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Institute for Energy Economics and Financial Analysis

Managing the transition to all-electric homes

An economical solution to Victoria's fossil gas dilemma

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Technical Appendices to this report are available to download from the IEEFA website.

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Key Findings

Switching gas appliances to efficient electric alternatives at end of life from 2025 is crucial to addressing Victoria's urgent gas supply shortfalls and emissions targets.

Gas distribution networks may face billions in unrecovered costs, but these are outweighed by the savings to consumers, and a plan is needed to wind the networks down.

Any delays increase the difficulty of the task, jeopardising emissions targets, and locking in hundreds of millions in costs for consumers.

State and federal governments must act to smooth the electrification transition by implementing standards and market arrangements for energy efficiency and demand-response capabilities, and building strong workforces and supply chains.

Executive Summary

Victoria faces gas supply shortfalls, and must dramatically cut emissions

Both the Victorian state and federal governments have committed to significant reductions in greenhouse gas emissions that are likely to require a rapid phase-out of fossil fuels.

A wide range of energy and climate experts internationally and within Australia have presented evidence that transitioning to all-electric homes offers one of the fastest and cheapest options to reduce emissions.

The Australian Energy Market Operator (AEMO) has also forecast that Victoria may face a long-term shortfall of gas supplies by 2027, driven by the rapid depletion of fossil gas reserves in Bass Strait. Without a significant reduction in Victoria's fossil gas demand, new supplies will need to be sourced from other states. This would require significant investment in new infrastructure that would likely need to be prematurely retired shortly after it was built if governments are to meet their emissions targets.

This is not only a problem for Victoria, as Australia's exposure to international gas markets has raised challenges for consumers in other jurisdictions. However, Victoria, where residential consumption accounts for the highest end-use fossil gas demand, has the greatest opportunity to benefit from rapid reductions in residential fossil gas demand.

Ending sales of new household gas appliances the most logical next step

The analysis in this report goes a step further than prior Australian analyses, focusing specifically on the economic implications of ending sales of residential gas appliances in Victoria from 2025.

While this may appear a bold proposition, it is unlikely that alternative approaches could address the simultaneous challenges of:

1. Reducing and delaying projected long-term gas supply shortfalls, while also contributing to emissions targets;
2. Delivering significant financial savings to households, and;
3. Avoiding inequitable outcomes for renters, if rental providers opt to replace like-for-like while homeowners shift to electricity on economic grounds.

Alternative approaches, such as increasing onshore gas supply, would entail longer lead times, higher uncertainties and poorer outcomes for energy bills, and would be incompatible with emissions targets.

There is a strong case for ending sales of gas appliances as early as 2025. 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. If upfront costs were amortised as a 10-year loan, consumers would see net savings of over $75 a month.

Overall, Victorians could save a collective $912 million in locked-in costs for each year that appliances were converted to electric at end of life rather than staying with gas, and be protected from the material risk that those appliances become stranded assets.

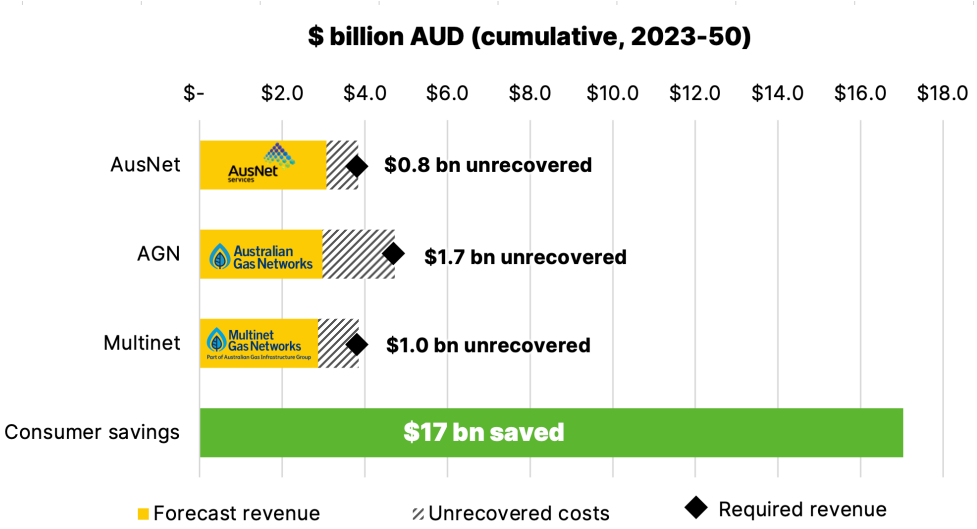
Transitioning gas appliances to electric alternatives could reduce Victoria's projected long-term gas supply shortfall by a cumulative 22% compared with AEMO's central *Step Change* Scenario, and by 53% compared with a worst-case scenario. The onset of a shortfall would also be delayed. It would also do most of the heavy lifting to align Victoria's residential fossil gas emissions with the state's economy-wide emissions reduction target, although additional measures would also be needed.

Benefits offset costs of winding down gas distribution networks

Electrification presents an inherent risk to gas distribution businesses, which is reflected in their high historic rates of return. Interim measures have been approved to accelerate their cost recovery, and regulate customer abolishments. However, the AER has acknowledged that these are not sustainable long-term solutions.

If consumers are to be protected from unprecedented cost rises, Victoria's three main distributors may face billions of dollars in unrecovered costs between now and 2050. However, these costs are much smaller than the total savings consumers could realise over the same period (Figure 1).

Figure 1: Victorian gas distribution networks' unrecovered costs vs consumer savings



Source: IEEFA analysis of network costs (described in Appendix B) and appliance upfront and running costs (drawing on Appendix A and C) Note: Assumes consumer prices are limited to a 2.5% pa real price cap.

Conversely, if networks continue to fully recover their costs from residential customers, those customers could face unprecedented price rises. This could trigger a "gas death spiral", where users leave the network in an uncontrolled and unpredictable fashion, leaving costs to be disproportionately borne by renters and low-income households.

Decision-makers will need to plan for winding down gas distribution networks, which includes a decision on who will bear the costs of decommissioning them. This decision ought to consider the inequitable outcomes that could occur if costs were passed onto consumers. It should also consider the high rates of return that networks have enjoyed over the past decade, and the degree to which they have already been compensated for their risks.

Victoria well placed to take immediate actions to accelerate transition

The cost of delaying the transition to electrification are significant, as the locked-in costs and stranding risks compound for every year Victorians continue to invest in gas appliances. Victoria also has a narrow window in which to avoid forecast annual gas supply shortages by 2027.

However, IEEFA's analysis finds several key actions Victoria can take to set the state up for a successful transition to all-electric homes:

1	Ensure gas appliances are replaced with efficient electric alternatives at end of life from 2025 in all applicable homes.
2	Encourage gas appliances to be replaced with efficient electric alternatives before end of life, where it makes financial sense.
3	Develop a plan to wind down gas distribution networks.
4	Identify and implement solutions for hard-to-electrify homes.
5	Strengthen standards and market arrangements to support greater uptake of energy efficiency, Distributed Energy Resources (DER) and demand flexibility.
6	Develop a strong electrification workforce and supply chain.

Victoria faces an urgent need to reduce residential fossil gas demand

Fossil gas is costing Victorian households money

Victorians are the largest consumers of fossil gas in the home – with about 2.4 million homes consuming a total of 104 petajoules (PJ) a year. This is more consumption than any other sector in the state, and accounts for 63% of total residential fossil gas consumption across Australia.[1]

Fossil gas once made economic sense as a household fuel. The discovery of large oil and gas reserves in Bass Strait in the 1960s gave Victorian homes access to low-cost gas.[2]

However, the economics of fossil gas in Victoria have shifted. The Bass Strait basins are declining,[3] which prompted the Australian Energy Market Operator (AEMO) to warn southern regions, including Victoria, they could face annual shortfalls of gas supply as early as 2027.[4]

Meanwhile, fossil gas produced in other regions of Australia is increasingly being shipped overseas, with Australia rising as one of the world's largest exporters of liquefied natural gas (LNG).[5] This means Victorians are increasingly competing with international markets for their fossil gas.

The full consequences of this shift were experienced in 2022 when, following Russia's invasion of Ukraine, the global price for fossil gas skyrocketed to unprecedented levels. As a result, the wholesale gas price in Victoria more than tripled from Q1 to Q2 in 2022.[6]

Electrification an effective solution to avoid supply shortfall

Victoria faces a choice between several options to address its imminent gas supply shortfalls.

Increasing the state's domestic gas supply is likely to be difficult. It is uncertain whether Victoria has commercially viable onshore fossil gas reserves,[7] they are typically more expensive than offshore sources,[8] and coal-seam gas (CSG) exploration (which faces myriad social licence concerns) is banned in the state's constitution.[9]

[1] DCCEEW. Australian Energy Update 2023 – Table F. September 2023.
[2] The Age. How Victoria got hooked on gas, and why the heat's on to find a new fuel. May 2021.
[3] ExxonMobil. The evolving role of Gippsland gas in Australia's east coast gas market. 22 March 2023.
[4] Australian Energy Market Operator. Gas Statement of Opportunities. March 2023. Page 14.
[5] Reuters. U.S. poised to regain crown as world's top LNG exporter. January 2023.
[6] AER. Victorian gas market average daily weighted prices by quarter.
[7] Resources Victoria. Types of onshore gas. December 2021.
[8] Core Energy & Resources. Gas Production Cost Estimates | Eastern Australia: ACCC Gas Market Inquiry. November 2018. Figure 5.3.2. Page 21.
[9] Premier of Victoria. Enshrining Victoria's Ban On Fracking Forever. March 2021.

Victoria could instead become a net importer of fossil gas from other regions, via pipelines or LNG import terminals. However, this requires expensive infrastructure to be built with long lead times.[10] Given the imminent pressure to meet Victoria's emissions targets, there is also a risk that new gas infrastructure investments become stranded shortly after they are completed.[11]

In parallel to the changing economics of fossil gas, the efficiency of electric household appliances has substantially increased, and Australia has emerged as a world leader in the uptake of low-cost renewable energy. Switching from fossil gas to electricity offers a broad range of benefits for consumer energy bills and emissions that make it a highly attractive option for mitigating gas supply shortfalls.

Victoria is not the only jurisdiction facing these pressures. Increasingly, Australian fossil gas is being locked up in contracts with international buyers, removing supply from the domestic east coast market.[12]

Victoria is making strides towards an electrified future

Victoria's emissions reduction targets are among the most ambitious in the country – a 75%-80% reduction on 2005 levels by 2035, and net zero emissions by 2045.[13]

Meeting this target is likely to require ambitious emissions reductions in all sectors, including the built environment, where burning fossil gas is the main source of Scope 1 emissions, those produced from direct combustion.

In 2022, the Victorian government released its first Gas Substitution Roadmap (GSR) – a first step in planning the transition away from fossil gas.[14]

The roadmap signalled the Victorian government's recognition that electrification is a cost-effective decarbonisation option for households.[15]

[10] For example, the 530km APLNG pipeline, located entirely in one state, had a timeline of three years from pipe manufacturing to being operational, even after the planning and approvals process. (APLNG. Project Description. March 2010. Page 20.)
[11] Global Energy Monitor. Pipeline Bubble: Tracking Global Oil and Gas Pipelines. February 2021. Page 33.
[12] Department of Climate Change, Energy, the Environment and Water (DCCEEW). Securing Australia's domestic gas supply. August 2022. Page 2.
[13] Victorian Department of Energy, Environment and Climate Action (DEECA). Climate action targets.
[14] DEECA. Victoria's Gas Substitution Roadmap. 2022.
[15] Ibid. Page 12.

Following the release of the GSR, the Victorian government has:

- Ensured that all new homes from 2024 will be all-electric,[16] which prevents further buildout of network assets and purchases of gas appliances that are likely to become stranded; and
- Revised the Victorian Energy Upgrades (VEU) program to remove incentives for purchasing gas appliances, and increase incentives for replacing gas with electric appliances.[17] This makes a material difference to the upfront cost of electrification. For instance, replacing a gas ducted heating system at end of life with multiple reverse cycle air conditioners can be cost-positive from day one.[18]

The ACT is another Australian jurisdiction that has made significant progress in planning for electrification. The territory was the first to legislate an end date for new gas connections, targeting 2045 to transition away from fossil gas.[19]

The transitions under way in Victoria and the ACT serve as case studies for other jurisdictions in Australia.

Ending sales of gas appliances is the only economical solution to reduce gas at the required pace

Gas appliances lock consumers into higher costs and asset-stranding risks

IEEFA estimates that Victorian consumers spend $845 million on new gas appliances each year.[20]

Following the Victorian government's decision to stop connecting new homes to the gas network, most gas appliances will be purchased in existing homes, when consumers replace their old gas appliances at their end of life.

These appliances are long-lived assets. Consumers buying a new gas heating system, for example, may expect it to last for 20 years.[21]

In general, electric appliances have higher upfront costs than gas appliances. However, their running costs are significantly lower – meaning their overall lifetime costs are much lower.

[16] Victoria State Government. Hon Lily D'Ambrosio MP. New Victorian Homes to go All Electric from 2024. 28 July 2023.
[17] DEECA. Electrification and home energy rating assessment updates. 18 May 2023.
[18] IEEFA modelling based on assumptions in Appendix C.
[19] ACT government. Everyday Climate Choices. Switching from gas. 2021.
[20] Including gas cooktops, gas heating systems (ducted and non-ducted) and gas hot water systems (storage and continuous flow). Based on cost and sales assumptions from Appendices A and C.
[21] EnergyConsult. Product Profile: Gas Ducted Heaters. January 2011. Page 24.

Customers who purchase gas appliances today are locking in higher lifetime costs than comparable electric appliances.

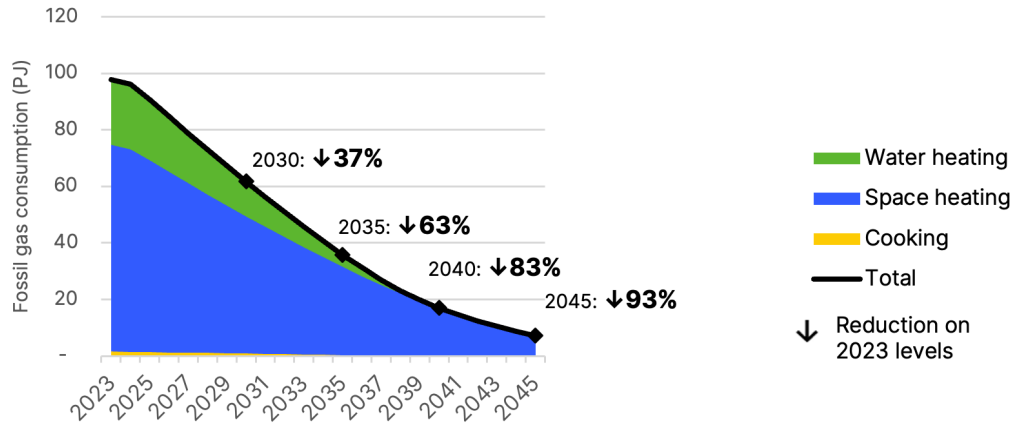
This assumes those appliances live out their expected lifespan. However, even more concerning is the possibility that those appliances become stranded assets if gas infrastructure is wound down. This is a legitimate concern as networks in Australia are already arguing to the regulator that their pipelines have shorter lifespans than previously assumed, by an order of decades.[22]

Moving to all-electric appliances would significantly reduce future gas supply shortfalls

IEEFA has modelled the potential effects of replacing all residential gas appliances with electric alternatives when they reach end of life, starting from 2025.

We found it represents one of the only interventions that could reduce residential fossil gas at the pace Victoria requires to meaningfully reduce its long-term gas supply shortfalls. It results in a 93% decrease on 2023 levels by 2045 (Figure 2).

Figure 2: Effect of replacing gas appliances with electric at end of life on Victoria's residential fossil gas demand



Source: IEEFA modelling (described in Appendix A)

Eastern Australia has no shortage of fossil gas, and is a major exporter of the fuel.[23] However, as Victorian fossil gas basins decline, the state is becoming increasingly reliant on accessing fossil gas from Queensland, via constrained infrastructure.

[22] For example, Dampier Bunbury Pipeline. Assessment of the Economic Life of the DBNGP. January 2020. Page 1.
[23] IEEFA. What's a Fair Price for Domestic Gas? December 2022. Page 5.

AEMO's 2023 Gas Statement of Opportunities (GSOO) forecast that southern regions could face annual shortages of domestic gas supply as early as 2027. They forecast a cumulative 1,389PJ of supply from 2027-2042 that is unsecured.[24]

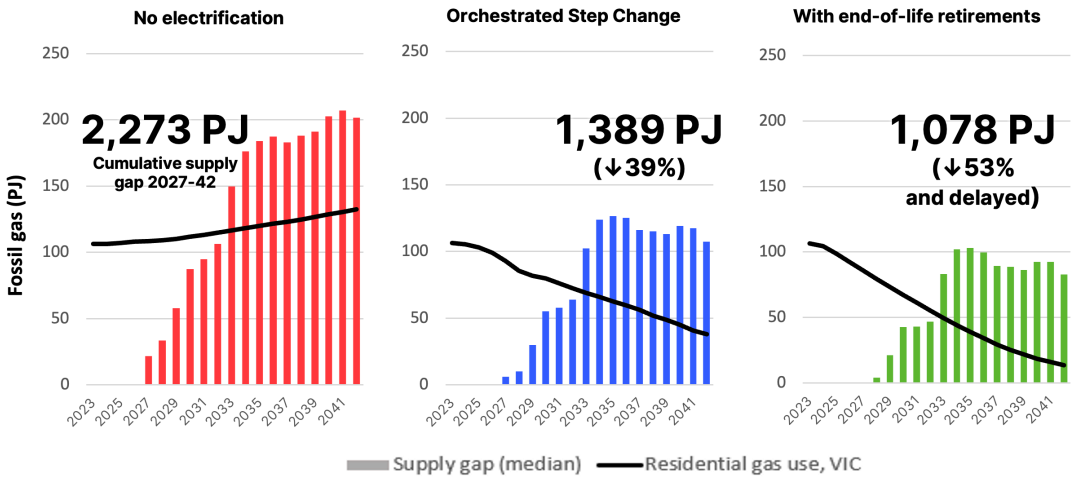
This estimate is based on AEMO's *Orchestrated Step Change* scenario, which assumes investments in electrification increase at a pace beyond current levels.[25] If such an increase does not eventuate, residential fossil gas demand could be much higher – as seen in AEMO's *No Electrification* sensitivity.

If Victorian households follow the *No Electrification* trajectory, the gas supply shortage becomes much worse – 2,273PJ cumulative to 2042.[26]

> **If all household gas appliances were converted to electric at end of life, the cumulative gas supply shortage is greatly reduced, to just over 1,000PJ.**

However, if all household gas appliances were converted to electric at end of life, the cumulative gas supply shortage is greatly reduced, to just over 1,000PJ. This is 53% lower than in *No electrification*, and 22% lower than in *Orchestrated Step Change*. It also delays the onset of the annual supply gap, with the first material gap not observed until 2029 (Figure 3).

Figure 3: Ending sales of gas appliances could delay and reduce the gas supply shortfall



Source: IEEFA analysis drawing on data from AEMO's GSOO (2023) and modelling in Appendix A.

[24] AEMO. Gas Statement of Opportunities. March 2023. Page 84.
[25] AEMO. 2023 Inputs, Assumptions and Scenarios Report. July 2023. Page 18.
[26] This is modelled by adding the difference in residential electrification between *No Electrification* and *Orchestrated Step Change* to the median supply gap in *Orchestrated Step Change*, i.e. it only considers the impact of inaction in the residential sector.

This analysis excludes any retirement of gas appliances before end of life, which can also be financially attractive and may further reduce supply shortfalls. Additionally, recent IEEFA analysis observed that there was also likely unrealised industrial fossil gas demand reduction opportunities in *Orchestrated Step Change*.[27] Reducing and delaying the onset of a long-term gas supply gap via residential actions could provide headroom and time for the Victorian government to identify and implement these opportunities, which could avoid the need for costly new gas supply investments.

Victoria's emissions goals necessitate a transition to all-electric appliances

Victoria's whole-of-economy emissions reduction targets are some of the strongest in Australia.

However, not all sectors are expected to decarbonise at the same pace. There may be a need for hard-to-abate sectors to decarbonise more slowly, where this can be compensated by other sectors decarbonising more quickly.

Residential buildings are likely to be one such sector, as the technologies to replace fossil gas use are mature and cost-effective.

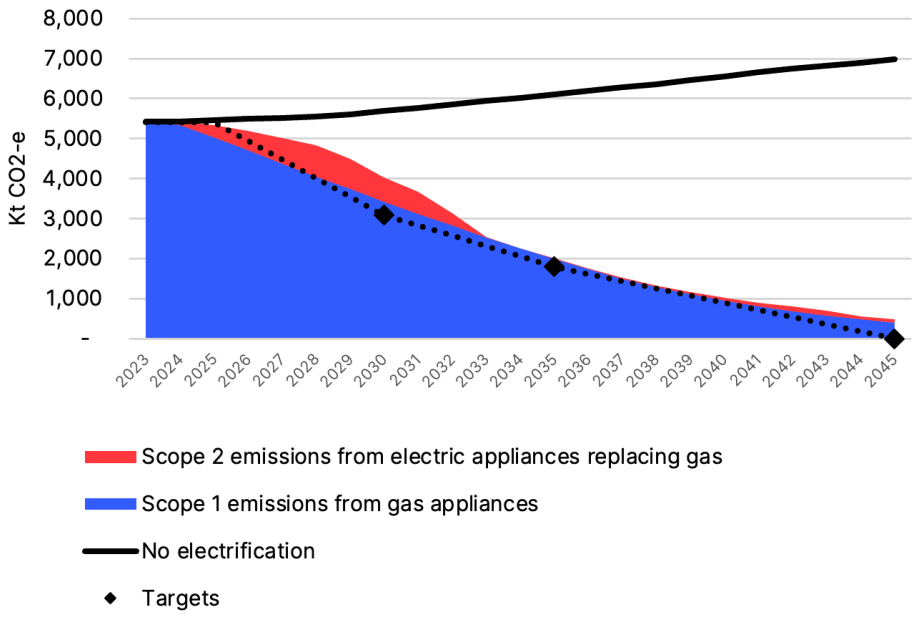
The expert panel that recommended Victoria's 2035 emissions reduction target acknowledged this, recommending that to align to this target, fossil gas use should be largely phased out by 2035, "with an immediate focus on Victoria's built environment".[28]

However, Victoria's residential fossil gas emissions are not on track to align to this target.[29] This is likely to result in additional pressure on hard-to-abate sectors to reduce their emissions, at a higher cost.

If gas appliances were replaced at their end of life with electric alternatives, residential fossil gas emissions could be brought closer to Victoria's 2035 targets (Figure 4).

[27] IEEFA. Australia can and should eradicate its gas supply gap – but not with more gas. April 2023.
[28] Independent Expert Panel for the Victorian 2035 Emissions Reduction Target. Victoria's 2035 Climate Action Target: Driving Growth and Prosperity. March 2023. Page 9.
[29] Residential stationary combustion emissions in Victoria have followed a long-term increasing trend over the past three decades (DCCEEW. National Greenhouse Gas Inventory. Paris Agreement Inventory. Victoria – 1.A.4.b.i. Stationary Combustion).

Figure 4: Electrifying gas appliances at end of life will reduce residential emissions, supporting Victoria's economy-wide targets



Source: IEEFA modelling (described in Appendix A)
Note: Victoria's emissions targets are expressed relative to a 2005 baseline. However, the downscaled targets in this chart are recalibrated to 2021. (E.g. a 45-40% reduction on 2005 levels by 2030 is considered a 19-26% reduction on 2021 levels.)

The analysis in Figure 4 also shows there is no meaningful increase in Scope 2 emissions (those incurred from generation of electricity) from electric appliances as gas appliances are replaced; the overall trajectory is still in decline from 2025. We have assumed that the emissions intensity of electricity follows AEMO's *Step Change* scenario, which means Victoria's energy grid is close to zero emissions before 2035.[30] These emissions are likely to fall faster if more homes rely on rooftop solar and battery systems.

Emissions don't reach absolute zero by 2045, highlighting that more effort will be needed if residential fossil gas emissions are to reduce entirely in line with, or well below, the economy-wide targets. However, end-of-life replacements do much of the heavy lifting (Box 1).

[30] AEMO. 2022 Integrated System Plan. Generation outlook. June 2022.

Box 1: End-of-life electrification of gas appliances is a strong starting point for decarbonising residential fossil gas

Electrifying household fossil gas use is one of the lowest-cost decarbonisation options available to governments.

Multiple modelling exercises have found a prominent role for residential electrification under decarbonisation pathways[31] – and this is one reason it features strongly in AEMO's Integrated System Plan scenarios.

The Independent Expert Panel behind Victoria's 2035 emissions reduction targets recommended fossil gas use be largely phased out by 2035, with an immediate focus on the built environment.[32]

This report discusses the implications of replacing gas appliances with electric alternatives at end of life in Victoria. This action alone would not be enough to phase out residential fossil gas by 2035; indeed, it is not enough to phase it out by 2045 in line with the economy-wide net zero target.

However, it does set a strong baseline, by doing the majority of the heavy lifting required to align residential fossil gas emissions with interim whole-of-economy emissions reduction targets.

End-of-life appliance replacements are not the only economical electrification scenario for households.

For example, in the illustrative household modelled by IEEFA, prematurely electrifying space heating has a payback period of seven years (or four years after current government rebates). Adding hot water to this leads to a payback period of 10 years (six after rebates), and adding cooking while also abolishing the gas connection, leads to a payback period of nine years (six after rebates).[33]

Premature appliance replacements will take longer to pay back than an end-of-life replacement decision. However, they still present as a net present value (NPV)-positive abatement opportunity, which could be further encouraged via incentive schemes and zero-interest loans.

Additionally, many households may have ageing gas appliances are not yet at end of life but may need replacement within the next 10 years. For these households, the effective payback period would be somewhere between the end of life and premature replacement cases presented here.

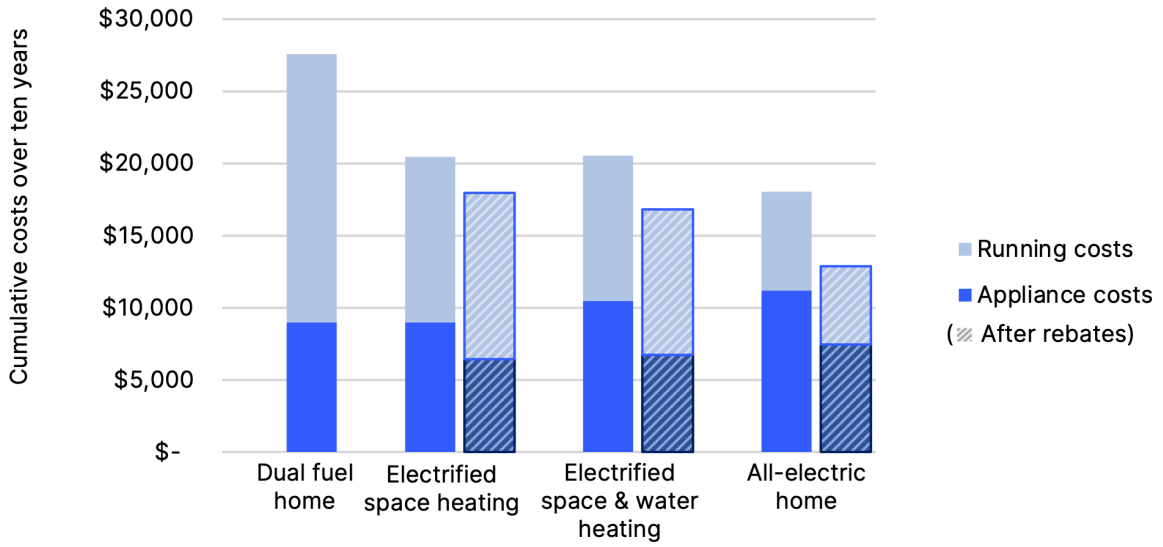
This report also discusses the fact that, as residential fossil gas volumes decline, the cost of delivering fossil gas to consumers is likely to increase. This may lead to premature appliance replacements becoming more attractive.

Fossil gas volumes could reduce to the point where the lowest-cost solution for the energy system is to transition the remaining users off the gas network.

Requiring new appliances to be electric from 2025 would benefit consumers

An estimated 340,000 gas appliances are up for replacement each year in Victoria.[34] If the effort that goes into replacing these appliances with gas were redirected to installing efficient electric appliances, an illustrative Victorian household could reduce their energy bills by $1,200 a year.[35] The savings compound over time – Figure 5 shows that all-electric homes are the lowest-cost option over a 10-year period.

Figure 5: All-electric homes are the lowest-cost option over a 10-year period



Source: IEEFA modelling (described in Appendix C). All-electric homes are assumed to incur a $220 abolishment fee, but avoid the annual gas supply charge.

Generally speaking, before Victorian and federal rebates, the upfront costs of electric appliances are more than gas appliances. However, if the costs of going all-electric were to be amortised over a 10-year period at current interest rates, consumers would still see net savings of greater than $70 a month.[36] At a macro level, Victorians could save a collective $931 million in locked-in lifetime

[31] For example, CSIRO and Climateworks Centre. Multi-sector energy modelling 2022: Methodology and results Final report. Page 9. December 2022; DEECA. Gas Substitution Roadmap. 2022. Page 59.
[32] Independent Expert Panel for the Victorian 2035 Emissions Reduction Target. Victoria's 2035 Climate Action Target: Driving Growth and Prosperity. March 2023. Page 9.
[33] See Appendix C for methodology.
[34] IEEFA analysis based on assumptions in Appendix A.
[35] Based on IEEFA modelling described in Appendix C.
[36] Ibid.

costs for each year that appliances were converted to an efficient electric alternative at end of life rather than staying with gas.[37]

These figures are simplified, as each household's electrification journey may be different. For example, apartment dwellers may face additional challenges in installing heat pumps for space or water heating. Conversely, houses that already use a reverse-cycle air conditioner for cooling face no additional upfront costs to start using it for heating also. Houses with rooftop solar would face lower running costs for electric appliances.

Other studies have found that electrification is generally cost-effective across other household types, although the incentive is often lower for higher-density housing.[38]

We have also included gas cooktops in these calculations. Although gas cooktops have lower energy consumption compared with other appliances, there is a strong economic argument for replacing them with electric alternatives at end of life (Box 2).

If a requirement were to be applied universally across owner-occupied and rented homes, this would lead to a more equitable outcome for tenants who are currently locked out of many electrification opportunities. This could be supported by appropriate minimum standards, discussed later in this report.

Box 2: Switching to induction cooktops could save consumers money

Victorians are more reliant on fossil gas for cooking than other states, and many Victorians still express a preference for cooking with gas.

As awareness of induction cooktops increases, these preferences are shifting, with research for the Victorian government suggesting more than a quarter of Victorians were considering purchasing induction cooktops when their gas cooktop retires.[39]

Cooktops consume very little energy compared with other home gas appliances, typically accounting for about 1.5% of a home's gas usage.[40]

[37] Based on assumptions described in Appendix A and C. Assumes current average market prices for gas and electric appliances, total energy consumption from EnergyConsult (2022), and a constant price for fossil gas and electricity based on current market offers.
[38] For example, see: GHD. All-Electric New Homes. April 2022. Page 15; and Acil Allen. Economic and Technical Modelling of the ACT Electricity Network: Strategic Report. April 2022. Page 229.
[39] JWS Research. Household energy preferences report: Research report. August 2021. Page 21.
[40] EnergyConsult. 2021 Residential Baseline Study for Australia and New Zealand for 2000 – 2040. November 2022. Table 9.

This low energy consumption means that excluding cooktops from a gas appliance phase-out is unlikely to materially impact running costs and emissions.

However, the economic case for switching from gas to induction cooktop becomes compelling if the cooktop is the last remaining gas appliance in the household.

At this point, switching to an induction cooktop offers the opportunity for the house to disconnect from the gas network permanently.

Permanently abolishing a home's gas connection attracts a $220 fee in Victoria. However, this is less than the average annual fixed charge that consumers pay to maintain a gas connection.

When these charges are considered, the decision to replace a gas cooktop with an induction stove once it reaches end of life may pay back in three years.[41]

In future, if large number of users electrify other appliances, it is likely that the fixed and volumetric charges consumers would pay to keep their gas cooktop would increase, making a switch even more financially compelling.

Increasingly, consumers are choosing to switch away from gas cooktops for health reasons, with 12% of childhood asthma in Australia is attributed to exposure to gas cooktops.[42]

Finally, for consumers that still prefer or require cooking with a flame, bottled gas could present a more economical solution than having gas delivered via a reticulated network. This is a common setup in other states that have less extensive gas infrastructure than Victoria. Given the likely volumes of gas would be very small, it is possible that this bottled gas could be switched to biomethane in future.

Victoria's gas distribution networks face high unrecoverable costs

Gas distribution network business models incompatible with electrification

Three gas distribution networks serve Victoria, with a total regulated asset base of $4.9 billion,[43] and 93% of their revenue is recovered from residential customers.[44]

Networks receive a regulated return on their revenue and have historically been incentivised to grow demand across their networks, via mechanisms such as weighted average price caps.[45] Victorian

[41] See Appendix C for methodology.
[42] Australian Journal of General Practice. Health risks from indoor gas appliances. Vol 15:12. December 2022.
[43] AER. State of the Energy Market 2022. September 2022. Page 162.
[44] AER. Gas Network Performance Report 2022. December 2022. Page 107.
[45] AER. Review of gas distribution network reference tariff variation mechanisms and declining block tariffs. May 2023. Page 15.

networks and the AER forecast a decline in fossil gas demand over the next five years, including a peak in customer numbers for AGN and an overall decline for Multinet.[46]

These forecasts are based on AEMO's *Orchestrated Step Change* scenario. As mentioned above, this scenario implies a step-up in investments in electrification. However, the scenario is also not aligned to Victoria's emissions reduction targets.[47] A trajectory that is more closely aligned to the state's targets, such as the one discussed in this report based on end-of-life appliance retirements, would accelerate the decline.

In response to the likely reduction in fossil gas volumes due to electrification, gas distribution and transmission networks have argued to the AER that the useful life of their pipelines is now much shorter than previously assumed.[48]

In their last access arrangement negotiations, the three Victorian distribution networks asked for $461 million in accelerated depreciation to account for this asset stranding risk, of which $333 million was approved by the AER.[49]

They also proposed charging exit fees of up to $950 to consumers to leave the network permanently.[50] The AER capped the reference tariff for abolishments at $220 but allowed the networks to socialise the remainder of that fee across all remaining consumers.[51]

The AER has foreshadowed that this is "only an interim measure", not a long-term solution for gas distribution networks.[52]

> **If residential fossil gas volumes are reduced by over 90% by the 2040s, it may not be financially or physically feasible to maintain large distribution networks to serve such a small energy demand.**

These developments raise questions over a realistic remaining lifespan for Victoria's gas distribution networks. If residential fossil gas volumes are reduced by over 90% by the 2040s, as in the economical electrification trajectory in Figure 2, it may not be financially or physically feasible to maintain large distribution networks to serve such a small energy demand.

[46] AER. Final decision: Multinet Gas Networks, Australian Gas Networks (Victoria & Albury) and AusNet Gas Services Gas distribution access arrangements 2023 to 2028. Attachment 12 – Demand. June 2023. Page 4.
[47] AEMO. Draft 2023 Inputs, Assumptions and Scenarios Report. December 2022. Page 28.
[48] 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.
[49] AER. Final decision: Multinet Gas Networks, Australian Gas Networks (Victoria & Albury) and AusNet Gas Services. Gas distribution access arrangement 2023 to 2028. Attachment 4 – Regulatory depreciation. June 2023. Page 4.
[50] AER. Final decision: Multinet Gas Networks Gas distribution access arrangement 2023 to 2028. June 2023. Page 29.
[51] AER. AER decision supports Victorian gas consumers in energy transition. June 2023.
[52] Ibid.

It will become unsustainable to recover all costs from consumers

IEEFA has modelled the impact of residential electrification on Victoria's gas distribution networks' revenue and prices, based on adapted models that were submitted by networks to the AER.[53]

We found that in a scenario where all gas appliances were replaced with electric appliances at end of life, the fixed and volumetric tariffs charged by gas distribution networks may need to increase an average of 7.7% and 7.5% a year respectively to enable networks to fully recover their costs.

This scenario assumes no further capital expenditure after 2023, and operating expenditure that declines as the number of customers shrink. However, networks' full costs could be higher if:

- Any additional capital expenditure is rolled into networks' regulated asset base, or;
- Operating expenditure does not decline as forecast (for example, in a situation where the geographical pattern of customers leaving the network is random, and the length of the underlying network does not substantially decrease).

The AER determines the reference tariffs that networks are allowed to charge, and typically sets these in line with the "regulatory compact", to allow networks to recover the efficient costs of their services. However, their primary remit is to act in the interest of energy consumers, and they are not obligated to allow full cost recovery of regulated networks.[54]

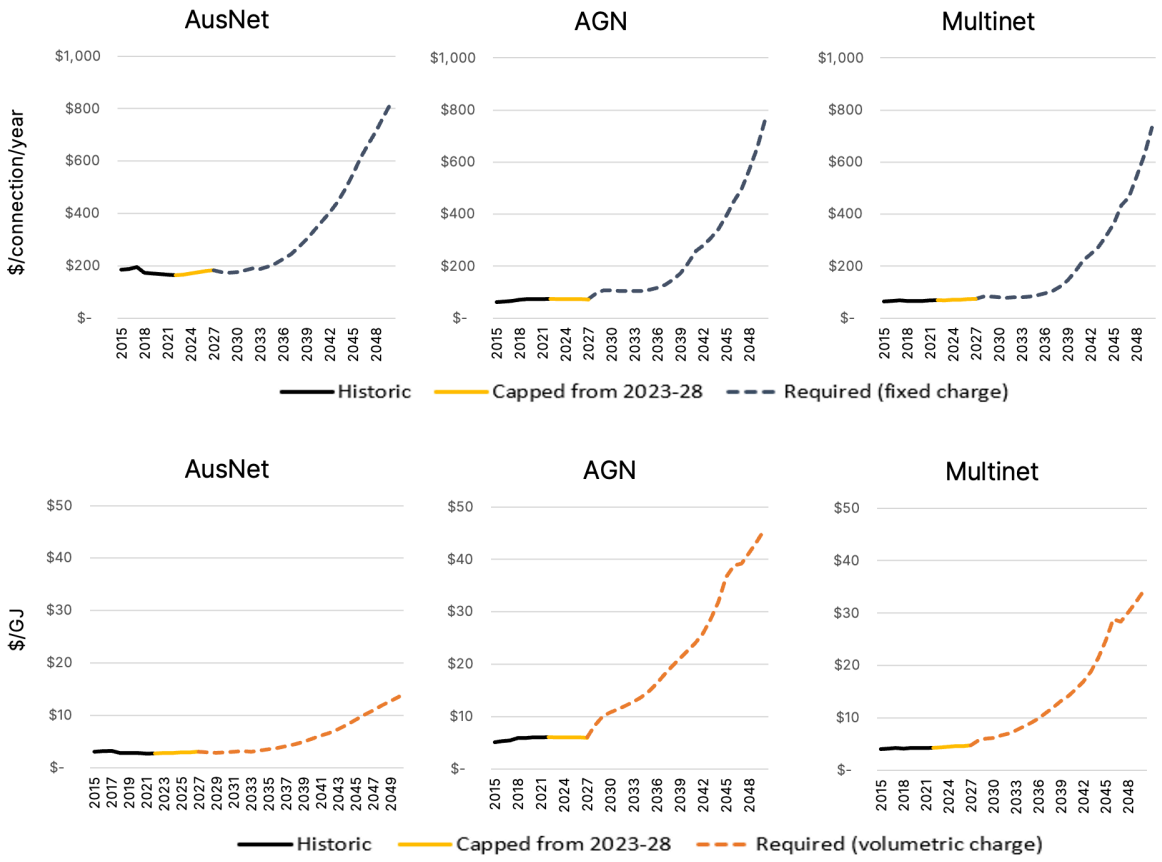
Put into context, the average real price rise that has been approved for Victorian gas distribution networks between 2015 and the end of the current access arrangement period (2027-28) ranges from -0.03% (decrease) to 1.3%.[55]

Figure 6 shows the historic real price increases approved by the AER across Victoria's gas distribution networks, followed by the modelled price increase that would be needed to enable full cost recovery in the electrification scenario discussed in this report. It is unrealistic to expect that the AER would pass on such significant price increases to consumers.

The modelling approach separately forecasts changes to the fixed and volumetric distribution charge, starting from the current proportions of network costs that are allocated to each charge.[56] It is possible that distribution networks could choose to alter the allocation of these costs to fixed or volumetric charges. Retailers may further choose to alter the customer-facing cost structures in their market offers.

[53] A detailed description of this methodology is in Appendix B.
[54] Under the National Gas Rules, gas networks are not guaranteed the ability to recover all of their costs. Provisions exist for capital redundancy, which enable the AER to make decisions regarding assets that cease to contribute to service delivery, and how such costs should be shared between networks and users. (AEMC. National Gas Rules. 85 – Capital Redundancy).
[55] Based on a review of AER Annual tariff variations for Victorian gas distribution networks.
[56] According to original network models described in Appendix B: 61% fixed / 39% volumetric for AusNet; 23% fixed / 77% volumetric for AGN; 25% fixed / 75% volumetric for Multinet.

Figure 6: Price rises required to recover gas distribution network costs in a strong electrification scenario



Source: IEEFA modelling (described in Appendix B). Note: All prices in real 2023 AUD.

These steep price rises occur because most of the networks' costs are associated with the size of their asset base, rather than the size of their customer base. If customers leave the network or consume less fossil gas, network costs will decline at a slower rate than customer disconnections.

Gas networks may face unrecovered costs, but all-electric consumers will be better off

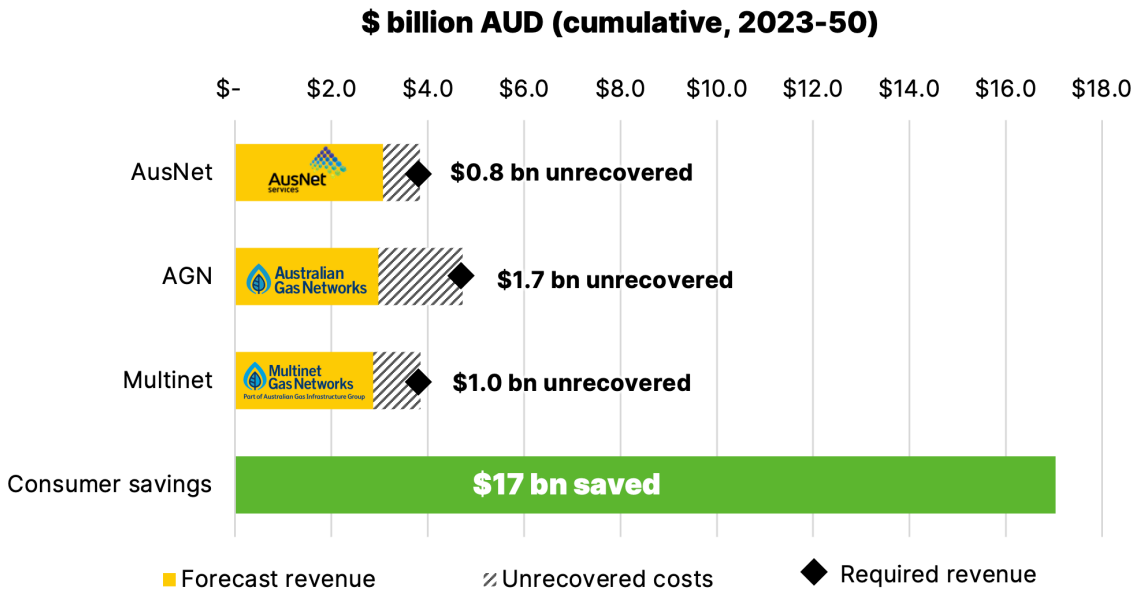
The AER has acknowledged that its responses to networks' asset stranding risks are not long-term solutions.[57] By the time Victoria's networks commence their 2028-32 access arrangements (and likely earlier in other states), the AER and governments may need to make difficult decisions to balance consumer price impacts and networks' ability to recover costs.

[57] AER. AER decision supports Victorian gas consumers in energy transition. June 2023.

IEEFA modelled the impact to networks' revenue if an annual real price cap of 2.5% pa were applied from 2028. We found that this could lead to a cumulative $3.5 billion in unrecovered costs between 2023 and 2050.

These unrecovered costs appear large but are significantly smaller than the $17 billion in savings consumers face by switching away from gas appliances at end of life (Figure 7). This figure factors in the savings in running costs of moving from gas to electric appliances, as well as the difference in upfront costs.

Figure 7: Effect of a 2.5% annual real price cap on unrecovered gas distribution network costs compared with consumer savings from electrifying gas appliances



Source: IEEFA analysis of network costs (described in Appendix B) and appliance upfront and running costs (drawing on Appendices A and C)

Note there is no historical precedent for the AER allowing a continued 2.5% pa real price increase over an extended period; it is well above the average historic real increase that has been allowed.

If a scenario with no real price increase were to be considered, the unrecovered costs could increase to $4.2 billion across all networks between 2023 and 2050.

This analysis excludes any socialised abolishment fees from the networks' operating expenditure after 2028. Including these fees could significantly increase the networks' costs in the short term, adding up to $41 million a year in additional operating expenditure needs by 2030.[58] However, the

[58] Based on approximately 60,000 Victorian customers disconnecting per year by 2030 (from modelling in Appendix A) and socialised abolishment costs that have been approved for the networks by the AER in their latest Access Arrangements.

AER has signalled that socialised abolishment costs are not a long-term solution, and we consider it unlikely that the AER would simultaneously expect networks to pass on these costs while being subject to a price cap that prevents full cost recovery.

Nonetheless, distribution networks, governments and regulators will need to agree on the most cost-efficient method to safely decommission parts of the gas network and determine who pays for this work.

Gas distribution networks have communicated to customers that their assets have a likely future role in delivering hydrogen and/or biomethane to homes. However, Box 3 examines the viability of these gases as an energy solution for most homes.

Box 3: 'Renewable gas' not part of the solution for gas networks

Gas distribution networks have proposed that repurposing their pipelines to deliver hydrogen and/or biomethane (described by the networks as "renewable gas") is a viable alternative to electrification.

A report produced by Frontier Economics for the lobby group Energy Networks Australia (ENA) argued that it made sense to utilise the existing gas network, and would be cheaper in terms of system costs to transition to hydrogen and biomethane rather than electrify all homes.[59]

However, this contradicts the majority of independent analysis, which finds electrification is a far cheaper option for homes. Recent IEEFA analysis looked into the prospects for hydrogen or biomethane for homes, and found that the delivered cost for hydrogen would be up to 2.7 times more expensive than fossil gas, and 10 times more expensive than switching to electricity.[60] This is before any additional costs for upgrading the network to be compatible with hydrogen are considered – which the gas networks have noted could be over 28% the cost of building a new network.[61]

The logistics of switching to hydrogen are complicated by the fact that existing appliances are incompatible with high blends of hydrogen. If the networks were to switch to hydrogen, households would need to upgrade their appliances to be hydrogen-compatible at the same time, or risk going without heating or hot water.

[59] Frontier Economics. The benefits of gas infrastructure to decarbonise Australia: A report for the Australian gas industry. September 2020. Page 5.
[60] IEEFA. 'Renewable gas' campaigns leave Victorian gas distribution networks and consumers at risk. August 2023. Page 10.
[61] APGA. Retail renewable gas forecast to cost customers less than retail renewable electricity. Page 1.

Biomethane offers greater compatibility with existing networks and appliances, however this gas simply isn't available at the scale needed to replace Victoria's fossil gas supply, and would be challenging to deliver to the existing transmission and distribution network.

Given Victoria's ambitious emission reduction targets, it is far more likely that hydrogen and biomethane would be reserved for end uses that are not able to cheaply electrify. Some residential homes may be harder to electrify than others and could benefit from a small-scale supply of biomethane that could be bottled. However, it is likely that these gases will have a more critical role to play at scale in hard-to-abate sectors such as heavy industry.

Networks may need to bear a large portion of their unrecovered costs

Governments and regulators will have to decide who pays for the significant unrecoverable costs gas distribution networks are likely to face.

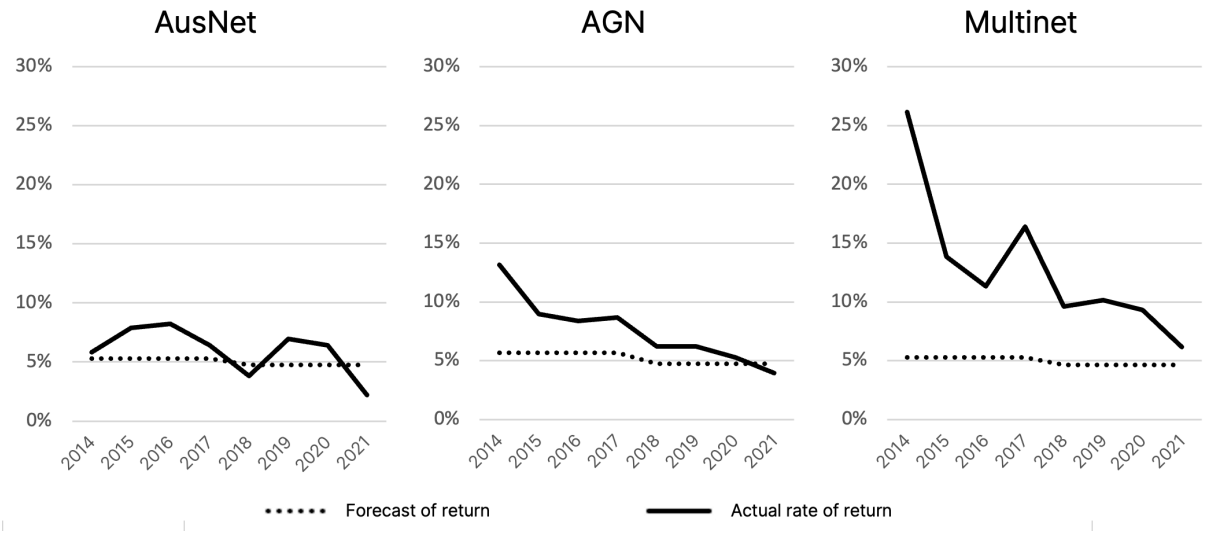
The AER has already transferred a greater share of risk onto consumers in its decisions. However, it has warned that this is not a sustainable solution. Combined with the fact that the regulator is obligated to act in the best interests of energy consumers, not networks, it is unlikely that consumers will be expected to bear the bulk of these unrecovered costs. This would also lead to inequitable impacts for households that have less capacity to electrify than others – such as renters or apartment dwellers.

Governments may consider if it is appropriate to compensate networks directly for some of their unrecovered costs. However, this is likely to be limited given the network's historic financial performance.

The AER has allowed for rates of return on the regulated equity of gas distribution networks well above what would be expected from a risk-free business. Furthermore, the actual rates of return on regulated equity have typically exceeded the forecast rate – in some cases by extraordinary margins (Figure 8).[62]

[62] AER. Gas network performance report 2022. Gas Networks – Financial performance data – 2014-21. December 2022.

Figure 8: Gas distribution network real return on regulated equity vs AER forecast rates



Source: AER. Real rates of return on regulated equity. Includes effects of incentive schemes.

These premium returns are far more typical of a business exposed to substantial risks, rather than a regulated monopoly. As these are large businesses with a highly diversified ownership base, it is unlikely governments will face significant pressure to subsidise their unrecovered costs. This would imply the networks should prepare to bear a large amount of these unrecovered costs.

A plan to wind down gas networks is necessary and manageable

Given their incompatibility with residential electrification, Victoria's gas distribution networks may need to be scaled down significantly or entirely decommissioned in coming decades.

Globally, several jurisdictions are planning to decommission their gas distribution networks entirely, and their experience is likely to offer valuable insights into how to orchestrate the process.[63]

As a local example, the Esperance Gas Distribution Network in Western Australia was switched off in 2023 after becoming financially unviable.[64] The WA government invested $10.5 million in supporting customers to transition largely to all electric appliances successfully,[65] with some users switching to bottled gas only where electrification was infeasible.[66]

[63] For example, Winterthur in Switzerland (Energy Cities. "We no longer need a (gas) pipeline network in residential areas". July 2023.)
[64] Horizon Power. Esperance Energy Transition Plan Customer hub. 2023.
[65] Western Australia State Government. Hon Bill Johnston MLA. Esperance electrification project an energy transition first. 21 March 2023.
[66] One Step Off the Grid. Why this state government is kicking gas out of a big coastal community. 28 April 2022.

While it is a small case study (379 customers), the switch-off of Esperance's network was far more abrupt than the winding down faced by Victoria. Yet it was orchestrated without customers losing essential energy supplies.

Another useful case study is Basslink, the key energy and communications network link between Tasmania and Victoria. When the company operating Basslink went into receivership in 2022 after being unable to pay its debts, the Tasmanian government was able to arrange for the cable to stay in service until a new owner was found.[67]

> **Governments are unlikely to face an inherent pressure to maintain the financial viability of gas distribution networks.**

In a similar vein, governments are unlikely to face an inherent pressure to maintain the financial viability of gas distribution networks. However, it will be in their interests to ensure networks are wound down in the most efficient way possible, minimising the support needed at the tail end of their operational life.

Governments and regulators have a number of options to support an efficient phase-down of gas distribution networks, and will need to consider which options best support, rather than hinder, the transition.

Reducing the barrier for homes to leave the gas network will be a critical step. Abolishment charges ($220 in Victoria; unregulated in other states) create a disincentive for consumers to leave.

The current regulatory regime for gas distribution networks incentivises them to increase demand; innovative solutions may be needed to incentivise networks to wind down.

Promotion of hydrogen and biomethane in gas distribution networks (Box 3) is counterproductive, as those gases do not represent a cost-competitive or viable option compared with electrifying, and promotions may fail to disclose this while encouraging customers to persist with gas.

A sustainable end point will need to be considered, which includes the minority of customers on gas distribution networks that are hard to electrify. AGN noted that possible futures for its business in South Australia could include operating a "tube and trailer" network, or a reduced "trunk line" business that focuses on major customers.[68]

[67] Renew Economy. Tasmania terminates contract with Basslink, as legal fight continues. 11 February 2022.
[68] AGN. SA Revised Final Plan July 2021 – June 2026. Attachment 9.6 - Future of Gas. 13 January 2021. Page 10.

Victoria needs a plan to phase out residential gas

An uncontrolled electrification transition could trigger a ‘gas death spiral’

If distribution networks were to fully or partially recover their costs from customers in an uncontrolled electrification scenario, this could trigger a scenario described as the “gas death spiral”.

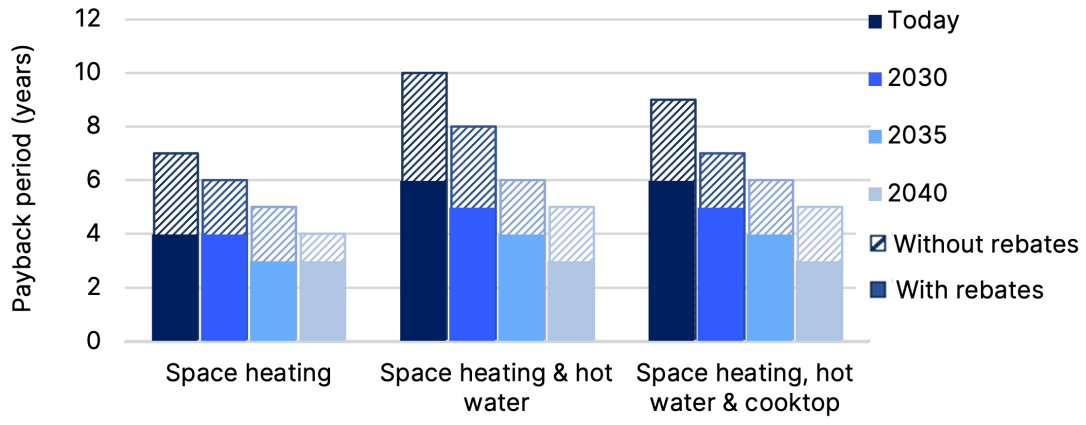
Under a “gas death spiral”, staying connected to the gas network attracts an increasing price premium, which in turn makes switching to electric appliances a more attractive option.

IEEFA has modelled how the full cost recovery price trajectory in Figure 6 impacts the economic case for household electrification.

Figure 9 shows three scenarios for an average Victorian household that relies on fossil gas for space heating, water heating and cooking. It shows that the payback period for switching one, two or all three of these appliances ranges from four to six years in 2023 (or seven to 10 years if government rebates are excluded).

Under the electrification scenario modelled in this report, an uncapped rise in gas distribution prices would improve the payback period of household electrification over time. For a house electrifying three end uses, the payback period halves from six to three years between 2023 and 2040. (Before government rebates, it drops from nine to five years.)

Figure 9: Gas distribution price rises make premature electrification more attractive to households



Source: IEEFA modelling detailed in Appendix B and C. Rebates include eligible VEECs and STCs. The ‘Space heating, hot water & cooktop’ scenario includes abolishment fees and avoided gas standing charges.

These payback periods assume households are replacing their appliances before their natural end of life. In other words, it is a measure of the attractiveness of electrification decisions in addition to the end-of-life appliance phase-down that underlies the modelling.

These calculations only consider the upfront cost of new electric appliances. However, many households would need to consider that their gas appliances could be due for replacement in the next 10 years anyway. This would make electrification even more financially attractive.

The likely timing and impact of a "gas death spiral" would depend on consumer behaviour in response to changes in the underlying economics, which is very difficult to model. This creates uncertainty in planning for how quickly Victoria would need to scale up its supply chains and workforces to support the installation of electric appliances.

A delay may compound cost lock-in and asset-stranding risks

There are parallels between an end-of-life gas appliance phase-out, and the Victorian government's decision in 2023 to stop connecting new homes to the gas network.[69] In both cases, the intervention aims to prevent growth of an asset base that is at risk of stranding (gas networks in the case of the government's announcement, and consumer assets in the case of an appliance phase-out).

> **It would be in consumers' interests to implement residential electrification policies as early as practical, as hundreds of millions of dollars in appliance lifetime costs could be avoided for each year that policy is brought forward.**

It would be in consumers' interests to implement residential electrification policies as early as practical, as hundreds of millions of dollars in appliance lifetime costs could be avoided for each year that policy is brought forward.

Given that AEMO has forecast annual supply shortfalls as early as 2027, starting an appliance phase-out as soon as practical also makes sense from an energy security perspective.

Finally, from an emissions perspective, a delay in action could take residential fossil gas emissions even further off track with respect to Victoria's emission reduction targets, which has implications for the decarbonisation effort needed in other sectors.

[69] Victoria State Government. Hon Lily D'Ambrosio MP. New Victorian Homes to go All Electric from 2024. 28 July 2023.

Challenges should not delay cost-effective electrification

There may be some cases where it is not immediately possible to replace gas appliances with efficient electric appliances. For example, in high-density housing where outdoor space is unavailable for heat pump units.

More work is needed to understand the extent of these barriers and develop long-term solutions. In the short term, compromises may need to be considered on a case-by-case basis that offer the least-cost solution for consumers. This could include:

- Installing less-efficient electric appliances, but reducing costs by enabling load-shifting and/or thermal efficiency improvements, or;
- For the minority hardest-to-electrify cases, moving to bottled LPG that could in future be substituted with biomethane.[70]

However, it should be noted that more than 70% of dwellings in Victoria are detached houses,[71] which generally offer the fewest barriers to electrification.

Benefits can be extended to renters and low-income households

Rental providers tend to favour installing the lowest-price fixed appliances irrespective of their fuel costs, because they are not responsible for paying energy bills. This split incentive makes it difficult for renters to access the benefits of electrification. A policy intervention that results in all new space heating, hot water and cooking appliances being electric could and should assist rented households.

A requirement to electrify gas appliances at end of life would deliver the best economic outcomes if supported by minimum efficiency standards for rentals. As of March 2023, heaters installed in rental properties in Victoria must meet energy-efficiency standards.[72] However, these standards could be tightened further to ensure that wherever possible:

- Cooktops are replaced with modern induction cooktops;
- Space heating appliances are replaced with heat pumps, with a coefficient of performance in line with the market average, and;
- Water heaters are replaced with heat pump systems.

Support will also be needed to ensure low-income households can overcome capital cost barriers to have equitable access to efficient electric appliances. However, as most gas-to-electric conversions are NPV-positive, financing structures could be designed to enable this at minimal cost to taxpayers.

[70] As biomethane supply in Victoria is highly constrained, this solution would need to be reserved for the most difficult-to-electrify use cases only. (See IEEFA. 'Renewable gas' campaigns leave Victorian gas distribution networks and consumers at risk. August 2023.)
[71] Australian Bureau of Statistics. Estimated Dwelling Stock. Table 03. 31 October 2022.
[72] Consumer Affairs Victoria. Rental properties – minimum standards. Heating.

The state government's Solar Victoria project has been running for more than five years, and has a wealth of experience in designing interest-free loan schemes and other incentive programs to support uptake of electric appliances and DER.[73] The Victorian government is well placed to learn from this experience in upscaling electrification policies.

Greater benefits can be unlocked if electrification is managed well

By implementing a managed plan to phase out residential fossil gas, Victoria has an opportunity to maximise the economic benefits of electrification and optimise the costs of its energy system.

For example, upgrading the thermal efficiency of existing houses while moving to electric appliances can unlock greater energy bill reductions, optimise upfront costs for consumers and significantly reduce electricity system investment costs.[74]

Electric appliances are not all equal. For instance, resistive electric systems for space and water heating consume many times more energy than heat pump systems, which also vary in efficiency. The Greenhouse and Energy Minimum Standards (GEMS) Act in Australia exists to provide a framework for appliance energy efficiency in Australia, including minimum efficiency standards for appliances. However, there is significant room for improvement to tighten these standards, particularly for hot water systems.[75]

Reverse-cycle air conditioner installations in Victoria are conventionally optimised for cooling (e.g. when placed high on walls), which may reduce their heating efficacy.[76] Installing units to optimise for heating instead could help reduce costs by "right-sizing" energy solutions.

> **Combining the benefits of well-orchestrated DER with household electrification presents a significant economic opportunity.**

Additionally, combining the benefits of well-orchestrated DER with household electrification presents a significant economic opportunity. With the right regulatory support, well-orchestrated deployment of rooftop solar and home storage uptake can lower electricity costs for all consumers by reducing electricity network peaks and capacity requirements.[77]

[73] Solar Victoria. What we do. 11 May 2023.
[74] Climateworks Centre. Renovation Pathways: Project update and preliminary findings of cost-benefit analysis. April 2023. Page 5.
[75] UTS Institute for Sustainable Futures. Domestic Hot Water and Flexibility. June 2023. Page 57.
[76] The Conversation. Replacing gas heating with reverse-cycle aircon leaves some people feeling cold. Why? And what's the solution? 2 October 2023.
[77] IEEFA. Saturation DER modelling shows distributed energy and storage could lower costs for all consumers if we get the regulation right. April 2023.

CSIRO analysis for Energy Consumers Australia (ECA) found that if DER and electrification assumptions aligned to AEMO's *Step Change* scenario, this would lead to increased utilisation of distribution networks, which lowers prices for all consumers in the long term.[78]

Electric household appliances could also offer significant demand flexibility services, reducing overall costs for all consumers. This is particularly true for residential hot water systems.[79] However, the standard that applies to demand response in Australia is outdated,[80] and the electricity market does not adequately compensate households for demand flexibility services.[81]

A recent IEEFA report recommended that a demand response capability be legislated under the GEMS Act, enabling manufacturers and the market to offer a broader range of demand flexibility solutions, and that aggregated household demand response should be included within AEMO's wholesale demand response mechanism.[82]

Workforce and supply chains will need to ramp up, which represents an opportunity

Replacing Victoria's household gas appliances with electric alternatives at end of life could require more than 800,000 electric appliance installations a year.[83]

However, as many of these installations would be occurring instead of gas appliance installations, this represents a redirection of effort rather than a new effort. It also builds on a substantial existing base of skillsets and supply chains. However, these will need to be scaled up, and the workforce engaged in selling and installing gas appliances may require retraining.

There are examples of workforces and supply chains successfully scaling up to support a transition to a new technology.

In the 2008-09 financial year, Australia installed almost 30,000 rooftop solar systems. Two years later, this increased more than tenfold to 360,000.[84] Australia is now a global leader in rooftop solar installations, with an industry that supports more than 13,000 jobs.[85]

This scale-up of rooftop solar installations took place within a sector that was little more than a cottage industry in 2009. However, scaling up household electrification has the advantage that it is starting from a well-established industry of electric appliance installations.

[78] CSIRO and Dynamic Analysis. Consumer impacts of the energy transition: modelling report. July 2023. Page v.
[79] UTS Institute for Sustainable Futures. Domestic Hot Water and Flexibility. June 2023. Page 1.
[80] IEEFA. Mandating AS4755 Ignores Households and Widely Supported International Solutions. August 2021. Page 2.
[81] IEEFA. Growing the sharing energy economy. October 2023. Page 5.
[82] IEEFA. Growing the sharing energy economy. October 2023. Page 9.
[83] Modelling in Appendix A.
[84] Australian PV Institute. Australian PV market since April 2001. June 2023.
[85] Australian Bureau of Statistics. Employment in Renewable Energy Activities, Australia. April 2020.

As another example of rapid scale-up, in Poland heat pump sales grew by 130% in one year (and more than 800% in a five-year period). This has been bolstered by major heat pump manufacturers investing in new capacity in the country, which is expected to create more than 3,500 jobs.[86] A Heat Pump Installer Academy has been established to support local distributors.[87] Efficient LED light globes were effectively non-existent in Victorian homes before 2010; however in the space of just over a decade they have become the dominant lighting technology.[88] This is due in part to proactive policies such as the Victorian Energy Upgrades program.

While the scale of the transition is large, so is the economic opportunity. Several organisations, including the Energy Efficiency Council[89] and Race for 2030,[90] are investigating issues around upscaling electrification supply chains and workforces in Australia, and Victoria would be well placed to accelerate these efforts.

Globally, other jurisdictions are taking a managed approach to electrification

Several jurisdictions have implemented policies to encourage a managed phase-out of gas appliances.

The California government plans to ban the sale of gas space heaters and water heaters by 2030,[91] with the San Francisco Bay Area enforcing zero-emissions requirements for new appliances as early as 2027.[92]

In the Netherlands, gas-powered central heating systems will need to be replaced with electric alternatives once they reach their end of life from 2026.[93]

In Germany, a jurisdiction with the same net zero target as Victoria, installation of new gas heating systems will be effectively banned from 2024.[94]

All of these jurisdictions have similar per-capita consumption of residential fossil gas to Victoria,[95] and hence provide useful case studies for how to transition the residential sector to electricity.

[86] Notes from Poland. Heat pumps boom in Poland, Europe's fastest growing market. April 2023.
[87] European Heat Pump Association. PORT PC: 2022 was the Year of Heat Pumps in Poland. February 2023.
[88] No reported stock in 2009, rising to 61.64m in 2021 (52% of all lighting). From EnergyConsult. 2021 Residential Baseline Study for Australia and New Zealand for 2000 – 2040. November 2022. Table 22.
[89] Energy Efficiency Council. Residential Energy Upgrades Workforce Mapping Project.
[90] Race for 2030. Energy Upgrades for Australian Homes.
[91] Los Angeles Times. California moves to ban natural gas furnaces and heaters by 2030. 23 September 2022.
[92] Reuters. San Francisco Bay area to phase out natural gas heating appliances. 17 March 2023.
[93] Euractiv. Netherlands to ban fossil heating from 2026, make heat pumps mandatory. 17 May 2022.
[94] The Guardian. Germany plans to ban installation of most oil and gas heating from 2024. 21 April 2023.
[95] Annual per-capita residential fossil gas consumption of 13.5-14.85 GJ pa based on ABS (2021), EnergyConsult (2022), US Census Bureau (2022), US Energy Information Administration (2023), Statistics Netherlands (2023), Planbureau voor de Leefomgeving (2023), Destatis (2021a) and Destatis (2021b).

Conclusion

Victoria can set itself up for a successful electrification transition

As this report highlights, household electrification presents a significant opportunity for Victoria to reduce consumer energy bills, avoid long-term supply shortfalls, and reduce its greenhouse gas emissions. To take advantage of this opportunity, Victoria should take immediate action across several key areas:

1. Ensure gas appliances are replaced with efficient electric alternatives at end of life from 2025 in all applicable homes

Victoria should consider ending the sale of household gas appliances by 2025, or taking equivalent measures that require gas appliances to be replaced by efficient electric appliances wherever possible at end of life.

Our analysis suggests that this may be the only single action that has the potential to reduce residential fossil gas consumption at the pace needed to mitigate long-term supply shortfalls and meet Victoria's emissions targets. It would also bring significant economic benefits to energy consumers.

There may be a minority of special cases where electrification is not immediately viable or cost-effective. These could be excluded in the short term without diminishing the benefits to the majority of households.

Implementing this step as early as 2025 makes the greatest economic sense, as a delay would reduce its effectiveness in mitigating impending annual gas supply shortfalls, meeting emissions targets, or addressing the cost-of-living crisis.

2. Encourage gas appliances to be replaced with efficient electric alternatives before end of life, where it makes financial sense

While replacing gas appliances with electric alternatives at their natural end of life generally offers the shortest payback periods, there are many situations where it makes financial sense to replace gas appliances before their end of life.

For the situations where this is true, households should be encouraged and supported to make the switch. In particular, rental properties and low-income households should be supported. These households are typically locked out of voluntary electrification opportunities and are at risk of bearing an inequitable cost burden under an unmanaged electrification transition.

Financing solutions, including low- and no-interest loans, are already being trialled by groups including Solar Victoria. Governments should work to expand such programs to reach as many households as possible.

3. Develop a plan to wind down gas distribution networks

Gas distribution businesses are incompatible with household electrification. Continuing to allow networks to recover their full costs from consumers is unsustainable as it would lead to unprecedented cost rises, and potentially trigger an unpredictable "gas death spiral".

If residential fossil gas reaches very low volumes by the 2040s in line with an economic electrification scenario, it may no longer be viable to supply it using large, reticulated gas networks.

Governments and regulators should prioritise developing a plan for the physical and financial decommissioning of gas networks.

This may mean gas networks face significant unrecovered costs, and a decision is needed on who pays for these. It is unlikely the AER would choose for consumers to bear these costs, and governments may be reluctant to significantly subsidise these costs, given the extraordinarily high rates of return that Victoria's distribution networks have historically received.

4. Identify and implement solutions for hard-to-electrify homes

While many homes are ready to electrify, the diversity of Victoria's housing stock means some homes may face unique challenges.

Multi-unit dwellings, for example, may be difficult to electrify, based on a combination of owner's corporation rules and physical constraints that limit the use of outdoor heat pump units.

More work is needed to understand the scale of challenge for these dwellings, and develop appropriate solutions. This could include removing cost or regulatory barriers, or deploying targeted small-scale alternatives to electrification, such as limited applications of biomethane. Large, reticulated gas networks are unlikely to present a cost-effective option to reach these consumer groups.

5. Strengthen standards and market arrangements to support greater uptake of energy efficiency, DER and demand flexibility

Transitioning to all-electric homes offers a significant opportunity to reduce consumer energy bills. However, bills and total energy system costs could be minimised if electrification is accompanied by other key demand-side actions.

Improving the thermal efficiency of homes can substantially reduce their heating and cooling needs, hence magnifying the difference in energy consumption from electric appliances compared with their gas predecessors.

Furthermore, not all electric appliances are equal. Older-style electric resistive space and hot water systems are cheaper upfront than heat pumps, but use significantly more energy to perform the same work. Strengthened minimum appliance efficiency standards will be required to ensure households, including rental properties, do not transition to inefficient electric appliances.

The effective orchestration of DER also offers a significant opportunity to optimise the energy system and reduce bills for all consumers, consideration should be given as to how to best make use of DER in tandem with newly electrified loads.

There is a significant untapped demand flexibility potential in electric appliances. However, unlocking this potential is likely to require revisions to electricity market arrangements to value residential demand flexibility, and an update to the GEMS Act requiring that priority household appliances be sold with demand-response capabilities. Details around these recommendations are outlined in a recent IEEFA report: Growing the Sharing Energy Economy.

6. Develop a strong electrification workforce and supply chain.

Supporting rapid deployment of efficient electric appliances in Victorian households will require a strong skilled workforce and secure supply chains.

Globally, other jurisdictions are rapidly upscaling their manufacturing and installation capacity to support their electrification transition. Australia has proved that it can be a world leader in rapid uptake of new technologies, and could unlock significant job opportunities by doing so.

Victoria should work closely with industry organisations to ensure that workforce and supply chain barriers are unlocked as a priority matter to support Victorian households on their electrification journey.

Detractors of the divestment strategy raise a number of objections on financial grounds: foremost, that divestment will cause institutional investment funds to lose money or undermine their ability to meet their investment objectives, thus ultimately harming their social mandates. They say foundations will have to give fewer grants and universities fewer scholarships, while public pension funds will be unable to meet their obligations, forcing governments to raise taxes.

Paradoxically, the fossil fuel sector's sudden fall from grace was largely caused by a drop in prices that grew out of a major technological innovation in the oil and gas sector: hydraulic fracturing (fracking). Fracking increased the supply of cheap oil and gas and emerged as a new source of supply that disrupted the dominance of OPEC and its supporters. In the post-2014 period, oil prices crashed, oil company revenues plummeted, expensive capital investments failed, massive amounts of reserves were written off as no longer economic, and major bankruptcies occurred. This decline

exposed long-standing weaknesses in the industry's investment thesis which was to assume that a company's value was determined by the number of barrels of oil (reserves) it owned.

In the new investment environment cash is king, creating a conundrum for the industry. Aggressive acquisition and drilling will likely lead to more losses for investors. However, if oil and gas companies pull back and acknowledge lower future returns and more modest growth patterns, their actions only confirm that the industry is shrinking.

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

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