November 2023

Institute for Energy Economics and Financial Analysis

Reducing demand – A better way to bridge the gas supply gap

Gauging the untapped potential for cost-effective gas efficiency and electrification in Australia's southern states

Amandine Denis-Ryan, CEO, IEEFA Australia

Contents

Figures and Tables

Key Findings

Untapped cost-effective interventions to improve gas efficiency and expedite electrification could slash gas demand by more than 40% by 2030 in southern states' residential buildings and industry.

These reductions could more than eradicate the anticipated gas supply gap, while also bringing energy bills down, alleviating Australia's cost-of-living crisis.

Increasing gas supply will instead come at a high cost that would have to be recovered through energy bills, while also undermining governments' emissions reduction efforts.

Ending sales of new gas appliances as soon as possible would deliver the largest reduction in gas demand while also materially reducing household bills.

Executive Summary

From as early as 2027, southern Australian states are facing an imminent shortfall in gas supplies as existing sources are exhausted. However, a deeper focus on the demand-side of the equation could potentially eradicate the gas supply gap while reducing energy bills, thereby easing cost-of-living pressures. This report explains how there is a much stronger financial case for supporting energy efficiency and electrification than investing in costly new supply options.

Australia is leaving many cost-effective opportunities to quickly reduce gas demand on the table. It is lagging on energy efficiency, which offers significant untapped opportunities. It is estimated that an average existing home requires about five times more energy for heating and cooling than a new home built in 2024. This increases to more than eight times for the least efficient 5% of homes. Victorian examples suggest that relatively simple upgrades could reduce gas use for heating by more than 40%, with a return on investment of 16%. Industrial energy efficiency is also significantly untapped with large opportunities in better data analysis and revisiting how to best deliver energy services. For example, a recent program found that 80%-90% of the energy used by compressed air systems is wasted.

Electrification with efficient heat pumps also has the potential to dramatically reduce gas use in residential buildings and industry. If gas appliances were replaced by efficient electric appliances at the end of their life, the average Victorian home could save $1,200 a year on its energy bills. IEEFA estimated that each year of delay to ending the sales of new gas appliances costs Victorians a collective $912 million in locked-in lifetime costs. In many cases, early retirements of appliances are also cost-effective. Heat pumps are already available for the medium temperatures required in most light manufacturing applications and are being developed for higher-temperature applications.

Implementing both energy efficiency and electrification interventions in parallel will deliver additional financial benefits, such as ensuring that new equipment is not oversized or unnecessary.

IEEFA modelled nine illustrative energy efficiency and electrification opportunities in southern states' residential buildings and industry. While the modelling is indicative only and does not fully capture the potential benefits, it nonetheless illustrates the size of the potential.

The modelled interventions deliver significant gas use reductions in the long term: residential buildings' gas use decreases to zero by the early 2040s; and industrial gas use decreases by more than 60% by 2045 compared with 2022. In total, the interventions achieve a near 80% reduction in gas use across residential buildings and industry. They also achieve significant gas demand reductions in the short term, with a reduction in gas demand of about 22% by 2027 and a 42% reduction by 2030 compared with 2022.

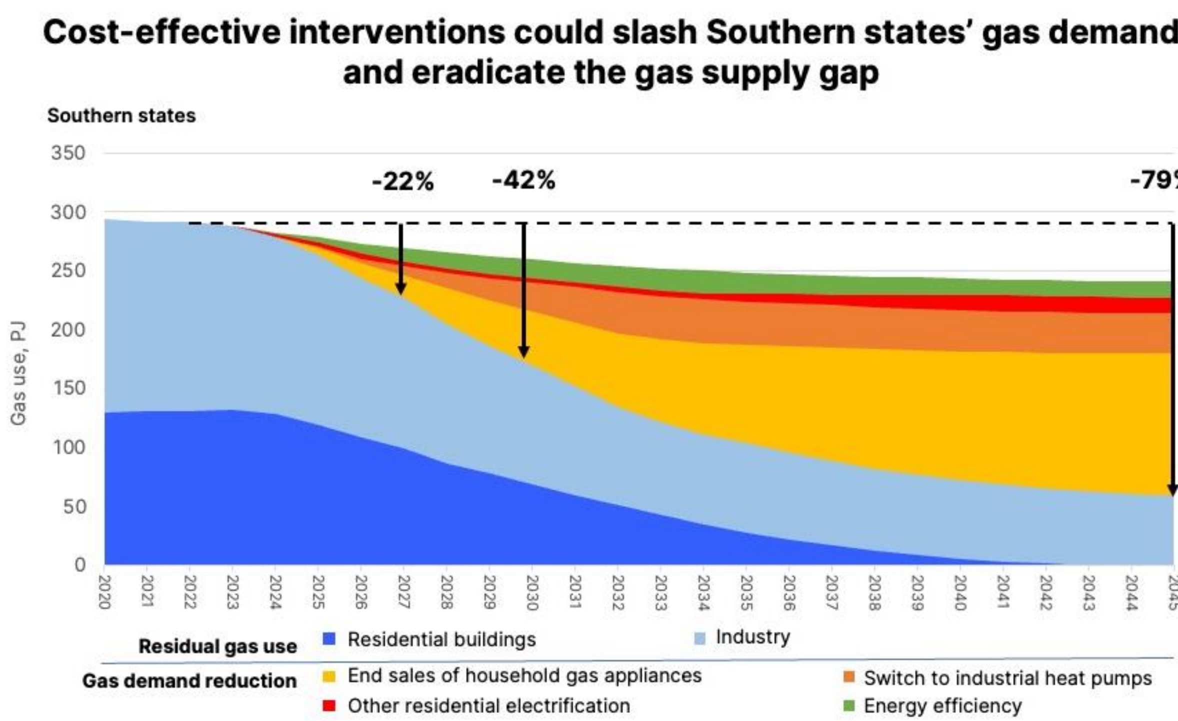
The reduction in gas demand is particularly high in Victoria, with reductions of 30%, 52% and 93% respectively in 2027, 2030 and 2045 compared with 2022. This is due to the strong probable

decrease in gas use for oil and gas production and associated chemicals production over the next two decades.

We found that these reductions could eradicate the gas supply gap. They could also reduce the requirement to redirect northern gas supplies to meet southern states' demand.

The alternative to delivering this reduction in gas demand would be to develop costly and emissions-intensive new gas fields and infrastructure. Three solutions are being considered: importing liquified natural gas (LNG); pipeline upgrades to deliver more gas from northern states; and developing new gas fields in southern states.

Building import facilities just to be able to receive liquified natural gas (LNG) in Victoria would cost between $250 million and $499 million. This is in addition to the high cost of LNG itself. LNG production is also extremely energy-intensive, adding about 20% to the emissions from gas combustion. Upgrading or building new pipelines is likely to be cost-prohibitive, with high capital costs required to be amortised over a short period of time. Transmission costs already represent a significant share of the cost of gas coming from Queensland to Victoria, and the long distances involved (more than 1,000km) mean it is an energy- and emissions-intensive task.



The Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA) are clear that achieving the objectives of the Paris Climate Agreement requires no new oil and gas developments. Therefore, developing new fields in Victoria is not an acceptable solution.

Energy efficiency and electrification present many additional benefits to the cost savings for consumers. Improved thermal efficiency was estimated to deliver 10 times as much savings in health costs as in energy costs, as well as improved wellbeing. Using electric cooktops rather than gas materially reduces childhood asthma risks. Investments in energy efficiency deliver multiple economic benefits, with nearly three times as many jobs created as when investing in new fossil fuel production, along with business productivity gains and a potential positive impact on Gross Domestic Product.

While electrification would drive increases in electricity use, ensuring that gas equipment is replaced by high-efficiency electric equipment and complementing electrification with energy efficiency measures would mitigate and may even offset this impact. Enabling new electric equipment to deliver flexible demand could also yield significant system benefits and reduce energy costs for all users.

Investments in energy efficiency and electrification will reduce energy bills, while every dollar invested in new gas supply, plus a profit margin, will have to be recovered through energy bills. Increasing the focus on demand-side opportunities can help alleviate Australia's cost-of-living crisis. IEEFA urges governments and energy agencies to consider these opportunities in more detail, and properly assess the costs and benefits of investing in reducing gas demand as compared to investing in increasing gas supply.

Introduction

With local gas reserves declining fast, southern Australian states – Victoria, New South Wales (NSW), South Australia (SA), the Australian Capital Territory (ACT) and Tasmania – are facing an upcoming gas supply gap, from as early as 2027.[1]

> **Government agencies tend to have a supply-side bias when looking at solutions to the gas supply gap.**

In previous reports, IEEFA has highlighted that government agencies tend to have a supply-side bias when looking at solutions to the gas supply gap. In June 2023 we wrote: “Several agencies consider a few demand scenarios, and then look at how the supply can meet the gap, rather than looking at what would be an optimum approach to manage both the supply and demand sides of the equation. In the 2023 GSOO [Gas Statement of Opportunities], AEMO [Australian Energy Market Operator] concluded that all future scenarios ‘forecast the long-term need for additional supply’. In its review of the supply-demand outlook, the Australian Competition and Consumer Commission (ACCC) accepts AEMO’s GSOO’s central scenario’s demand forecast, and therefore uniquely looks at supply-side solutions to fill the gas supply gap.”[2]

Our submission to the Climate Change Authority’s consultation on the ‘Economic modelling of potential Australian emissions reduction pathways’ highlighted that this bias is embedded in both the energy models and the scenarios used to support emissions and energy strategy decisions. The models used are hampered by insufficient granularity on the costs required to increase gas supply or build new gas infrastructure,[3] and exclude the material economic benefits of increased demand-side action, for example regarding health and job creation.[4] As mentioned above, scenarios typically include fixed assumptions on the uptake of energy efficiency and electrification, and then solve for supply increases needed to meet the resulting demand. No scenario uses fixed supply-side assumptions to explore in more detail the opportunities that exist to further reduce demand.[5]

This report builds upon previous IEEFA research that looked at how further demand-side action could help alleviate the gas supply gap. Our recent detailed analysis of residential electrification in Victoria showed that switching gas appliances to efficient electric alternatives at end of life from 2025 “could reduce Victoria’s projected long-term gas supply shortfall by a cumulative 22% compared with AEMO’s central Step Change Scenario, and by 53% compared with a worst-case scenario”.[6]

[1] AEMO. Gas Statement of Opportunities 2023. April 2023. Page 82.
[2] IEEFA. Australia needs 1.5°C aligned national energy pathways. June 2023. Page 11.
[3] IEEFA. Submission to the Climate Change Authority: Economic modelling of potential Australian emissions reduction pathways. September 2023. Page 6.
[4] Ibid. Page 4 and 14.
[5] Ibid. Page 12.
[6] IEEFA. Managing the transition to all-electric Victorian homes. November 2023. Page 5.

This report also looks at other untapped opportunities to reduce gas demand through cost-effective energy efficiency and electrification measures. It then provides a quantification of the potential gas demand reduction those opportunities would deliver in the southern states. The analysis particularly focuses on opportunities to reduce gas demand in Victoria given that it represents about three quarters of residential gas demand and nearly half of industrial gas demand in the southern states.[7] It is a high-level analysis and aims to illustrate the potential for more demand-side action, which should be investigated in more detail by government and energy agencies.

We are leaving profitable opportunities to cut gas demand on the table

Australia is lagging on energy efficiency and has significant untapped potential

In its April 2023 review of Australia's energy policy, the International Energy Agency (IEA) highlighted that recent energy efficiency improvement rates have slowed down to about 1.9% per year, and that they should be increased to 4.2% a year until 2030 to align with the global IEA Net Zero roadmap.[8]

Australia's housing stock presents very poor thermal efficiency. In Victoria, for example, a study by Sustainability Victoria (SV) found that a representative sample of existing houses were considerably less efficient than new buildings – rating at about 1.8 NatHERS (Nationwide House Energy Rating Scheme) stars on average, compared with six stars for new homes built today.[9] From next year, new homes will be built to a new standard of seven stars.[10] This means that an existing home in Victoria will require about five times as much energy to heat and cool it as a home built in 2024.[11]

> **An existing home in Victoria will require about five times as much energy to heat and cool it as a home built in 2024.**

In the Victorian study, households achieved savings on their gas use for heating of 18%, 21% and 10% respectively by implementing draught sealing, easy and difficult ceiling insulation measures[12]. The cost associated with these upgrades was just under $1,400, which offered an average payback of six and a half years in 2019.[13] This is an annual rate of return on investment of 16%, better than

[7] Based on Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW). Australian Energy Update 2022. Table F. September 2022.
[8] International Energy Agency (IEA). Australia 2023 - Energy policy review. April 2023. Page 12.
[9] SV. Energy Efficiency Upgrade Potential of Existing Victorian Houses. September 2016. Page 6.
[10] Victorian Department of Energy Environment and Climate Action (DEECA). 7 star energy efficiency building standards.
[11] NatHERS. NatHERS Star Band Criteria. Thermal load for a 1.8-star Melbourne home estimated at 415 MJ/sqm as compared with 83 MJ/sqm for a seven-star home.
[12] SV. Energy Efficiency Upgrade Potential of Existing Victorian Houses. September 2016. Page 40.
[13] SV. Comprehensive energy efficiency retrofits to existing Victorian houses. April 2019. Page 11.

most investments. With gas bills increasing on average 26% between 2022 and 2023 alone, payback periods are likely to be much shorter today.[14]

Another study by SV looked at gas ductwork across eight houses. It found that in half of those houses, gas heating savings of 15% to 23% could be achieved for a capital cost of about $2,500-$3,000 to reduce heat leaks and losses.[15] This study only looked at a comprehensive upgrade of the ductwork; we couldn't find any analysis of the savings that could be delivered by less costly targeted repair of the tears and holes present in most houses' ductwork.

In industry, there are many untapped opportunities. In Victoria, SV found that food and beverage manufacturing businesses could significantly cut their energy costs with a range of interventions offering paybacks shorter than two years. For example, implementing heat recovery saved businesses $75,000 annually on average and cost less than $100,000 to implement. Installing meters on high-energy equipment saved more than $20,000 annually for a cost of less than $25,000[16] (noting that metering alone may not save energy, further analysis of the data provided is required to identify opportunities to improve energy productivity). The Gas Efficiency Improvement Program (GEIP), launched in NSW in 2015, helped 51 businesses save about 300,000 gigajoules (GJ) of gas per year. This vastly exceeded the program objective of 100,000 GJ in gas savings per year.[17]

A comprehensive analysis of energy efficiency opportunities identified and implemented by large industrial energy users under the Australian government's former Energy Efficiency Opportunities (EEO) program found that the top performers implemented energy savings amounting to about 14% of their energy use. This was six times the average, which amounted to just 2.4% energy savings. The same trend was observed independently of the sector or the energy intensity of the company. The main factor that differentiated top performers from other companies was the regular analysis of energy data.[18]

Since the closure of the EEO program in 2014[19], there has been no government program targeted at energy efficiency across all large industrial facilities. Several programs have offered funding to companies to assess the opportunities to reduce their energy use – such as the Industrial Energy Transformation Studies Program.[20] The government will also provide further support through the Powering the Regions Fund and the National Reconstruction Fund.[21] However, there is a large gap in terms of building capabilities across the sector and identifying innovative, disruptive solutions that can dramatically reduce energy use.

---

[14] St Vincent de Paul Society. Victoria Energy Prices July 2023. September 2023. Page 2.
[15] SV. Gas Heating Ductwork Retrofit Trial. January 2016. Page 18.
[16] SV. Energy efficiency in manufacturing food and beverage. August 2023.
[17] ClearHorizon. Gas Efficiency Improvement Program Evaluation. November 2017. Page 1.
[18] Climateworks Australia. Tracking Progress towards a low carbon economy. 6. Special report. Summary report. July 2013. Pages 8-9.
[19] DCCEEW. Closed energy programs. October 2022.
[20] Australian Renewable Energy Agency (ARENA). Industrial Energy Transformation Studies Program.
[21] DCCEEW. National Energy Performance Strategy: consultation paper. November 2022. Page 11.

> **A recent NSW program found that 80%-90% of energy used by compressed air systems is wasted.**

A recent NSW program found that 80%-90% of energy used by compressed air systems is wasted. Compressed air systems account for about 10% of industrial electricity use, so removing this wastage could have a significant impact on Australia's electricity usage.[22] The program identified that, on average, 30% to 65% of the compressed air produced was lost through leaks.[23] Across 49 sites, energy costs were more than halved through interventions with payback periods of six months.[24] It also found that alternative technologies could deliver up to 90% energy savings, with a range of business productivity benefits.[25]

Several programs have identified the need for improved capabilities in companies and consultants on gas efficiency. A few participants in the GEIP program voiced concerns with the lack of local expertise in gas efficiency compared with Europe and the US.[26] Several service providers in the NSW compressed air system program mentioned they lacked specific expertise on the technology and often relied on manufacturers for maintenance and advice. However, manufacturers don't have incentives to reduce energy costs and sometimes made adjustments that actually increased energy use.[27]

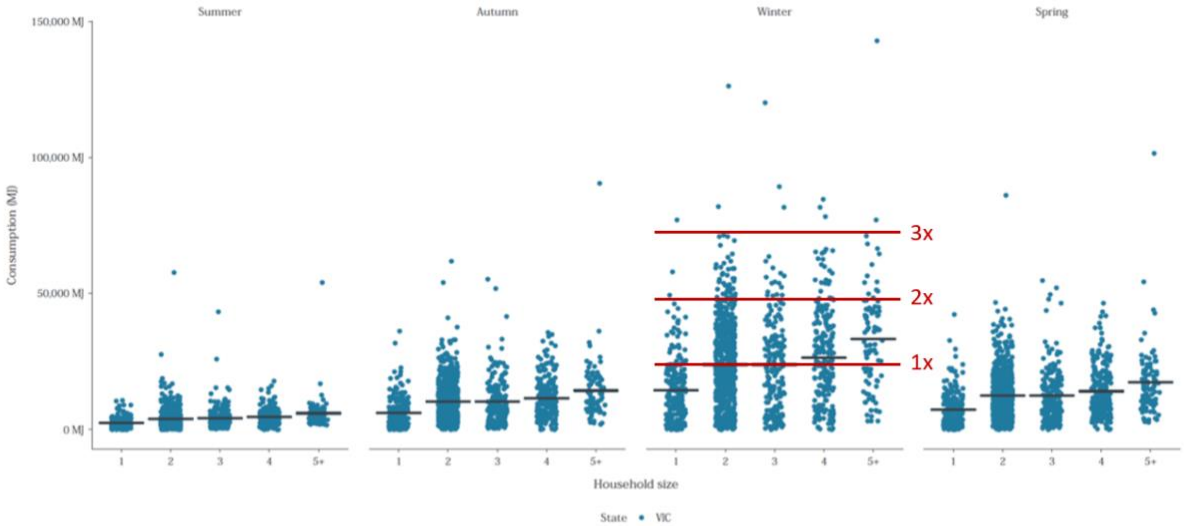
Strategically targeting large energy users could help achieve fast gas reduction

Households are not uniform in energy consumption. SV found that 5% of the houses they sampled rated at less than 0.5 stars, and another 8% rated between 0.5 and 1 stars. A 0.5-star house has a thermal load 60% bigger than an average existing house.[28]

A large-scale survey of households conducted by Frontier Economics for the Australian Energy Regulator (AER) found a significant spread of gas consumption in Victoria. Over the winter months, assuming that the state average equates to the average for two and three people households, then we can see that a material share of households have a consumption higher than twice the average, and some outliers have consumptions that are several multiples of the average (Figure 1).[29]

[22] Australian Alliance for Energy Productivity (A2EP). Compressed air systems. April 2021. Page 2.
[23] Ibid. Page 6.
[24] Ibid. Page 5.
[25] Ibid. Page 3.
[26] ClearHorizon. Gas Efficiency Improvement Program Evaluation. November 2017. Page 18.
[27] A2EP. Compressed air systems. April 2021. Page 7.
[28] NatHERS. NatHERS Star Band Criteria.
[29] Frontier Economics. Residential energy consumption benchmarks. 9 December 2020. Page 108.

Figure 1: Victoria: seasonal gas consumption and benchmarks



Source: Frontier Economics. Red lines were added by IEEFA and represent multiples of the state average consumption levels.

Electric heat pumps present a cost- and energy-efficient way to reduce gas demand

Gas is a very inefficient way to provide heat compared with modern heat pump technologies. Gas boilers typically can deliver 0.8 units of heat energy for each unit of gas consumed, while heat pumps can typically deliver three to five units of heat energy for each unit of electricity consumed.[30] This is why electrification is expected to play a big role in improving energy productivity.[31]

Heat pumps can already replace gas heating and water heating systems cost-effectively in residential and commercial buildings. Many households already use heat pumps via their reverse-cycle air conditioners. In November 2023, IEEFA published a report on residential electrification in Victoria, which found that: "If gas appliances were required to be replaced with efficient electric alternatives at their end of life, the average Victorian home could save $1,200 a year on their energy bills."[32]

The report estimated that each year of delay before ending the sales of new gas appliances will cost Victorians a collective $912 million in locked-in lifetime costs. The report found that ending sales of new gas appliances as early as possible would not only present material economic benefits, but also

[30] Energy Efficiency Council (EEC) and A2EP. Harnessing heat pumps for net zero. February 2023. Page 12.
[31] IEA. Net Zero Roadmap. 2023 Update. September 2023. Page 117.
[32] IEEFA. Managing the transition to all-electric Victorian homes. November 2023. Page 5.

help the state achieve its emissions reduction targets and reduce the impending gas supply gap. It also found that it would help deliver a manageable and equitable energy transition.[33]

In industry, heat pumps are also already used commonly for refrigeration but rarely for heating. Conventional heat pumps can deliver heat up to 80°C, and heat pumps that deliver 80-100°C already exist commercially. This covers a significant share of industrial heating applications, in sectors like food and beverages, textiles and wood products manufacturing.[34] This temperature range is already being extended to higher temperatures:

The Australian Alliance for Energy Productivity (A2EP)'s CEO Jarrod Leak said in March 2022 that: "Almost all food and beverage processing has a demand for sub 100 degree heat, especially for cleaning and sterilising but also for many drying applications. […] The new range of heat pumps being developed for 150 degrees Celsius heat will be the real game changer, with the ability to transform many more industries such as brick and paper manufacturing."[35]

> **The new range of heat pumps being developed for 150 degrees Celsius heat will be the real game changer, with the ability to transform many more industries**

In 2020, a bottom-up analysis of 11 industrial sectors representing the vast majority of Europe's industrial emissions found that 78% of energy demand can be electrified with technologies that are already established, and 99% can be electrified with the addition of technologies under development.[36]

Heat pumps offer lower operating costs. Currently, they have much higher upfront costs than traditional steam boiler solutions; however, this could be significantly improved through increasing economies of scale given their currently low market penetration.[37]

The fact that heat pumps can be automated or controlled remotely can provide additional financial benefits compared with gas equipment. Some businesses currently run boilers outside working hours for various reasons, such as the high cost of staff having to work overtime to bring equipment up to operating conditions by the start of the working day. Flexible heat pumps with thermal storage can be optimally managed, further reducing the required energy input.[38] Businesses might also be able to participate in demand response programs, which can provide additional revenues.

[33] IEEFA. Managing the transition to all-electric Victorian homes. November 2023. Page 5.
[34] EEC and A2EP. Harnessing heat pumps for net zero. February 2023. Page 99.
[35] ARENAWIRE. Heat pumps electrifying industrial processes. 22 March 2022.
[36] Environmental Research. S. *Madeddu et al*. The CO_2 reduction potential for the European industry via direct electrification of heat supply (power-to-heat). 25 November 2020.
[37] EEC and A2EP. Harnessing heat pumps for net zero. February 2023. Page 105.
[38] Conversations with Alan Pears, Senior Industry Fellow at RMIT University and energy efficiency expert. October 2023.

Comprehensive efficiency and electrification measures could yield further benefits

Addressing demand-side solutions individually leads to missed opportunities. There are many financial and other benefits to considering multiple interventions as a package.

For example, improving thermal efficiency in homes at the same time as electrifying heating could help reduce the size of the heat pumps required to heat or cool the house. This will in turn make electrification more financially accessible by reducing the capital costs required for the new equipment. Thermal efficiency will also help to leverage existing reverse-cycle air conditioners to provide heating services. Most heat pumps were installed high up on walls as it is an optimum position to provide cooling. However, with poor thermal efficiency this could deliver poor comfort when delivering heating services. Improving thermal efficiency addresses this issue.[39] Cleaning filters regularly is also key to ensuring the continued high efficiency of reverse-cycle air conditioners, which most households do not currently realise.[40]

> **In businesses, identifying inefficiencies in the set-up of their current heating systems would help make sure that electric replacements are not oversized.**

In businesses, identifying inefficiencies in the set-up of their current heating systems would help make sure that electric replacements are not oversized. Replacing a gas boiler like for like with a heat pump is likely to be more costly than required. In many cases, existing gas boilers deliver heating services less efficiently than assumed and could be replaced by a smaller heat pump with thermal storage, energy recovery and smart controls to provide the required heat output. Gas-sourced heat is also often delivered at temperatures higher than actually needed for processes where heat pumps are suitable. In some cases, it might be found that a completely different set-up could deliver the same services. Many businesses have backup gas boilers that are never or extremely rarely used. A recent project for the RACE for 2030 Cooperative Research Centre (CRC) in which fruit farmers were interviewed found that instead of using steam or open vats of hot water to sterilise fruit, using an alternative, such as an ultraviolet (UV) lamp could potentially offer a more efficient solution. Redesign of processes to utilise point-of-use heat pumps, often with thermal storage, could also cut heat distribution losses and increase flexibility, reducing standby losses and optimising business productivity.[41]

[39] The Conversation. Replacing gas heating with reverse-cycle aircon leaves some people feeling cold. Why? And what's the solution? 2 October 2023.
[40] Choice. How to clean your air conditioner. 12 September 2022.
[41] Conversations with Alan Pears, Senior Industry Fellow at RMIT University and energy efficiency expert. October 2023.

Gas demand reduction could more than fill the gas supply gap

Cost-effective interventions could slash southern states' gas demand

For this report, IEEFA modelled the potential impact of a series of interventions to improve energy efficiency and accelerate electrification in southern states' residential buildings and industry. This covered Victoria, NSW, SA, the ACT and Tasmania. Separate modelling was also conducted for Victoria alone given that it represents the majority of the gas use across those states.

This modelling is indicative only and aims to illustrate the potential of demand-focused interventions on gas use. In the absence of robust data, we have made conservative assumptions on the size of the potential. These interventions do not represent the totality of the potential to reduce gas demand from energy efficiency and electrification in both sectors.

Table 1 presents a summary of the interventions modelled. A more detailed description of the assumptions used to support the calculations is included as a technical appendix at the end of this document.

We have applied these interventions to a detailed model of gas appliances in residential homes,[42] as well as a calculated baseline for industrial energy use (see technical appendix). The industrial baseline includes a decline in gas production in southern states aligned with the GSOO's anticipated production levels.[43]

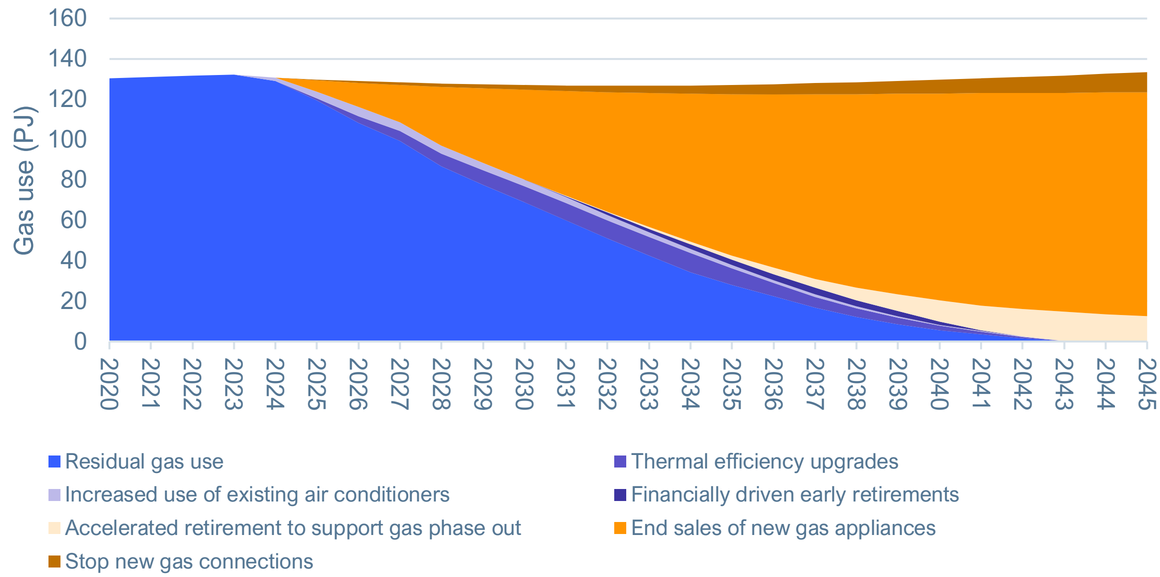
The modelled interventions deliver significant gas use reductions: residential buildings' gas use decreases to zero by 2042; and industrial gas use decreases by 63% by 2045 compared to 2022. The largest reductions are delivered by ending the sale of new gas appliances for residential buildings, and the implementation of heat pumps in industry.

[42] IEEFA. Appendices - Managing the transition to all-electric Victorian homes. November 2023. Appendix A.
[43] AEMO. Gas Statement of Opportunities 2023. April 2023. Figure 27.

Table 1: List of interventions modelled (light grey = electrification, dark grey = energy efficiency)

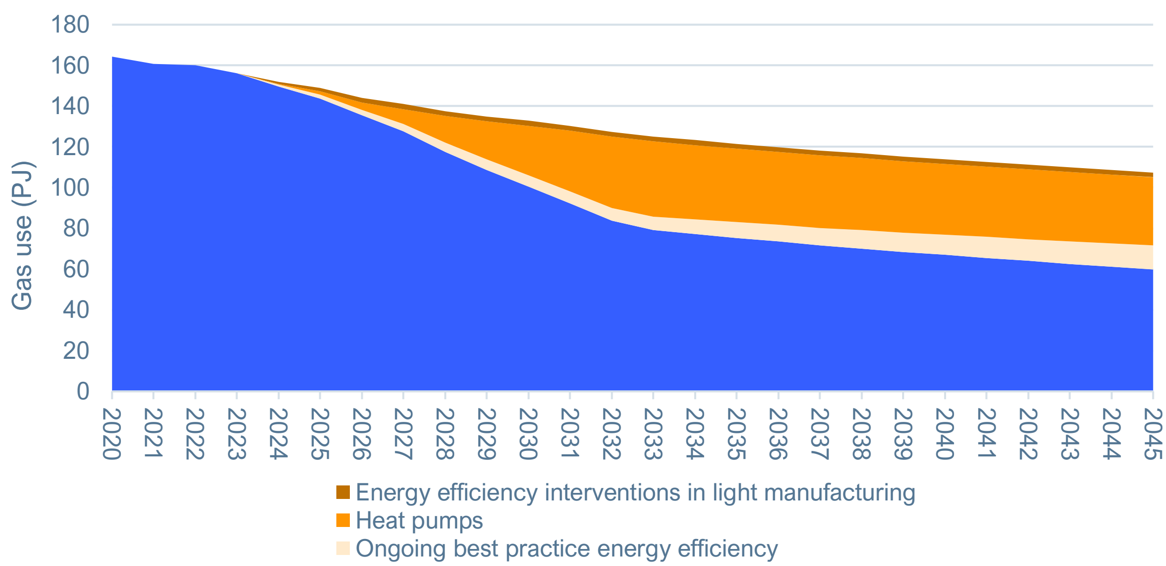
Intervention	Description
Residential buildings	
Stop new gas connections	An end to new gas connections is implemented in NSW, SA and Tasmania from 2025. (Victoria and ACT already have this in place, with Victoria's policy starting in 2024 and ACT's in 2025.)
End sales of new gas appliances	An end to the sale of new gas appliances is implemented from 2025. It is assumed that in the first three years some exclusions are warranted for 'hard-to-electrify' households, while appropriate solutions are developed.
Accelerated retirement to support gas phase-out	Natural retirements of gas appliances would likely leave a small trail of gas users after it has become uneconomical to run the gas networks. Most of this remaining gas use would come from gas heating, which is also the most economical to electrify. As a result, we have assumed that a managed phase-down is implemented that sees the gas networks shut down in the early 2040s.
Financially driven early retirements	Early retirement of gas appliances will be highly cost-effective for many households, for example those not using all of their solar photovoltaic (PV) electricity generation, or those with just one gas appliance left in their household. Indeed, replacing this last appliance means they could stop paying the high fixed costs associated with their gas connection. In addition, gas distribution prices will likely go up as networks usage decreases, improving the economics of electrification.
Increased use of existing air conditioners	Many households using gas for heating have reverse-cycle air conditioners, but most only use those air conditioners for cooling. They could significantly reduce their gas bill by displacing their gas heating energy use completely or partially. This would be particularly attractive when gas ducted systems are used to heat the whole house when heat is only required in living areas.
Thermal efficiency upgrades	As discussed earlier in this report, simple thermal efficiency upgrades could deliver material energy savings with relatively short paybacks, especially if applied in priority to the least efficient / highest gas-consuming houses.
Industry	
Energy efficiency interventions in light manufacturing	High levels of energy efficiency savings are usually available in light manufacturing businesses, which haven't had the capabilities or bandwidth to explore those opportunities in the past. Improving metering and data analysis to identify erroneous settings, recovering waste heat, and address leakages and losses can often deliver high savings at low cost with very short paybacks.
Heat pumps	A high proportion of gas use could be switched to heat pumps in light manufacturing businesses such as food and beverage manufacturers, which represent a material share of Victoria's industrial gas use in particular. Heat pumps are also likely to be available for select applications in heavier industry in the short-to-medium term.
Ongoing best practice energy efficiency	Energy efficiency is not a one-time improvement opportunity. New technologies and solutions are developed that deliver continuous improvement. Recent examples include improvements in controls, energy monitoring and automation. Rethinking the way in which we deliver energy services can lead to step changes in energy use as per the compressed air example mentioned in the report.

Figure 2: Southern states' residential gas use reduction delivered by modelled interventions (PJ)



Source: IEEFA

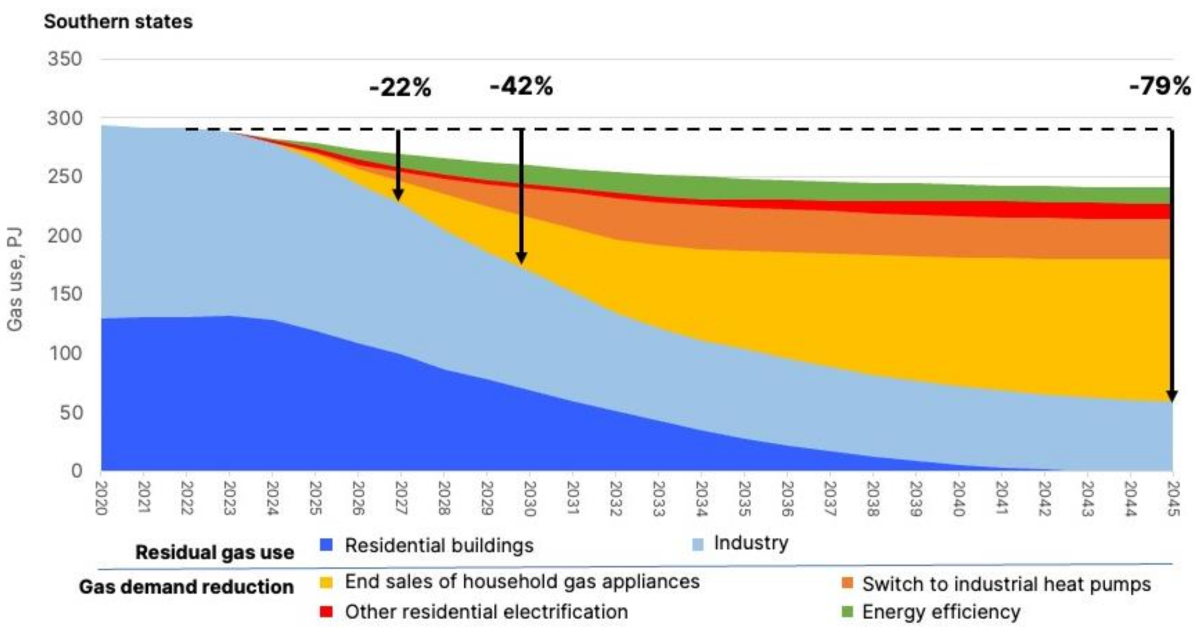
Figure 3: Southern states' industrial gas use reduction delivered by modelled interventions (PJ)



Source: IEEFA

In total, the interventions achieve a 79% gas demand reduction by 2045 across the combination of residential buildings and industry. They also deliver a 42% reduction in gas demand by 2030. These strong reductions are partially explained by the reduction in baseline industrial gas use, reflecting the expected decrease in oil and gas production in Victoria, as well as in basic chemicals production that is reliant on local gas.

Figure 4: Total reductions achieved in southern states' residential/industrial gas demand



Source: IEEFA

Simple interventions could eradicate the gas supply gap

IEEFA has estimated the impact of these interventions on the gas supply gap forecasted by AEMO for the southern regions. The scope of the analysis included in this report and the AEMO analysis are different, so we had to make some assumptions to do the comparison. This approach has limitations and only provides indicative results. We recommend that AEMO (or a regulatory body such as the ACCC) explores demand-side opportunities such as those analysed in this report in more detail in future updates of the GSOO to get a better understanding of their potential impact on the upcoming gas supply gap in southern regions.

The assumptions we made are as follows:

- We used the 'Green Energy Exports (1.5°C)' scenario as a reference, given that it is the only scenario that is aligned with Victoria's emissions reduction targets, and the one that already presents the lowest gas supply gap.[44,45]
- We scaled the forecasted residential and commercial gas use under that scenario[46] and compared it to our analysis of residential gas consumption
- We scaled the forecasted industrial gas use under that scenario[47] and compared it to our analysis of industrial gas consumption.
- We compared the reduction in gas consumption between that scenario and our analysis with the maximum gas supply gap under that scenario.[48]

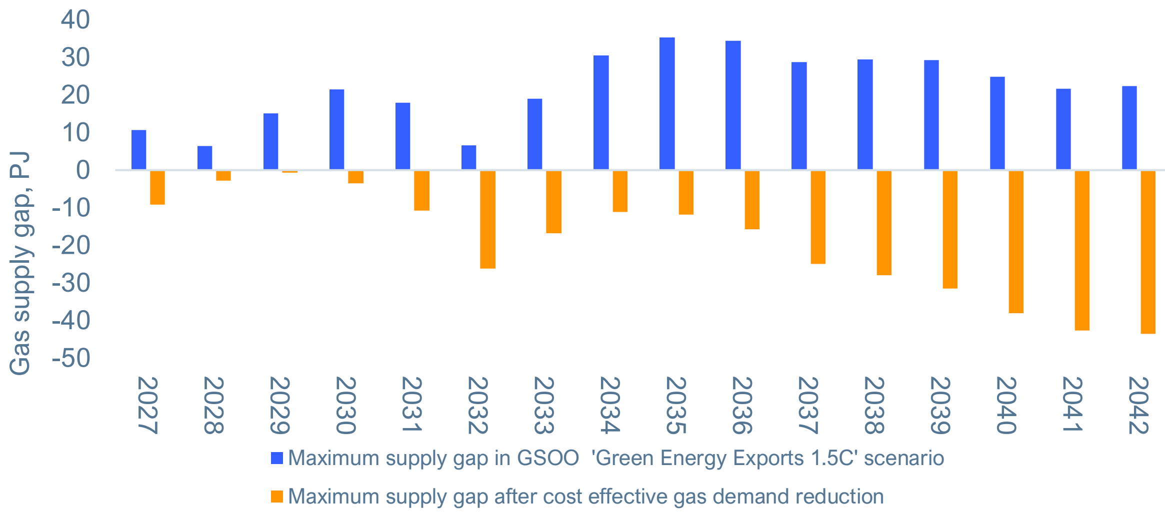
The comparison of IEEFA's analysis and the GSOO modelling is shown in the technical appendix. As can be seen in Figure 12 and Figure 13, the most material difference between IEEFA's analysis and the GSOO modelling comes from industrial gas use.

> **This analysis shows that the interventions modelled could probably more than eradicate the gas supply gap in southern regions.**

This analysis shows that the interventions modelled could probably more than eradicate the gas supply gap in southern regions. It could also materially reduce the volume of gas required to be diverted from northern LNG exports.[49]

[44] AEMO. Draft 2023 Inputs, Assumptions and Scenarios Report. December 2022. Page 28.
[45] AEMO. Gas Statement of Opportunities 2023. April 2023. Figure 6.
[46] Ibid. Figure 15.
[47] Ibid. Figure 16.
[48] Ibid. Figure 6.
[49] Ibid. Figure 84.

Figure 5: Estimated maximum gas supply gap in southern regions before and after interventions, with 'Green Energy Exports (1.5°C)' scenario as a benchmark (PJ per annum)



Source: AEMO and IEEFA

This analysis focused on residential buildings and industrial gas demand reduction opportunities. Additional opportunities would exist in other sectors, which could further reduce the requirement to redirect northern gas supplies to meet southern states' demand.

We also compared the results of our analysis to the gas supply gap in the GSOO's 'Orchestrated Step Change (1.8°C)' scenario and found that the interventions delayed the gas supply gap to 2033 and reduced it to a maximum of 40 petajoules (PJ) even under that scenario (see Figure 14).

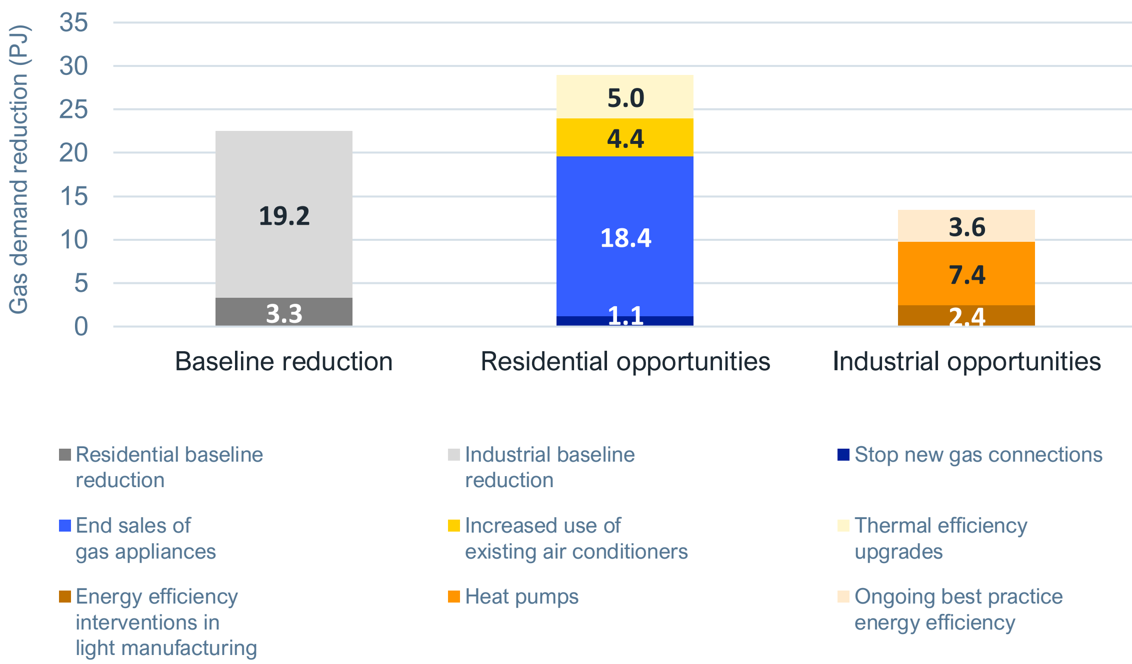
Significant opportunities exist to achieve large demand reductions quickly

With a lot of focus on the short-term gas supply gap in the coming years, demand-side opportunities are often discarded as requiring too much lead time. Our analysis suggests that some interventions could be implemented in the coming years and deliver material gas demand reductions by 2027 when the gas supply gap is first expected to materialise.

In particular, ending sales of gas appliances in applicable houses as soon as 2025 could deliver nearly 18 PJ in gas demand reductions by 2027. Installing heat pumps in a limited number of industrial businesses is also a material opportunity. Educating households on the benefits of using reverse-cycle air conditioners to replace or complement their gas heaters could deliver significant savings without requiring any new equipment installations or capital investments.

In total we identified 40 PJ of potential gas savings by 2027 compared with the baseline gas use. In addition, 2027 baseline gas use could decrease by about 23 PJ compared to 2022. In total, this could drive a 22% reduction in gas demand in 2027 compared with 2022.

Figure 6: Opportunities to reduce gas use in southern states' residential buildings and industry by 2027 compared with 2022 (PJ)



Source: IEEFA

Major gains to be made in Victoria

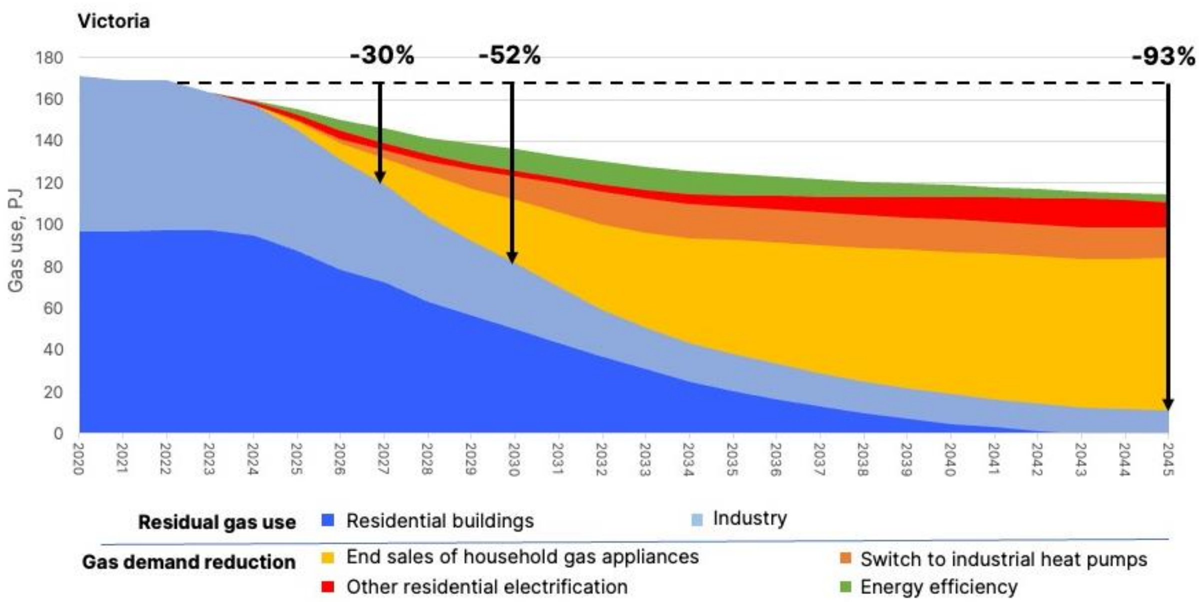
Given that Victoria represents the majority of the gas use in southern states, IEEFA separately modelled the opportunities available in the state. We found that the interventions modelled could even reduce gas use more dramatically in Victoria, in particular due to the changing composition of its industrial sector.

In total, the interventions achieve a 93% gas demand reduction by 2045 across the combination of residential buildings and industry. They also deliver a halving in gas demand by 2030, and a near-30% reduction in 2027 compared with 2022.

> **The interventions deliver a halving in gas demand by 2030, and a near-30% reduction in 2027 compared with 2022.**

With the modelled decline in local gas production and associated industries, Victoria's industry will increasingly be composed of light manufacturing sectors such as food and beverage manufacturing, which present large opportunities for energy efficiency and electrification.

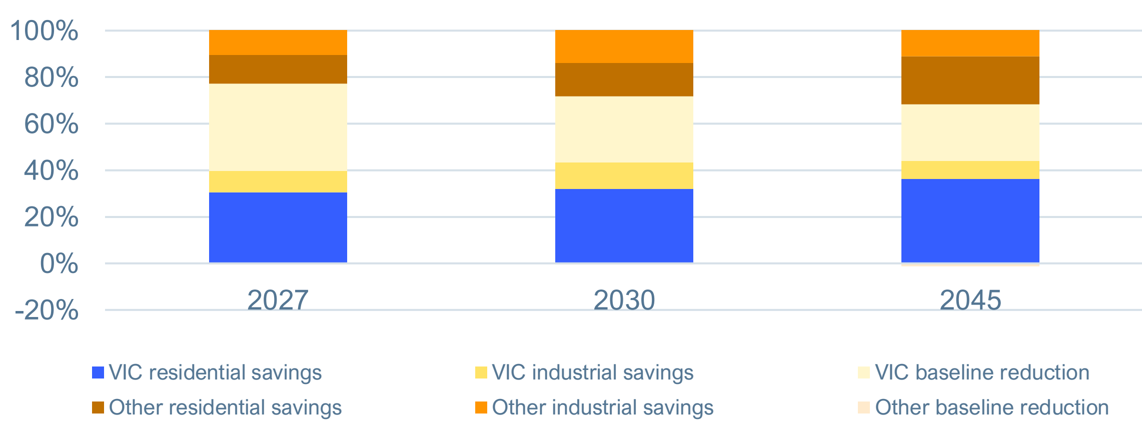
Figure 7: Total gas demand reductions achieved in Victoria's residential buildings and industry



Source: IEEFA

As a result, Victoria represents the largest share of the opportunities to reduce gas demand among the southern states, in particular in the shorter term.

Figure 8: Proportion of gas demand reduction that would be delivered by Victoria compared with other southern states



Source: IEEFA

Costly supply developments add to bills and emissions

Three main options exist to increase gas supply in the southern states:

- Building liquified natural gas (LNG) import facilities to bring in gas from LNG-producing regions in Australia or abroad;
- Upgrading the existing pipelines delivering gas from northern states, or building new pipelines; or
- Developing new gas fields in southern states.

All of these options require very large upfront capital investments for long-lived assets, which will need to be recovered, plus a profit margin, through energy bills.

Increasing supply to the southern states will come at high cost

Gas has historically been a low-cost energy source in Victoria, with the state enjoying wholesale prices of about $4-$5/GJ for many years.[50] The development of the Queensland LNG projects in the early 2010s connected the east coast to global LNG markets and pricing, which contributed to an increase in prices.[51] More recently, tightening domestic gas supply and international events have driven gas prices to levels well above those seen historically, with record highs observed in 2022.[52]

> **The two proposed LNG import facilities in Victoria, in Geelong and Port Philip Bay, are estimated to respectively cost about $350 million, and between $250 million and $499 million.**

The two proposed LNG import facilities in Victoria, in Geelong and Port Philip Bay, are estimated to respectively cost about $350 million, and between $250 million and $499 million.[53] This is just the cost of being able to receive LNG in Victoria. The cost of LNG itself is highly volatile. On 7 November 2023, the price of LNG in Australia was estimated at about $24/GJ.[54] Shortly after Russia invaded Ukraine on 24 February 2022, the price of LNG peaked at about four times this price.[55] With a probable LNG supply glut coming from the mid-2020s, the price of LNG is likely to fall.[56] However, there remains some uncertainty about future LNG prices, with futures for the Japan Korea Marker

[50] Australian Competition & Consumer Commission (ACCC). Inquiry into the east coast gas market. April 2016. Page 35.
[51] ACCC. East Coast Gas Inquiry 2015. April 2016. Page 2.
[52] ACCC. Gas Inquiry January 2023 Interim Report. January 2023. Pages 14 and 16.
[53] Australian Government, Department of Industry, Science and Resources (DISR). Resources and energy major projects: 2022. Data. December 2022.
[54] ICIS LNGEdge pricing data. Accessed on 7 November 2023. Based on the ICIS LNG spot FOB Australia assessment of US$14.90/million British thermal units (Btu). (Disclaimer).
[55] Ibid. Based on the ICIS LNG spot FOB assessment of US$68.95/million BTU on 8 March 2022.
[56] IEA. World Energy Outlook 2023. October 2023. Page 20-21.

(JKM) suggesting LNG spot prices will remain relatively high (above $15/GJ) until May 2027 and above $10/GJ out to late 2029.[57]

A previous IEEFA report estimated that the total cost of bringing gas from Queensland to Victoria could add up to nearly $5/GJ[58], and this would likely increase due to the required pipeline upgrades. For example, Australia's largest gas pipeline operator APA is spending $270 million on upgrading part of its eastern Australia gas network to carry more gas from Queensland to the southern states, particularly Victoria. It will increase winter peak capacity of APA's network of pipelines in eastern Australia by 25% through additional compression and associated works on both the South West Queensland Pipeline (SWQP) and the Moomba Wilton Pipeline (MWP). The SWQP runs from Wallumbilla in southern Queensland to Moomba in the Cooper basin in South Australia. The MWP runs from Moomba to Young in southern New South Wales (NSW). This does not reflect the full journey of the gas from the onshore coal seam gas fields in the Surat basin in Queensland to Victoria.[59] These costs are in addition to the cost of the gas itself. While production costs in the Bowen/Surat basins are on average $4.75/GJ,[60] recent prices offered in the past two years have generally been in line with or above $10/GJ.[61]

With Victoria targeting a 75%-80% reduction in its emissions by 2035, and net zero emissions by 2045,[62] it is unlikely that new or upgraded pipeline assets would fulfill their full economic life, pushing prices higher in the short-to-medium term. For example, the operators of the Dampier Bunbury pipeline in Western Australia argued to the regulator that electrification will materially shorten its economic lifetime compared with the default asset life of 70 years.[63]

Increasing supply will put the global climate goals at risk

Australia is a party to the Paris Agreement,[64] a legally binding international treaty on climate change with the objective to "[hold] the increase in the global average temperature to well below 2°C above pre-industrial levels and [pursue] efforts to limit the temperature increase to 1.5°C above pre-industrial levels".[65] Both the Intergovernmental Panel on Climate Change (IPCC) and the IEA state that new developments in oil and gas are incompatible with the global goal of 1.5°C with no/low overshoot.[66,67]

---

57 Intercontinental Exchange, Japan Korea Marker LNG Future, Accessed on 6 November 2023.
58 IEEFA. Australia can and should eradicate its gas supply gap – but not with more gas. 3 April 2023.
59 APA East coast grid expansion.
60 IEEFA. Australia can and should eradicate its gas supply gap – but not with more gas. 3 April 2023.
61 ACCC. Gas Inquiry June 2023 Interim Report. 30 June 2023. Pages 42 and 69.
62 DEECA. Climate action targets. May 2023.
63 Dampier Bunbury Pipeline. Five year plan for Dampier to Bunbury Natural Gas Pipeline 2021-2025. Attachment 9.2 – Assessment of the Economic Life of the DBNGP. January 2020. Page 1.
64 DCCEEW. International climate action.
65 United Nations Framework Convention on Climate Change (UNFCCC). The Paris Agreement.
66 Intergovernmental Panel on Climate Change (IPCC). AR6 Synthesis Report – Longer Report. 2023. Page 24.
67 IEA. Net Zero by 2050: A Roadmap for the Global Energy Sector. May 2021. Page 21.

The IPCC stated in its latest Synthesis Report that existing oil and gas developments may even need to be retired early: "Projected cumulative future CO_2 [carbon dioxide] emissions over the lifetime of existing fossil fuel infrastructure without additional abatement exceed the total cumulative net CO_2 emissions in pathways that limit warming to 1.5°C (>50%) with no or limited overshoot. They are approximately equal to total cumulative net CO_2 emissions in pathways that limit warming to 2°C with a likelihood of 83%".[68]

> **IEA stated in its latest World Energy Outlook that there is no need for additional oil and gas investments even in its Stated Policy Scenario (STEPS), aligned with about 2.4°C of warming**

The IEA stated in its latest World Energy Outlook that there is no need for additional oil and gas investments even in its Stated Policy Scenario (STEPS), aligned with about 2.4°C of warming: "Today's level of investment in all fossil fuels, including oil and gas, is significantly higher than what is needed in the APS [Announced Pledges Scenario, aligned with about 1.7°C warming] and double what is needed in the NZE [Net Zero Emissions by 2050 Scenario, aligned with about 1.5°C warming] in 2030."[69]

This means developing new gas fields in Victoria is not a satisfactory solution, as it would compromise global climate goals.

In addition to contributing to increased emissions via the combustion of gas in buildings or industrial facilities, gas production is also responsible for large volumes of direct emissions. Fugitive emissions from oil and gas production in Australian amounted to 21 million tonnes of carbon dioxide-equivalent ($MtCO_2e$) in 2021, or nearly 5% of national emissions.[70]

A large share of those emissions come from the venting of CO_2 contained naturally in the gas fields. Several of the wells associated with the largest proposed gas project in Victoria "have yielded high carbon dioxide (CO_2) levels. One of the wells had a CO_2 content of 25.65%, another two 18.25% and 14.61%, and at least another three wells had CO_2 readings of more than 10%. This compares to CO_2 levels up to 22.8% at the Gorgon gas field, the dirtiest gas field used for LNG exports in Australia."[71]

More than one third of oil and gas fugitive emissions is methane (natural gas), which has a disproportionate impact on climate change.[72] Indeed, over a 20-year period, methane warms as much as 82 times more than CO_2[73], and it was estimated to have contributed to around 30% of the

[68] IPCC. AR6 Synthesis Report – Longer Report. 2023. Page 24.
[69] IEA. World Energy Outlook 2023. October 2023. Page 202. (Global warming alignment of scenarios on Page 158-159)
[70] DCCEEW. Australia's National Greenhouse Accounts. Paris Agreement inventory. 2022.
[71] IEEFA. Australia can and should eradicate its gas supply gap – but not with more gas. April 2023.
[72] DCCEEW. Australia's National Greenhouse Accounts. Paris Agreement inventory. 2022.
[73] IPCC. AR6. WG1. Climate Change 2021: The Physical Science Basis. Chapter 7. 2021. Page 1017.

rise in global temperatures.[74] In addition, the IEA estimates that Australia has been underreporting fugitive methane emissions associated with oil and gas production by about 90%.[75]

Fugitive methane emissions occur both at the site of production, and as leaks in the transmission and distribution system. Transporting gas from Queensland to Victoria would mean transporting gas over more than 1,000km of pipeline, which would present a high risk of methane leakage in gas transmission networks.[76]

> **A recent analysis of the LNG value chain in Australia found that LNG production is responsible for nearly 40 MtCO2e annually, or about 20% of the emissions from the combustion of the gas itself.**

LNG production is also highly energy-intensive. A recent analysis of the LNG value chain in Australia found that LNG production is responsible for nearly 40 $MtCO_2e$ annually, or about 20% of the emissions from the combustion of the gas itself. Liquefaction and export processes were found to be responsible for more than twice the amount of emissions than the production of the gas. According to the analysis: "The processes associated with production and export of LNG are highly energy-intensive, with LNG plants alone responsible for approximately one-quarter of Australian gas consumption for both thermal and electrical energy generation."[77]

Further action on the demand side will have additional benefits

Many other benefits have been associated with energy efficiency improvements and electrification. A recent study showed that gas stove use is estimated to be responsible for 12% of childhood asthma in Australia, highlighting the benefits of moving to electricity.[78] The Victorian Healthy Homes Programs found that limited thermal efficiency upgrades could deliver very significant health and wellbeing improvements:

"Analysis indicated that a relatively minor upgrade (average $2,809) had wide-ranging benefits over the winter period. […] Exposure to cold temperatures (<18°C) was reduced by 43 minutes per day. […] Householders in the intervention group were more than twice as likely as controls to report that their home felt warmer over winter. These gains in thermal comfort were obtained despite a significant reduction in gas use in upgraded homes, and no change in electricity use. […] Importantly, the upgrade was associated with benefits in health, with reduced breathlessness, and improved quality of life, particularly its mental health and social care aspects. Health benefits of the upgrade were reflected in cost savings, with $887 per person saved in the healthcare system over

---

[74] IEA. Global methane tracker 2023. Understanding methane emissions. 2023.
[75] IEEFA. Gross under-reporting of fugitive methane emissions has big implications for industry. July 2023.
[76] IEEFA. Australia can and should eradicate its gas supply gap – but not with more gas. April 2023.
[77] Australian Industry Energy Transitions Initiative. Phase 1 Technical report. June 2021. Pages 56-58.
[78] Australian Journal of General Practice. Health risks from indoor gas appliances. December 2022.

the winter period. Cost-benefit analysis indicated that the upgrade would be cost-saving within 3 years – and would yield a net saving of $4,783 over 10 years – due to savings in both energy and health. Savings were heavily weighted towards healthcare: for every $1 saved in energy, more than $10 is saved in health."[79]

Another study showed that investing in energy efficiency creates more jobs than investing in fossil fuel production, finding that "on average, 2.65 full-time-equivalent (FTE) jobs are created from $1 million spending in fossil fuels, while that same amount of spending would create 7.49 or 7.72 FTE jobs in renewables or energy efficiency. Thus each $1 million shifted from brown to green energy will create a net increase of 5 jobs."[80]

The IEA identified multiple benefits from improved energy efficiency including business productivity gains and a potential positive impact on Gross Domestic Product (GDP).[81]

Improving electricity efficiency could offset increases in electricity use

While electrification has a great potential to reduce gas demand, it will drive increases in electricity use, which could add to the already challenging task of decarbonising Australia's electricity system. However, if electrification is done hand in hand with increased energy efficiency, and if it enables more flexible demand, it could lead to net system benefits.

CSIRO modelling of the energy transition found that electrification leads to higher utilisation of existing electricity infrastructure, particularly of the distribution networks.[82] In August 2023, CSIRO's Chief Energy Economist Paul Graham said: "System benefits are quite complex to explain, but essentially the more electricity people use, the cheaper it becomes for everyone. […] If demand increases outside of peak times that means there's no requirement for new infrastructure. Instead, it just makes better use of existing assets, and the cost per unit drops."[83]

> **System benefits are quite complex to explain, but essentially the more electricity people use, the cheaper it becomes for everyone.**

The University of Technology Sydney (UTS) modelled several future domestic hot water scenarios and found that a scenario with rapid electrification using heat pumps and flexible demand technologies delivered the best economic outcomes with $6.7 billion in energy cost savings by 2040.

79 SV. The Victorian Healthy Homes Program. August 2022. Page 5.
80 Economic Modelling. *H. Garrett-Peltier*. Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model. February 2017.
81 IEA. Multiple benefits of energy efficiency. March 2019.
82 CSIRO. Consumer impacts of the energy transition: modelling report. July 2023. Page v.
83 CSIRO. Future savings for all-electric households. July 2023.

Under that scenario, domestic water heaters could provide 22 GW of flexible demand potential and 45 GWh/day of flexible demand depth.[84]

IEEFA has also found that studies suggesting that electrification would lead to costly impacts on electricity distribution networks are likely overstated, since:

- Victoria's operational electricity demand peak is higher in summer than winter;
- Peak operational demand in summer has trended downwards since its record high in 2009 (attributed to greater uptake of distributed energy resources); and
- Record peak winter demand is around 20% lower than record peak summer demand.

"This implies considerable headroom to electrify Victoria's winter loads before peak demand would exceed historic highs. […] Furthermore, national data from the AER suggests that distribution networks are a long way from exceeding their capacity. Overall distribution network utilisation, defined as maximum demand divided by capacity, is currently only 42%, with utilisation of individual networks varying from as low as 18% (Essential Energy, NSW) to no more than 71% (Powercor, Vic). […] Recent modelling by CSIRO for Energy Consumers Australia examined delivered electricity prices if uptake of electric appliances, electric vehicles and home storage were aligned to AEMO's most likely Step Change scenario. They found the growth in volume of electricity sold would be more significant than growth in peak demand, leading to increased utilisation of distribution networks and lower prices."[85]

Moreover, adding demand response capability to new electric equipment and making it easier to participate in demand response programs could help to deliver significant system benefits.[86]

Based on the relative efficiency and coefficient of performance (COP) of gas heating and heat pumps, a GJ of gas used for heating will be replaced by about one fifth of a GJ of electricity.[87,88] If electrification was combined with energy efficiency improvements – such as thermal efficiency in homes, and energy efficiency audits in industry – this could potentially be reduced to less than a sixth.

The electrification interventions modelled in this report would deliver a reduction in gas demand by 2030 of 74 PJ in the southern states, equivalent to 16% of their total gas use today.[89] In counterpart, if using a one-to-six ratio, it would require an increase in electricity use of about 12 PJ, or 2% of the southern states' electricity use today.[90] The impact varies significantly depending on the state considered. In Victoria, a 44 PJ decrease in gas use by 2030 would require about 7 PJ more

[84] UTS. Domestic hot water and flexibility. June 2023. Page 6.
[85] IEEFA. Senate inquiry on residential electrification. 28 September 2023. Page 6.
[86] IEEFA. Growing the sharing energy economy. 13 October 2023.
[87] IEEFA. 'Renewable gas' campaigns leave Victorian gas distribution networks and consumers at risk. August 2023. Page 10.
[88] EEC and A2EP. Harnessing heat pumps for net zero. February 2023. Page 12.
[89] DCCEEW. Australian Energy Update 2022. Table F. September 2022.
[90] Ibid.

electricity – which is equivalent to 4% of today's electricity use. In other states, a 30 PJ decrease in gas use by 2030 would require about 5 PJ more electricity, equivalent to 1.3% of their 2022 annual electricity use.

This level of increase could be more than offset in volume by improvements in electricity efficiency in the states, including those suggested in this report: thermal efficiency upgrades in homes, as well as energy efficiency interventions in industry. For example, compressed air systems are estimated to represent about 10% of industrial electricity use,[91] which added up to about 11 PJ of electricity across NSW, SA and Tasmania in 2022.[92] Halving this electricity use by capturing a share of the opportunities discussed earlier in this report could deliver a similar volume of electricity demand reduction to that required to support the electrification interventions modelled. Simple measures such as educating households to regularly clean their reverse-cycle air conditioners' filters can also help to mitigate the increase in electricity use from electrification by delivering 5% to 15% savings in their energy use.[93]

A more thorough investigation of the impact of electrification on the electricity demand profile would need to be performed to better understand the impact on each state's electricity system. As discussed earlier, maximising the potential for flexible demand, in particular from hot water systems, could likely help manage any increases in electricity demand at peak time.

Conclusion

This report identified that there is a large untapped potential for cost-effective energy efficiency measures and electrification in residential buildings and industry. High-level analysis shows that those opportunities could deliver large reductions in gas use in Victoria, potentially more than enough to fill the upcoming gas supply gap.

Investments in energy efficiency and electrification will reduce energy bills, while every dollar invested in new gas supply, plus a profit margin, will have to be recovered through energy bills. Increasing the focus on demand-side opportunities can help to alleviate Australia's cost-of-living crisis.

Reducing gas demand can not only deliver cost benefits for consumers, but it can also deliver improved health outcomes and more jobs. It will also be critical to help Australia achieve its emissions targets, supporting global climate objectives.

[91] A2EP. Compressed air systems. April 2021. Page 2.
[92] DCCEEW. Australian Energy Update 2022. Table F. September 2022.
[93] Daikin. How often should I clean the filters in my air conditioner?

IEEFA recommends that governments and energy agencies consider these opportunities in more detail, and properly assess the costs and benefits of investing to reduce gas demand as compared to investing in increasing gas supply.

We also identified a critical gap in energy data that makes estimation of the potential for energy efficiency and electrification difficult. Filling this data gap will be critical to help manage the energy transition.

Technical Appendix

Interventions modelled in this report

The analysis in this report is meant to be indicative only. The table below presents the assumptions included in the modelling. The interventions were implemented in the order of the table. For residential households, the assumptions were primarily informed by sources from Victoria, given that it represents the vast majority of residential gas use in the southern states.

Table 2: Assumptions used to model the interventions included in this analysis

Intervention	Key assumptions
Residential buildings	
Stop new gas connections	• NSW, SA and Tasmania stop new gas connections from 2025.
End sales of new gas appliances	• Gas appliances switch to efficient electric appliances at time of replacement. • 85% replacement from 2025. • 100% replacement from 2028.
Accelerated retirement to support gas phase-out	• 100% of retirements post-2043 brought forward. • Early retirements are spread over the years to provide a smooth trajectory.
Accelerated retirement to support gas phase-out	• Assumes that a growing share of natural replacements are brought forward due to cost effectiveness: ○ 20% of natural replacements between 2028 and 2032 are brought forward. ○ 30% of replacements between 2033 and 2037. ○ 50% of replacements between 2038 and 2043. • Early retirements are spread over the years to provide a smooth trajectory.
Increased use of existing reverse-cycle air conditioners	• 50% of energy use for gas heating is in households who also have at least one reverse-cycle air conditioner. ○ There is little conclusive data on the ownership of reverse-cycle air conditioners in Victoria and other southern states. This number was based on a few different data sources, and assumes some continued increase in ownership in the last decade. ○ The residential baseline study estimated that there are about as many air conditioners as households in Victoria.[94] However, this figure seems low given that 59% of households had one air conditioner and 19% of households had two or more air conditioners already in 2011, likely already achieving this proportion more than a decade ago.[95] ○ In 2014, it was estimated that about 47% of households in the southern states and 38% of households in Victoria had reverse-cycle air conditioners.[96] ○ However, in 2008, it was estimated that there were already 41% of households with a reverse-cycle air conditioner in Victoria.[97] ○ In 2008, the same study found that reverse-cycle air conditioners represented 61% of air conditioners in Victoria, and that they had been the most popular system of cooling since 1994.[98]

[94] Australian Government, Energy rating. 2021 Residential Baseline Study for Australia and New Zealand for 2000 — 2040. Output tables for Australia. November 2022.
[95] Australian Bureau of Statistics (ABS). Household Water and Energy Use, Victoria, October 2011. August 2012.
[96] ABS. Environmental Issues: Energy Use and Conservation, Mar 2014. December 2014.
[97] ABS. Household Water, Energy Use and Conservation, Victoria, Oct 2009. June 2010.
[98] Ibid.

	○ Larger households are more likely to have an air conditioner.[99] • 35% of gas use for heating can be reduced on average per household by using existing reverse-cycle air conditioners instead of / in combination with gas heating systems (we could not find any data on this opportunity). • 35% of households implement the intervention after a successful three-year campaign (1/3 households implement the intervention in the first year, 2/3 in the second year, and all in the third year).
Improved thermal efficiency	• The intervention is modelled on implementation of ceiling insulation and draught sealing as per the SV study quoted in the report. • 42% gas savings achieved for heating in households where the intervention is implemented, based on the successive implementation of draught sealing, ceiling insulation (easy) and ceiling insulation (difficult) in the SV study.[100] • 40,000 households that use gas for heating are upgraded in 2025, followed by 80,000 households a year from 2026 until 2034 across the southern states. Three quarters of those are in Victoria, which aligns with the proportion that the states represent in residential gas use. • Each year, 10% of the previously upgraded households electrify their heating. • By 2034, this results in 50% of households still using gas for heating having been upgraded across the southern states (which represents 9% of total households). • After that date, it is assumed that the proportion of households using gas that have been retrofitted stays constant (they electrify at the same rate as other households using gas). • The program focuses on high energy users first, with the first 5% of upgraded households using gas for heating consuming twice as much gas as average households, and the next 15% of households consuming 50% more gas than average households. After this, upgraded households are assumed to consume the same as the average.
Industry	
Energy efficiency intervention in light manufacturing	• Light manufacturing defined as: food, beverage and tobacco manufacturing; textile, clothing and footwear and leather manufacturing; wood and wood products manufacturing. • 15% energy savings achievable through detailed audit, improved metering and data analysis. • Intervention implemented in businesses representing 50% of light manufacturing gas energy use over three years (with linear uptake).
Heat pumps	• Percentage of gas users switched to heat pumps: ○ 80% in food and beverage manufacturing. ○ 70% in other light manufacturing gas use. ○ 25% in pulp, paper and printing gas use. ○ 15% in non-metallic mineral products and other manufacturing. • The opportunity is progressively implemented: ○ 1% of the opportunity is implemented in 2024. ○ 3% in 2025. ○ 5% in 2026. ○ 10% in 2027. ○ 15% per year from 2028-32. ○ 6% in 2033.
Ongoing best practice energy efficiency	• In light manufacturing, an average of 1.2% improvement in energy efficiency per annum is achieved from 2027 onwards. • In heavy manufacturing, an average of 0.8% improvement in energy efficiency per annum is achieved from 2024 onwards.[101]

[99] ABS. Household Water and Energy Use, Victoria, October 2011. August 2012
[100] SV. Energy Efficiency Upgrade Potential of Existing Victorian Houses. September 2016. Page 40.
[101] Based on Climateworks Australia. Pathways to deep decarbonisation in 2050. Technical report. September 2014. Page 84. Assuming a share of the potential is captured in historical gas use trends.

Industry baseline gas use

Industrial gas use was projected based on recent trends and gas production projections included in the GSOO from the AEMO:

- For all manufacturing sectors, we used the average rate of change in gas use over the past five years to project future gas use.[102] We have grouped under 'heavy manufacturing' a range of subsectors, which are not broken down in the energy statistics due to confidentiality issues.
- For oil and gas production, we used the GSOO's existing and committed plus anticipated gas production trajectory from southern states to project future gas use within the sector itself.[103]
- For pulp, paper and printing, we also decreased the energy use by two thirds in 2024 compared with 2022 to account for the closure of the paper-producing plant at Maryvale, which was the last operating plant of its kind in the southern states.[104] After that date, we applied the average rate of change.

Victoria

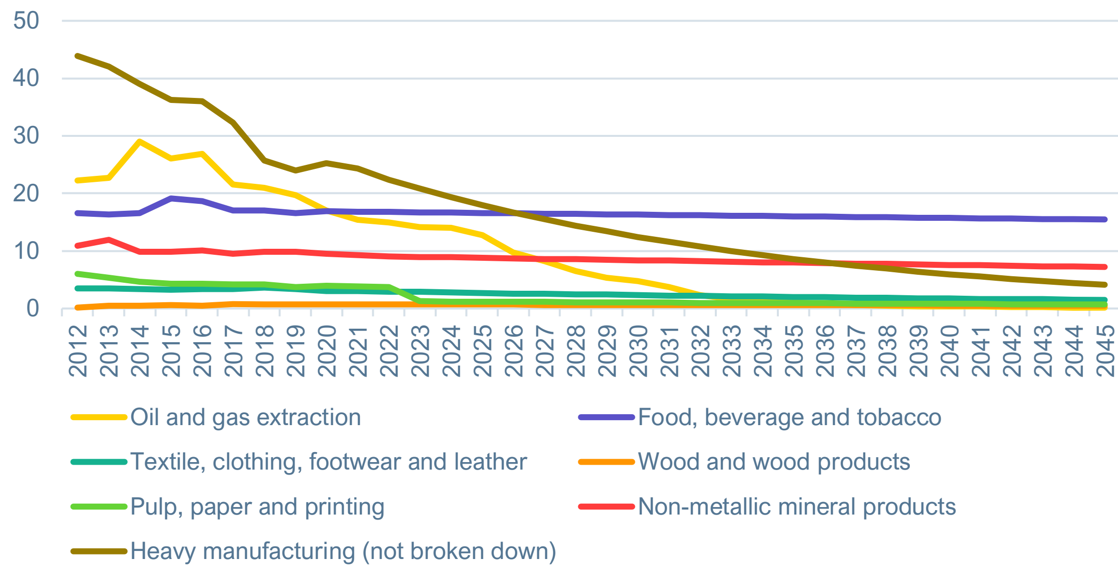
Gas use from oil and gas production sees a strong decline over the next two decades, in line with the expected production reduction.

Gas use from 'heavy manufacturing' also sees a very strong decline, in line with recent trends. This category is likely dominated by a few large basic chemical plants for which gas use is kept confidential. This strong decline would therefore reflect the phasing out of gas production, which has been a key input to those plants.

As a result, light manufacturing represents a growing proportion of Victoria's industrial gas use over time. In particular, food manufacturing becomes its largest component from the mid 2030s onward.

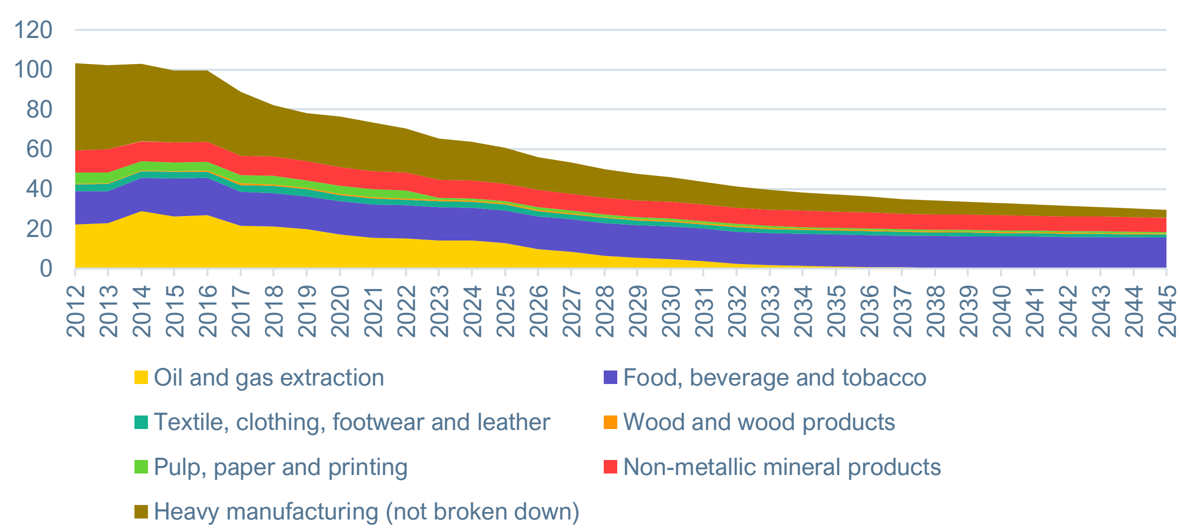
[102] Based on DCCEEW. Australian Energy Update 2022. Table F. September 2022.
[103] AEMO. Gas Statement of Opportunities 2023. April 2023. Figure 27.
[104] ABC. Maryvale paper producing plant to close with loss of up to 200 jobs. February 2023.

Figure 9: Victorian industry baseline gas use by subsector (PJ)



Source: DCCEEW and IEEFA

Figure 10: Victorian industry baseline gas use (PJ)

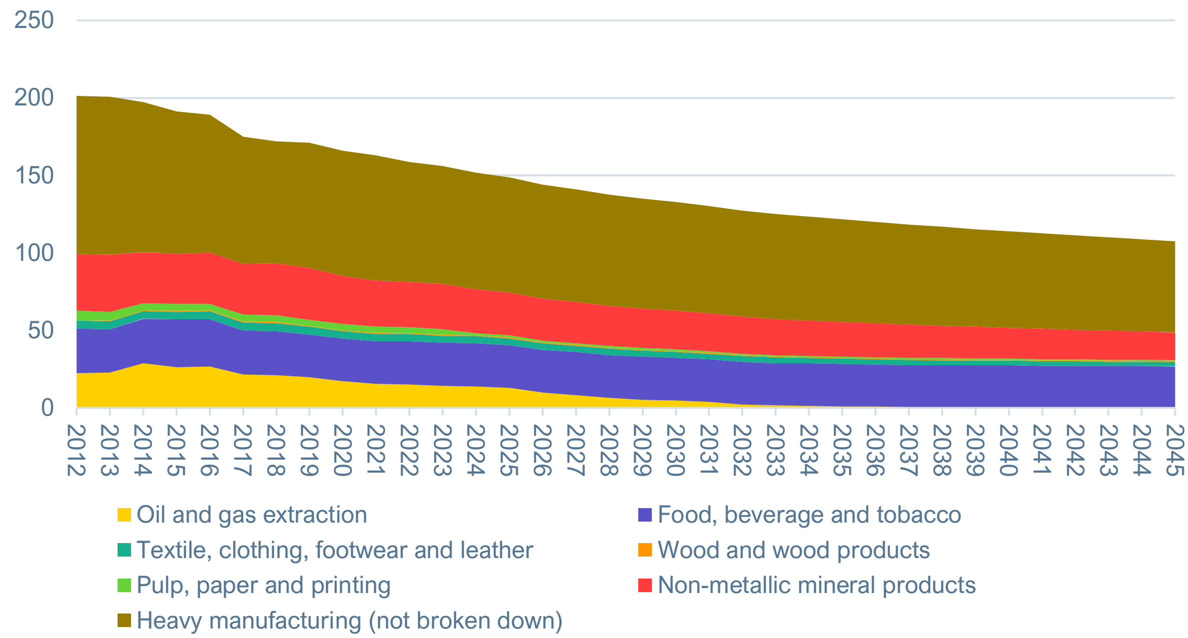


Source: DCCEEW and IEEFA

Southern states

The reduction in 'heavy manufacturing' is not as steep as in Victoria. This is because the energy use in this category has actually increased in the last five years across states other than Victoria.

Figure 11: Southern states industry baseline gas use (PJ)



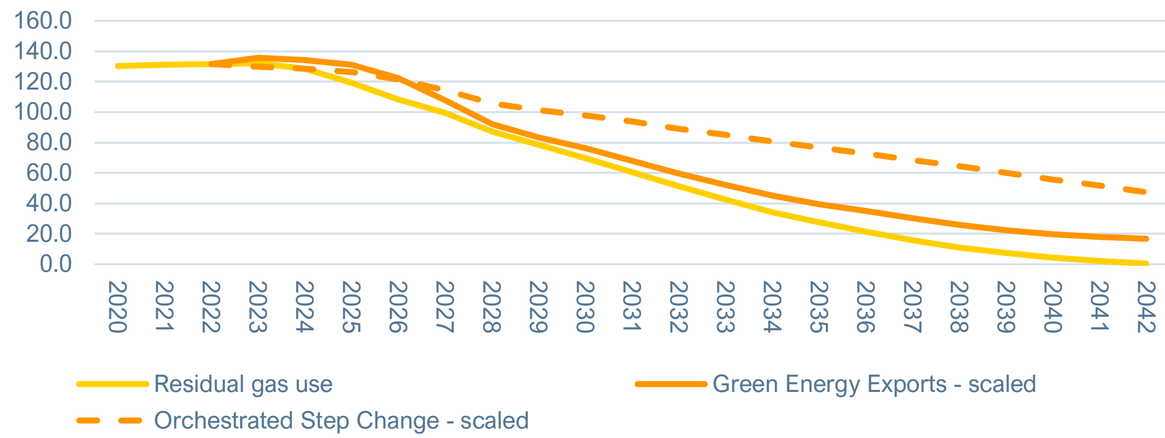
Source: DCCEEW and IEEFA

Comparison of our analysis to GSOO scenarios

The two graphs below show how we compared our analysis to GSOO forecasts under the 'Green Energy Exports (1.5°C)' scenario results. We also included the 'Orchestrated Step Change (1.8C)' scenario for reference, as it is considered the most likely scenario by AEMO.[105] We considered 2022 as the reference year as it is the last year of actual data availability.

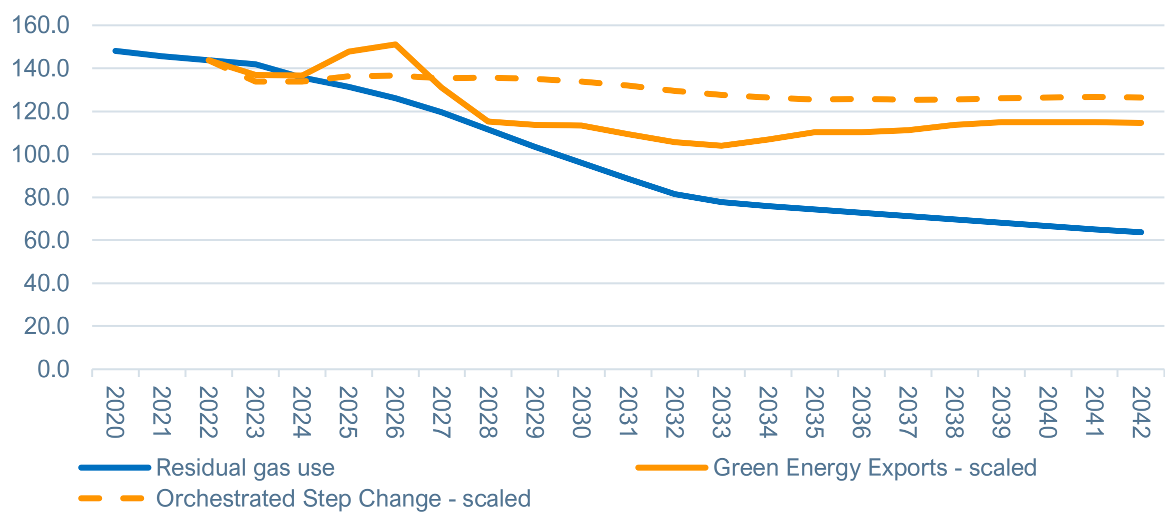
[105] AEMO. Gas Statement of Opportunities 2023. April 2023. Page 7.

Figure 12: Comparison of IEEFA analysis results and GSOO scenario for residential gas use (PJ)



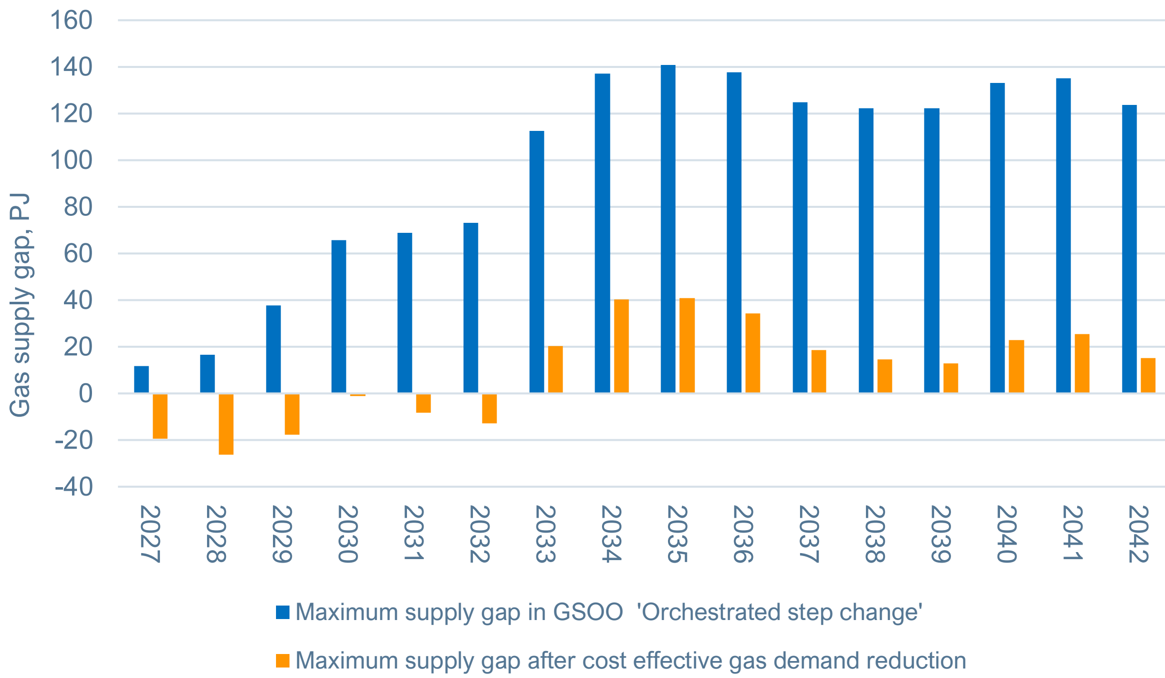
Source: AEMO and IEEFA

Figure 13: Comparison of IEEFA analysis results and GSOO scenario for industrial gas use (PJ)



Source: AEMO and IEEFA

Figure 14: Estimated maximum gas supply gap in southern regions before and after interventions, with 'Orchestrated Step Change (1.8°C)' scenario as a benchmark (PJ per annum)



Source: AEMO and IEEFA

About IEEFA

The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

About the Author

Amandine Denis-Ryan

Amandine is the CEO at IEEFA Australia. Amandine is a recognised expert in net zero emissions transitions across the economy. She led the development of the first domestic net zero emissions pathway for Australia and subsequent updates, which are considered to be the reference for Paris-aligned pathways and used by business, finance and government organisations. She has worked with and advised many organisations on the strategy, investment and risk implications of the energy transition. adenisryan@ieefa.org

Acknowledgements

IEEFA thanks Alan Pears, Senior Industry Fellow at RMIT University and energy efficiency expert, for his advice and input into this report. IEEFA also thanks Jay Gordon, Kevin Morrison and Joshua Runciman for their contributions to the report.

Institute for Energy Economics and Financial Analysis