitution Roadmap

The Victorian Government is committed to reaching net zero greenhouse gas emissions by 2050 and has set emissions reduction targets of 28 to 33 per cent by 2025 and 45 to 50 per cent by 2030 to get us there. Achieving our interim targets, and ultimately net zero emissions, will require us to cut emissions across the entire economy – including from the use of natural gas, a fossil fuel, by households, industry and commercial businesses. In the 2020-21 State Budget, the Victorian Government committed to developing a Gas Substitution Roadmap (the Roadmap) to help us achieve these interim targets and navigate the path to net zero emissions. This consultation paper seeks your views on this important work.

Natural gas has been a crucial part of Victoria's energy mix for many years. Gas is used widely for heating, hot water and cooking in homes and business, and fires much of Victoria's manufacturing. In fact, Victoria consumes more energy from gas than from electricity.[1] To maintain a strong and prosperous economy and protect the interests of Victorian consumers, we must maintain energy affordability, security, reliability and safety while progressively decarbonising our gas sector.

Victoria has the highest national level of gas reticulation and a significantly higher level of residential gas usage than any other Australian state or territory. Whilst this creates challenges to decarbonising such a large proportion of Victoria's energy use, it also enables Victoria to capture low cost energy efficiency and electrification opportunities and take bold, innovative action to embrace the opportunities and be a world leader in the adoption of zero emission energy technologies and practices.

There are many ways we can reduce emissions from today's natural gas use. These include improving energy efficiency of buildings, appliances and equipment, reducing fugitive emissions that arise from gas production and transportation, switching from gas to renewable electricity sources, and adopting more sustainable gaseous fuels such as hydrogen and biogas. The best pathway to net zero emissions is unknown at this stage but will likely occur through a combination of these technologies and coordinated actions and will be influenced by consumer choices, technology costs and advancements in lower emission technologies.

Energy efficiency drives down demand and is one of the best ways to reduce emissions and cut energy costs for households and businesses and the Victorian Government already has a range of measures to save energy and bring down energy bills.

1 Australian Energy Market Operator (AEMO), *Gas Statement of Opportunities*, 2021; AEMO, *Electricity Statement of Opportunities*, 2020.

Victoria's Climate Change Strategy

On 2 May 2021, the Victorian Government released its **Climate Change Strategy**. The strategy sets out the Victorian Government's current action on climate change and our next steps.

It will keep Victoria on track to meet our target of net zero emissions by 2050, while also seizing the opportunities of climate action through advancing clean and innovative technologies, investing in new industries and creating Victorian jobs and cost savings.

At the heart of the strategy are ambitious targets to reduce emissions by 28-33 per cent by 2025 and 45-50 per cent by 2030 – charting a strong course to net-zero emissions and confirming Victoria's position at the forefront of climate change ambition both across Australia and internationally. Achieving these interim targets – and, ultimately net zero emissions – will require action across all sectors of the economy by governments, businesses and the community.

To help coordinate this action, the Government has prepared emissions reduction pledges for each emissions sector for 2021–2025 – the first in a progression of five-yearly pledges required under the Climate Change Act 2017.

Victoria's emission reduction targets have already been set for 2025 and 2030 and the 2035 target will be set in 2023. The Government's energy sector pledge identifies how Victoria's Roadmap will support actions to meet these targets by identifying policy mechanisms to reduce emissions and establishes targets for 2025 and 2030 for the displacement of natural gas with more sustainable energy alternatives. The Roadmap will also establish a strategic framework for decisions on further actions required to set and meet the 2035 target.

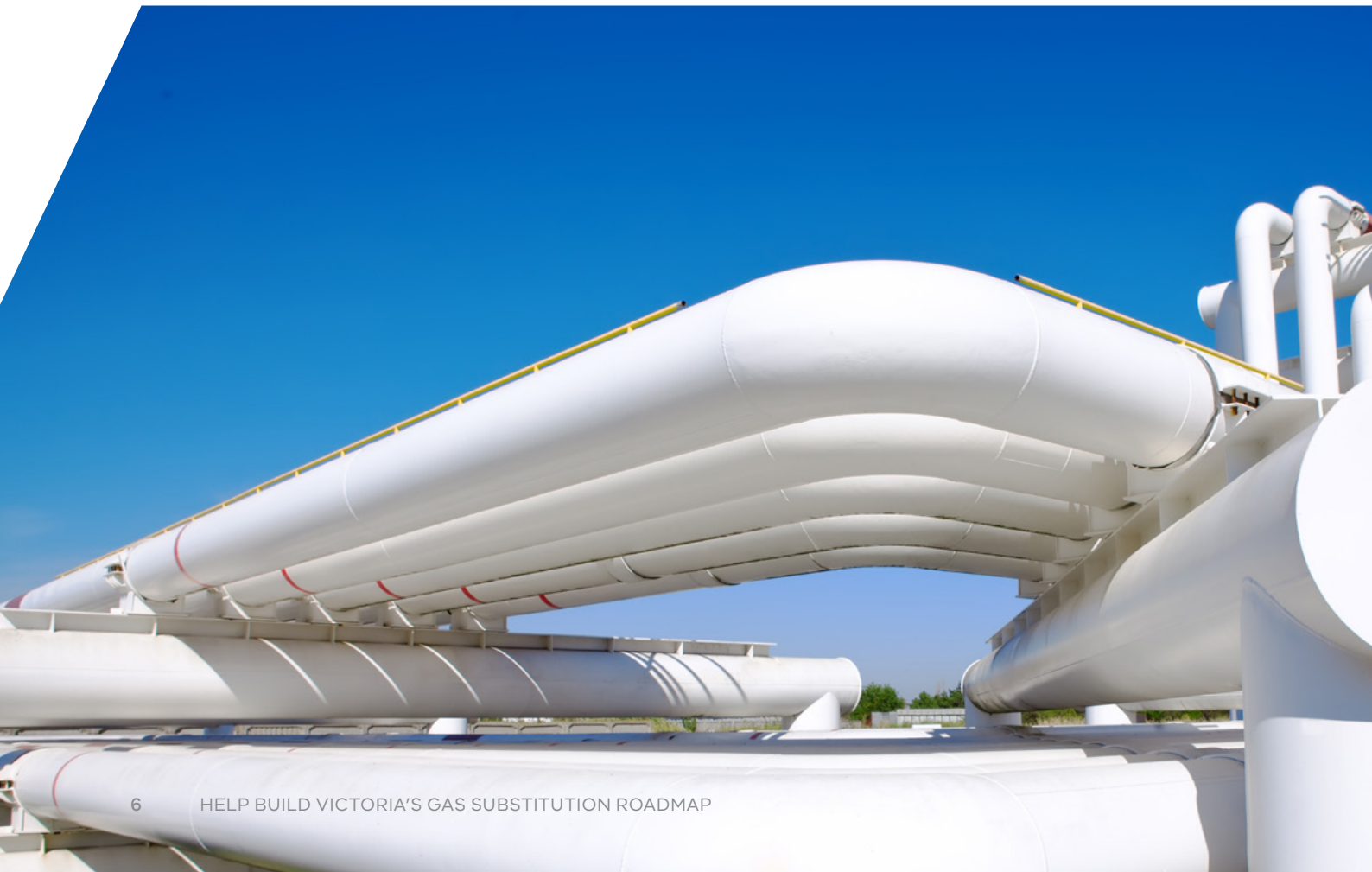
Electrification, hydrogen and biogas will all likely play a role in the decarbonisation of gas. Residential gas use and some commercial and industrial gas use can be readily electrified. Some electrical appliances are already more energy efficient and cost-effective than their gas counterparts, particularly where households have rooftop solar photovoltaic (PV) panels. Hydrogen can be a substitute for natural gas, either through gas blending or complete replacement in the long term, and whilst it is currently more expensive than natural gas, significant cost reductions are predicted within the next few years. There are already existing examples of commercial operations in Victoria that utilise heat onsite made from biogas, which can also be upgraded into biomethane for injection into the existing gas network.

The core purpose of the Roadmap is to explore and identify the right mix of these various approaches for Victoria, along with milestones and a detailed action plan. These milestones and actions will help Victoria achieve its interim emissions reduction targets, and ultimately get to net zero emissions.

The Government is undertaking extensive analysis and stakeholder engagement to inform the development of the Roadmap. In addition to this consultation paper, the Government has commenced 'deep-dive' investigations.

Deep dive investigations include:

- A detailed scenario analysis of the costs, benefits, barriers and impacts of different transition pathways on all sectors of the Victorian economy
- A study to identify opportunities to reduce fugitive emissions across the natural gas supply chain
- An examination of potential measures to enhance reliability across the gas supply chain
- An investigation of potential policy mechanisms to support the increased uptake of renewable options such as hydrogen and biogas



The Roadmap will also be informed by Infrastructure Victoria's analysis of Victoria's gas infrastructure needs, as well as extensive stakeholder consultation.

Reducing emissions on such a broad scale and across such a broad range of activities will affect many stakeholders. The Victorian Government is seeking the views of the community and industry to better understand the opportunities and challenges that this transition will bring. Consultation will occur through stakeholder workshops, residential and industrial consumer surveys, one-on-one meetings with stakeholders and feedback on this consultation paper.

Infrastructure Victoria's inquiry into the implications for the transition to net zero emissions for gas infrastructure in Victoria

The Victorian Government has sought advice from Infrastructure Victoria (IV) on the nature and optimal timing of decisions supporting the decarbonisation of gas use in Victoria, including opportunities to support increased use of more renewable and zero emissions energy alternatives. The work is also intended to promote improved understanding of the key opportunities, issues, choices, costs and benefits associated with decisions impacting gas infrastructure.

IV will consult on its early findings in mid-2021 and provide a final report to the Treasurer by 31 December 2021. The IV workstream will inform the development of the Roadmap.

This advice will be an important input into the broader gas decarbonisation pathway analysis being undertaken in the development of the Roadmap and in the identification of key milestones and actions that can harness Victoria's existing gas infrastructure to help Victoria achieve emission reductions through the use of hydrogen, biomethane and carbon capture and storage (CCS).

$1.6 billion to support renewable energy and improve energy efficiency

The Victorian Government is already taking a range of actions to reduce emissions and support an orderly transition to a clean energy economy. This includes initiatives to promote energy efficiency and support the development of lower emission alternatives for the use of natural gas.

In the 2020-21 State Budget, the Victorian Government committed $1.6 billion to accelerate Victoria's transition to clean energy, create thousands of jobs, lower energy bills and drive down emissions.

$540 million

To support the establishment of Renewable Energy Zones to ensure coordinated, timely investment in renewable energy generation.

$108 million

To prepare Victoria for innovative renewable energy technologies, including offshore wind and hydrogen.

$31 million

To establish a Business Recovery Energy Efficiency Fund (BREEF) providing grants to help large industrial energy users introduce energy efficiency and demand management technologies.

$30 million

To support energy efficiency and onsite renewables on farms through the Agriculture Energy Investment Plan.

$17 million

To expand the Victorian Energy Upgrades (VEU) program, with new ambitious energy management and efficiency targets out to 2025.

$447 million

To improve the energy efficiency of homes for low income and vulnerable Victorians, including

$335 million

To assist 250,000 low-income households to install reverse cycle air conditioners

$112 million

Upgrades to improve thermal performance (with insulation and draught-proofing) and replace inefficient appliances in 35,000 public and community housing properties.

$12.6 million

To fund the design and delivery of a second Victorian Renewable Energy Target (VRET) auction to contribute towards meeting the Government's legislated VRET of 40 per cent by 2025 and 50 per cent by 2030.

$191 million

To expand the Solar Homes program, which includes $85.91 million to provide 17,500 rebates over households to install batteries along with rebates for up to 15,000 small businesses to install solar PV on their work premises.

$10.9 million

To explore the potential for grid and neighbourhood scale batteries to support the electricity grid and address the intermittency of solar and wind electricity generation.

$10 million

To support investment in waste to energy technologies that will help reduce reliance on natural gas and divert waste from landfill, and research support to clarify regulations around by-products from waste to energy facilities.

$10 million

Strengthened minimum energy efficiency standards for new homes by 2022.

VISION

Sustainable, secure, reliable, affordable, safe energy

Promoting the long-term development of a renewable and zero emissions hydrogen production industry in Victoria

Supporting the Hydrogen Energy Supply Chain (HESC) project piloting hydrogen production in the Latrobe Valley for export to Japan. The project involves the conversion of coal into hydrogen. If the project is commercialised, the carbon by-products will be captured and stored underground as part of the companion CarbonNet project.

$10 million

Releasing the Victorian Renewable Hydrogen Industry Development Plan to support renewable hydrogen developments, including:

$6.2 million

Grant support for pilots, trials and demonstrations

$1 million

Business cases for industrial users under the Accelerating Victoria's Hydrogen Industry Program

+$62.9 million

In the 2021-2022 budget the Victorian Government committed a further $62.9 million to ensure continued maintenance of a safe, secure, reliable and affordable energy system for all Victorians

Key facts about the use of natural gas in Victoria

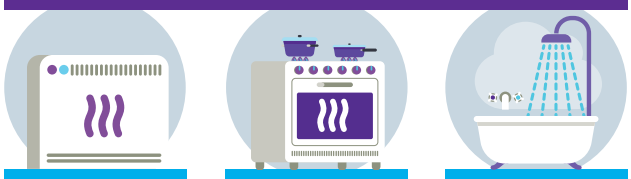
2 million+

VICTORIAN GAS CUSTOMERS

2,050,000	64,600	600+
RESIDENTIAL	COMMERCIAL	LARGE INDUSTRY

61%

OF VICTORIA'S GAS USE IS RESIDENTIAL AND COMMERCIAL



SPACE HEATING	COOKING	HOT WATER

#1 GAS USE

Space heating

Leading use of natural gas in Victoria

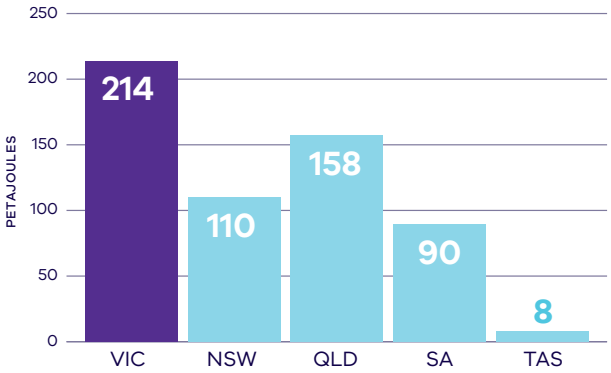
Due to Victoria's colder winters, winter peak demand is roughly *three times higher* than summer

#2 Industry

Mostly manufacturing process heating

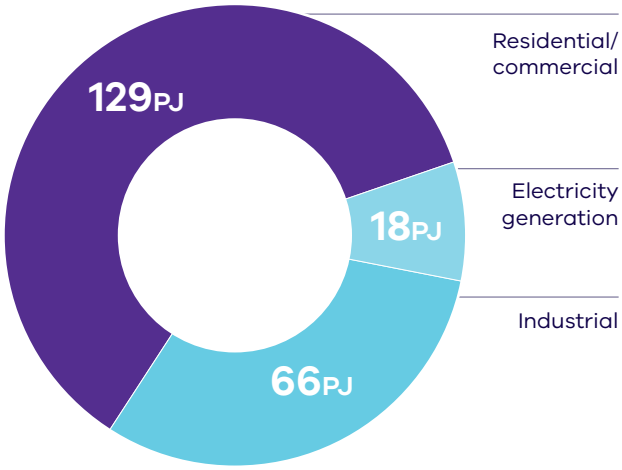
Victoria accounts for 37% of domestic gas consumption in the East Coast Gas Market

Gas consumption in East Coast Gas Market 2020

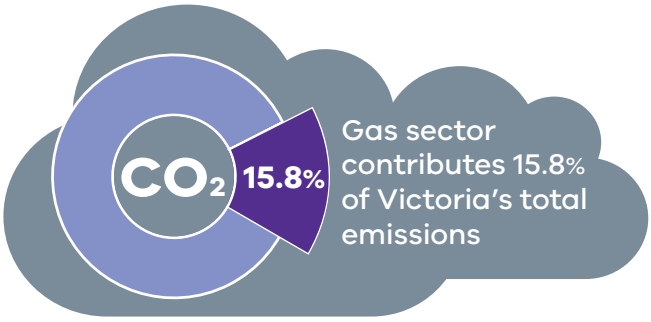


AEMO, National Electricity and Gas Forecasting, online data portal forecasting.aemo.com.au/Gas/AnnualConsumption/Total

Gas consumption in Victoria 2020



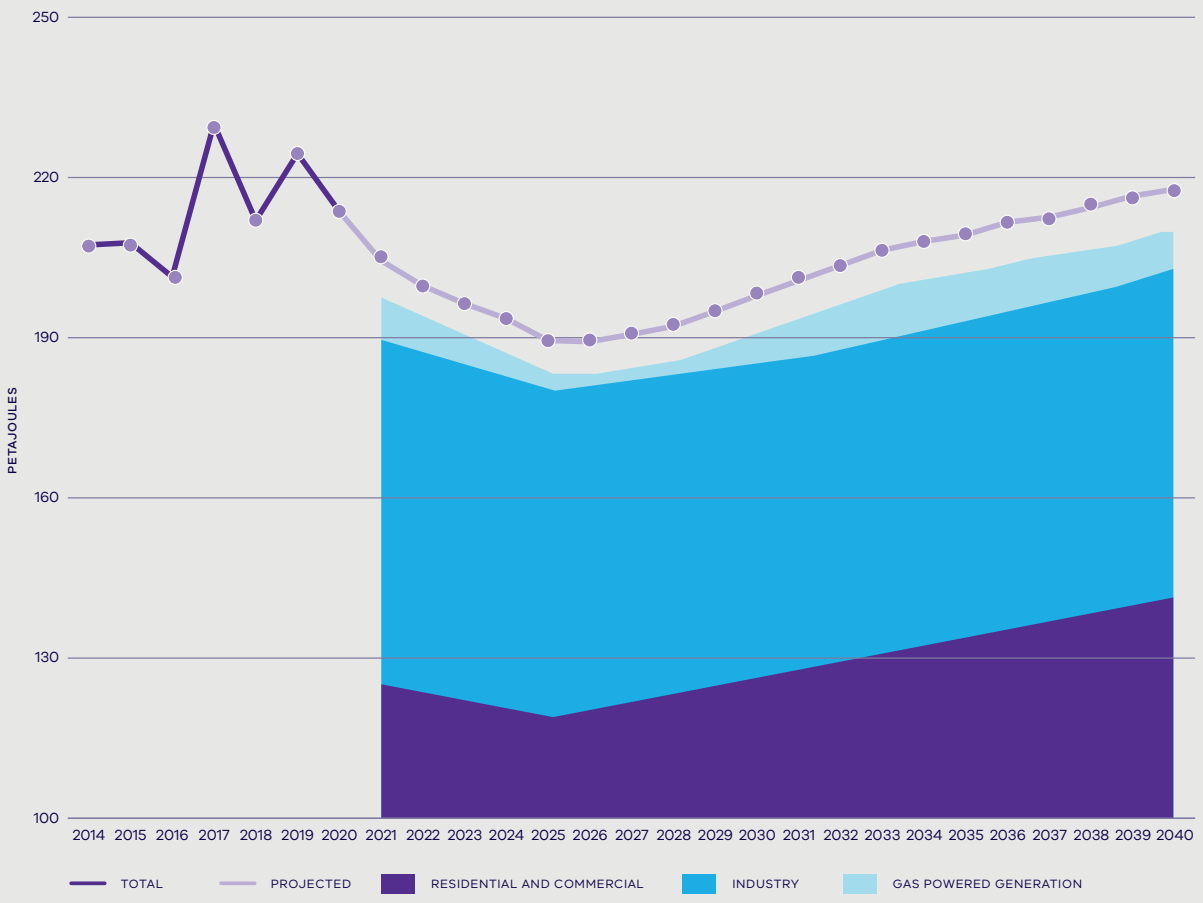
PJ= petajoules, Source: AEMO



Including both fugitive emissions and emissions associated with the combustion of gas. Approximate estimates, based 2018 State and Territory Greenhouse Gas Inventories, AEMO and National Greenhouse Gas Accounts

Since 2014, total gas consumption in Victoria has varied between 200-230 PJ per annum. AEMO forecasts that total gas use will decline gradually over the next five years as Victorian Government energy efficiency and renewable energy initiatives are implemented out to 2025. Though these programs are expected to continue and to reduce gas demand, they are not incorporated into forecasting from 2025.[1]

Total actual and projected gas consumption in Victoria



Source: AEMO

1 AEMO, National Electricity and Gas Forecasting. forecasting.aemo.com.au/Gas/AnnualConsumption/Total

A projected rise in natural gas consumption – if realised – would see the gas sector's emissions increase significantly, even as the share of emissions from other sectors of the economy declines. Such an increase in natural gas consumption cannot be sustained if Victoria is to continue to be able to set and meet ambitious interim emission reduction targets and play its part in global efforts to address climate change.

1

How the Victorian gas system currently works

Victorians get their gas through a network of pipelines, which connect gas fields, processing facilities and storage facilities to end customers. This physical system is operated through a commercial market, which allows gas to be traded between producers and users, and balances supply and demand. A range of national and state regulatory bodies ensure that this system operates safely and efficiently.

Victoria's gas system consists primarily of gas fields and processing facilities that extract and process gas, high pressure pipelines that transport this gas around the state, and low-pressure distribution pipelines that deliver gas to customers. Most gas is produced from the offshore Gippsland and Otway basins, and the largest processing facility is at Longford in the east of the state. The largest storage facility is an underground facility at Iona in the south-west.

Most high-pressure pipelines in Victoria are part of the Declared Transmission System (DTS). The main exceptions are the key interstate pipelines, which transport gas to and from New South Wales, South Australia and Tasmania. These pipelines in turn connect Victoria into the wider east coast gas network, which also includes Queensland, the ACT and the Northern Territory.

Some large gas users are supplied directly from high pressure pipelines, but most users are supplied through the distribution network. Some regional towns are not connected to the main gas network and are instead supplied by trucking in compressed natural gas (CNG), which is then reticulated through local distribution networks. Other users are not connected to pipeline networks and instead use Liquified Petroleum Gas (LPG) supplied in bottles or cylinders.

Gas producers and customers interact through a regulated gas market, the Victorian Declared Wholesale Gas Market (DWGM). The participants in the DWGM are primarily private players, who invest, buy and sell on a commercial basis within the market rules. An important group of DWGM participants are gas retailers, who buy gas on a wholesale basis and on-sell it to smaller customers.

Prices and revenues for Victoria's gas pipelines are not primarily determined through market forces. The DTS and Victoria's gas distribution networks are regulated by the Australian Energy Regulator, which determines the prices and revenues they can charge. This regulatory regime exists because these businesses are 'natural monopolies' that could charge excessive prices to consumers if they were not regulated.

The regulatory arrangements affecting Victoria's gas system are summarised in **Regulators in the gas sector on page 56**.

Victoria's gas system

Natural gas extraction
- Gippsland Basin
- Otway Basin
- Cooper Basin

Non-declared transmission and distribution
- Mortlake, Bairnsdale

Interstate connectors
- Import from NSW
- Export to SA, TAS, NSW
- 35–40% of Victorian production exported

Production facilities
- 70% via Longford

Declared wholesale gas market
- 59 market participants

Declared Transmission Pipeline Network
- Large industrial users
- Direct from wholesale market

LPG cylinders, bottles

Storage
- Port Campbell

Declared Distribution Pipeline Network

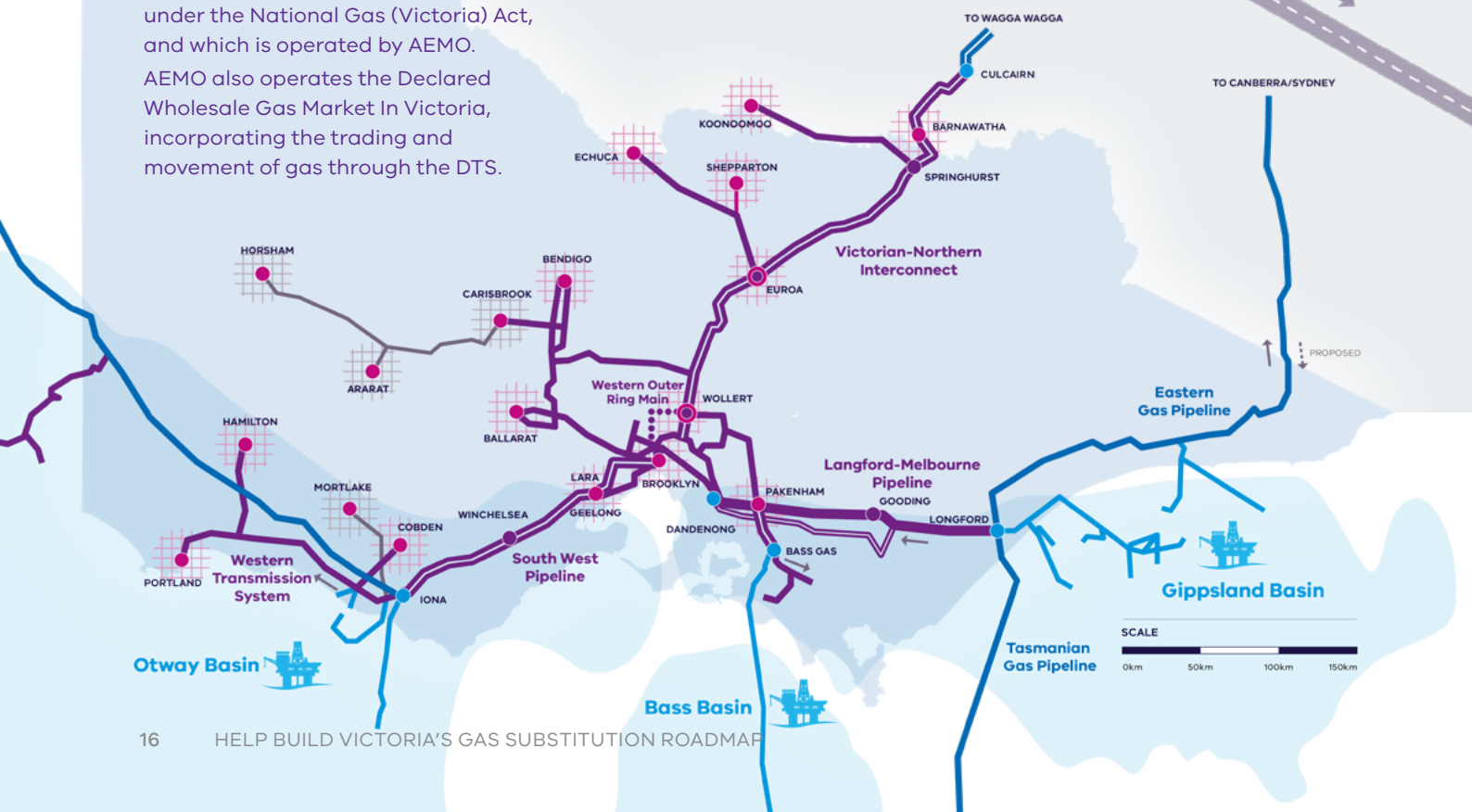
Gas retail market
- 19 retailers

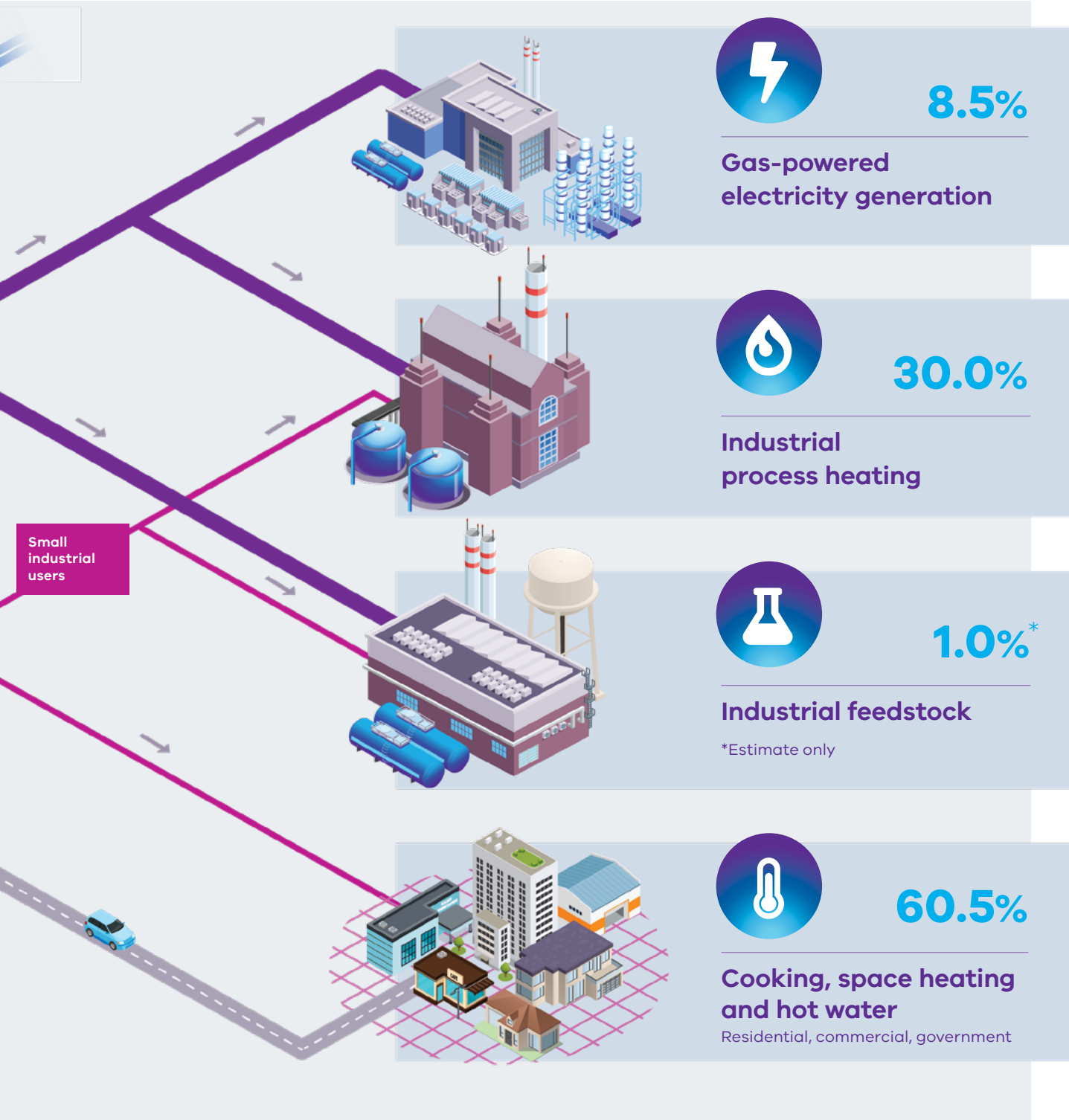
LPG retail market
- Numerous local retailers

Declared Transmission System

The Victorian gas Declared Transmission System (DTS) refers to the principal gas transmission pipeline system identified under the National Gas (Victoria) Act, and which is operated by AEMO.

AEMO also operates the Declared Wholesale Gas Market In Victoria, incorporating the trading and movement of gas through the DTS.





LEGEND

Extraction

- Gas basin
- Gas field pipeline
- Injection/withdrawal facility

Interstate pipeline

- Bi-directional
- Single direction

Transmission

- Declared Transmission Pipeline Network Bi-directional
- Declared Transmission Pipeline Network
- Proposed pipeline
- Compressor station

Distribution

- Declared Distribution Pipeline Network
- Non-declared Distribution Pipeline Network
- Local distribution network gateway
- Local distribution network

2

How natural gas is used in Victoria

Gas has a range of uses in Victoria, and plays an important role in our economy. The largest use for gas is for residential and commercial space heating, cooking and hot water.
Gas also dominates energy use in Victoria's manufacturing sector, where it is used mostly for industrial process heating, but also as a vital chemical feedstock for a range of products.
Finally, gas has also played an important role as a back-up source of energy for power generation, though the amount of gas-fired power generation can vary strongly from year to year.

END USE 1

Cooking, space heating and hot water

Residential, commercial and government

More Victorian households use gas for cooking, space heating and hot water than anywhere else in Australia. The largest use is for space heating, which is heavily concentrated in winter. This contributes to a strong seasonal pattern in Victoria's gas demand – demand on a cold winter day is about three times that of a summer day. Residential and commercial users are collectively the largest users of natural gas in Victoria.

Residential and commercial use is 61% of Victoria's total gas use[1]

2.2 million residential and commercial gas connections[3]

83% of Victoria's households are connected to mains gas[2]

This accounts for 42% of Australia's household gas connections

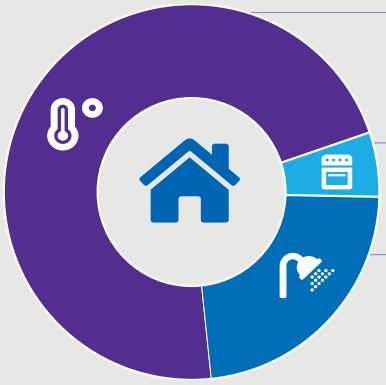
66% of Victoria's households use gas for water heating[4]

This accounts for 44% of Australia's gas water heating

64% of Victoria's households use gas for space heating[4]

More households than the rest of Australia

Residential gas use in Victoria



Space heating 74%
Using the most gas per household on average

Cooking 2%
Despite widespread use

Water heating 24%
Used in 66% of Victorian households

Source: Grattan Institute, Flame Out: the Future of Natural Gas

Improved efficiency in gas appliances, as well as in residential and commercial buildings, has meant that gas use has not grown significantly despite Victoria's strong population growth

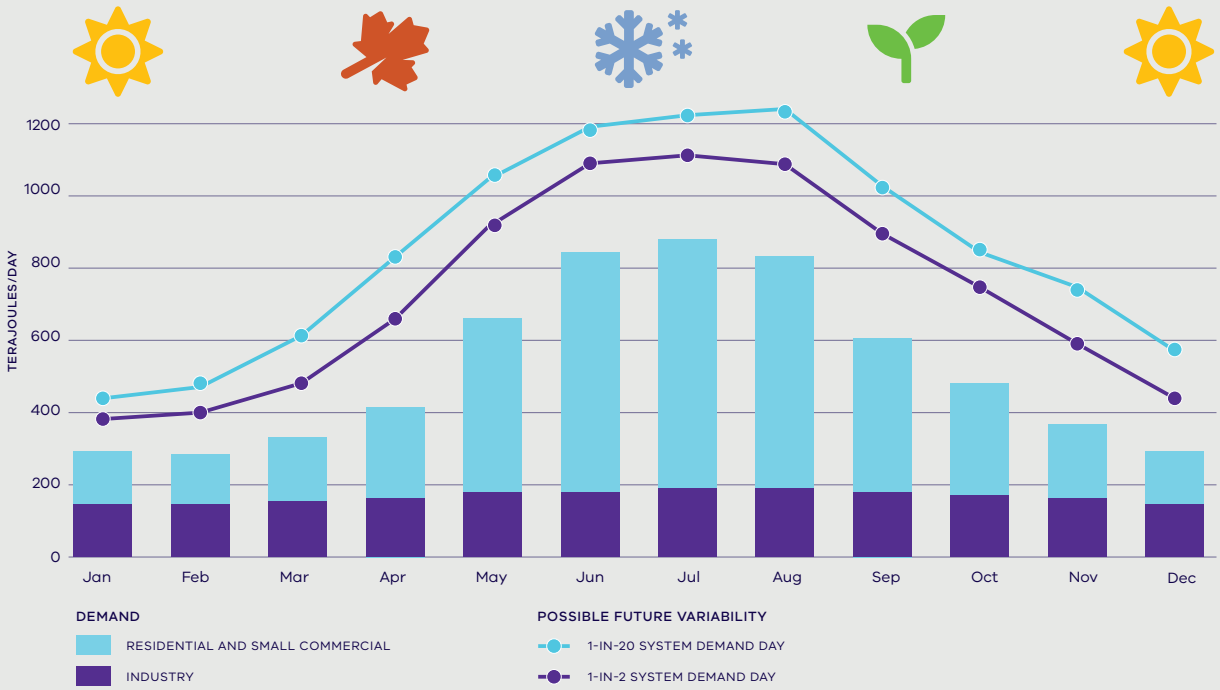
1 AEMO, National Electricity Forecasting forecasting.aemo.com.au/Gas/AnnualConsumption/Total
2 Australian Bureau of Statistics (ABS), Environmental Issues: Energy Use and Conservation, 2014
3 AEMO, Victorian Gas Planning Report, 2021.
4 ABS, Environmental Issues: Energy Use and Conservation, 2014

Winter demand is roughly three times higher than summer, primarily due to heating

Consumption of gas in household, commercial and government settings peaks in winter, primarily due to heating demand. On 9 August 2019, one of the coldest days in 2019, Victoria recorded its highest ever demand day of 1,308 TJ.[5]

By comparison, industrial customer demand is relatively flat throughout the year.

FIGURE 1 **Gas demand by month, industry vs residential and small commercial[6]**



5 AEMO, Victorian Gas Planning Report, 2020
6 AEMO, Victorian Gas Planning Report, 2021

END USE 2

Industrial process heat and feedstock

The Victorian industrial and manufacturing sector is a significant consumer of natural gas, and is critical to the state's economy. Industry mainly uses gas for process heat, creating steam, hot water or hot gases to drive manufacturing processes. Industry also uses gas as a feedstock, with ethane, a component of some raw natural gas sources, playing an important role in Victorian manufacturing.

Industrial use is 31% of Victoria's total gas use[7]

That's 66.3 petajoules

39% of process heating in Australia is greater than 800°C[9]

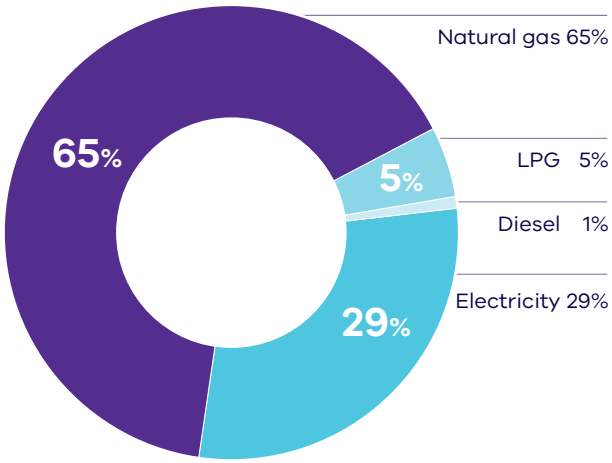
Natural gas is 65% of Victoria's industrial energy use[8]

Renewable energy alternatives for process heat

	<250°C	250–1300°C	>1300°C
Electric heat pump	Yes		
Geothermal	Yes		
Biomass combustion	Yes	Yes	
Biogas combustion	Yes	Yes	Yes
Solar thermal – direct	Yes	Yes	Yes

Source: Universtity of Melbourne, Melbourne Energy Institute, Switching off gas, australiainstitute.org.au 2015

Victoria's industrial energy use



Gas is used for heating across a range of temperatures, with limited viable alternatives currently for high-temperature heat (>800°C),[9] although this may change as technology improves. According to ARENA, up to 39 per cent of industrial process heating in Australia is at temperatures of greater than 800°C.[10]

Feedstock

Aside from process heat, natural gas also has a role as a manufacturing feedstock. In Victoria the use of gas as a feedstock is concentrated in the plastics industry, where ethane, a component of some raw natural gas sources, is used to make polyethylene, which in turn is used to make a variety of products such as piping, tanks and packaging.

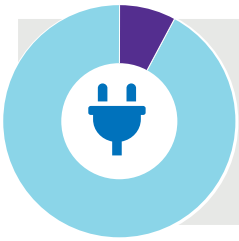
7 AEMO National Electricity Forecasting forecasting.aemo.com.au/Gas/AnnualConsumption/Total
8 Strategy. Policy. Research., Electrification Opportunities in Victoria's Industrial Sector, 2019. vic.gov.au/sites/default/files/2020-02/Appendix_6_Electrification_Industrial.pdf
9 arena.gov.au/assets/2019/11/renewable-energy-options-for-industrial-process-heat.pdf
10 arena.gov.au/assets/2019/11/renewable-energy-options-for-industrial-process-heat.pdf

END USE 3

Gas-fired power generation

Historically, gas-fired power generation (GPG)'s ability to fast-start and ramp up quickly has made it well suited to respond rapidly to meet demand peaks and fill gaps in electricity supply from other sources.

As Victoria's energy mix continues to develop and change over the coming years, this firming role could instead be filled by a number of technologies including hydro-power, hydrogen, distributed generation, demand response and grid-scale battery storage, such as Victoria's 300 megawatt Big Battery at Moorabool near Geelong. Some of these technologies are already economically competitive with gas, whilst others will become increasingly competitive over time.

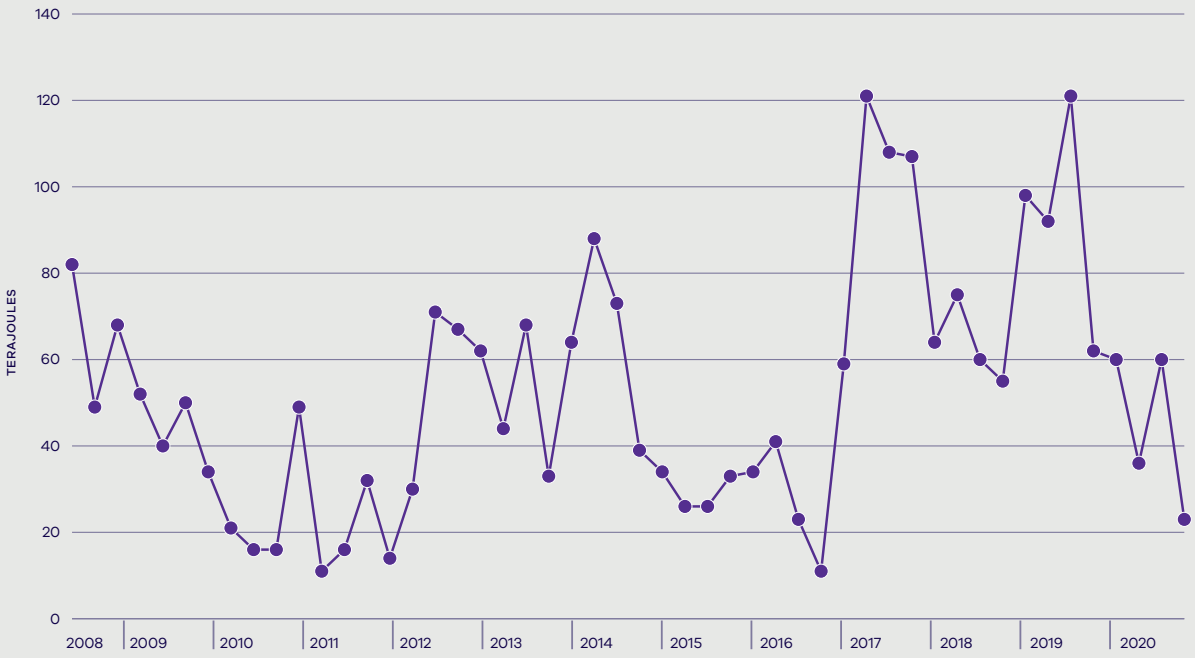


Victoria's gas power stations generated just over 8% of the state's electricity

2019, Australian Energy Update 2020 | energy.gov.au , table O

Demand for GPG is highly variable, depending on factors such as overall electricity demand, the availability of coal-fired generation and output from variable renewable generation such as solar and wind.[11]

FIGURE 2 Average daily Victorian gas used for power generation TERAJOULES



Source: Average daily gas used for gas powered generation | Australian Energy Regulator (aer.gov.au)

11 Australian Energy Regulator, Average Daily Gas Used For Gas Powered Generation

3

Decarbonisation pathways for the gas sector

There are many ways to reduce emissions from today's gas use. These include improving energy efficiency and switching to alternative, lower emissions energy sources. Reducing fugitive emissions from the production and transport of gas will also be important. The right combination of these 'decarbonisation pathways' is uncertain today. A key purpose of this consultation paper is to elicit stakeholder views on the strengths and weaknesses of each pathway across the full range of gas-using sectors.

Gas decarbonisation pathways

It is likely that a combination of the following decarbonisation pathways will be used to reach Victoria's emissions reduction targets

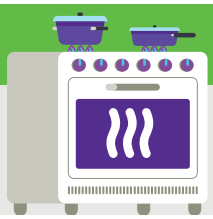
The Victorian Government has set ambitious, yet achievable five yearly interim targets to reduce the state's emissions from 2005 levels – by 28–33 per cent by 2025, and 45–50 per cent by 2030 – on the way to net zero emissions by 2050.

Improving energy efficiency

Housing energy efficiency upgrades, appliance upgrades

Electrification

Substituting gas appliances for electric appliances and equipment



Substituting natural gas with hydrogen

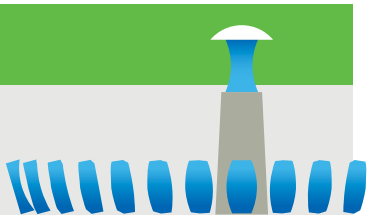
Or renewable methane produced from hydrogen

Substituting natural gas with biogas

From the anaerobic digestion of organic material

Emerging technologies

Concentrated solar thermal, carbon capture and storage, geothermal

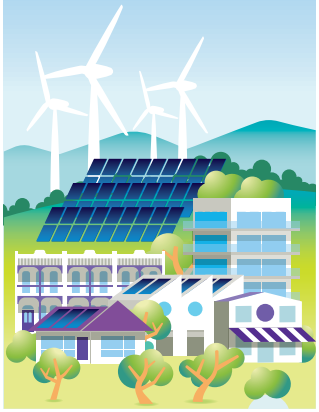


Addressing fugitive emissions

Leaks, venting and flaring of gases in the extraction, production, processing, storage, and transportation of fossil fuels

NET ZERO EMISSIONS 2050

YEAR	REDUCTION
2030	45–50%
2025	28–33%



There are a range of issues and questions the Victorian Government is taking into account to inform development of the Roadmap (and on which we are seeking the views of industry and the community), including the following.

Key questions

For each pathway	What are the key benefits, risks, and potential impacts on various end-users, on energy affordability, safety, security, reliability and equity?
	What is the scale of the opportunities and potential to accelerate uptake?
	What are the key technical, regulatory and economic barriers?
	What are the roles to be played by government, industry and how will consumers preferences be accounted for in the transition?
	What are the likely timings of technical maturity and economic viability?
	What are the best ways to maintain social acceptability and consumer confidence?
	What are the inter-dependencies and trade-offs with other pathways (are pathways complementary or alternatives)?
	What are the key uncertainties and potential for unintended consequences?

PATHWAY

Improving energy efficiency

Victoria can reduce gas-related emissions by making our homes and workplaces more energy efficient and improving energy efficiency in industry.

Victoria has a strong track record of improving household and business energy efficiency, in ways that save both emissions and money. Victoria's flagship energy and emissions savings program – Victorian Energy Upgrades – provides incentives for the installation of energy efficient equipment in thousands of Victorian households and businesses each year, which reduces their energy bills.

Minimum energy efficiency standards for buildings and upgrades to existing buildings can make a significant contribution to reducing gas use for heating, and, together with upgrades to appliances and equipment, have been highly effective in delivering energy savings, emissions reductions, and supporting Victorian businesses and households to manage their energy costs. Considering this strong track record, there may be scope to extend and expand Victoria's efforts to improve energy efficiency.

In particular, there are likely to be opportunities to improve the efficiency of gas use by larger industrial users. For this reason, the Victorian Government is supporting a range of initiatives to promote energy efficiency, including establishing a Business Recovery Energy Efficiency Fund (BREEF) to help large industrial users introduce energy efficiency and demand management technologies, and expanding the flagship Victorian Energy Upgrades program to include insulation of hot water pipework, replacement of commercial and industrial gas boilers, smart thermostats and energy management systems for businesses.

The Roadmap will give consideration to how government, along with industry, might further promote energy efficiency as a means to achieve our climate goals while also strengthening our economy.

END USE	PROSPECTS AND KEY CONSIDERATIONS
Cooking, space heating and hot water	Ambitious new targets for the VEU program have been set for 2022 to 2025 period, including new gas efficiency measures for households and businesses. The targets have been modelled to reduce energy demand by seven per cent by 2025, compared to business-as-usual levels.
	Regulatory reform to building standards provides an opportunity to improve building thermal performance and require installation of efficient appliance and equipment.
	Regulatory reform is required to increase minimum efficiency standards for new buildings and rented homes.
	Setting comprehensive national standards for appliances and equipment energy efficiency provides a cost-effective pathway for ensuring consumers save money and reduce emissions in new buildings and replacement stock.
	Minimum standards for heating in rental homes, introduced in March 2021, are expected to drive the installation of around 100,000 efficient heaters. Further standards for ceiling insulation and draught-sealing (ensuring buildings are efficient to heat) and hot water will deliver additional benefits.
Industrial process heat	There are many ways larger commercial and industrial users can reduce their gas use, potentially sufficient to reduce industrial gas use by 25 per cent nationally.[1]

1 AIG, EEC and CEFC, Australian Manufacturing Gas Efficiency Guide, p. 7.

PATHWAY

Electrification

Renewable energy is supplying a rapidly growing share of Victoria's electricity. This decarbonisation of the grid means that many household, commercial and industrial gas users can reduce emissions by switching from gas appliances to electricity, particularly when electric appliances are more efficient than the gas appliances they are replacing.

Electrical appliances are much more efficient than gas appliances for a range of household and commercial uses. Heat pumps, such as reverse cycle air-conditioners, efficiently transfer heat energy for space heating and cooling, and require far less energy than a gas heater for an equivalent heating load. Similarly, heat pump water heaters are more energy efficient than gas water heaters, and induction cooktops are more efficient than gas stoves. These appliances are all becoming more common and affordable, and so in many cases using these efficient electric appliances will see consumers both save money and reduce emissions. Switching to electrical appliances is particularly cost-effective for households installing rooftop solar PVs.

Electricity also has the potential to replace gas for some industrial needs. These can include industrial-scale heat pumps for hot water and low-temperature steam, using electromagnetic waves to generate heat through induction and microwave technologies, and passing electricity through a heating element (as used in electric ovens and boilers).

Heat pumps and electromagnetic industrial heat sources are generally more efficient than equivalent gas equipment, but equipment cost and technical feasibility varies across the broad range of industrial energy applications. In general, it is more feasible to replace gas with electricity for low-temperature industrial needs than for higher temperatures.

Electrification, however, will increase Victoria's electricity demand. Potential for peak demand increases in winter due to household heating and has implications for electrical network capacity. However, there is currently significant headroom for early action as Victoria's summer peak electricity demand is higher than the winter peak and the maximum capacity of the system is lower in hot weather. The implications on electrical infrastructure and the management of additional electrical demand will be a key consideration for the Roadmap and are further discussed in **Key issue 1 Maintaining electricity reliability with new sources of demand on page 40**.

END USE	PROSPECTS AND KEY CONSIDERATIONS
Cooking, space heating and hot water	A small but growing number of Victorian homes are either being built as, or converting to, all-electric appliances.
	The $335 million heating upgrades program will assist 250,000 low-income households (including an estimated 150,000 households with old gas space heaters) to replace inefficient heaters with efficient reverse cycle air conditioners.
	The Victorian Energy Upgrades program is looking to develop incentives for electrification opportunities where they reduce emissions and save consumers money. As the electricity system decarbonises, electrification upgrades will offer increasing emissions reduction opportunities from 2022.
	The relative affordability of replacing gas with electric appliances varies, depending on whether the building has rooftop PV, the age of existing gas appliances, and the appliance energy efficiency ratings. In most cases, it is cheaper to establish new homes as all-electric now.[2]
	The cost of switching to electric appliances in existing buildings is likely to come down over time; however, surveys have found that although electricity may be cheaper, some consumers still favour gas for heating and cooking.
	Building and planning settings need to be reviewed to ensure they are able to embrace a rapidly changing energy mix and innovations in new technologies.
Industrial process heat	There are a range of feasible and cost-effective uses for electricity to replace gas for industrial heating; electric heat pumps, for example, are commercially available for heat processes up to 160°C.
	Using electricity to provide higher temperature heat is generally less practical and more expensive.

2 Alternative Technology Association, *Household fuel choice in the National Energy Market* 2018
renew.org.au/wp-content/uploads/2018/08/Household_fuel_choice_in_the_NEM_Revised_June_2018.pdf

PATHWAY

H2

Substituting natural gas with hydrogen

Hydrogen can be burnt for heat in place of natural gas across a range of uses. These include in homes and businesses, in heavy industry and for electricity generation. It can also be used as a chemical feedstock.

To reduce emissions, hydrogen must be produced from low-emissions sources. The most prospective ways of doing this are by using renewable electricity to split water into hydrogen and water ('green hydrogen' or 'renewable hydrogen') or by producing hydrogen from fossil fuels and capturing and storing the resulting carbon dioxide.

Hydrogen can be used in place of natural gas for a range of uses. The best way to switch small gas users such as households and small businesses to hydrogen is to replace natural gas in the distribution pipeline with hydrogen. In the near term, hydrogen can be blended with natural gas at low levels through the gas distribution network without needing to replace pipelines, appliances and meters. In the long-term, moving to 100 per cent hydrogen in today's distribution network may require some changes to pipelines, and widespread changes to appliances and meters.

Larger users could consume hydrogen from pipelines or by generating it onsite. The best economic approach will vary depending on a range of factors, such as the size and flexibility of the hydrogen load, the proximity to renewable energy resources, and available electricity network capacity.

Large users could use hydrogen for higher temperature heat needs (which are generally not well suited to electrification), or as a chemical feedstock in some circumstances. Power generation is another potential large-scale use of hydrogen.

The Victorian Government is partnering with industry to explore the potential for the development of hydrogen production facilities, including support development of hydrogen supply chains, through both the HESC project and through the implementation of a **Renewable Hydrogen Industry Development Plan**.

While hydrogen is currently more expensive than natural gas, it is projected to become more cost competitive in the future as electrolyser production economies of scale ramp up and as electricity prices decline. Renewable hydrogen can also be converted into renewable methane, although the commercial viability of this is yet to be established.

Renewable hydrogen production requires water and large amounts of renewable energy. The Victorian Government is actively exploring opportunities across the State to use recycled water and storm water in the production of renewable hydrogen.

END USE	PROSPECTS AND KEY CONSIDERATIONS
Cooking, space heating and hot water	Current domestic gas appliances can function with a natural gas hydrogen blend up to 10 per cent by volume[3] (although this figure may be higher in some cases, the upper limits of safe blending are currently the subject of numerous studies). Blending hydrogen with natural gas above this threshold requires a change out of appliances, distribution piping, and end-user piping.
	Investigations are currently underway into the development of domestic appliances which can operate at higher concentrations of hydrogen.
Electricity generation	Hydrogen can be stored and used as a feedstock for electricity generation either through a fuel cell or combusted to power a conventional turbine. Depending on the level of reliance on hydrogen, storage may be required to support heavier use during seasonal peaks, subject to cost considerations.
Industrial process heat	Hydrogen can be used to provide high temperature process heat that is not well suited to electrification.
Industrial feedstock	Hydrogen is not widely used as a feedstock in Victorian industry. However, it can be used as a feedstock for a range of chemical products, particularly ammonia and ammonia-derived fertilisers and explosives.

3 CSIRO, National Hydrogen Roadmap

ReWaste biogas facility in Wollert, to the north of Melbourne. Courtesy Yarra Valley Water.

PATHWAY

Substituting natural gas with biogas

Biogas is a renewable energy source derived from the anaerobic digestion of organic material such as industrial and agricultural waste, wastewater, or energy crops. Biogas is not widely used in Victoria, but it may play a role in reducing emissions from gas – particularly because it can be converted to biomethane, which is chemically identical to, and completely substitutable with, methane. Using waste to make biogas also aligns with Victoria's commitment to achieving a more circular economy.

Biogas can be upgraded into biomethane which can be injected into the existing gas network without the need for modifying gas pipelines or appliances. Although there are currently no biomethane plants yet operating in Victoria, upgrading biogas to biomethane occurs in other parts of the world, particularly in the European Union. Importantly, biomethane is chemically the same as methane, the principal component of natural gas, and so can replace gas wherever it is used today.

By contrast, biogas includes significant volumes of carbon dioxide and other gases, and so is not 'pipeline quality' – it must be used in facilities designed to use the quality of biogas available. In Victoria today this includes small electricity generators that run on landfill gas, and for process heat in some piggeries and pulp and paper manufacturing.

The commercial viability of replacing natural gas with biogas and biomethane will depend largely on the availability and location of biomass (organic waste), and the cost of digestion and biomethane purification facilities.

END USE	PROSPECTS AND KEY CONSIDERATIONS
Cooking, space heating and hot water	Injecting biomethane into the reticulated gas network presents no technical issues. But fully replacing natural gas with biomethane to meet domestic needs would require biomass resources greater than currently available from existing pig waste, in the form of new plant crops, which would place pressure on existing land uses and water availability.
Electricity generation	Biogas, once purified, can be burned to produce electricity for the grid, such as is being trialled at Melbourne Water's Western Treatment Plant and at Yarra Valley Water's ReWaste facility.
Industrial process heat	Biogas is currently being used onsite for process heating. The use of biogas for onsite use may increase over time due to recent increases in the cost of natural gas.
	It is feasible to inject biomethane into the gas network and use it wherever natural gas is used today.
Industrial feedstock	Biomethane can replace methane as an industrial feedstock.

PATHWAY

Emerging technologies

Emerging technologies such as solar thermal and geothermal could replace natural gas in a range of commercial and industrial applications. Carbon capture and storage also has the potential to decarbonise some existing and new industries. The cost, technical and commercial viability of some of these technologies is highly uncertain.

Concentrated solar thermal

Concentrated solar thermal (CST) technologies use mirrors to concentrate sunlight and produce heat captured in fluids such as molten sodium, which can be used immediately or stored for later use. The hot fluids can create steam for direct use in industry, or for powering a turbine to generate electricity. While this technology is already being used, it has yet to be established at scale in Australia, due to high set-up costs. However, future cost reductions could allow it to meet both lower and higher-level heat requirements of industry.

Carbon capture and storage

Carbon capture and storage (CCS) is a process of capturing and permanently storing carbon emissions. It can reduce emissions from processing of natural gas, from some industrial processes, and from producing hydrogen from fossil fuels.

Victoria's CarbonNet project is investigating the potential for establishing a commercial-scale CCS network in Gippsland. The network would bring together multiple carbon dioxide capture projects and transport the carbon dioxide via a shared pipeline and inject it into deep underground, offshore storage sites in Bass Strait. Such a project, if proven to be technically feasible and economically viable, and combined with the HESC project, could play a role in enabling Victoria to continue use of some natural gas and produce non-renewable hydrogen while meeting climate change emissions targets. Residual carbon emissions associated with CCS projects would need to be offset by other strategies.

Megalim concentrated solar power and thermal electric power plant in Israel's Negev Desert

Thermal waste-to-energy

Rather than using organic waste to create biogas, waste can also be burned for energy (often called 'thermal waste-to-energy' technologies). This can also replace natural gas in various industrial applications, while also diverting waste from landfills and reducing greenhouse gas emissions from Victoria's waste sector. A state-of-the-art waste-to-energy plant is planned for the Maryvale pulp mill in the Latrobe Valley, which has the potential to reduce its greenhouse gas emissions and reduce its reliance on gas by around one-third. Once complete, the plant will incinerate municipal, commercial and industrial waste, including non-recyclable waste from the mill, to generate steam and electricity for the mill and electricity for the grid.

Geothermal

Geothermal energy comes from extracting the heat which exists in rocks and water bodies underground. This heat can be used for heating buildings, power generation and for industrial processes.

One approach is to extract heat from natural hot water reservoirs (hot sedimentary aquifers). For example, the Latrobe Valley Authority has noted that Gippsland has a high-quality geothermal resource that is currently largely unused, consisting of 70°C water at a very accessible depth, insulated by a layer of coal. This resource could be useful for low-temperature heat applications in industry or commercial settings. For example, the Gippsland Regional Aquatic Centre is using this resource for heating.

Another approach is to use the stable temperature of the ground as a heat sink for cooling applications, and as a heat source for low-temperature heating applications, via a heat pump. This approach, sometimes called a geothermal heat pump, can improve the efficiency of heat pumps in a range of low-temperature applications across households, commercial businesses and industry.

Shredded municipal waste used as alternative fuel in rotary cement kiln

PATHWAY

Addressing fugitive emissions

Fugitive emissions result from leaks, venting and flaring of gases in the extraction, production, processing, storage, and transportation of fossil fuels. Fugitive emissions represent about three per cent of Victoria's total greenhouse gas emissions.

Around 55 per cent of these come from the production, transmission, storage and distribution of natural gas.[4] Reducing these emissions will play an important part in meeting our 2050 net zero target and many companies have already taken action to reduce fugitive emissions.

Fugitive emissions, including methane and carbon dioxide, can occur at various stages along the gas supply chain: in the initial extraction and production process, along the pipeline network and at the point of use. The Roadmap will consider how such emissions can best be minimised in future.

GAS SUPPLY CHAIN	HOW FUGITIVE EMISSIONS OCCUR	OPTIONS AND REMEDIAL ACTIONS	PROSPECTS AND KEY CONSIDERATIONS
Extraction and production	Venting and flaring during production	Technical and other options to be identified	Determining what measures industry is already undertaking, whether any further opportunities from best-practice models, including international, may be applicable in Victoria, and the costs of such measures
Transmission	Potential leakage from transmission infrastructure, including compressors	Technical and other options to be identified	Options to be assessed for efficiency and viability for implementation
Distribution	Leakage from ageing and corroded pipelines	Replacement programs progressively replacing ageing pipelines with high-density polyethylene	Determining the cost and benefits of accelerated replacement High density polyethylene is also suitable to transport hydrogen
End uses	Ageing and inefficient domestic appliances; inefficient use of appliances	Potential scope to address through energy efficiency measures	Determining timing and cost of remedial actions

4 Victorian Government, Victorian Greenhouse Gas Emissions 2018, 2018

4

Gas industry transition issues and challenges

The Victorian Government is committed to maintaining energy affordability, security, reliability and safety for all Victorians during the transition to a clean energy economy. A number of issues and challenges need to be managed to achieve this.

KEY ISSUE 1

Maintaining electricity reliability with new sources of demand

Electrification will likely play a significant role in decarbonising gas in Victoria. But this will increase electricity demand, including at peak times, and so may place additional stress on the electricity grid.

Decarbonising the energy sector tests the capability of the electricity networks to accommodate the increase in demand if gas load is converted to electrical load through electrification or hydrogen production. While there is headroom for early action on electrification of winter gas consumption, extensive electrification of a range of gas loads, alongside growth in electricity demand from electric vehicles, may require significant investment in electricity generation, storage and network assets to maintain reliability. It is important that this investment is sufficient and occurs in a timely way to meet this growth in electricity load, while continuing to deliver affordable and reliable energy supplies while driving down emissions.

The full implications for Victoria of electrifying space heating, for example, particularly during winter peaks, will be a key consideration for the Roadmap. Electrifying all gas space heating load would significantly increase electricity demand in winter, but it is also clear that new capabilities are emerging that can help Victoria better manage future peaks in electricity demand.

These include:

- Measures to incentivise users to shift electricity demand away from 'peak' times, as well as opportunities to enhance the demand response capability of households and businesses
- Improved thermal efficiency in buildings to reduce the need for heating, particularly during the winter, as well as the use of efficient heat pump technology
- The establishment of a network of grid and neighbourhood scale batteries in Victoria to provide back-up electricity supply and support the network
- The development of 'distributed energy' networks, including generation from rooftop solar by households and businesses, as well as the potential for electricity storage in home batteries or electric vehicles, which could also support the grid while offsetting peak demand for power
- The development of renewable energy zones to support and accelerate investment in new large scale renewable generation capacity
- The potential in the future for hydrogen to be used for electricity generation or in fuel cells to provide power directly to users.

Key questions

What policies are needed to ensure that the electricity network can reliably serve new sources of demand from electrification of gas demand, hydrogen production and electric vehicles?

What is the role for gas-fired power generation and hydrogen in maintaining electricity reliability?

KEY ISSUE 2

Transitioning to more sustainable gaseous fuels with minimal disruption to end-users

Victoria has extensive gas infrastructure, and it may make sense to continue to use this infrastructure, but replace natural gas with substitute fuels. This is straightforward for biomethane, which can be used in existing pipelines and appliances without modification. The picture for hydrogen is more complicated, and is likely to require some changes to pipelines, metering and equipment – potentially creating disruption for end-users.

Biomethane can be injected into the natural gas network in smaller or larger proportions without modification to pipelines, or gas appliances. But other gaseous fuels create more transitional challenges when replacing natural gas. For example, hydrogen could cause degradation ('embrittlement') if injected into high pressure gas pipelines. Hydrogen can be injected into those parts of the Victorian gas distribution network which use polyethylene piping, but, at blends greater than around 10 per cent hydrogen, it would require adjustments to household gas appliances, gas metering equipment and possibly some pipe fittings.

A wholesale switch over of the distribution network to 100 per cent hydrogen supply is a long-term possibility. The Roadmap will give consideration to the practicality of a switch over to alternative gaseous fuels, particularly as to how this switch over could be achieved safely over time allowing for natural gas to continue to operate in other parts of the network. This will include consideration of the implications of such a switch over for large industrial users. Consideration will also be given to the implications for current LPG users.

Key questions

What are the key technical challenges in converting existing gas networks to accommodate more sustainable gaseous fuels?

What are the potential costs and opportunities in switching to more sustainable gaseous fuels for consumers?

KEY ISSUE 3

Maintaining the reliability, affordability and safety of gas supply

Given the reliance on gas in Victoria, gas will continue to play a role in meeting Victoria's energy needs for years to come. Until such time as renewable and zero emissions alternatives become available at scale and are embraced by the market, it is important to maintain a reliable supply of affordable gas.

Victoria is part of an interstate gas market. The creation of an LNG export market from Queensland altered the supply-demand balance in Australia and linked the domestic gas price to the international gas price, leading to a tripling of domestic gas prices from $3-4 per gigajoule (GJ) in 2015 to $9-12 in 2019. Prices in early 2021 have since declined to below $8 per GJ in 2021 reflecting softening demand and increased competition amongst suppliers.[1]

As the COVID-19 pandemic and its effect on demand is likely to be a contributor to these softer prices, the decline may be temporary. Higher gas prices are particularly challenging for commercial and industrial gas users and complicate their long-term investment decisions. Manufacturing is central to the Victorian economy and the government recognises that for gas-dependent local manufacturing to be viable, a reliable supply of affordable gas is essential.

The Roadmap will consider measures required to ensure energy affordability, reliability and safety both in the nearer term and as the sector transitions to net zero emissions, as well as measures to maintain and enhance reliability across the gas supply chain, including both supply and demand side options.

Key questions

What are the affordability, reliability and safety considerations related to gas supply and gas infrastructure, both in the short term and during a long-term transition to a decarbonised gas sector?

What policies are needed to ensure that the gas system continues to operate reliably and safely and remain affordable for end-users during this transition?

1 Australian Competition and Consumer Commission, Gas Inquiry 2017-2025: Interim report, January 2021

Gas supply outlook for Victoria

For over fifty years, Victoria has had access to low cost, abundant natural gas, extracted from offshore gas fields located in Bass Strait.

However, as AEMO has indicated in its 2021 Gas Statement of Opportunities (GSOO), these gas fields are rapidly depleting. AEMO is forecasting an overall decline in Victoria's production of 43 per cent from 360 PJ per year in 2021 to 205PJ per year in 2025. AEMO has indicated that the establishment of an LNG import terminal at Port Kembla in New South Wales, together with the Eastern Gas Pipeline being made bidirectional to enable south-bound flow of gas to Victoria, addresses the risk of an imbalance in supply and demand, provided that the import terminal is operating by 2023.[1]

Victoria has already acted to bolster local gas supply with the restart of the onshore conventional gas industry from 1 July 2021 and the 2018 release of new gas exploration blocks in Victorian offshore waters (within three nautical miles of the Victorian coast). The Victorian Government will require gas producers to prioritise domestic gas consumers by first making reasonable and genuine offers to the domestic market for any gas production arising in Victoria.

The Victorian Government passed the Petroleum Legislation Amendment Act (2020) to set up the framework for an orderly restart of conventional gas exploration and development in 2021. To ensure a best practice regulatory regime, the Government is updating the supporting Petroleum Regulations and will be releasing a Regulatory Impact Statement for public consultation soon.

Lochard Energy's proposal to expand Victoria's underground storage capacity at the Iona Underground Storage facility and GB Energy's proposal to develop Golden Beach gas field as a gas production site before converting it into an underground storage facility will assist to meet winter peak demand.

The expected completion of the Western Outer Ring Main in 2022, a proposed 50-kilometre buried transmission gas pipeline to connect existing pipelines in Melbourne's west and north, will help to alleviate current constraints in Victoria's south-west pipeline and improve the ability to refill the Iona Underground Storage facility.

Other gas infrastructure proposals, including potential to import LNG directly to Victoria, may also play an important role in securing Victoria's gas supply by supporting an increased diversity of suppliers. Any proposals but must be fully compliant with Victorian environmental and planning laws to proceed.

1 Australian Energy Market Operator (AEMO), Gas Statement of Opportunities, 2021

KEY ISSUE 4

Supporting Victoria's workforce, industry and the institutions that support them

As in all major technological disruptions, the decarbonisation of gas will require the building of new and emerging skills and capabilities in the affected workforces and supply-chains. This includes producing, installing and maintaining appliances and equipment, and building new energy infrastructure, as well as providing adequate training opportunities to upskill our workforce.

The gas industry employs many Victorians, including in the extraction and production of gas, and around 20,000 registered and licensed gasfitters. Thousands of Victorian workers supply and manufacture gas appliances and equipment, or maintain the safety of the gas system. There are a number of gas appliance manufactures in Victoria, including Rheem, Seeley International, IXL Home and Illusion Australia.

There are likely to be opportunities to use these established skills to underpin emerging biogas and hydrogen industries. For example, the Victorian Government recently released a Renewable Hydrogen Industry Development Plan, which examined ways to develop skills for the emerging hydrogen, including cross-sector knowledge and re-skilling. Organisations such as the Plumbing Industry Climate Action Centre and unions also have a role to play in building workforce capability.

Furthermore, the Victorian Government's new Clean Economy Workforce Skills initiative, which includes a Skills and Jobs Taskforce and a Workforce Development Strategy, will support government investment in the Victorian TAFE and Training system so that the gas workforce has the necessary skills to support the decarbonisation of the gas industry. These efforts will help prepare workers for roles across the hydrogen value chain, creating benefits for both them and the wider economy.

Key questions

What workforce skills and industry capabilities are required to transition to new and emerging energy sources?

How can government, industry and unions best work together, including through the Victorian TAFE and Training system, to help to build these skills and capabilities, and support existing workers through the transition?

How do we maximise local job opportunities, including for industry training centres such as that operated by the Plumbing Industry Climate Action Centre, to prepare workers for the future?

KEY ISSUE 5

Managing uncertainty in the transition

Victoria is adopting a 'no regrets' approach to the transition away from reliance on natural gas, by exploring a range of pathways to reduce gas-related greenhouse emissions, and retaining the flexibility to adjust our approach in response to new information.

A long-term and broad transition to net zero emissions is inherently uncertain. The policy decisions the Victorian Government makes today must allow room to adapt to new information, and to emphasise different decarbonisation pathways as their relative economic and technical feasibility become clearer over time.

Key uncertainties include:

- The speed at which the cost and technical feasibility of various technologies will change
- The pace and scale of commercial investment, including how this will be affected by other uncertainties, and whether this will result in significant economies of scale or network effects (where one group of users choosing a technology changes the attractiveness of that technology for other users)
- Demand for and utilisation of existing infrastructure, including whether and when demand might fall below critical thresholds that affect their operational and commercial viability
- Policy and investment decisions of other governments internationally and within Australia, particularly in respect of policy and regulation of the gas sector and decarbonisation initiatives
- Social licence and consumer preferences, which may take time to understand, particularly in respect of new and emerging technologies.

To account for these and other uncertainties over the short, medium and longer term, the Victorian Government will be taking a precautionary and staged approach to decarbonising gas. This approach recognises that each of the pathways outlined earlier will likely have some role to play in future, and that seeks to keep viable options open in the future while pursuing no regrets measures today.

Key question

What key uncertainties should the Roadmap take into account, and what is the government's role in reducing these uncertainties?

KEY ISSUE 6

Transitioning the Victorian economy efficiently and equitably

The decarbonisation of gas is one part of a broader transformation taking place within the energy sector, and across the Victorian economy more broadly. The impact of this transition to more sustainable energy sources will likely be profound and far-reaching, with both challenges and opportunities ahead as we move toward net zero greenhouse gas emissions by 2050.

In many cases, moving from natural gas to electricity will save consumers money as well as reducing emissions.[2]

But such a switch can still create financial challenges for many consumers, particularly low-income and vulnerable households. The Roadmap will consider how these difficulties can be managed, to ensure that the costs of any transition are borne equitably.

Particular challenges include:

- The extent to which the upfront cost of switching from gas to electric appliances are a barrier to the uptake of more sustainable technologies, notwithstanding the longer-term emissions and running cost benefits.
- The challenges such upfront costs may present for low-income and vulnerable households, and those in regional Victoria (including users of CNG and LPG for heating, hot water and cooking).
- Recognising the contribution of energy affordability to the competitiveness of Victorian industry.

Victorian Energy Upgrades

Victorian Energy Upgrades sets a target to increase the amount of energy efficiency undertaken in Victoria. Since the program was established in 2009, more than 480,000 households have undertaken activities under the program that save gas.

We are increasing number of opportunities under the program to make more efficient use of gas, including residential space and water heating and commercial gas boilers.

As part of changes to the National Construction Code planned to take effect from September 2022, Victoria will remove regulatory barriers to installing efficient electric hot water systems in new homes. This will help households to capture further benefits from investing in solar panels and supporting those who choose all-electric new homes.

2 Renew Report Household Fuel Choice in the NEM 2018 (renew.org.au)

Key questions

How can we ensure that the costs of transition to lower emissions energy sources are borne equitably?

How can we help low-income and vulnerable households manage any upfront costs in changing energy sources?

What are the barriers for households in improving the efficiency of their use of gas for heating, cooking and hot water and/or switching to solar/pump hot water in existing homes?

What are the opportunities for the Victorian Energy Upgrades program to incentivise efficient gas use, thermal upgrades of buildings (e.g. insulation) and electrification?

What issues and elements do you see as most important to improve the energy and emissions performance of new homes?

Gas Substitution Roadmap
Outcomes framework and multi-criteria assessment

To support an analysis and assessment of pathways to decarbonise gas in Victoria, the Roadmap will establish an outcomes framework incorporating a range of key considerations and associated measures, as proposed below.

OUTCOMES FRAMEWORK MEASURES	DESCRIPTOR
Emissions reduction	Reducing Victoria's emissions to net zero by 2050, and meeting interim emission reduction targets
Energy security and reliability	Achieving security and reliability of energy supply while maintaining affordability
Affordability and equity	The net cost of energy for households and businesses
Safety	Minimising safety risks related to the construction, manufacture, operation and maintenance of the energy system
Market viability	Levelised cost of supply relative to revenue for market operators
Social licence	Level of community and consumer acceptance of alternatives to natural gas
Social impacts	The impacts of decarbonising gas on health, wealth and energy accessibility
Economic impacts Including workforce and industry impacts	Direct and indirect impacts of decarbonising gas on economic output and employment (direct and indirect jobs associated with renewable energy and energy efficiency initiatives)
Environmental impacts	The impact of decarbonising gas on Victoria's natural resources

Key questions

Do the range of outcomes measures identified above adequately cover key considerations for assessing the costs and benefits of options and strategies to decarbonise the use of gas in Victoria?

What would be appropriate metrics through which to measure these outcomes?

Summary of key questions

There are a range of emerging key pathways to addressing the carbon impact of gas in Victoria. These include:

Improving energy efficiency

Electrification

Substituting gas for electric appliances/ equipment

Substituting natural gas with hydrogen

Substituting natural gas with biogas

Emerging technologies

Such as carbon capture and storage, solar thermal and geothermal

Addressing fugitive emissions

Key questions

For each pathway	What are the key benefits, risks, and potential impacts on various end-users, on energy affordability, safety, security, reliability and equity?
	What are the scale of opportunities and potential to accelerate uptake?
	What are the key technical, regulatory and economic barriers?
	What are the roles to be played by government, industry and how will consumers preferences be accounted for in the transition?
	What are the likely timings of technical maturity and economic viability?
	What are the best ways to maintain social acceptability and consumer confidence?
	What are the inter-dependencies and trade-offs with other pathways (are pathways complementary or alternatives)?
	What are the key uncertainties and potential for unintended consequences?
Fugitive emissions	What are the opportunities and barriers to further reductions in fugitive emissions?

Key issue 1

Maintaining electricity reliability with new sources of demand	What policies are needed to ensure that the electricity network can reliably serve new sources of demand from hydrogen production, electric vehicles and electrification of gas demand?
	What is the role for gas-fired power generation and hydrogen in maintaining electricity reliability?

Key issue 2

Transitioning to more sustainable gaseous fuels with minimal disruption to end-users	What are the key technical challenges in converting existing gas networks to accommodate more sustainable gaseous fuels?
	What are the potential costs and opportunities in switching to more sustainable gaseous fuels for consumers?

Key issue 3

Maintaining the reliability, affordability and safety of gas supply	What are the affordability, reliability and safety considerations related to gas supply and gas infrastructure, both in the short term and during a long-term transition to a decarbonised gas sector?
	What policies are needed to ensure that the gas system continues to operate reliably and safely and remain affordable for end-users during this transition?

Key issue 4

Supporting Victoria's workforce, industry and the institutions that support them	What workforce skills and industry capabilities are required to transition to new and emerging energy sources?
	How can government, industry and unions best work together, including through the Victorian TAFE and Training system, to help to build these skills and capabilities, and support existing workers through the transition?
	How do we maximise local job opportunities, including for industry training centres such as that operated by the Plumbing Industry Climate Action Centre, to prepare workers for the future?

Key issue 5

Managing uncertainty in the transition	What key uncertainties should the Roadmap take into account, and what is the government's role in reducing these uncertainties?

Key issue 6

Transitioning the Victorian economy efficiently and equitably	How can we ensure that the costs of transition to lower emissions energy sources are borne equitably?
	How can we help low-income and vulnerable households manage any upfront costs in changing energy sources?
	What are the barriers for households in improving the efficiency of their use of gas for heating, cooking and hot water and/or switching to solar/pump hot water in existing homes?
	What are the opportunities for the Victorian Energy Upgrades program to incentivise efficient gas use, thermal upgrades of buildings (e.g. insulation) and electrification?
	What issues and elements do you see as most important to improve the energy and emissions performance of new homes?

Glossary

TERM	DEFINITION
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ARENA	Australian Renewable Energy Agency
Biogas	Renewable energy source derived from the anaerobic digestion of organic material (biomass) such as industrial and agricultural waste, wastewater treatment sludge or energy crops
Biomethane	Has the same chemical composition as methane, the principal component of natural gas, by removing impurities, biogas can be upgraded into biomethane which can then be injected into existing gas networks
BREEF	Business Recovery Energy Efficiency Fund
CNG	Compressed natural gas. Where delivery by pipeline is not available, gaseous methane can be compressed and delivered in pressurised cylinders
Decarbonisation	Reducing or eliminating the amount of carbon released to atmosphere from combustion of fossil fuels such as natural gas
DELWP	Department of Environment, Land, Water and Planning
DJPR	Department of Jobs, Precincts and Regions
DTS	Declared Transmission System
DWGM	Declared Wholesale Gas Market
EPA	Environment Protection Authority
ESC	Essential Services Commission
ESV	Energy Safe Victoria
GPG	Gas-fired power generation
GSOO	Gas Statement of Opportunities
HESC	Hydrogen Energy Supply Chain
Hydrogen	The most abundant element in the universe, with a low density and high energy potential
IV	Infrastructure Victoria
LNG	Liquified natural gas. Where transporting gas by pipeline is not practical (i.e. for international export from Australia) it is converted by cooling to a condensed liquid form, and then returned to a gas at the delivery point
Low-emissions gaseous fuels	Gas derived from low emission sources such as hydrogen and biogas Can include renewable hydrogen and hydrogen produced from fossil fuels and capturing and storing the resulting carbon dioxide
LPG	Liquefied petroleum gas. A combination of propane and butane This is used in regional areas with no reticulated gas for water and space heating and cooking It is also used as a transport fuel (Autogas)
Methane	This principal component of natural gas, able to be used for burning in gas turbines and in domestic appliances, and which is supplied to end-users through the gas system
Natural gas	Natural gas is a non-renewable gaseous substance (fossil fuel) found in naturally-occurring underground reservoirs When first produced, raw natural gas often includes impurities such as water and carbon dioxide (which must be removed before sale), methane, and other components such as ethane, propane and butane Sales quality natural gas is primarily methane
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
PJ	Petajoule (unit of measurement for gas): 1PJ = 1,000 TJ
PV	Solar photovoltaic technology, also known as solar cells, are panels that convert sunlight to electrical energy
Renewable hydrogen	Hydrogen produced using renewable energy
TJ	Terajoule (unit of measurement for gas): 1 TJ = 1,000 GJ
VEU	Victorian Energy Upgrades program
VHIP	Victorian Hydrogen Investment Program
VGPR	Victorian Gas Planning Report
Waste-to-energy	A process for converting waste material into energy, either through high-temperature incineration to power steam turbines, through capturing fugitive gasses at landfill sites or by means of anaerobic digestion (i.e. of organic material)

Regulators in the gas sector

National	Australian Energy Market Commission (AEMC)	Establishes the National Gas Rules under which gas producers, users and pipelines must operate in eastern Australia
	Australian Energy Regulator (AER)	Enforces the National Gas Rules In particular, it determines prices and revenues that can be charged by the owner of the DTS and Victoria's gas distribution networks, and regulates or monitors the prices or revenues of other gas pipelines
	Australian Energy Market Operator (AEMO)	Manages the day-to-day operation of the DWGM and is responsible for matching supply and demand within the DWGM and so maintaining the security of the DTS
State	Energy Safe Victoria (ESV)	Victoria's independent safety regulator, responsible for electricity, gas and pipeline safety including associated pipeline infrastructure as well as end use gas appliances for large industrial, commercial and household customers
	Essential Services Commission (ESC)	Responsible for licensing a range of gas businesses in Victoria, as well as for a number of relevant Codes and Guidelines
	Department of Environment, Land Water and Planning (DELWP)	Co-administers, with ESV, the Pipelines Act 2005, which governs the construction and operation of pipelines carrying liquid and gaseous fuels at high pressure in Victoria It is also responsible for Critical Infrastructure Resilience of the energy sector via the Emergency Management Act 2013
	Department of Jobs, Precincts and Regions	Administers the Petroleum Act 1998 co-administers, with NOPSEMA, the Victorian Offshore Petroleum and Greenhouse Gas Storage Act2010 to regulate gas and petroleum exploration and extraction within Victoria
	Victorian Building Authority (VBA)	Also has some oversight over standard gas installations and of gasfitters
	WorkSafe Victoria	Victoria's workplace health and safety regulator including oversight of Major Hazard Facilities
	Environment Protection Authority (EPA)	Victoria's environmental regulator

Accessibility

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Photos in this document containing people were taken prior to March 2020 before physical distancing and masks were required.

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