28 February 2025

Katie Brown
Executive Director - Electrification, Efficiency and Safety
Energy Division
Department of Energy, Environment and Climate Action

Via: Engage Victoria (https://engage.vic.gov.au/building-electrification) and Gas Roadmap (DEECA) (gas.roadmap@deeca.vic.gov.au)

ENA's response to the Victorian Building Electrification RIS

Energy Networks Australia (ENA) welcomes the opportunity to make a submission to the Victorian Building Electrification Regulatory Impact Statement (referred to hereafter as the RIS).

ENA represents Australia's electricity transmission and distribution and gas distribution networks. Our members provide over 16 million electricity and gas connections to almost every home and business across Australia.

ENA supports reaching net zero emissions by 2050 or earlier, which requires coordinated actions across all sectors. Australia will need to play a vital role to both decarbonise its domestic economy and its emission intensive industries.

ENA's submission is supported by detailed analysis in the following attachments:

1. Impacts of Forced Electrification on the Victorian Energy System, Costs and Emissions, L.E.K. analytical report 18 February 2025 **(Attachment 1)**
2. Analysis of Victorian RIS assumptions, ACIL Allen, 23 February 2025 **(Attachment 2)**

Key messages

1. Our detailed, independent analysis shows that the Government's preferred option in the building electrification RIS **would lead to significantly higher energy costs for all Victorian customers**. This includes:

   Increased overall energy system costs (electricity, gas and customer costs) for Victoria by $22 billion over 20 years including **increase wholesale electricity costs**, which will impact not only the portion of new load that is switched from gas to electricity, but also all electricity users – that is homes and businesses - across Victoria. **The increased cost of electricity alone is more than the savings from reduced gas** consumption. Including the additional capital expenses from replacing gas assets under Forced Electrification increases these overall costs further.

A material amount of new natural gas peaking generation to be built and used, both in Victoria and elsewhere in the NEM, to meet the additional electricity demand. This will result in 0.5 tonnes of additional emissions to generate the electricity required, with a system cost of $1,222 per tonne, for every 1.0 tonnes of gas consumption emissions saved from FY25-45.

The increase in electricity demand during peak periods, in the winter mornings and the evenings, occurs at the same time when cheaper electricity in the form of wind and solar is at its lowest. This means more expensive generation is needed which drives up wholesale prices.

2. The Government's preferred option under the building electrification RIS **would not solve the gas shortage and gas supply challenges facing the state imminently.**

   The Government's preferred option would not significantly decrease gas demand to address Victoria's impending gas supply shortage. This supply challenge is one that needs to be addressed within the next 2 to 3 years, regardless of this policy, and is best done by fostering a supportive policy environment to enable rapid investment in gas supply infrastructure.

3. The Government's preferred option under the building electrification RIS **would do little to meaningfully reduce emissions before 2034, as emissions savings in the gas system are** largely offset by increased gas and coal emissions in the electricity system.

   The net emissions impact per year under the Building Electrification Regulatory Impact Statement are expected to be between an 0.1% increase to a 2.2% reduction to Victoria's current total annual emissions (at an average cost to consumers of $1,222 per tonne). This saving is relatively small compared to the c.200m+ tonnes of petrol emissions forecast over that period.

ENA Recommends:

Not proceeding with the RIS options, preferred or otherwise, and, rather;

1. A continuation of the progressive electrification of Victorian households when it suits their needs and circumstances. Forcing Victorians to electrify before the electricity generation system is ready to cope (with adequate renewables and storage connected) would deliver poor economic and reliability outcomes for all Victorian customers and put the energy system under unnecessary pressure.

2. A shift in focus by the Victorian Government to provide more strategic support for actions that can reduce emissions and benefit customers, such as more local renewable generation and storage, more charging infrastructure to encourage greater uptake of EV's.

ENA engaged L.E.K. Consulting to assess the impact of the Government's preferred option under the RIS on Victorian customers (the L.E.K. Report). L.E.K. partnered with Endgame Analytics to provide a 'whole of energy system' analysis of the impacts of the RIS – considering the wholesale electricity and gas market impacts, network costs, customer costs of electrification and the notional changes in emissions. This detailed analysis uses inputs and assumptions based on lived experience for customers that electrify and realistic expectations for the future entry of new generation and transmission in the electricity system. The L.E.K. Report is included in **Attachment 1**.

ENA also engaged ACIL Allen to conduct an independent review of the inputs and assumptions to the Victorian building electrification RIS. This review is included in **Attachment 2**.

ENA's submission focusses on the impacts of the RIS through an energy trilemma perspective covering costs (both at the system level and at the customer level), reliability (electricity system, gas supply and role of gas networks), and sustainability (emissions). We also identify alternative options that the Victorian government could pursue to lower emissions.

ENA's members have also provided detailed submissions, including responding to the specific consultation questions in the RIS.

Yours sincerely,

Dominique van den Berg

Chief Executive Officer

Energy Networks Australia
energynetworks.com.au
info@energynetworks.com.au

Unit 5, Level 12, 385 Bourke Street,
Melbourne VIC 3000
+61 3 9103 0400

Energy Networks Association
T/A Energy Networks Australia
ABN: 75 106 735 406

Modelling the impacts of the RIS on the Victorian energy system

The Victorian building electrification RIS outlines three major challenges for Victoria. These include the cost of energy for Victorian consumers, energy security and reliability and energy sector greenhouse gas emissions. The Government's preferred regulatory option to address these challenges is Option 3: *Electrification of all new and existing residential buildings (excluding existing residential cooking) and all new commercial buildings.*

Given the potential impact of the Government's preferred option and the concerns raised in the independent assumptions review (see below), ENA engaged L.E.K. to assess the impact of the RIS on Victorian customers. L.E.K. partnered with Endgame Economics to prepare a 'whole of energy system' analysis of the impacts of the RIS – considering the wholesale electricity and gas market impacts, the network costs, customer costs of electrification and the notional reductions or increases in emissions.

L.E.K. modelled two scenarios for the Victorian energy system. A "progressive electrification" scenario where existing households and businesses progressively electrify when it makes good financial sense for them to do at rates consistent with recent historical customer preferences. This scenario includes all policies introduced prior to the RIS. The second scenario was a "forced electrification" scenario which adopted the settings of the Government's preferred option within the RIS.

Both scenarios showed a declining gas demand and an increased electricity demand. However, forced electrification resulted in greater reductions in gas demand and consequently, higher electricity demand, as shown below (Figure 1).

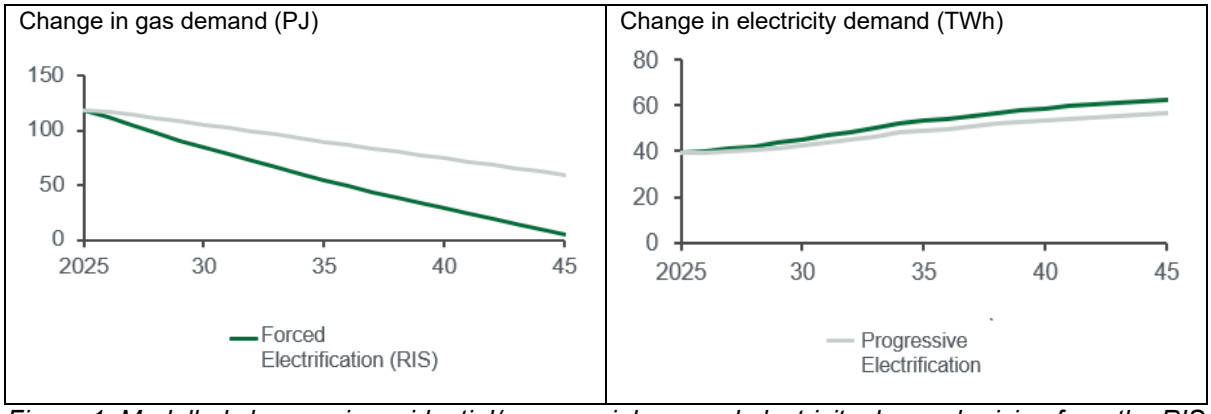

Figure 1: Modelled changes in residential/commercial gas and electricity demand arising from the RIS (Source: LEK (2025))

The RIS would reduce local gas demand in Victoria by 21 PJ in 2030 and 54 PJ by 2045. The electrification of this gas load will require an additional 2.6 TWh of electricity generation in 2030 and 5.8 TWh in 2045. The daily and seasonal consumption for gas heating means that over a quarter of the increased electricity consumption cannot be met by renewables and comes from gas fired generation.

Metrics, inputs and assumptions

It is useful to compare the headline metrics of the Victorian RIS with the updated LEK modelling using the key metrics of overall economic benefit, energy security and reliability in terms of gas savings and wholesale electricity prices and reductions in greenhouse gases.

Several key assumptions in the building electrification RIS appear to favour the Government's preferred option. Revising the results using assumptions that align with the real, lived experience and

more aligned with industry understanding of future conditions across the energy system would significantly swing the results away from the Government's preferred option.

The modelling approach as well as key inputs and assumptions are set out at pages 23 to 29 of the LEK Report in **Attachment 1**.

In addition, ENA commissioned ACIL Allen to undertake a high-level review of the RIS assumptions, and to identify any material issues and errors with the RIS methodology. ACIL Allen was selected as they are well experienced with the Victorian energy system and Victorian policy settings around gas through their earlier work on the Victorian Gas Substitution Roadmap.

ACIL Allen found that several key assumptions are not appropriate or realistic for this RIS, and once adjusted would entirely negate the net benefits and broader economic benefits for Victoria found in the Government's modelling. This includes electricity and gas price inputs, carbon price inputs, gas disconnection costs, the applied discount rate, and relative appliance costs. ACIL Allen's report to ENA can be found at **Attachment 2**.

Energy costs increase for all Victorian customers

LEK modelled the wholesale price impacts from the Government's preferred option under the RIS. As noted above, the RIS results in local gas savings from electrifying households and in turn increases electricity demand.

The net result of brown coal retirement, and the expected pace of wind and solar capacity additions, means that the wholesale electricity price in Victoria is expected to increase relative to today. The completion of transmission projects allows additional renewable generation to enter the system from the early 2030s and this then places downward pressure on wholesale electricity prices, which stabilise in the early 2040's. The LEK analysis finds that the RIS would create additional electricity demand resulting in an average increase of $5/ MWh over the modelling period.

These higher wholesale prices impact customers in two ways. For gas customers, they are electrifying into a period of higher electricity prices and this is partly offset by avoided gas costs. For existing electricity customers, the extra demand from the RIS increases the wholesale price so they will pay more for each kWh of electricity they consume. The extra costs from the higher electricity consumption and prices outweighs the wholesale savings from lower gas consumption.

Alongside higher electricity generation and storage costs are higher appliance costs in switching from gas to electricity. This analysis uses a higher capex cost for electrification than assumptions adopted by in the RIS. The LEK analysis is based on data gathered by ACIL Allen[1] and Frontier Economics[2] directly from gas and electric appliance installers in Victoria in 2022. Figure 2, shows that the RIS incurs a net cost to Victorian energy customers of $22 bn by 2045.

[1] ACIL Allen (2024), *Delivering lower cost decarbonisation for gas customers and the Australian economy*, available from: https://acilallen.com.au/projects/energy/renewable-gas-target-delivering-lower-cost-decarbonisation-for-gas-customers-and-the-australian-economy

[2] Frontier Economics (2022), *Cost of switching from gas to electrical appliance in the home*, available from: https://gamaa.asn.au/wp-content/uploads/2022/07/Frontier-Economics-Report-GAMAA.pdf

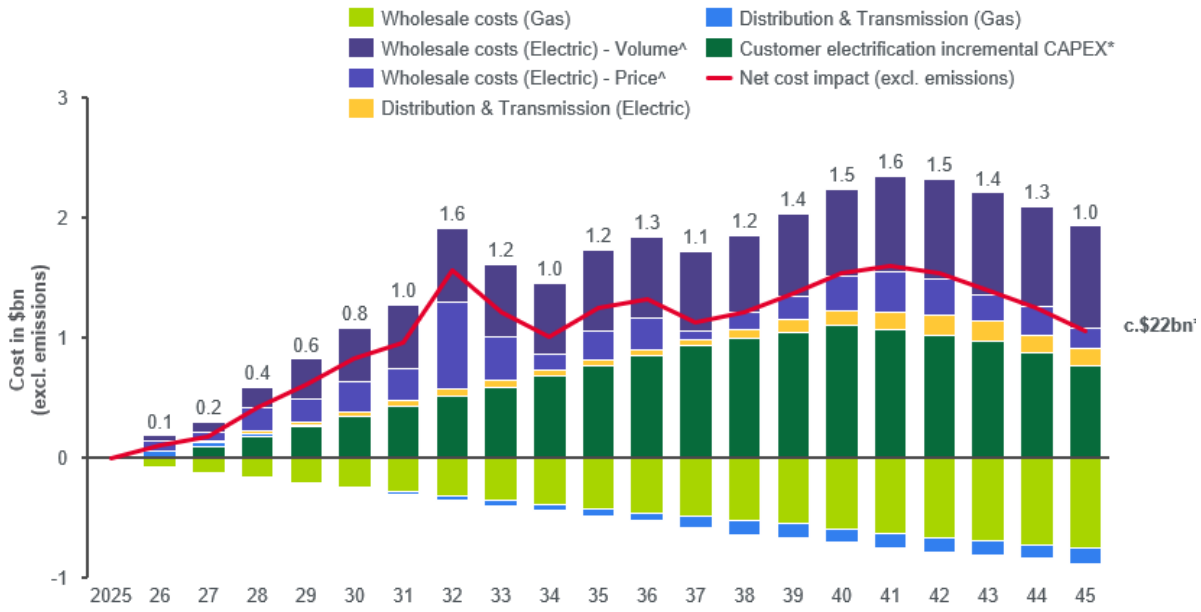

Figure 2: Total system cost impacts from the RIS (Source: LEK (2025))

Five generic household types were modelled to illustrate the impacts of those system costs on Victorian energy customer bills. While all customers have their individual circumstances we chose customer types that illustrate the impact on customer bills from the RIS across a broad spectrum of representative Victorian households. The customer types are set out at page 18 of the LEK Report

For all customer types annual bills will increase, every year over the next 20 years under the RIS. This is to varying extents but includes increases to electricity bills due to the higher wholesale electricity prices arising from increased electricity demand during winter peaks.

This will impact all customers including those who already have solar and have already made the switch from gas appliances. This finding is important and is likely an unintended consequence of the RIS which should be closely considered by the Victorian Government.

The Government's preferred option under the RIS has other secondary effects, including increases in gas prices as network fees are recovered by a reduced number of customers.

The energy system becomes less reliable

One of the unintended consequences of the RIS is that the increase in electricity demand during peak periods will result in more times when the Victorian energy generation system is operating at its limits, and this increases system reliability risks.

During the winter period, the system is heavily reliant on firm generation assets such as coal, gas generation and various forms of longer duration storage. The increased demand from the Government's preferred option under the RIS:

- requires more of this higher cost generation and storage, and
- increases the amount of time when the Victorian electricity system is under strain.

The LEK Report in Attachment 1 shows, at page 15, the electricity demand and price impact of the Government's preferred option under the RIS during a week in 2031. It shows a system that is more constrained and more likely to experience reliability issues due to limited supply.

Overall, electrification in the Victorian energy system is expected to increase daily consumption peaks[3]. While decarbonisation and electrification can reduce annual gas demand, peak demand is still expected to increase. There is an increase in both electricity and gas peak demand, which requires investment in generation and storage infrastructure for both electricity and gas peakers. The Victorian government should implement policies that provide a supportive environment for the industry to invest in, design, build and operate the required infrastructure.

Respected energy system analysts concur that electrification of residential and commercial gas load in Victoria will increase peak demand in winter and change the Victorian electricity system from being summer peaking to becoming winter peaking. These months of increased demand coincide with lower renewable output as shown in Figure 3.

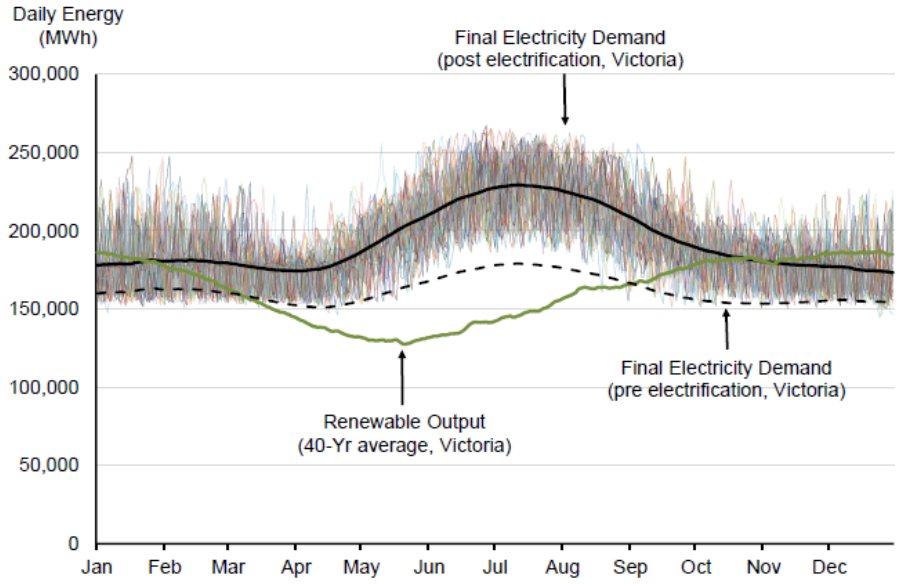

Figure 3: Electricity demand and modelled renewable generation for Victoria averaged over a 40 year period (Source: Simshauser and Gilmore (2024))

Emissions reductions are marginal and come at very high cost

LEK found that emissions saved from electrification under the Government's preferred option are largely offset by additional emissions from electricity generation across the NEM to meet the increased electricity demand. The RIS does not produce material emission reductions until 2034. The average abatement cost to 2045 is $1,222/ t CO_2-e.

Figure 4 shows the net emissions reductions under the Government's preferred option over the 20 years to 2045.

[3] Simshauser and Gilmore (2024), *Policy sequencing: on the electrification of gas loads in Australia's National Electricity Market*, available from: https://www.griffith.edu.au/__data/assets/pdf_file/0023/2064560/2024-10-NEM-Electrification-07.01.pdf

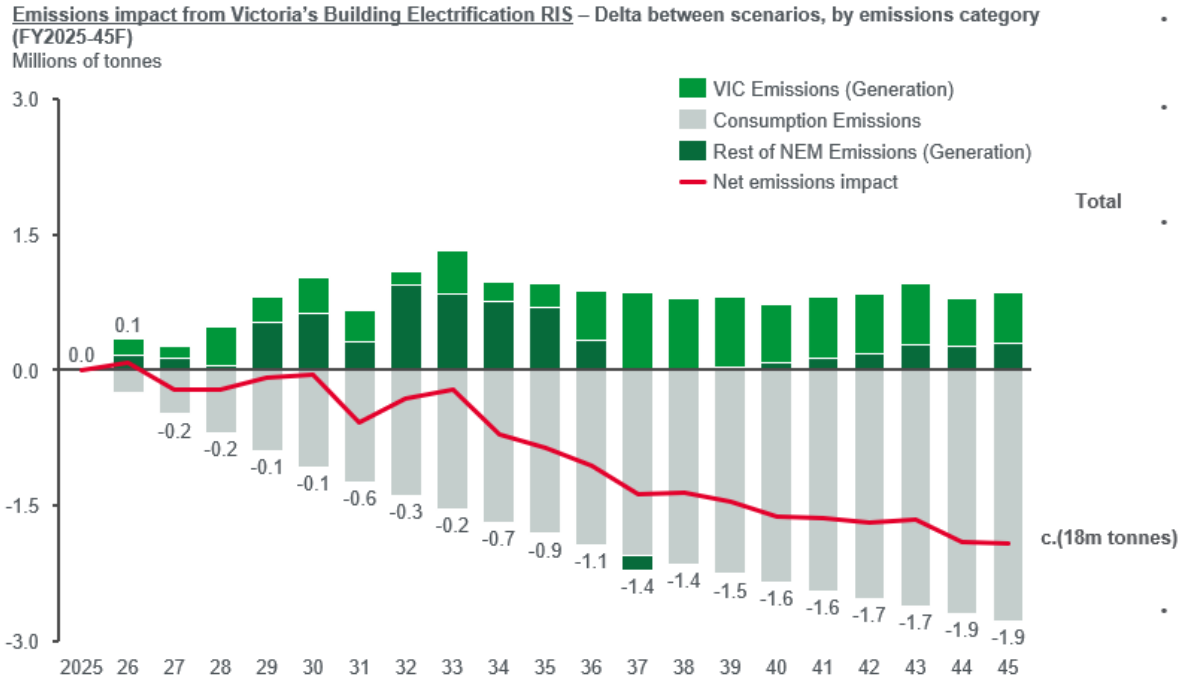

Figure 4: Emission reductions from RIS (Source: LEK (2025))

The L.E.K. analysis demonstrates:

- There will be greater coal and gas peaker generation to meet the increased electricity demand under the **Building Electrification RIS** in the period up to 2034
- As a result, emissions savings from reduced gas consumption are largely offset by increased emissions from greater coal and gas peaker generation to support the grid over the first 10 years
- Forced Electrification does not begin to produce net emissions savings until 2031, at which time those savings represent <1% of Victoria's 2022 emissions. To put this into perspective, these savings are less than 10% of the C200m+ tonnes of petrol emissions forecast over the same period.
- Cumulative savings of 18 million tonnes are achieved at a cumulative consumer cost of $22 billion. This equates to an implied cost of abatement of $1,222 / t CO2-e saved, much higher than alternative abatement options*. If customer electrification capex costs were half what we have modelled the implied abatement cost would be $838 per tonne, still higher than most alternatives

There are better options to manage the energy transition in Victoria

Victorian households can and want to participate in the transition in a meaningful way. While natural gas provides around 70 per cent of energy to Victorian homes (not including transport fuels), it represents 6 per cent[4] of Victorian emissions.

Households should be encouraged to continue to make choices to decarbonise their homes in ways that suit their needs and in an affordable, staged approach. Australia has some of the highest rates of installed rooftop solar and customers want to continue to be a part of the solution to reducing emissions.

While individual circumstances will vary, research consistently shows that the best 'bang for buck' to decarbonise households starts with rooftop solar, energy efficiency practices and purchasing an EV (and charging it from solar). Any support for household emissions reductions should be targeted at those most in need and initially at the improved efficiency, solar and EV applications that will make the biggest difference for customers. As a whole, electricity and gas networks support customers to make *decarbonisation choices* that are best suited to them, at least cost. There is no one-size-fits-all solution, and individual circumstances must be considered, including consumer preferences, location, budget, and home type.

Given the high costs associated with the RIS, and the very high abatement costs, there are better ways to achieve Victoria's emissions reduction targets and meet customers' needs for low-cost energy. Policies that focus on connecting more local generation and storage on the distribution grid can bring down bills while reducing emissions.

ENA's "The Time is Now" report conducted 'whole of system' modelling that assessed a range of actions that could be taken within the distribution system and considered which are the most impactful across both emissions and customer cost outcomes. The report finds there are tangible actions that can be taken today that would significantly benefit customers across whole of system and emissions costs, including:

- Allowing DNSPs to establish and operate local energy hubs, including connecting more renewables within the distribution network, for all the community to benefit from. This could be achieved by providing clearer guidance on the regulatory path for a more integrated program of work;
- Better utilising the extra capacity of batteries connected directly to the local grid and get more of them connected, making sure all customers benefit. This could be achieved through more extensive class waivers in the near term, and through more appropriately valuing the network services that batteries can provide by updating the customer export curtailment value for batteries;
- Providing incentives for commercial operators to install more solar panels on existing rooftops and share it with the local community. This could be achieved through programs to incentivise larger scale rooftop solar to facilitate investment above self-consumption and to expand existing programs to provide low-cost, CER financing options for renters and customers without access to capital;
- Classifying kerbside EV chargers as a distribution service to allow networks to put more chargers in more places and improve equitable access to charging while reducing range anxiety; and
- Syncing resources to the grid in a coordinated and flexible way so that the benefits can be shared with the community, including through progressing the CER Roadmap actions at speed, including those relating to technical standards, role definitions and market and customer interactions.

[4] Victorian homes and small businesses consumed 102 PJ of natural gas in 2022/23 producing 5.2 Mt CO_2. Victoria's net emission are 84.7 Mt so emissions from natural gas used in homes represents 6.2%.

ENA would welcome the opportunity to work with the Victorian government throughout the energy transition. We have attached the LEK and ACIL Allen reports and provided responses to the consultation questions below. If you wish to discuss any of the matters raised in this response further, please contact Dennis Van Puyvelde, Head of Renewable Gas, via: dvanpuyvelde@energynetworks.com.au.

Energy Networks Australia
energynetworks.com.au
info@energynetworks.com.au

Unit 5, Level 12, 385 Bourke Street,
Melbourne VIC 3000
+61 3 9103 0400

Energy Networks Association
T/A Energy Networks Australia
ABN: 75 106 735 406

Attachment 1

Impacts of Forced Electrification on the Victorian Energy System, Costs and Emissions

L.E.K. analytical report

18 February 2025

Context and Disclaimer – Terms of Access and Receipt

- L.E.K. Consulting (*L.E.K.*) wishes to draw the following important provisions to your attention prior to your receipt of or access to the L.E.K. report dated 18 February 2025 (*the L.E.K. Report*) including any accompanying presentation and commentary (*the L.E.K. Commentary*).
- The L.E.K. Report and any L.E.K. Commentary have been prepared for Energy Networks Australia (*the Client*) in accordance with a specified scope of work described in the letter of engagement with the Client (*the Engagement Letter*). L.E.K. may provide upon request a copy of the Engagement Letter;
- Any person or entity (including without limitation the Client) which accepts receipt of or access to the L.E.K. Report and any L.E.K. Commentary (*the Recipient*) agrees to be bound by the terms and conditions set out below;
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  - the analysis contained in the L.E.K. Report and any L.E.K. Commentary are subject to the key assumptions, further qualifications and limitations included in the Engagement Letter and the L.E.K. Report and L.E.K. Commentary, and are subject to significant uncertainties and contingencies, some of which, if not all, are outside the control of L.E.K.; and
  - any L.E.K. Commentary accompanying the L.E.K. Report is an integral part of interpreting the L.E.K. Report. Consideration of the L.E.K. Report will be incomplete if it is reviewed in the absence of the L.E.K. Commentary and L.E.K. conclusions may be misinterpreted if the L.E.K. Report is reviewed in absence of the L.E.K. Commentary. The Recipient releases L.E.K. from any claims or liabilities arising from such an incomplete review;
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Background: Energy Networks Australia has engaged L.E.K. to analyse the impact of the policy instruments that are the subject of the Victorian Government's Building Electrification RIS

- The Victorian Government released its Gas Substitution Roadmap in July 2022, with a further Update released in December 2023. The Roadmap proposes a pathway and set of policy instruments to phase out gas use in residential and commercial buildings, and to support industrial users to electrify or transition to renewable gas fuel sources

- A Building Electrification Regulatory Impact Statement (RIS) was released in December 2024. This RIS covers several policy levers to electrify Victorian gas customers, including:
  - Electrifying all new residential buildings
  - Electrifying "most" commercial buildings where appropriate electric appliance options are readily available
  - Requiring the replacement of gas appliances at the end-of-life with electric for residential buildings (with gas cooktop appliances exempt, as articulated by the Victorian Government as its preferred option)
  - Requiring the replacement of gas appliances at the end-of-life with electric for "relevant commercial buildings"

- L.E.K. has been engaged on behalf of Energy Networks Australia to assess the impact of the RIS on Victorian customers. L.E.K. has partnered with Endgame Analytics to prepare a 'whole of energy system' analysis of the impacts of the RIS – considering the wholesale electricity and gas market impacts, the network costs, customer costs of electrification and the notional reductions/increases in emissions. L.E.K.'s work adopted a similar approach and assumptions to the recent *The Time is Now* report produced for Energy Networks Australia (see next page for more detail). This has been used to assess the impact of the RIS at both a system wide level, and at an individual customer level.

Context: *The Time is Now* report outlined benefits for consumers of making better use of distribution networks outside of peaks. By contrast, forced electrification will add pressure during peaks

- The ENA and L.E.K.'s 2024 report *'The Time is Now: Getting Smarter with the Grid'* emphasises that policy levers that maximise the utilisation of the existing electricity distribution grid are a more effective and economical strategy for advancing Australia's energy transition than the immediate replacement of gas appliances with electric ones

- Key insights from *The Time is Now* include:
  - Accelerated Renewable Integration: By empowering electricity distribution networks to play a more dynamic role, Australia can expedite its progress toward achieving 82% renewable energy by 2030. This approach involves integrating additional rooftop solar capacity, front-of-meter generation, and distribution-connected battery storage, as well as supporting the adoption of electric vehicles.
  - Cost Savings: Increasing the utilisation of today's electricity distribution grid can deliver sizeable financial benefits. The report estimates that such improvements could save consumers roughly $160 annually and reduce overall system costs by $7 billion in 2030 alone.

- These outcomes are due to better utilisation of existing infrastructure and spare capacity in electricity distribution networks to support more generation and to enable electrification of transport in the short term. This delivers benefits to consumers immediately, allowing the energy transition to move forward while larger grid transformations, the construction of new generation capacity, and the retirement of coal generation all take place over the coming decade.

- By contrast, the changes that are proposed under the Building Electrification RIS are imposed on the Victorian electricity grid and the wider NEM before these larger grid transformations and capacity investments have been made. This places additional pressure on the grid during peak periods (unlike the changes in *The Time is Now*, that are designed to increase grid utilisation outside the peaks).

- This report describes the expected impacts of the forced electrification of buildings under the RIS on Victorian energy costs and emissions.

Contents

Key findings: the Victorian Government's proposal will cost consumers $22bn additional over the next 20 years

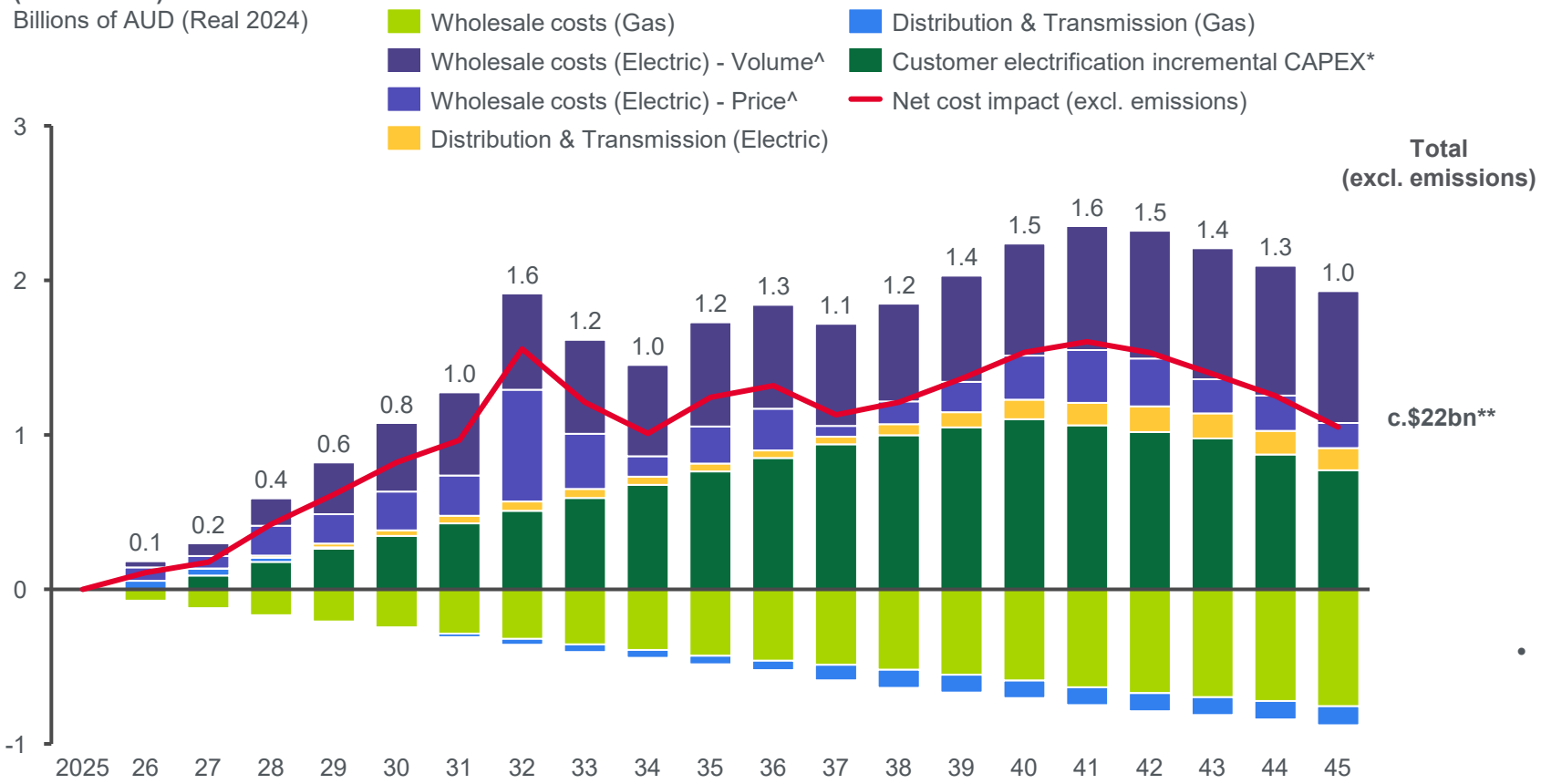
- We have conducted a 'whole of energy system' modelling exercise that compares the implementation of Victorian Government's Building Electrification Regulatory Impact Statement (a '**Forced Electrification**' scenario) against the likely alternative outcomes (a '**Progressive Electrification**' scenario where customers electrify appliances progressively when it makes good financial sense to do so).
- We found that pursuing the policies set out in the Forced Electrification scenario will:
  - **Increase overall energy system costs** (electricity, gas and customer costs) for Victoria by $22bn over 20 years
  - **Increase wholesale electricity costs**, which will impact not only the portion of new load that is switched from gas to electricity, but also all electricity users across Victoria
  - **Require a material amount of new natural gas** peaking generation to be built and used, both in Victoria and elsewhere in the NEM, to meet the additional electricity demand. This will result in 0.5 tonnes of additional emissions to generate the electricity required, with a system cost of $1,222 per tonne, for every 1.0 tonnes of gas consumption emissions saved from FY25-45
  - Significantly **increase the risk of breaching the secure electricity system operating conditions** with there being c.10+ more hours on average of electricity prices exceeding $500/MWh each year under the Forced Electrification scenario (reflecting more time for the system under considerable strain)
- Victorian electricity supply in the late 2020s and early 2030s will already be constrained as the connection of renewable energy zones will still be ongoing. Our modelling applies a set of realistic constraints to the rate of build of new generation capacity, reflecting the most likely outcome for actual electricity supply in Victoria during the proposed period of forced electrification for the Building Electrification RIS. The effects of forcing customers to switch to electric appliances will exacerbate the period of constrained supply, and place additional cost of living pressure on Victorian energy consumers.
- The increased cost of electricity alone is more than the savings from reduced gas consumption. Including the additional capital expenses from replacing gas assets under Forced Electrification increases these overall costs further.
- The net emissions impact per year under the Building Electrification Regulatory Impact Statement are expected to be between an 0.1% increase to a 2.2% reduction to Victoria's current total annual emissions (at an average cost to consumers of $1,222 per tonne of abatement, as noted above).

LEK™

Under the forced electrification scenario the increase in wholesale electricity prices will be higher than the cost savings a consumer receives by not spending on gas (by c.$22bn from FY25-45F)

System cost impacts from Victoria's Building Electrification RIS – Delta between scenarios, by cost category (FY2025-45F)

Billions of AUD (Real 2024)



- The Forced Electrification scenario results in uneconomic outcomes for customers as wholesale electricity prices are higher than the cost saving a consumer receives by not spending on gas
  - Wholesale electricity prices are c.$5 / MWh higher on average under the forced electrification scenario, with a wider gap observed in the early 2030s when electricity supply is most constrained
  - This means that even without the incremental cost to purchase efficient electric appliances, it is more expensive for customers as the complete shift to electricity will increase wholesale electricity costs and outweigh the total cost savings from reduced gas consumption
- The cumulative cost to consumers of the Forced Electrification scenario is $22bn over 20 years and results in emissions impacts of a 0.1% increase to 2.2% decrease (see next page)

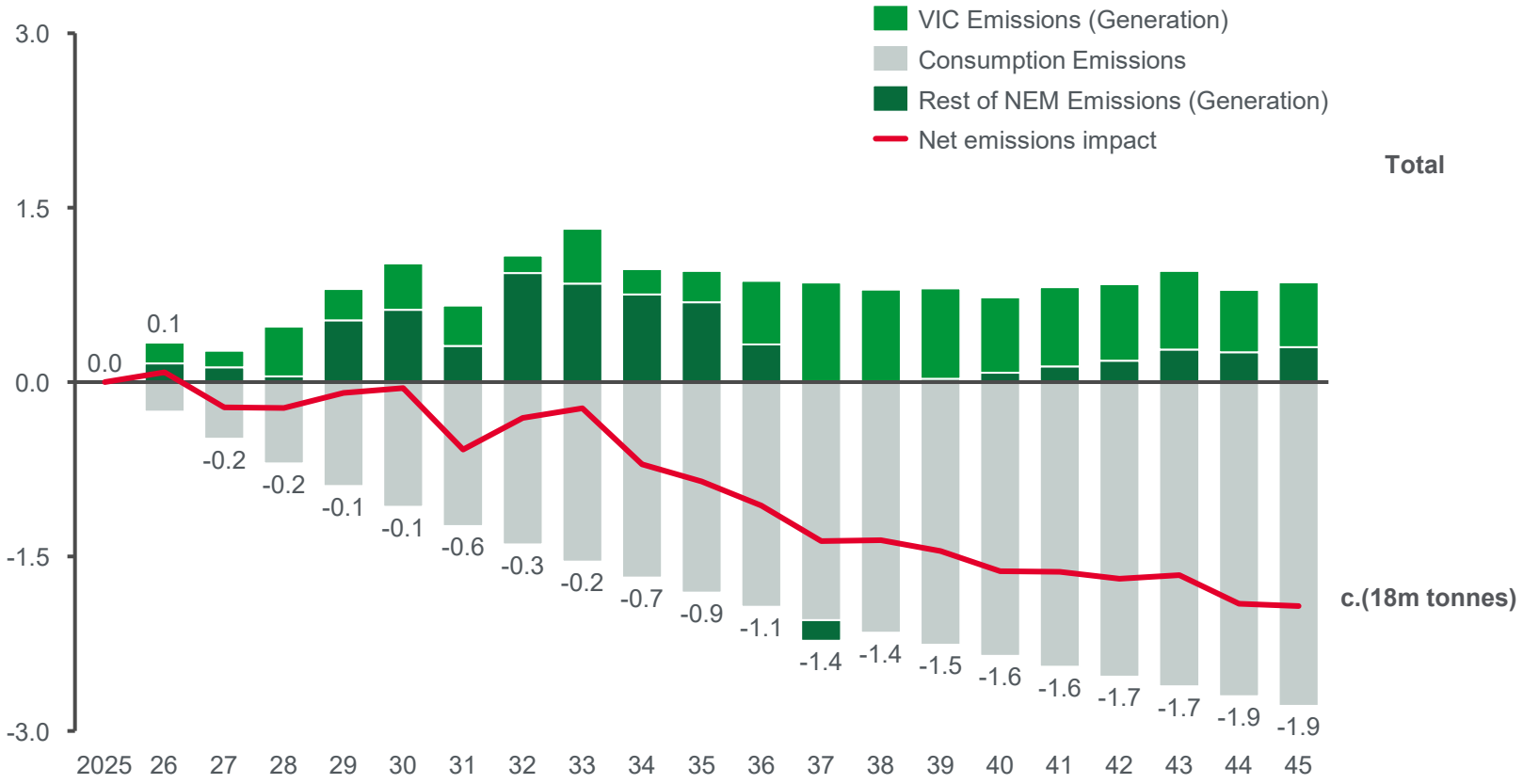
Notes: * Customer electrification capex represents the incremental cost of electrifying (ie. the cost difference where an electric appliance is more expensive than a gas alternative)
** Total is cash costs only, and excludes the implied value of emissions saved which are valued at c.$5 billion over the 20 years based on the AER's value of emissions reduction
^ Volume includes the incremental wholesale costs from additional electricity consumed as a result of higher electrification;
^ Price includes the impact of higher electricity costs under the Forced Electrification scenario on all electricity being consumed in Victoria

Source: AEMO Draft 2024 ISP; AEMO GSOO 2024; ABS; ACIL Allen; AER; AEMC; Australian National Greenhouse Accounts Factors; Climate Council; Endgame Analytics; L.E.K. Modelling

Forced electrification results in very low net emissions savings prior to 2034, as there will be increased emissions from electricity generation

Emissions impact from Victoria's Building Electrification RIS – Delta between scenarios, by emissions category (FY2025-45F)

Millions of tonnes



- Analysis demonstrates there will be greater coal and gas peaker generation to meet the increased electricity demand under the Forced Electrification scenario in the period up to 2034
- As a result, emissions savings from reduced natural gas consumption are largely offset by increased emissions from greater coal and gas peaker generation to support the grid over the first 10 years
- The Forced Electrification does not begin to produce material net emissions savings until 2031, at which time those savings represent <1% of Victoria's 2022 emissions
- Cumulative savings of 18 million tonnes are achieved at a cumulative consumer cost of $22 billion. This equates to an $1,222 per tonne of CO2e saved, much higher than alternative abatement options*.

Note: * Prior L.E.K. reports have calculated that Australian heavy industry (eg. cement production, steel production, aluminium smelting) can be decarbonised at abatement costs of $240-$710 per tonne CO2e

Source: AEMO Draft 2024 ISP; AEMO GSOO 2024; ABS; ACIL Allen; AER; AEMC; Australian National Greenhouse Accounts Factors; Climate Council; Endgame Analytics; ENA Time is Now; L.E.K. research and analysis

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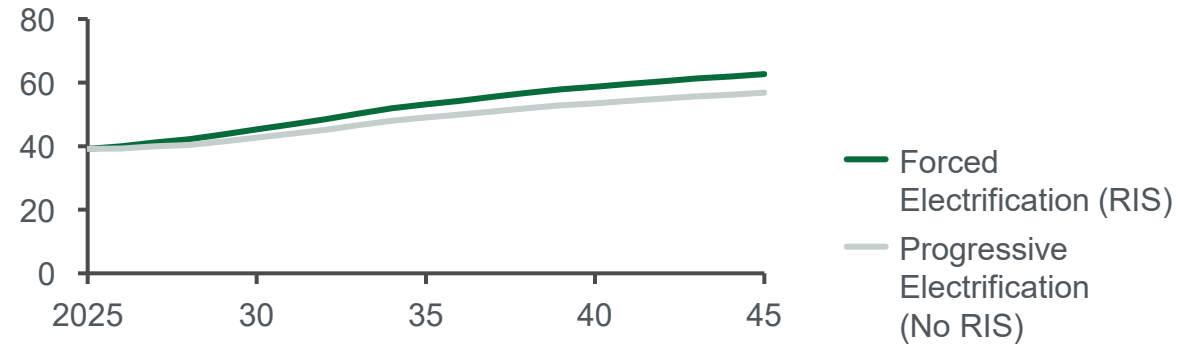
Our modelling has isolated the impact of Forced Electrification by comparing the energy system cost impact to Victorian customers across two scenarios

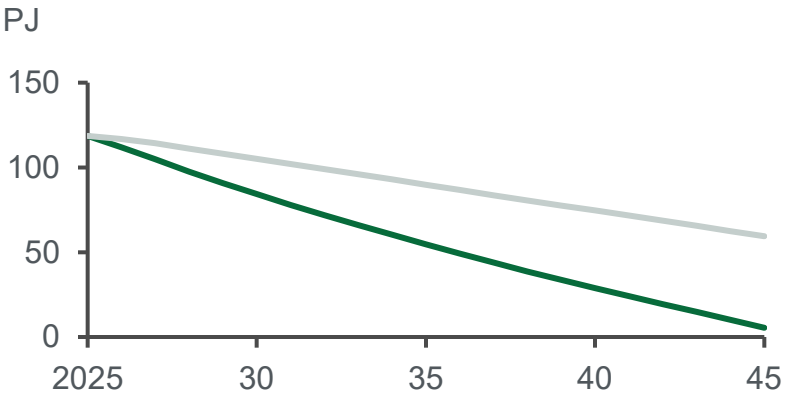
Modelling approach

- We have modelled two scenarios for the Victorian energy system:
  - A '**Forced Electrification (Building Electrification RIS)'** scenario in which existing Victorian households and addressable commercial businesses progressively electrify their premises over a 20-year period (2025-2045) in line with the policy instruments being proposed. Under this scenario all new households are electric only, and all gas appliances that can be feasibly electrified at their end-of-life are replaced with electric appliances, and gas is disconnected once a premises no longer has any gas appliances. Electrification of gas cooktops is exempt from the RIS, so the modelling assumes gas cooktops electrify at a rate consistent with historical consumer preferences
  - A **'Progressive Electrification (No Building Electrification RIS)'** scenario, in which existing households and commercial businesses progressively electrify when it makes good financial sense to do so, at rates consistent with existing policy and historical consumer preferences, and net gas disconnections maintain their historical rate. This scenario includes all existing policy measures that were introduced prior to the current Building Electrification RIS, but excludes any measures that have been discussed but not introduced
- Our modelling tests the impacts of these assumptions on all aspects of the Victorian energy system including the impacts on electricity supply/demand and wholesale prices, gas supply and availability, and total costs to consumers (including the incremental cost of new appliance investments)

Victoria residential / commercial electricity demand, by scenario (FY2025-45)



Victoria residential / commercial gas demand, by scenario (FY2025-45)



Note: By 2030 Victorian residential/ commercial gas demand reduces by 35PJ under the Forced Electrification scenario and 14PJ under Progressive Electrification.

Source: L.E.K. modelling; AEMO GSOO 2024

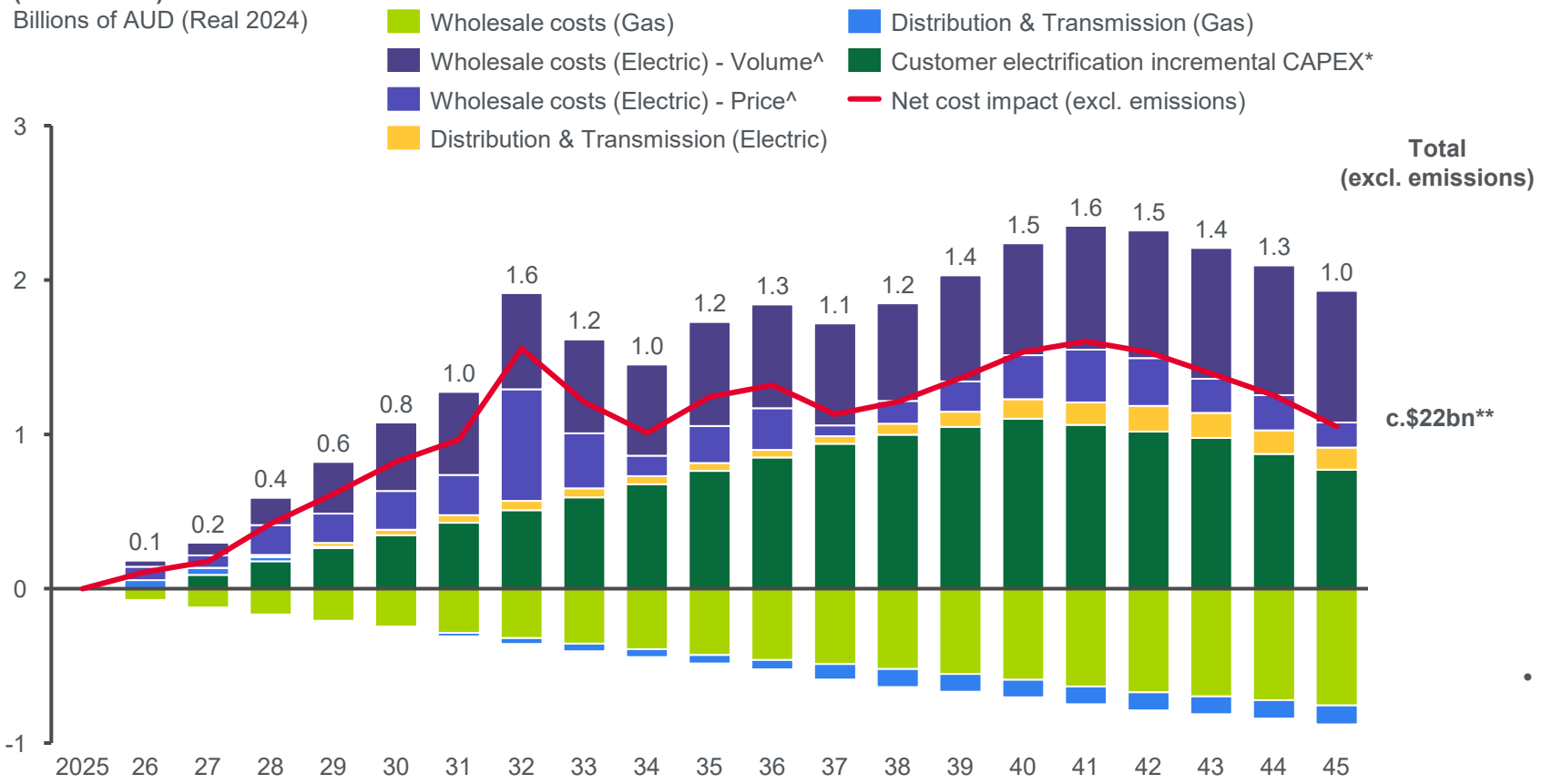
Contents

Analysis shows that pursuing the Building Electrification RIS will increase energy system costs for all Victorian customers by c.$22bn from FY25-45F

System wide impact

System cost impacts from Victoria's Building Electrification RIS – Delta between scenarios, by cost category (FY2025-45F)

Billions of AUD (Real 2024)



- The **Building Electrification RIS** (Forced Electrification) results in uneconomic outcomes for customers as wholesale electricity prices are higher than the cost saving a consumer receives by not spending on gas
  - Wholesale electricity prices are c.$5 / MWh higher on average under the forced electrification scenario, with a wider gap observed in the early 2030s when electricity supply is most constrained
  - This means that even without the incremental cost to purchase efficient electric appliances, it is more expensive for customers as the complete shift to electricity will increase wholesale electricity costs and outweigh the total cost savings from reduced gas consumption
- The cumulative additional cost to consumers of the Forced Electrification scenario is $22bn over 20 years and results in emissions impacts of a 0.1% increase to 2.2% decrease

Notes: * Customer electrification capex represents the incremental cost of electrifying (ie. the cost difference where an electric appliance is more expensive than a gas alternative)
** Total is cash costs only, and excludes the implied value of emissions saved which are valued at c.$5 billion over the 20 years based on the AER's value of emissions reduction
^ Volume includes the incremental wholesale costs from additional electricity consumed as a result of higher electrification;
^ Price includes the impact of higher electricity costs under the Forced Electrification scenario on all electricity being consumed in Victoria

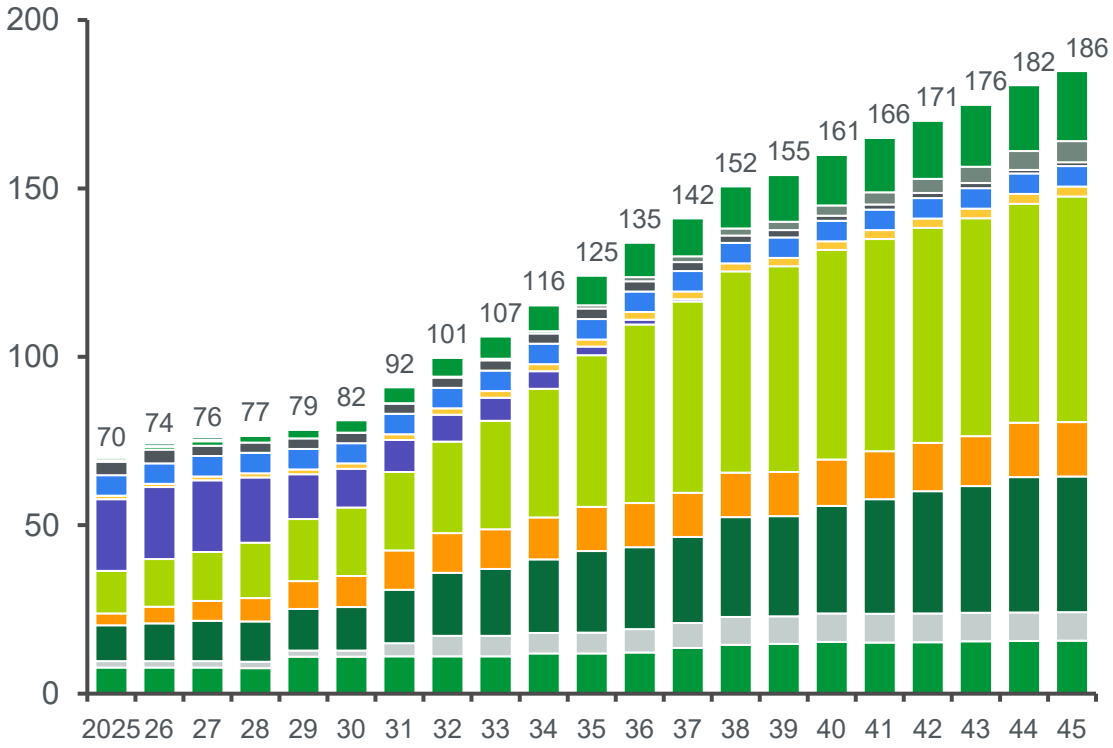
Source: AEMO Draft 2024 ISP; AEMO GSOO 2024; ABS; ACIL Allen; AER; AEMC; Australian National Greenhouse Accounts Factors; Climate Council; Endgame Analytics; L.E.K. Modelling

Up to 4.1GW of additional generation capacity is needed to meet the higher electricity demand under Forced Electrification, with 27% of additional demand met by additional gas peaker output (1 of 2)

System wide impact

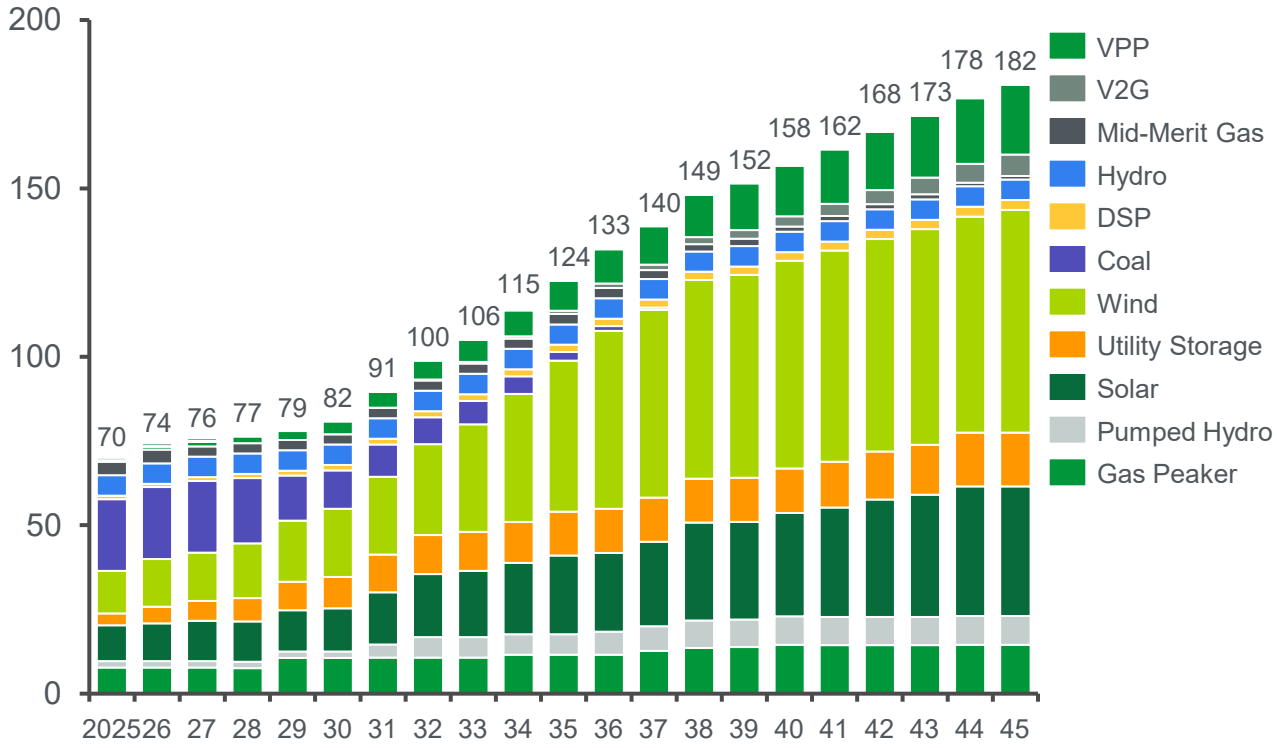
Forced Electrification: NEM-wide installed capacity* (FY2025-45)

GW



Progressive Electrification : NEM-wide installed capacity* (FY2025-45)

GW



Note: * Large scale generation only, chart excludes rooftop solar capacity additions
Source: Endgame Analytics modelling; L.E.K. analysis

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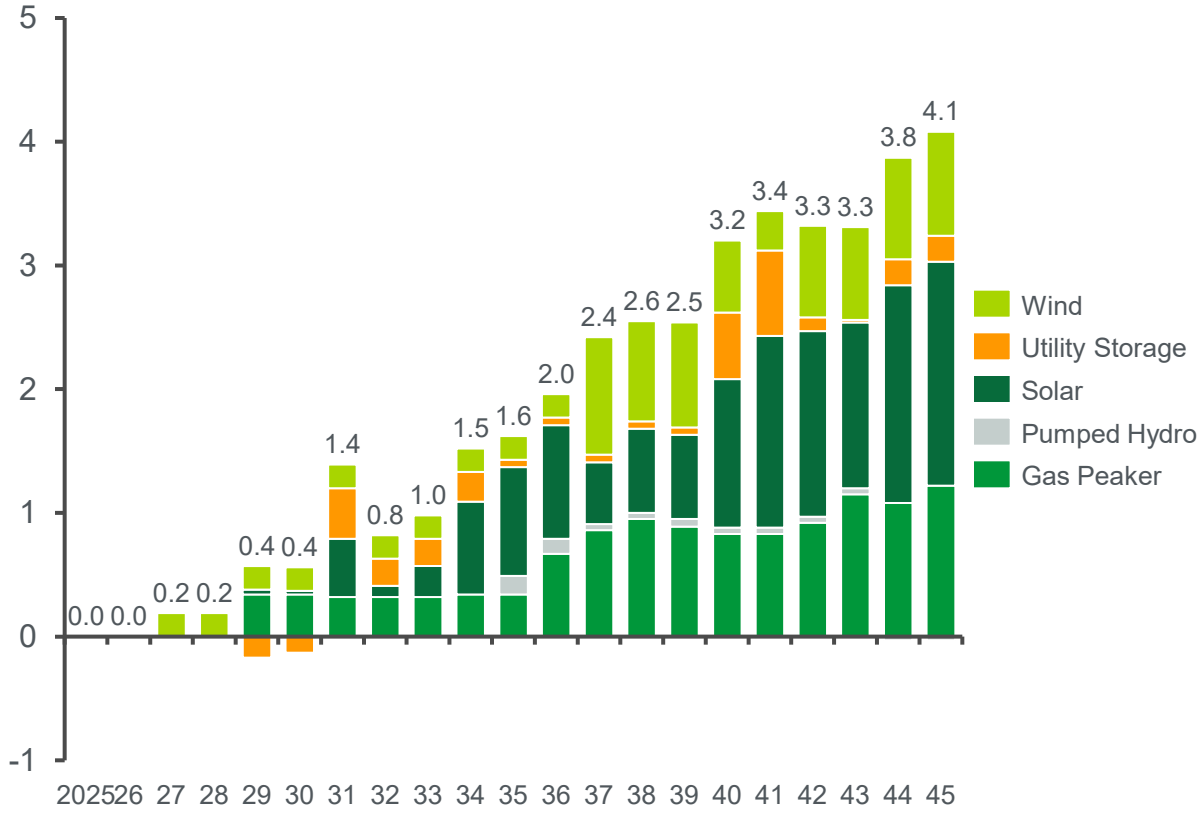
Up to 4.1GW of additional generation capacity is needed to meet the higher electricity demand under Forced Electrification, with 27% of additional demand met by additional gas peaker output (2 of 2)

System wide impact

NEM-wide installed capacity delta (Forced vs Progressive Electrification) (FY2025-45)

GW



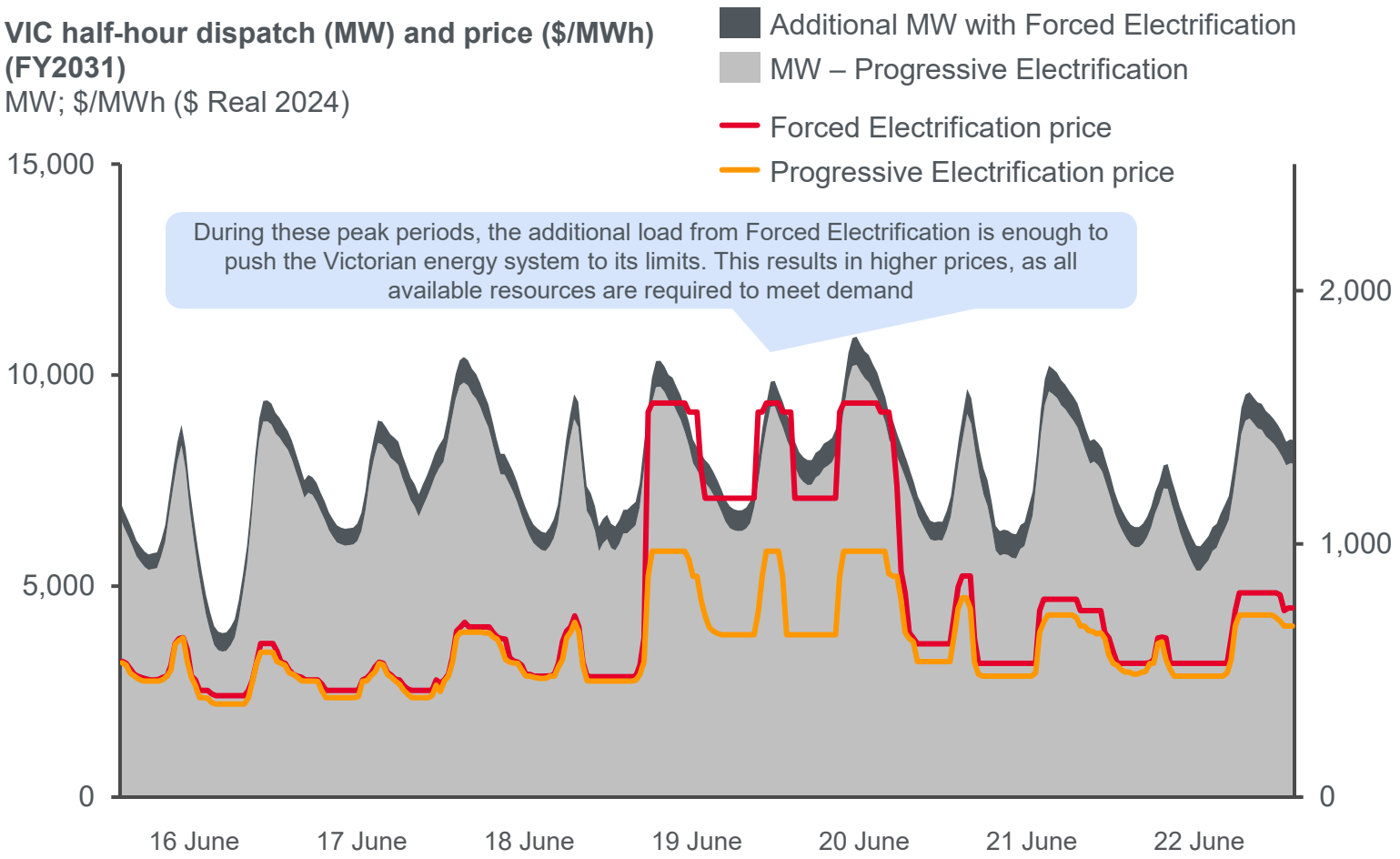
- The National Electricity Market (NEM) will require additional electricity supply to meet the additional demand resulting from RIS policies, with an additional 1.4GW of installed capacity required in 2031 vs no RIS, and an additional 4.1GW by 2045
- The shape of the daily and seasonal consumption curves for gas heating means that much of the increased electricity consumption from electrifying gas occurs in mornings / evenings and during winter, when the ability for renewables or shallow energy storage to supply the required electricity is lowest
- As a result, the market requires additional gas peaker capacity to meet this demand, even though it is not the most cost-effective option at other times
  - During the first 10 years of the RIS (2025-2034) electricity supply in Victoria is most constrained. New transmission projects have not yet been completed, which limits the rate at which new renewable generation can be added
  - During this period c.27% of the additional electricity demand that arises from the RIS must be met with gas peaker generation, which results in both higher electricity prices for Victorian consumers, and higher emissions from electricity generation than would otherwise have occurred

Source: Endgame Analytics modelling; L.E.K. analysis

Particularly in winter months, the electricity system is at risk of breaching system security operating conditions, relying heavily on generation with higher cost

System wide impact

VIC half-hour dispatch (MW) and price ($/MWh) (FY2031)
MW; $/MWh ($ Real 2024)



- Peak seasonal electrification demand in winter coincides with times when Victoria's wind and solar resources are at their lowest
- During these periods the electricity system is heavily reliant on firm generation assets such as coal, gas generation and various forms of energy storage. These resources (typically bidding in at higher costs when the system is constrained) magnify the impact on wholesale prices, as generation with higher costs are dispatched
- This chart shows a modelled 1-week period in June 2031, with several days of low wind output (June 19-20). During this period the Victorian electricity system relies heavily on coal, gas generation, battery storage, hydro, and imports from other states
  - Under the Forced Electrification (RIS) scenario demand is higher, resulting in prices (shown as the red line) of $1000-1500 per MWh for several days, compared to $500-1000 per MWh under the Progressive Electrification (No-RIS) scenario

Source: Endgame Analytics modelling; L.E.K. analysis

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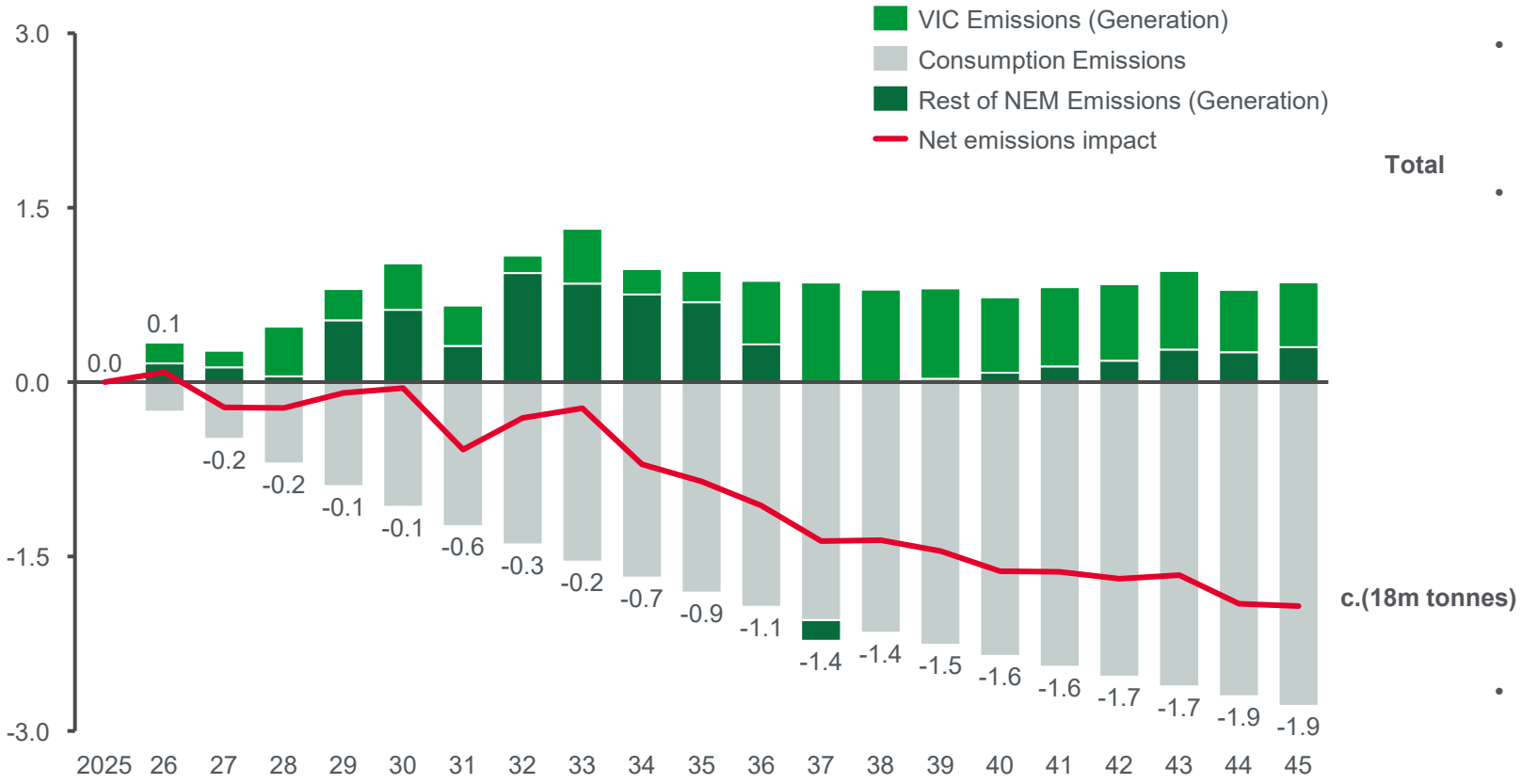
The Victorian Government's Building Electrification RIS produces very low net emissions savings prior to 2034, as the increased emissions from electricity generation that is needed offset any savings

System wide impact

Emissions impact from Victoria's Building Electrification RIS – Delta between scenarios, by emissions category (FY2025-45F)

Millions of tonnes



- There will be greater coal and gas peaker generation to meet the increased electricity demand under the **Building Electrification RIS** in the period up to 2034
- As a result, emissions savings from reduced gas consumption are largely offset by increased emissions from greater coal and gas peaker generation to support the grid over the first 10 years
- Forced Electrification does not begin to produce material net emissions savings until 2031, at which time those savings represent <1% of Victoria's 2022 emissions
  - This saving is relatively small compared to the c.200m+ tonnes of petrol emissions forecast over that period
  - Cumulative savings of 18 million tonnes are achieved at a cumulative consumer cost of $22 billion. This equates to an implied cost of abatement of $1,222 per tonne of CO2e saved, much higher than alternative abatement options*. If customer electrification capex costs were half what we have modelled the implied abatement cost would be $838 per tonne, still higher than most alternatives
- The net annual carbon emission impact from the RIS (an 0.1 million tonne increase of CO_2e in 2026, shifting to a 1.9 Mt decrease in CO_2e by 2045) ranges from an increase of +0.1% to a decrease of 2.2% of Victoria's 2022 total state carbon emissions of 84.7 Mt CO_2e

Note: * Prior L.E.K. reports have calculated that Australian heavy industry (eg. cement production, steel production, aluminium smelting) can be decarbonised at abatement costs of $240-$710 per tonne CO2e

Source: AEMO Draft 2024 ISP; AEMO GSOO 2024; ABS; ACIL Allen; AER; AEMC; Australian National Greenhouse Accounts Factors; Climate Council; Endgame Analytics; ENA Time is Now; L.E.K. research and analysis

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We have assessed the impact of Forced Electrification at an individual customer level based on 5 customer archetypes, which collectively cover c.85% of Victorian households today

Customer level impact

Customer type A

Ducted gas heating, gas cooktop and gas hot water

- Customer type A represents a customer that has not yet electrified their household gas assets under all scenarios – this means that they have gas heating, gas cooktop and gas hot water
- This is reflective of the majority of residential customers today
- Over time, this type of customer becomes less common as they electrify all assets except for the gas cooktop

Customer type B

Full disconnection from gas. Electrical appliances high efficiency

- Customer type B has fully disconnected from the gas network
- This customer has the financial means to replace its gas assets with high efficiency electrical appliances (efficiency of 350% - space conditioning, 300% - water heating, 84% - cooking) and so by 2030 this customer has fully electrified and disconnected from the gas network

Customer type C

Full disconnection from gas. Electrical appliances high efficiency Requires additional capex (e.g., power system upgrade)

- Customer type C is similar to Customer type B; this customer is fully disconnected from the gas network
- However, this customer has faced additional costs associated with switching their gas appliances out for electric, and disconnecting from the gas network
- For example, this customer might require a power system upgrade in their home

Customer type D

Full disconnection from gas. Electrical appliances low-efficiency

- Customer type D is similar to customer type B, but lacks the financial means to invest in high-efficiency electrical appliances
- As a result, this customer has replaced their appliances at end of life with below average efficiency (appliance efficiency reduction of c.38% compared to the high efficiency appliances in customer type B)

Customer type E

Remains connected but with reduced usage. Gas cooktop, electric hot water, and electrical heating

Invests in solar

- Customer type E is reflective of a customer that has electrified most of their appliances with exception of their gas cooktop, and are able to self-generate electricity with solar
- This has been modelled to understand whether the economics are better for a customer that has made the investment into solar and therefore reduces their exposure to wholesale electricity costs

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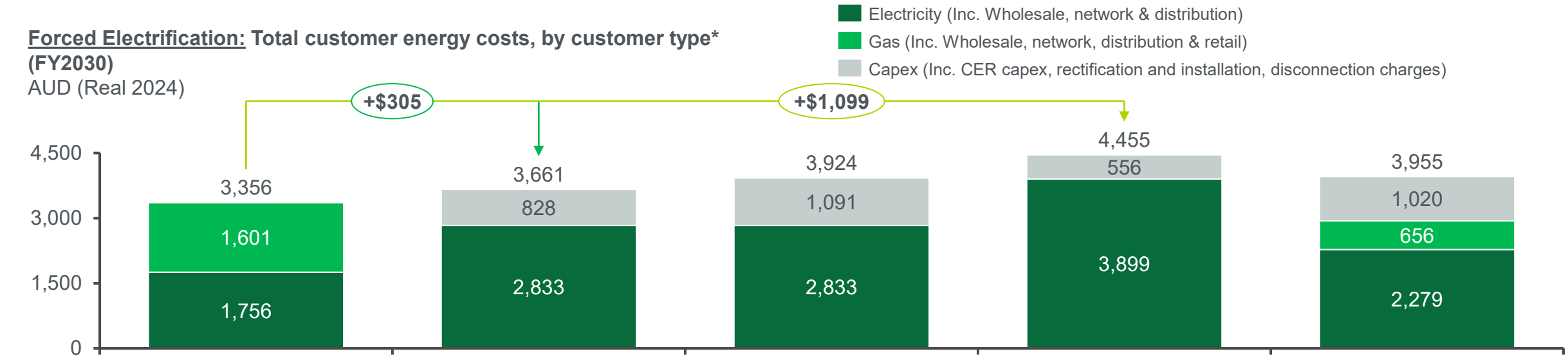
In FY30, customers that have electrified due to the Building Electrification RIS are worse off

Customer level impact

Forced Electrification: Total customer energy costs, by customer type* (FY2030)
AUD (Real 2024)



VIC house-holds****	*c.980k*	*c.800k*	*Subset of customer type 2*	*c.410k*	*c.60k*
	Customer type A ***Ducted gas heating, gas cooktop and gas hot water***	***Customer type B*** ***Full disconnection from gas. Electrical appliances high-efficiency***	***Customer type C*** ***Full disconnection from gas. Electrical appliances high-efficiency*** *Requires additional capex*	***Customer type D*** ***Full disconnection from gas. Electrical appliances low-efficiency***	***Customer type E*** ***Remains connected but with reduced usage. Gas cooktop, electric hot water, and electrical heating*** *Invests in solar*
	Gas network connected	***Disconnected***	***Disconnected***	***Disconnected***	***Gas network connected***

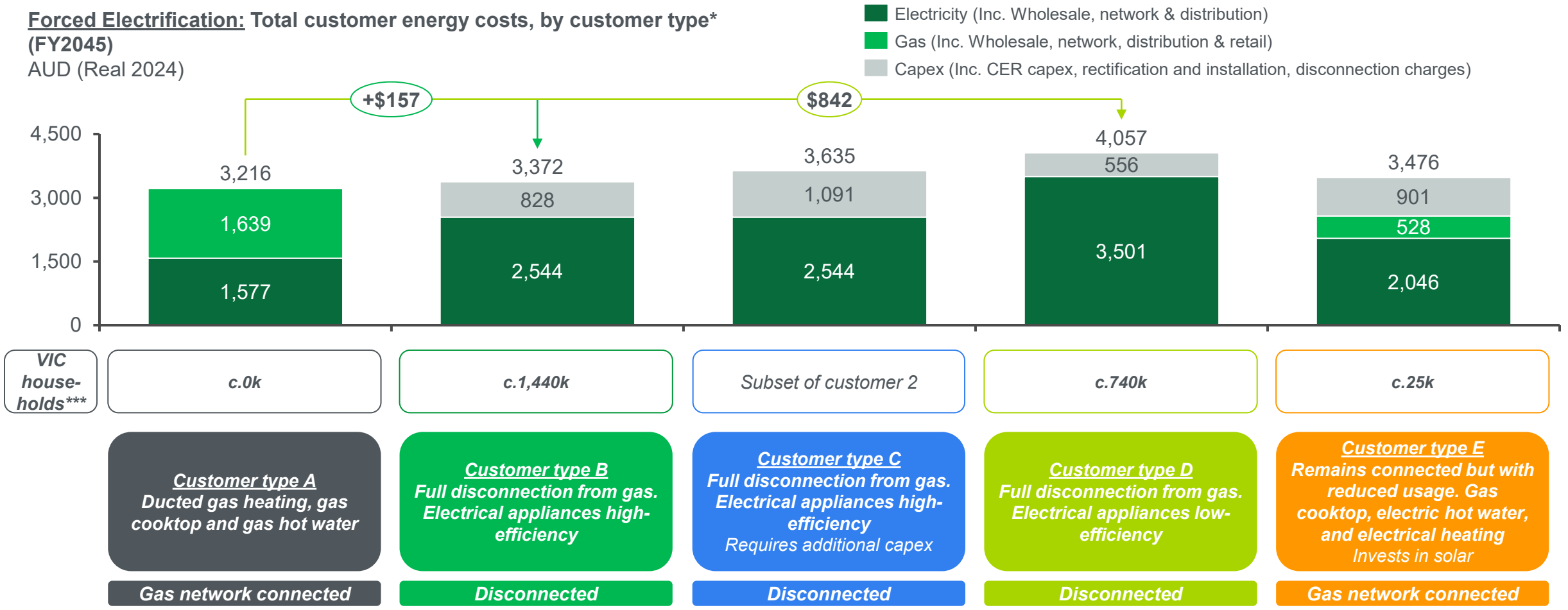
Note: * Energy includes the cost of gas, electricity and amortised electrification costs (excludes ICE fuel costs)
Source: AEMO Draft 2024 ISP; AEMO GSOO 2024; ABS; ACIL Allen; AER; AEMC; Australian National Greenhouse Accounts Factors; Climate Council; Endgame Analytics; L.E.K. Modelling

The average Victorian house is assumed to have three bedrooms, single storey & free standing. Gas space heating in two rooms

By 2045, electrified customers are still worse off compared to customer archetype A, with total costs 5% greater for high efficiency electrification and 26% greater for low efficiency electrification

Customer level impact

Forced Electrification: Total customer energy costs, by customer type* (FY2045)
AUD (Real 2024)



VIC household***	c.0k	c.1,440k	Subset of customer 2	c.740k	c.25k
	Customer type A Ducted gas heating, gas cooktop and gas hot water	**Customer type B** Full disconnection from gas. Electrical appliances high-efficiency	**Customer type C** Full disconnection from gas. Electrical appliances high-efficiency. Requires additional capex	**Customer type D** Full disconnection from gas. Electrical appliances low-efficiency	**Customer type E** Remains connected but with reduced usage. Gas cooktop, electric hot water, and electrical heating. Invests in solar
	Gas network connected	Disconnected	Disconnected	Disconnected	Gas network connected

Note: * Energy includes the cost of gas, electricity and amortised electrification costs (excludes ICE fuel costs);
Source: AEMO Draft 2024 ISP; AEMO GSOO 2024; ABS; ACIL Allen; AER; AEMC; Australian National Greenhouse Accounts Factors; Climate Council; Endgame Analytics; L.E.K. Modelling

The average Victorian house is assumed to have three bedrooms, single storey & free standing. Gas space heating in two rooms

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We have examined the effect of Forced Electrification on the major customer cost components derived from three models – including the impact on energy bill components, customer capex and emissions

	Wholesale modelling	Network modelling	Customer cost modelling
System wide / customer costs	• **Wholesale costs (gas):** Total wholesale cost derived from total gas consumption in VIC (incl. residential, commercial, industrial and GPG) and $/GJ • **Wholesale costs (electricity):** Total wholesale cost based on VIC electricity demand and wholesale electricity price ($/MWh) **Note:** This analysis uses a combination of economic assumptions and practical historical build rates to determine the entry rate for new electricity generation capacity. This differs from the assumptions in AEMO's ISP, which assumes state and federal targets for generation entry are met without consideration of economic criteria or historical build rates. See page 26 for details.	• **Distribution and transmission (gas):** Distribution and transmission costs across VIC based on estimated network capex and opex. Opex includes the cost associated with safe disconnection • **Distribution and transmission (electricity):** Distribution and transmission costs across VIC, including the costs of any additional investments needed to meet new peak demand under the RIS **Note:** This analysis assumes the major infrastructure projects specified in AEMO's ISP are all delivered, but we apply delays of 1-2 years vs. AEMO's assumptions to align to current expected project timelines. See page 26	• **Customer electrification capex:** Total incremental cost associated with electrifying gas assets. Cost includes the incremental appliance capex, as well as the installation and rectification and disconnection charge borne by consumers. These costs have been amortised over the life of the asset **Note:** This analysis uses a higher capex cost for electrification than assumptions adopted by DEECA. Our analysis is based on data gathered by ACIL Allen and Frontier Economics directly from gas and electric appliance installers in Victoria in 2022. • **Customer CER Capex:** Capex associated with solar PV, BTM storage, and incremental EVs • Excludes ICE vehicle petrol costs
Emissions	• **Generation emissions:** Emissions (and shadow emission costs) associated with coal, gas peaker and mid-merit gas technology		• **Gas consumption emissions:** Emissions (and shadow emissions costs) associated with gas appliance consumption

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A number of inputs and assumptions are used to drive the analysis

	Wholesale modelling	Network modelling	Customer cost and emissions modelling

Key inputs	• Electricity demand assumptions
	• Electricity supply-side assumptions:
	  – Costs of investment and operation of different generation types
	  – Committed investment plans for generation and transmission (incl. state govt targets)
	  – Coal retirement plans
	• Gas demand assumptions
	• Gas supply assumptions
		• Existing electricity and gas network investment plans
		• Current price determinations
		• Future regulatory determination assumptions
		• Future network throughput and peak demand
			• Customer investment plans, timing and costs:
			  – Capex for electrification asset types and associated costs; timing of electrification investments
			  – Capex for other CER investments
			• Current and forecast fuel consumption
			• Forecast fuel costs

Key outputs	• New generation capacity investments and retirements
	• Wholesale electricity price and energy cost
	  – NEM electricity supply/demand balance by dispatch period (30 mins), for each period 2025-2050
	• Gas supply/demand balance and cost
	• Future network throughput and peak demand
		• Electricity network capex and opex
		• Electricity network revenue and costs / tariffs
		  – Average price (c/kWh)
		• Gas network costs
			• Total costs related to energy consumed in residential / commercial premises
			• Emissions from electricity and gas generation across the NEM
			• Emissions from gas consumed in Victoria
			• Cost impact for different customer archetypes

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Modelling sources and assumptions – 'whole of energy system' (1 of 2)

Demand assumptions (FY25-45)	Source / Notes	Values	
Wholesale costs (electricity)	Endgame Analytics modelling based on changes to electricity consumption	Average load weighted wholesale price (RIS): FY30: 172 ($/MWh) FY45: 146 ($/MWh)	Average load weighted wholesale price (No RIS): FY30: 166 ($/MWh) FY45: 143 ($/MWh)
Wholesale costs (gas)	AEMO ISP GPG fuel prices - *Step Change scenario*	Average across Victorian GPG units: FY25 - $17.35 ($/GJ) FY45 - $14.01 ($/GJ)	
Generation emissions	**Emissions factor**: National Greenhouse and Energy Reporting (NGER)	Generation type: Coal - 1.3 (t/MWh) Gas Peaker - 0.54 (t/MWh) Mid-Merit Gas - 0.56 (t/MWh)	
	Emissions price: AER's Value of Emissions Reduction (VER)	FY25 - 75.55 ($/t) FY45 - 307.91 ($/t)	
Distribution and transmission (electricity)	Consistent with the approach in *The Time Is Now*, distribution costs reflect approved and forecast network capital and operating expenditures without increased electrification, with additional peak load for electrification used as a driver for additional distribution network investment	Total network MAR (RIS): FY25 - $3,233m FY30 - $3,553m FY45 - $4,661m	Total network MAR (No RIS): FY25 - $3,233m FY30 - $3,518m FY45 - $4,518m
Distribution and transmission (gas)	*AGIG & AusNet Network Modelling* – Includes opex associated with disconnections**	Total network MAR (RIS): FY25 - $700m FY30 - $738m FY45 - $385m	Total network MAR (No RIS): FY25 - $700m FY30 - $745m FY45 - $509m
Customer electrification capex	*ACIL Allen - Renewable Gas Target 2024* - Incremental capex costs from gas to electric asset including appliance cost, installation and rectification	Residential: Cooktops - $823 Water heating - $2,661 Space conditioning - $9,199	Commercial*: Cooktops - $823 Water heating - $8,117 Space conditioning - $36,595
Gas consumption emissions	**Gas consumption**: L.E.K. modelling	Residential / Commercial consumption (RIS): FY25:119 PJ FY45: 5 PJ	Residential / Commercial consumption (No RIS): FY25: 119 PJ FY45: 59 PJ
	Emissions factor: National Greenhouse and Energy Reporting (NGER)	Emissions factor - 51.53 (Tonnes of CO_2/GJ)	

Note: * Commercial electrification CAPEX has been scaled up / down depending on the building size and primary use case; ** The Gas Substitution Roadmap has capped customer disconnection fees for customers at $220 (excl. GST), consequently, the $220 charge has been allocated to the customer archetypes and the remaining c.$730 has been allocated to network Opex costs

All prices are in real FY24 dollars

Modelling sources and assumptions – 'whole of energy system' (2 of 2)

Supply assumptions (FY25-45)	Assumptions	Rationale
Federal renewable energy targets (RET)	• Excluded & subject to economic entry	• Assumes investors in new generation capacity require an economic return in order to invest • Storage targets are assumed to be met as storage has favourable economics during periods of wholesale price volatility and system constraints
State RET pre-FY2030	• Excluded & subject to economic entry; some policies might not be met – VIC storage target met – 2.6GW	
State RET post-FY2030	• Excluded & subject to economic entry; some policies might not be met – VIC storage target met – 6.3GW	
Infrastructure timing	• Committed projects: – Snowy 2.0 – Dec 2031 – VNI West – Dec 2032 – Marinus Link Stage 1 – Dec 2033 • Delayed Loy Yang A retirement: – 2 units retire in FY35 – 2 units retire in FY36	• Assumes major infrastructure projects are delivered as per AEMO's ISP optimal development pathway, but with 1-2 year timing delays consistent with delays to other large energy infrastructure projects in the NEM • Assumes Loy Yang A retirement is slightly delayed to meet expected generation shortfalls in the Victorian region
Build limit	• 4GW/year new VRE across the NEM (onshore wind + solar) before 2030 • Constrained onshore wind build: – 1.5GW/year (FY27-28) – 2GW/year (FY29-30) – Constraint increases by 1GW/year from FY30-45 • No constraints to offshore wind build, but subject to economic entry • Allow PHES build from FY35 • VIC gas peakers: – Allow new entrants (FY34) – 3GW total gas capacity – ISP	• Assumes the build rate for new onshore wind generation capacity in the NEM is constrained at levels consistent with the highest historical build rates due to ongoing limitations from supply chains, planning approvals, and social licence. These constraints are assumed to relax over time

Modelling limitations: the modelling assumptions include a number of limitations that collectively may understate the increased system cost impacts of the Building Electrification RIS

Modelling limitations	Limitation	Potential impact
Electrification Load Curves	• Modelling applies the AEMO load curves for the electrification load profile that results from conversion of gas appliances to electricity on a time of day basis. Some analysis suggests that these curves may under-estimate the 'peakiness' of demand from gas networks and as a consequence may underestimate the additional peakiness from electrification	• A more peaky electrification load would result in more system constraints and higher prices during peak periods
Impacts of other new electricity loads	• Our modelling uses AEMO's load forecasts for Victoria from the 2024 Integrated System Plan. These forecasts may underestimate the impact of new large loads (e.g. data centres) that have been announced in the past 18 months	• If larger data centre loads eventuate these may place further pressure on electricity demand in Victoria, leading to higher prices
Impacts of renewable gas	• Our analysis does not include a future role for renewable gas, which could reduce emissions from continued use of gas appliances	• If a role emerges for renewable gas the emissions profile of customer archetypes that continue to use gas appliances will fall, further reducing the emissions benefit of Forced Electrification
Practical limitations on electrification	• Our modelling assumes that electrification under the Forced Electrification scenario is possible at the rates and timelines proposed under the Building Electrification RIS. Practical constraints that may impact the implementation (e.g. supply chain constraints, availability of electricians) have not been applied.	• The presence of practical constraints may slow the pace of electrification, changing the profile and realisation of benefits vs. our modelling

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Modelling sources and assumptions – Customer archetypes (1 of 2)

Customer bill assumptions (FY2030)	Source	Customer A *All gas*	Customer B *All high efficiency electric*	Customer C *All high efficiency electric w/ additional capex*	Customer D *All low efficiency electric*	Customer E *Gas cooktop & water, high efficiency electric conditioning + Solar*
Total electricity demand (kWh)	*ACCC's 2023 Inquiry into the NEM report*	5,232	8,443	8,443	11,619	8,258
Wholesale electricity costs ($/kWh)	*Endgame Analytics Modelling*	No RIS – $0.166, RIS – $0.172				
Network electricity costs ($/kWh) (transmission and distribution)	*Consistent with the approach in The Time Is Now*	No RIS – $0.067, RIS – $0.070				
Retail electricity costs and margin (% of total bill cost)	*Essential Services Commission of Victoria 2024 VDO review*	25%				
Total electricity costs ($AUD)		**1,756**	**2,833**	**2,833**	**3,899**	**2,279***
Total gas demand (MJ)	*ENA - 2022/23 Gas Network Benchmarking Report*	46,600	-	-	-	1.398
Wholesale gas costs ($/MJ)	*AEMO ISP GPG fuel prices - Step Change scenario*	c.$0.012				
Network gas costs ($AUD per connection)	*AGIG & AusNet Network Modelling*	No RIS – $340, RIS - $376				
Retail gas costs and margin (% of total bill cost)	*ACCC Gas Inquiry Report*	40%				
Total gas costs ($AUD)		**1,601**	-	-	-	**656**

Note: * Includes reduction from PV self consumption

All prices are in real FY24 dollars

Modelling sources and assumptions – Customer archetypes (2 of 2)

Customer bill assumptions (FY2030)	Source	Customer A *All gas*	Customer B *All high efficiency electric*	Customer C *All high efficiency electric w/ additional capex*	Customer D *All low efficiency electric*	Customer E *Gas cooktop & water, high efficiency electric conditioning + Solar*
Incremental capex - $AUD *(Amortised over average asset life - c.14 years)*	*ACIL Allen - Renewable Gas Target 2024* *Frontier Economics - Cost of switching from gas to electric appliances* *ATO*	-	12,683 *(816)*	12,683 *(816)*	8,497 *(544)*	11,680 (747)
Disconnection fee - $AUD *(Amortised over forecast period - 20 years)*	*Gas Substitution Roadmap*	-	242 *(12)*	242 *(12)*	242 *(12)*	-
Additional capex* - $AUD *(Amortised over forecast period - 20 years)*	*Frontier Economics - Cost of switching from gas to electric appliances in the home*	-	-	5,250 *(263)*	-	-
Solar system size - kW	*Energy Council Solar Report Q3 2023*	-	-	-	-	6.7
Avg. yearly generation - kWh	*Australian Renewable Energy Agency*	-	-	-	-	9,782
PV self-generated consumption - %	*Australian Renewable Energy Agency*	-	-	-	-	15
Solar system capex - $AUD *(Amortised over average asset life - c.25 years)*	*CSIRO GenCost for rooftop PV*	-	-	-	-	8,790 *(273)*

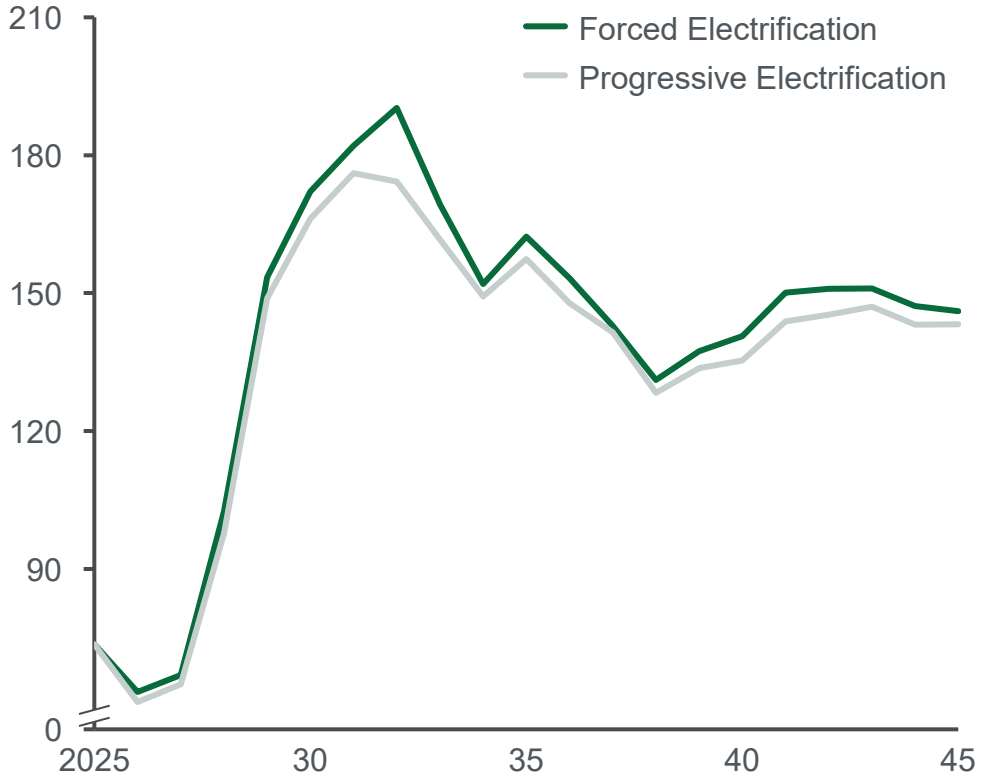
Note: * Additional capex = Cost of a power supply upgrade for a typical Victorian house

All prices are in real FY24 dollars

Contents

Electricity prices are the primary driver causing a delta between RIS and no RIS scenarios. The RIS adds an additional $5-15/MWh, increasing electricity prices to c.$190/MWh by FY2032

VIC: Load weighted average Regional Reference Price (RRP) (FY2025-45)
$/MWh (Real 2024)

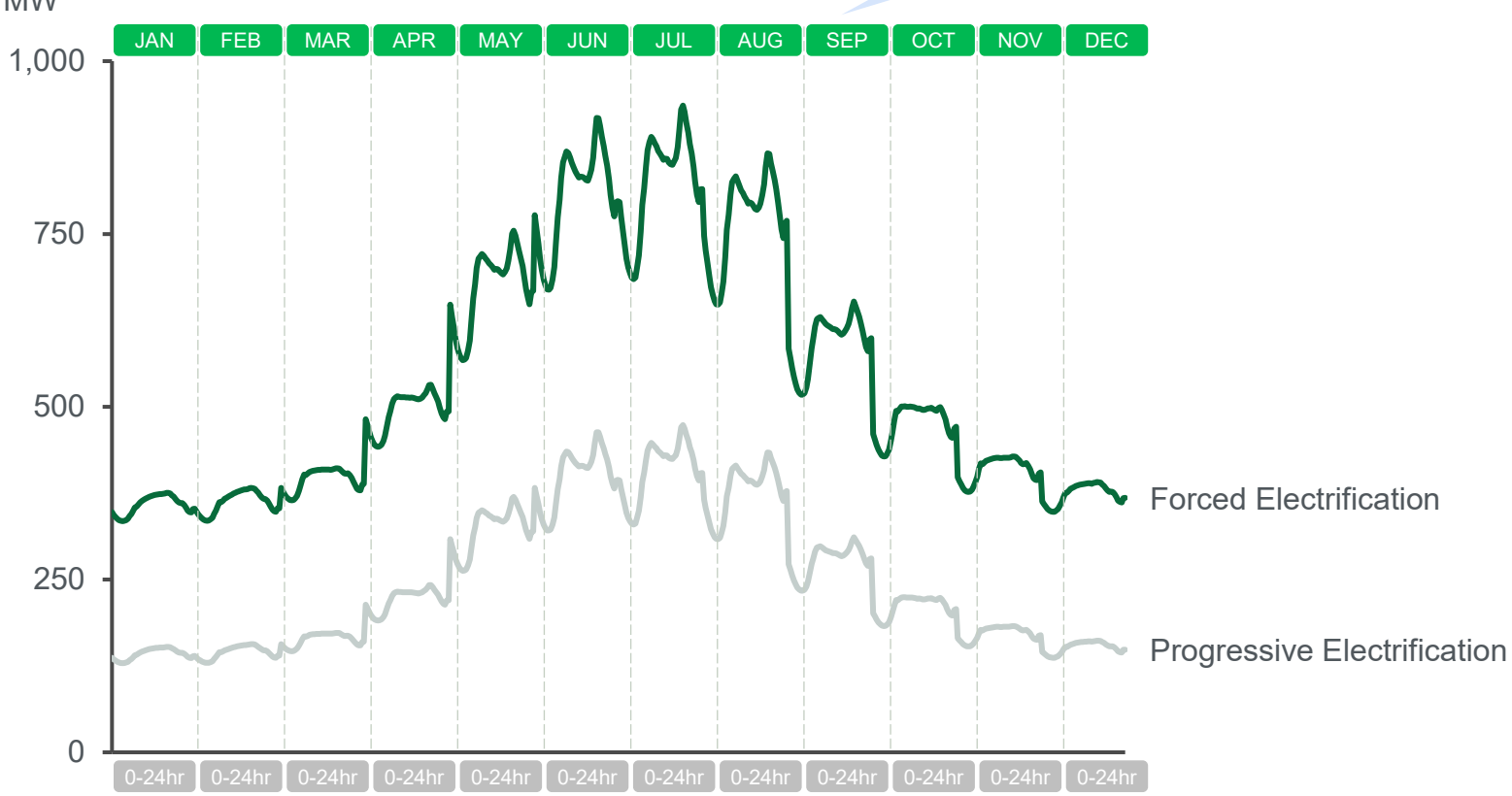


- Our modelling assumes coal plant retirements occur in line with AEMO's ISP and currently announced retirement plans. We assume addition of new renewable generation capacity and supporting transmission in line with the ISP optimal development pathway, but with practical constraints applied to the pace at which new generation is built and new transmission completed (see page 26 for full detail)
- The net result of brown coal retirement, and the expected pace of wind and solar capacity additions, means that wholesale electricity prices in Victoria are expected to increase significantly relative to today (this is consistent with modelling under the ISP, and L.E.K./ENA's *The Time is Now* report)
- As transmission interconnectors are completed and additional wind and solar enters the system from the early 2030s downward pressure is placed on prices, stabilising at levels c.2x current prices
- Wholesale prices are c.$5 / MWh higher on average under the Forced Electrification (RIS) scenario (compared to under the Progressive Electrification scenario), with a wider gap observed in the early 2030s when electricity supply is most constrained
- Under Forced Electrification, the system faces additional pressure to reliably supply electricity – with there being c.10 more hours on average per year of electricity prices exceeding $500/MWh each year under the RIS scenario
- There are several factors of uncertainty which could further exacerbate the impact of the RIS:
  - These prices are based off AEMO's half-hourly demand forecasts for electrification demand. Some analysis suggests that electrification demand could be peakier than AEMO forecasts (ie. more concentrated in periods of high demand), which would place further upwards pressure on wholesale prices and electricity network costs, especially during critical peak periods during winter when renewable electricity supply is also low (see page 15)
  - Additional demand from data centres has not been incorporated, which could drive further increases in wholesale prices

Source: Endgame Analytics modelling; L.E.K. analysis

The Forced Electrification scenario exacerbates the existing electricity load in the winter months and the demand peaks in the morning and evening

VIC: Average load demand, by 30min time intervals and month (FY2030)

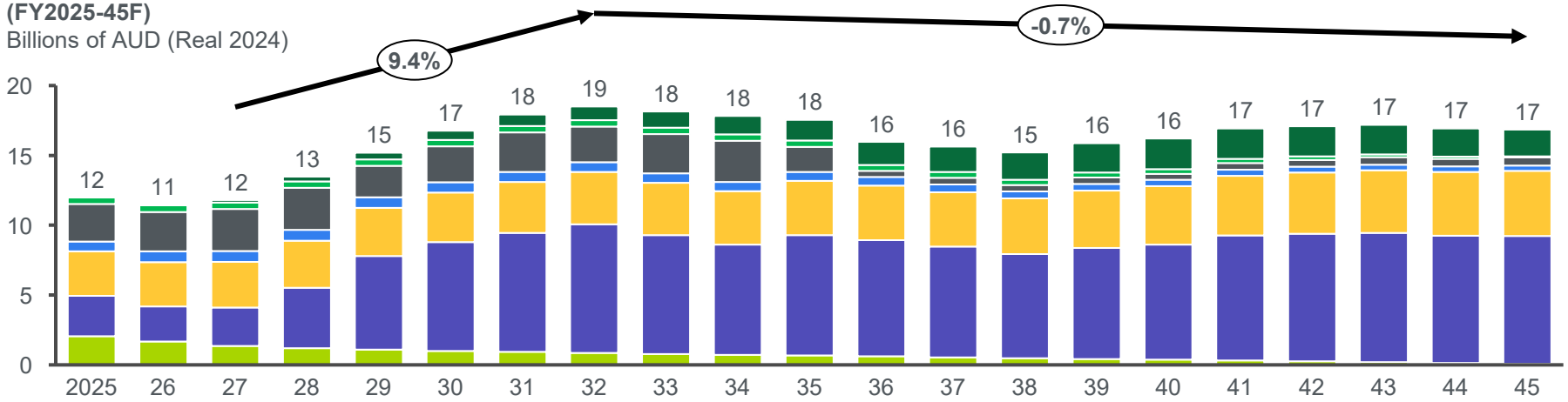


- Since most residential gas is used for space heating in VIC, the additional electrification load is primarily seen in the winter months
- The winter profile is peakier than the summer profile due to residential space heating use
- Over summer the profile is flatter as the business electrification load makes up a larger proportion of the profile

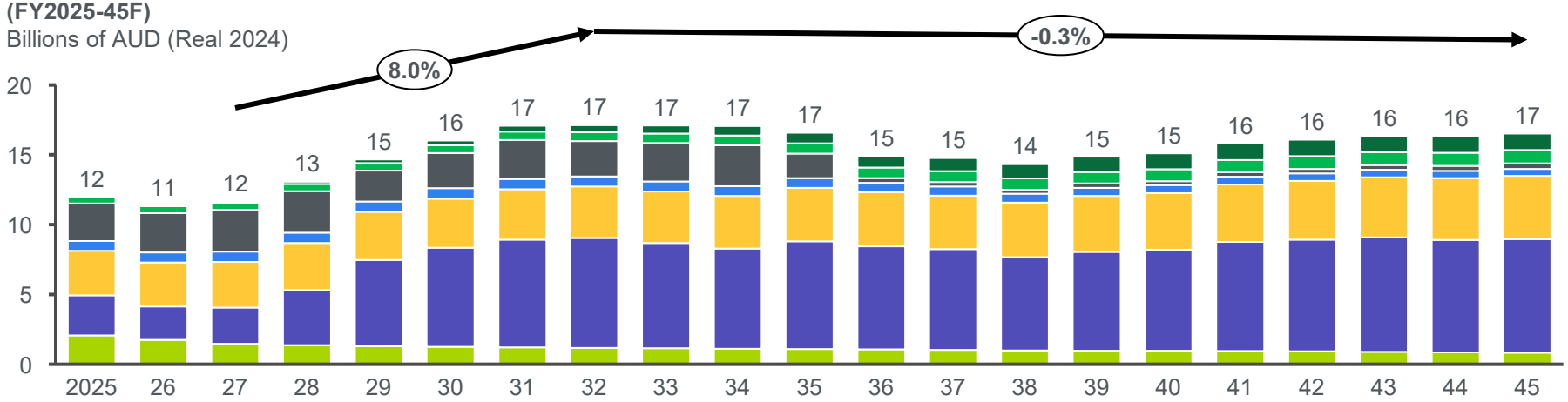
Source: Endgame Analytics modelling

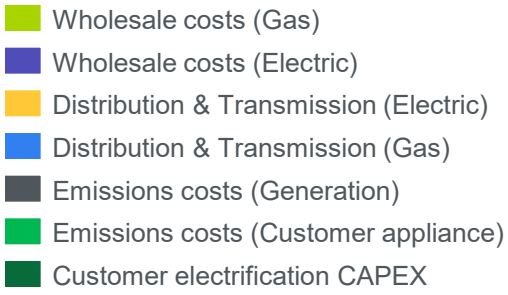
Forced Electrification causes total energy system costs in Victoria to grow by c.9% from FY27-32, compared to 8% under Progressive Electrification, primarily driven by wholesale electricity costs

Forced Electrification cumulative system cost - by cost category (FY2025-45F)
Billions of AUD (Real 2024)



Progressive Electrification cumulative system cost - by cost category (FY2025-45F)
Billions of AUD (Real 2024)



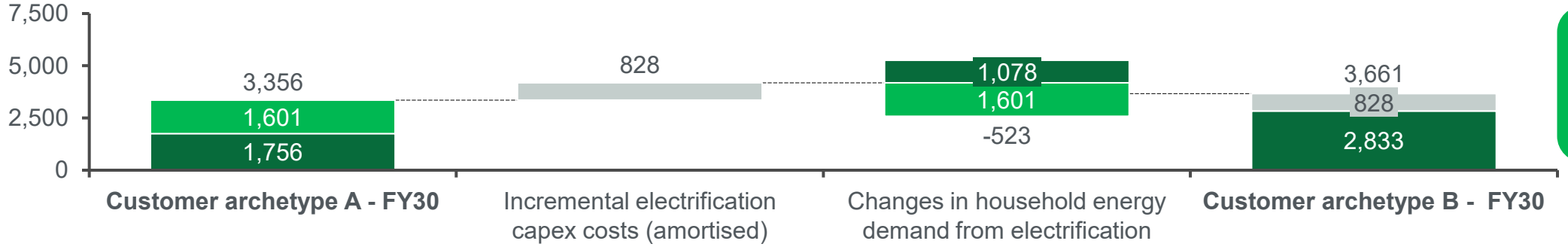


Source: AEMO Draft 2024 ISP; AEMO GSOO 2024; ABS; ACIL Allen; AER; AEMC; Australian National Greenhouse Accounts Factors; Climate Council; Endgame Analytics; L.E.K. Modelling

Customers that electrify their gas appliances face higher costs due to the additional investment in appliances, and the projected rise in electricity prices

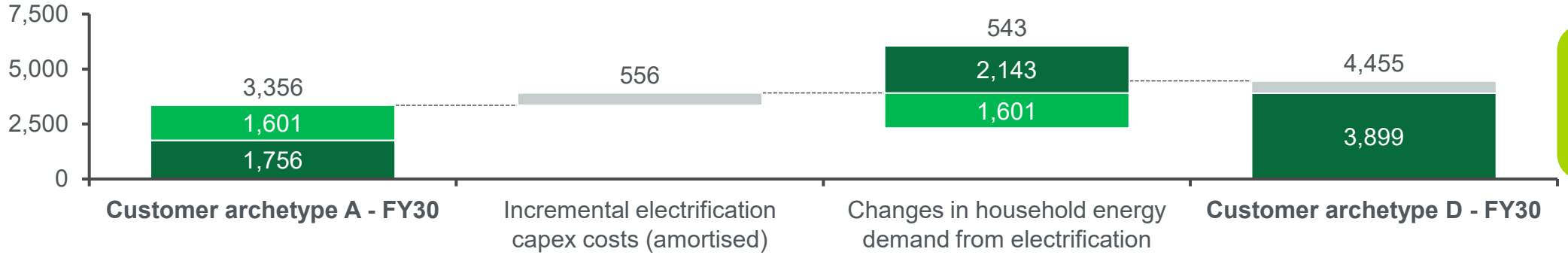
Forced Electrification: Customer archetype A conversion to archetype B, by incremental costs (FY2030)
AUD

Average wholesale costs
Electricity (Inc. Wholesale, network & distribution) 172 ($/MWh)
Gas (Inc. Wholesale, network, distribution & retail) 12 ($/GJ)
Capex (Inc. CER capex, rectification and installation, disconnection charges)



Customer type B
Full disconnection from gas. Electrical appliances high-efficiency

Forced Electrification: Customer archetype A conversion to archetype D, by incremental costs (FY2030)
AUD



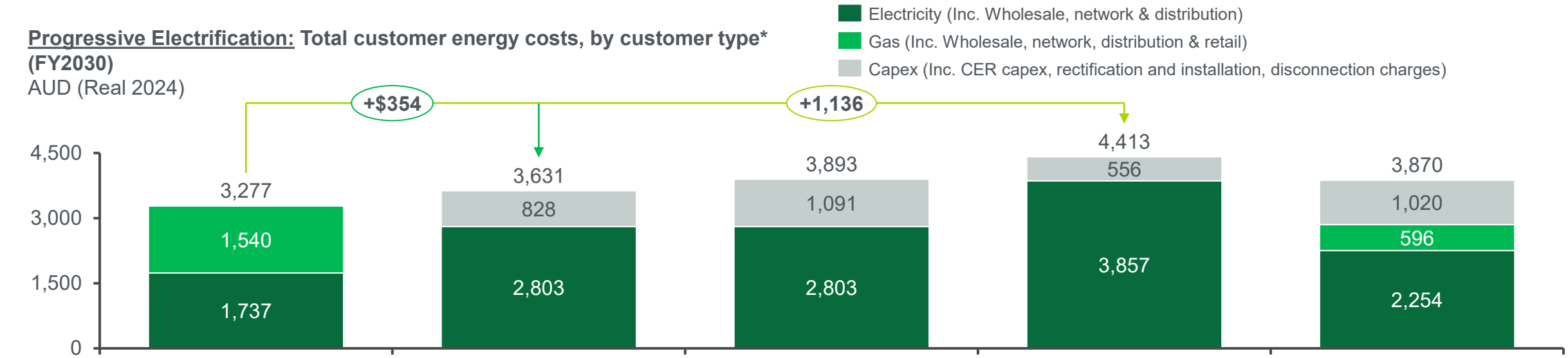
Customer type D
Full disconnection from gas. Electrical appliances low-efficiency

Source: AEMO Draft 2024 ISP; AEMO GSOO 2024; ABS; ACIL Allen; AER; AEMC; Australian National Greenhouse Accounts Factors; Climate Council; Endgame Analytics; L.E.K. Modelling

In FY30, customers that have electrified due to Progressive Electrification are worse off

Customer level impact

Progressive Electrification: Total customer energy costs, by customer type* (FY2030)
AUD (Real 2024)



VIC house-holds**	c.1,260k	c.610k	Subset of customer type 2	c.320k	c.60k
	Customer type A Ducted gas heating, gas cooktop and gas hot water	**Customer type B** Full disconnection from gas. Electrical appliances high-efficiency	**Customer type C** Full disconnection from gas. Electrical appliances high-efficiency. Requires additional capex	**Customer type D** Full disconnection from gas. Electrical appliances low-efficiency	**Customer type E** Remains connected but with reduced usage. Gas cooktop, electric hot water, and electrical heating. Invests in solar
	Gas network connected	Disconnected	Disconnected	Disconnected	Gas network connected

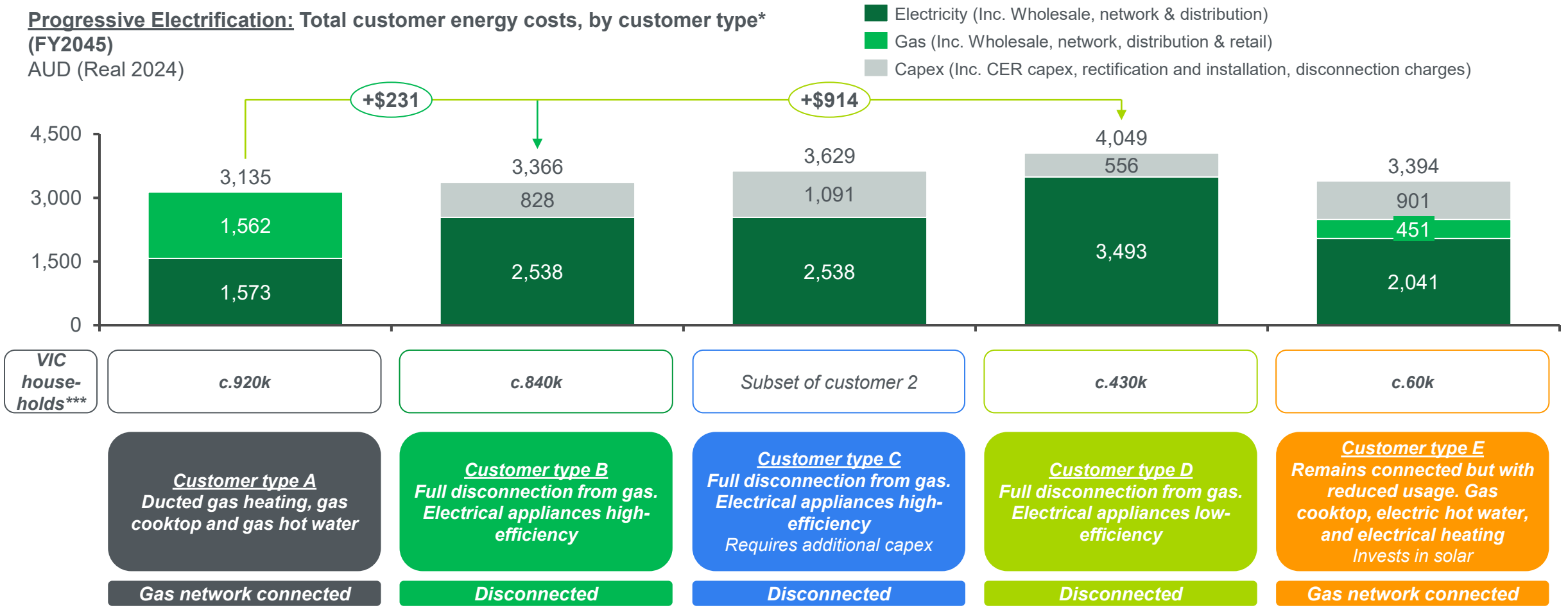
Note: * Energy includes the cost of gas, electricity and amortised electrification costs (excludes ICE fuel costs);
Source: AEMO Draft 2024 ISP; AEMO GSOO 2024; ABS; ACIL Allen; AER; AEMC; Australian National Greenhouse Accounts Factors; Climate Council; Endgame Analytics; L.E.K. Modelling

The average Victorian house is assumed to have three bedrooms, single storey & free standing. Gas space heating in two rooms

By 2045, electrified customers are still worse off compared to customer archetype A, with total costs 7% greater for high efficiency electrification and 29% for low efficiency electrification

Customer level impact

Progressive Electrification: Total customer energy costs, by customer type* (FY2045)
AUD (Real 2024)



Note: * Energy includes the cost of gas, electricity and amortised electrification costs (excludes ICE fuel costs);
Source: AEMO Draft 2024 ISP; AEMO GSOO 2024; ABS; ACIL Allen; AER; AEMC; Australian National Greenhouse Accounts Factors; Climate Council; Endgame Analytics; L.E.K. Modelling

The average Victorian house is assumed to have three bedrooms, single storey & free standing. Gas space heating in two rooms

Briefing note			
To	Dennis van Puyvelde (Energy Networks Australia)	**Date**	23 February 2025
From	Guy Dundas	**Ref**	J1693
Subject	Update to analysis of Victorian RIS assumptions – building electrification RIS		

Key Findings

The Victorian Building Electrification Regulation Impact Statement (RIS) is likely to have a significant impact on the use of gas appliances and therefore on Victorian gas distribution networks. Energy Networks Australia (ENA) has asked ACIL Allen to undertake a high-level review of the RIS assumptions, building on our previous work on the rental standards RIS, to identify any material issues and errors with the RIS methodology.

ACIL Allen has found that:

- The RIS uses retail electricity and gas prices to estimate benefits from changes in energy use. For a cost-benefit analysis (CBA) it is more appropriate to consider only the societally-avoidable component of energy costs (primarily wholesale costs), rather than the full retail cost. Using retail energy prices overestimates the level of avoided energy costs in the RIS, and therefore the net present value (NPV) of all the considered regulatory options. Although it is not possible to precisely estimate the scale of this effect based on the information provided, we estimate that changing this approach could reduce the NPV of the preferred regulatory option by about $1.4 billion.
- The RIS does not adopt the carbon prices set out by Australia's Energy Ministers (including the Victorian Energy Minister) in guidance published in May 2024, instead adopting a higher series. We estimate that adopting lower carbon price assumptions in line with those agreed by Energy Ministers would have a material effect on the RIS conclusions, potentially reducing the NPV of the preferred regulatory option by about $650 million.
- The RIS underestimates the true cost of disconnecting a property from the gas network, and therefore overestimates the NPV of the analysed regulatory options. Sensitivity analysis undertaken as part of the RIS indicates that correcting this assumption would reduce the NPV of the preferred regulatory option by about $200 million.
- Together the changes above would reduce the NPV of the preferred regulatory option by about 45%, from $5 billion to about $2.75 billion.
- In addition, the RIS adopts a 4% discount rate, which is too low for a CBA of this type. We consider that the Victorian Government's own guidelines support the use of a 7% discount rate. This change would further reduce the NPV of the preferred regulatory option from $2.75 billion to about $1.6 billion over 10 years (a cumulative 68% reduction from the original estimate of $5 billion).
- In addition to the issues identified above, the assumed cost of hot water heat pumps and multi-split reverse-cycle air-conditioners set out in the RIS generally appear too low, and the cost of some gas appliances appears too high. Adjusting these assumptions would further reduce the NPV of the regulatory options analysed, but the RIS does not provide sufficient information for us to make an indicative estimate of this effect. Nevertheless, we consider that it is possible that adjustments to appliance cost assumptions could eliminate the net benefit of this option, which would indicate that the recommended regulatory action is not justified.
- The finding in the CGE modelling that the options will have an overall positive impact on Victoria's gross state product, seems to be due to an incorrect treatment of the additional capital expenditure requirements and subsequent capital stock, with the consequence that the modelling is inconsistent with the CBA and with standard economic theory.
- Overall, we can see that a range of assumptions in the building electrification RIS favour the regulatory options under consideration. The information presented gives little confidence that the proposed regulatory changes are in the interest of Victorian energy consumers or Victoria as a whole.

Background

In May 2024 the Victorian Government released draft analysis by Deloitte Access Economics ('Deloitte') entitled *Minimum energy efficiency and safety standards for rental homes – Regulatory Impact Statement* ('the rental standards RIS') for consultation. This document undertook cost-benefit analysis (CBA) to justify proposed regulations that would prescribe minimum standards for rental properties. The proposed standards include effective bans on installing new gas water heating and gas space heating appliances in rental properties.

In August 2024 ACIL Allen completed a review of the rental standards RIS for Energy Networks Australia (ENA). Our review focused on the RIS measures relating to hot water and heating and cooling, as these will have the most material impact on gas distribution networks represented by ENA. Our review identified a number of assumptions that, in our view, were likely to favour the preferred regulatory options (i.e. the effective ban on new gas appliances). We considered that there was a low-to-medium probability that the RIS has erred in supporting the preferred hot water regulatory option, and a medium-to-high probability that the RIS had erred in supporting the preferred heating and cooling regulatory option.

In December 2024 the Victorian Government released a draft Regulation Impact Statement supporting further regulatory options to promote electrification in residential and commercial buildings ('the building electrification RIS'). This RIS is supported by Deloitte analysis and appears to adopt many of the same assumptions and approaches as the rental standards RIS. The Victorian Government expects to review submissions during early-to-mid 2025 and make regulations by the end of 2025.

As with the rental standards RIS, the building electrification RIS is likely to have a significant impact on the use of gas appliances and therefore on gas distribution networks represented by ENA. ENA has asked ACIL Allen to undertake a high-level review of the building electrification RIS assumptions, building on our previous work on the rental standards RIS, to identify any material issues and errors with the RIS methodology (including where problematic assumptions and approaches that may have been translated from the rental standards RIS).

The building electrification RIS considers four regulatory options, each of which constrain appliance choice and limit the circumstances in which gas appliances can be installed to some degree. The regulatory options under consideration are:

- Option 1: electrification of all new residential and commercial buildings
- Option 2: electrification of all new and existing residential buildings, and all new and existing commercial buildings except existing commercial kitchens
- Option 3 (preferred option): electrification of all new and existing residential buildings except existing residential cooking, and all new commercial buildings
- Option 4: electrification of all new and existing residential buildings.

Scope of this review

The two RISs have important similarities and differences. The key similarity is that both RISs propose constraints on the ability of property owners to install new gas appliances in existing residential properties.

There are a range of differences that are worth noting as context:

- The building electrification RIS also regulates appliance choice in new residential properties. The building electrification RIS seeks to extend the requirements of Victoria's adoption of the 2024 National Construction Code to ensure that all new buildings are all-electric, not just new buildings that require a planning permit.
- The building electrification RIS applies to commercial properties as well as residential properties.

— The building electrification RIS applies to both owner-occupied and rental properties, whereas the rental standards RIS only applied to rental properties.

— The rental standards RIS included measures seeking to improve building energy efficiency as well as appliance choice, whereas the building electrification RIS only affects appliance choice.

As our review of the building electrification RIS is brief and high-level, our focus is on areas of overlap between the two where we can bring across and update insights from our work on the rental standards RIS. This area of focus are how the building electrification RIS regulatory options affect appliance choice in existing dwellings, particularly hot water and heating and cooling appliances. We do not analyse in detail aspects of the RIS applying to:

— new residential dwellings

— commercial buildings.

Despite these differences and limitations, we consider that insights from our previous analysis are material to the building electrification RIS. Figure 6.2 of the building electrification RIS makes clear that $4.4 billion of the present value costs of the preferred option are from the residential sector, out of a total of about $5.8 billion (or about three quarters). It is reasonable to assume that the benefits are also heavily weighted to the residential sector and so, in general, residential outcomes are a key driver of overall RIS outcomes. Similarly, as appliance choice is already heavily constrained (all-electric) in new buildings requiring a planning permit, it is reasonable to assume that the majority of impacts from the proposed regulatory options in the building electrification RIS come through effects on existing homes rather than new homes.

Specific assumptions

The sections below highlight where assumptions and methodological choices used in the building electrification RIS are problematic and work to over-state the benefits of the proposed regulatory options (particularly by constraining the use of gas appliances in favour of electric appliances).

Energy prices

As in the rental standards RIS, the building electrification RIS uses retail electricity and gas prices to estimate benefits from changes in energy use. As we noted in our review of the rental standards RIS, in our view this represents a fundamental error in the basis of estimation of costs and benefits in the RIS. The argument for this position is set out in more detail in section 3.2 of our attached review of the rental standards RIS for more detail but, in summary:

— many elements of retail energy costs are not directly related to the total volume of energy consumed and therefore are not economically avoidable at a societal level (even if they are avoidable at the level of a single household or business energy bill)

— using retail energy costs rather than only considering the societally-avoidable components of energy costs tends to overstate the avoided energy costs in a CBA.

Tables 6.2 and 6.3 of the building electrification RIS show that avoided energy costs is the largest benefit category for the preferred regulatory option, whether considered over either 10 or 20 years. Clearly, reducing the level of avoided energy costs by considering only the societally-avoidable component of energy costs will have a material impact on the RIS analysis, and tend to weaken the case for the preferred regulatory option (or, indeed, any of the considered regulatory options).

In broad terms our analysis of the rental standards RIS indicates that moving to avoidable costs rather than retail costs in the building electrification RIS might reduce the level of avoided energy costs by about one-third, which would reduce the net present value of the preferred regulatory option by about $1.4 billion over a 10-year period or in the order of $2 billion over a 20-year period.

Correcting the basis of avoided energy cost estimates would have a material effect on the RIS analysis and could change the conclusions when combined with other assumptions changes highlighted in this note.

Appliance efficiency

We have reviewed the energy use estimates for heating and hot water appliances in the building electrification RIS and consider these assumptions to be plausible.

Carbon prices

The building electrification RIS sets out assumed carbon prices. It further details this assumption as being from the Intergovernmental Panel on Climate Change's (IPCC's) 6th Assessment Report. The stated carbon prices for 2024 to 2032 are the same as those used in the rental standards RIS, and the extrapolated series to 2050 is presented in a chart (which was not presented in the rental standards RIS).

As we set out in section 3.6 of our attached review of the rental standards RIS, it is unclear why the RIS does not adopt the carbon prices set out by Australia's Energy Ministers (including the Victorian Energy Minister) in guidance published in May 2024. These carbon prices (also known as the 'value of emissions reduction', or VER) draw on IPCC analysis as well as the value of Australian Carbon Credit Units, and are noticeably lower than the RIS assumption. It follows that adopting this lower VER carbon price estimate would reduce the value of avoided greenhouse gas emissions in the building electrification RIS, which is the second largest benefit category (after avoided energy costs).

With the information available it is not possible to undertake a precise analysis of the effect of changing the adopted carbon price series to the VER. We undertook informal analysis of this kind for the rental standards RIS and generally found that changing the carbon price series would reduce the value of avoided greenhouse gas (GHG) emissions by about 20%. This in turn would reduce the NPV of the preferred regulatory option by about $650 million.

Changing carbon price assumptions to be in line with the VER values agreed by Energy Ministers would have a material effect on the RIS analysis and could change the conclusions when combined with other assumptions changes highlighted in this note.

Gas disconnection costs

The building electrification RIS assumes a $242 cost to disconnect a property from the gas network. This cost is based on the regulated cost of disconnection set by the Australian Energy Regulator (AER). This cost is lower than the $300 assumption used in the rental standards RIS.

As set out in section 3.7 of our attached review of the rental standards RIS, we consider this to underestimate the true societal cost of safely disconnecting a customer from the gas network. In regulatory determinations on the Victorian gas distribution networks, the AER has accepted estimates of the true cost of abolishment in the order of $800-$1000 per property. The regulatory decision to limit the cost paid by disconnecting customers to $242 means that the rest of this cost is incurred by gas networks and 'socialised' across the broader network cost base. In other words, it is paid for by customers that continue to use gas, rather than by the disconnecting customer. In a CBA we are seeking to understand the costs and benefits of an action on a society as a whole, and so it is essential that the entire cost of gas network disconnection be included, not simply the component that is paid for by the disconnecting household.

It follows that the cost of gas disconnection is significantly underestimated in the building electrification RIS. In turn, it is likely that the net benefits of the preferred regulatory option are overestimated.

The effects of using the correct approach to costing customer disconnection is tested through the RIS' high gas abolishment cost sensitivity (Table 6.7). This indicates only a modest effect on the preferred regulatory option's NPV over 10-years, reducing it from $5 billion to $4.8 billion. Nevertheless, this change would reinforce the effect of other assumption changes highlighted in this note, which together could change the RIS conclusions on the preferred regulatory option.

Cumulative effect

The cumulative effect of the changes to energy prices, carbon prices and gas disconnection costs is a reduction in the NPV of the preferred regulatory option by about $2.25 billion over 10 years, or a 45% reduction from about $5 billion to about $2.75 billion. This reduction comprises a $1.4 billion reduction from the adjustment to the basis of avoided energy cost estimates, a $650 million reduction from an adjustment to assumed carbon prices, and a $200 million reduction from an adjustment to the cost of gas disconnection.

Discount rates

As for the rental standards RIS, the building electrification RIS adopts a 4% discount rate (with sensitivity analysis at 2% and 7%). As we noted in our analysis of the rental standards RIS, a real discount rate of 4% is at the low end of the range of discount rates used as the central case for CBAs of this type. Central rates of 5% or 7% are more commonly used, with the NSW Government's guidelines recommending 5% and the Commonwealth Government's guidelines recommending 7% (see section 3.1 of our attached review of the rental standards RIS for more detail).

The Victorian Government's own guidelines (issued by the Department of Treasury and Finance in 2013) recommend a rate of 4 per cent for 'Category 1' assessments where benefits are not easily translated to monetary terms, or a 7 per cent rate for 'Category 2' assessments where benefits are more easily monetised. We consider this RIS to be better classified as a Category 2 assessment as the main costs and benefits relate to energy usage and appliances costs, which can be readily monetised. By contrast, Category 1 projects would typically involve services such as schools, hospitals, police stations and civic open spaces. Based on this, we do not consider that the building electrification RIS follows the Victorian Government's own guidelines.

Adopting a 5% or 7% discount rate rather than 4% would materially change the RIS calculations, and could change the conclusions when combined with other assumption changes. The sensitivity analysis conducted as part of the RIS indicates that adopting a 7% discount rate reduces the net present value (NPV) of the preferred regulatory option from $5 billion to $3.2 billion over a 10-year assessment period.

However, this change to the discount rate cannot be considered as additive alongside the other changes identified above, because a change to the discount rate will change the present value of the various cost and benefit streams. In general we would expect a higher discount rate to have a bigger effect on avoided energy costs and avoided GHG emissions than on capital costs, because the nature of the preferred regulatory options is that they require consumers to purchase more expensive appliances upfront, which then delivers a stream of benefits (avoided energy and GHG costs) over time, and a higher discount rate will reduce the stream of benefits more because they occur later in time.

We have attempted to account for this by reducing the present value of capital cost streams by 18% and energy and GHG cost streams by 30%, which re-creates the change in NPV shown in the RIS' discount rate sensitivity for the preferred option. We assess the change in discount rate to further reduce the NPV of the preferred regulatory option from $2.75 billion (based on the cumulative effect of assumption changes highlighted above) to about $1.6 billion, representing a combined $3.4 billion (68%) reduction.

It follows from this analysis that adopting a more appropriate central discount rate of 5% to 7% would have a material effect on the RIS analysis, and the NPV of the preferred regulatory option is far lower than assessed in the RIS when considering the combined effect of all the assumptions changes highlighted in this note.

Appliance capital costs

Hot water

In our review of the rental standards RIS we noted that the RIS used heat pump hot water capital cost assumptions that are lower than those from analysis undertaken by GHD for the Victorian Government in 2021 (with appropriate inflation adjustments – see Table 3.7 from our attached review of the rental standards RIS). Heat pump costs in the building electrification RIS have decreased further relative to the rental standards RIS (Table 1). In the current inflationary cost environment we do not consider that it is credible that appliance costs have declined in the past six months, and so we consider that the building electrification RIS significantly underestimates the cost of heat pump hot water units. In turn this is likely to underestimate the costs and overestimate the net benefits of the regulatory options considered.

By contrast with the heat pump costs, which are underestimated relative to the GHD analysis, gas instant and solar/gas-boosted hot water system costs are overestimated in the building electrification RIS relative to GHD's analysis (Table 1). This pattern is generally consistent with that seen in the rental standards RIS.

Table 1 Comparison of water heater capital costs

Appliance type	Building type	GHD estimate	Rental standards RIS estimate	Building electrification RIS estimate	Change: GHD to building electrification RIS	Change: rental standards to building electrification RIS
Heat pump	Class 1	$4,997	$4,530	$4,175	-16%	-8%
	Class 2		$4,167	$3,870		-7%
Gas instant	Class 1	$2,030	$2,556	$2,658	31%	4%
	Class 2	$2,030	$2,124	$2,204	9%	4%
Solar gas	Class 1	$4,843	$7,537	$6,939	43%	-8%
	Class 2		$6,514	$6,050		-7%

Notes: GHD estimates increased by about 10% to account for inflation between April 2022 and the present (calculated based on ABS CPI). Negative changes indicate that estimates in the building electrification RIS are lower than in previous analyses. For simplicity we have not included discrete wiring costs in the heat pump installation cost (which we did do in our analysis of the rental standards RIS).

Source: ACIL Allen analysis of rental standards and building electrification RISs; GHD (2022), All-electric new homes: cost assessment, Appendix B; ABS Consumer Price Index, September Quarter 2024.

Heating and cooling appliances

We have identified a number of anomalies with the building electrification RIS' assumptions on heating and cooling appliance capital costs.

The most notable anomaly is that the RIS assumes that the cost of installing appliances is lower in existing properties than in new properties. This is counter-intuitive and generally not credible as installations in new homes have a number of advantages over those in existing homes:

- installing gas piping or electrical cabling between the meter and an appliance is easier and cheaper during construction as this will typically avoid drilling through existing walls or working in fully enclosed roof spaces
- appliance location will be more flexible in a new property and installation will be less disruptive due to the property being an established worksite
- the costs of removing existing appliances and rectifying any changes will be avoided (though we note that this has been taken into account explicitly through estimated appliance removal costs).

The counter-intuitive nature of these assumptions means that it is possible that the appliance installation costs presented have simply been mis-translated, and the existing property costs are in fact the new property costs (and vice versa).

This complication makes comparison of the published assumptions with other studies difficult. That said, we can observe that multi-split reverse-cycle air-conditioner (RCAC) costs are significantly underestimated relative to GHD's analysis:

— GHD's analysis, with inflation adjustments, indicates costs of about $13,400 for a new Class 1 dwelling and $9,000 for a new Class 2 dwelling

— the building electrification RIS assumes $7,706 for an existing Class 1 dwelling, $11,094 for a new Class 1 dwelling, $5,213 for an existing Class 2 dwelling and $6,788 for a new Class 2 dwelling.

This assumption is very important as the building electrification RIS assumes that 50% of the Class 1 buildings that electrify their heating will adopt multi-spilt RCACs.

On the same basis, GHD's estimates of ducted gas heating costs are also higher than those used in the building electrification RIS, but this is not as material to the analysis as:

— the extent of cost under-estimation is significantly lower for gas ducted heaters than for multi-split RCACs

— gas appliances are cheaper overall, and so their capital cost is not as important a driver of RIS outcomes

— the existing stock has far more as heaters than electric heaters, so the cost of installing new electric heaters will be more important to RIS outcomes than the cost of new gas heaters.

Combined effect

Overall, we consider that the published appliance cost assumptions set out in the building electrification RIS are problematic, and the net benefits of the regulatory options considered are likely to be over-estimated. However, the RIS does not provide sufficient information for us to make an indicative estimate of the size of this effect.

Nevertheless, we consider that it is entirely possible that adjustments to appliance cost assumptions could reduce the NPV of the preferred regulatory option by more than $1.6 billion, which would eliminate the net benefit of this option and indicate that the recommended regulatory action is not justified.

Conclusions

As for the rental standards RIS, we can see that a range of assumptions in the building electrification RIS favour the regulatory options under consideration, specifically by favouring electric appliances over gas appliances. Rebasing these assumptions to values that are better supported by the literature and established regulatory assessment practice (including the Victorian Government's own guidance on discount rates) would be likely to materially reduce the net present value of all the regulatory options considered. Given the complex interaction of the various assumptions, it is not possible to decompose the effect of each change and assess at arms' length whether the issues identified above would be sufficient to change the overall RIS conclusions (in other words, to make the net present value of the proposed regulatory options fall to below zero). However, we have identified changes that could reduce the NPV of the preferred regulatory option by about 68%, from over $5 billion to about $1.6 billion (over 10 years). Further revision of appliance capital cost estimates could well eliminate the remaining net benefit of the preferred regulatory option, indicating that the recommended regulatory action is not justified.

Overall, we consider that the breadth of poorly-based assumptions and the general bias in favour of assumptions that improve the cost-benefit outcomes of electrification, means that there is a strong case for the Victorian Government to completely revise its analysis of the proposed regulatory options.

There are further reasons to be sceptical of the RIS conclusions. The RIS states an assumption of a 20-year life for gas hot water and heating systems, but regulatory options 2, 3, 4 see residential and commercial gas use decline to very low levels

over a 15-year period (2025 to 2039), before stabilising. It is unclear how the measures would achieve such rapid gas use reductions given the appliance life assumptions.

Further, a static assumption of a fixed 20-year life for appliance, while convenient for modelling purposes, is not likely to reflect consumer behaviour in the real world. In practice, appliance life is flexible, and can be extended through repair and refurbishment. Given the substantial costs of retrofitting whole-of-house electrical heating (often over $10,000), in practice it is likely that many homeowners will avoid appliance replacement in response to the restrictions created by the RIS, and instead refurbish their existing gas appliances. The energy efficiency, emissions and safety implications of potential gas appliance life extensions does not appear to have been considered in the RIS, even at a high-level.

In summary, the information presented gives little confidence that the proposed regulatory changes are in the interest of Victorian energy consumers or Victoria as a whole.

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Appendices

A Review of CGE modelling

This section provides a review of the computable general equilibrium (CGE) modelling for the estimation of the broader economic impacts of electrification of buildings on GSP and sectoral GVA.

A.1 Introduction

In addition to the CBA, Deloitte undertook CGE modelling to test the potential impact of regulations on broader economic outcomes. The methodology and results are presented in Section 7.3 (pp. 111-118) and Appendix E (pp. 184-188).

Deloitte used the Deloitte Access Economics in-house CGE model called DAE-RGEM. While the specific details of the model are not publicly available, it is based on the extensively published model and database of the Global Trade Analysis Project (GTAP) and is generally deemed credible throughout the Australian CGE modelling community.

By the nature, CGE models such as DAE-RGEM are inherently highly flexible with users able to use multiple methods for applying a shock to the model when estimating the potential impacts of a policy compared to the baseline projection of the economy. For example, a change in consumption of a particular commodity (say, gas) can be achieved by solving for a productivity variable, a tax or other price variable, or by a variable that shifts consumer preferences. Further, these can be applied to specific consumers, to all consumers uniformly, or to a mix of the two. The choice of the variables used to solve for a policy shock is called the "closure" of the model and the choice of the closure used can have significantly different implications for the macroeconomic results. This includes the possibility of a sign change (that is, the estimated GDP impacts of a policy shock could be positive under one closure choice, but negative under another). It is up to the practitioner to ensure that the most appropriate closure is used for the specific application.

While the information provided does not specifically allow the closure to be determined, the nature of the task and results allows a judgement to be made about how the modelling was approached and whether it is reasonable.

A.2 Review

On review, there are two key issues with the modelling. First, the treatment of the additional capital expenditure (namely the additional cost associated with the appliance upgrade and installation costs plus the building upgrade costs, less the avoided capital cost of cooling appliances and avoided gas network costs). Second, the method employed for substituting gas for electricity. In summary:

1. The treatment of the additional capital expenditure in the CGE modelling is deemed to have incorrectly generated large positive net impacts for the Victorian economy with the consequence that the modelling is inconsistent with the CBA and with standard economic theory.
2. The method employed for substituting gas for electricity (and the selection of which impacts were attempted to be modelled) is not the best practice that would be expected for an analysis such as this. However, in the absence of a decomposition of the existing results it is uncertain how large an impact it will have on the results.

These issues are discussed in turn below.

Treatment of additional capital expenditure

In general, when implemented properly, results from CGE modelling tend to align with the results of CBA modelling. While there may be differences in the merit order of alternative options, these can usually be traced back to additional considerations in the CGE modelling associated with the regional effects of changes in relative local content, wealth transfers, movements in primary factors between regions, or changes in terms of trade.

In the case of the Deloitte modelling for the RIS, there is a starkly different outcome in the estimated impacts of Option 2 in the CGE modelling compared to the CBA modelling. In particular, in section 7.3.1, Deloitte state that:

> *Option 2 has the highest incremental GSP impact relative to the Base Case at around $1 billion per annum.*

And:

> *The GSP impacts under Options 3 are just under $396 million per annum on average over the modelled period.*

In contrast, the CBA modelling found that the net present value over a 20-year period was $3,514 million for Option 2 (with a BCR of 1.17) and $7,472 million for Option 3 (with a BCR of 1.91). The explanation provided by Deloitte for the difference is:

> *This is due to the higher scale of electrification required under Option 2 relative to the other options.*

Given the relative changes in the avoided energy costs are only +44% (based on Table 6.3), while the relative GSP impact is +153%, this explanation does not make sense. Indeed, when looking across all of the scenarios, the relative magnitudes of the CGE results seem to more closely match the relative changes in net additional investment. Consequently, it seems likely that the various net capital costs (i.e. additional appliance upgrade and installation costs, building upgrade costs less the avoided capital cost of cooling appliances and avoided gas network costs) were introduced into the CGE modelling as additional investment for the Victorian economy with the money being drawn from the global investment pool[1]. More importantly, however, based on these results it seems probable that Deloitte did not isolate the required investments and subsequent capital stock, and instead added it to the general investment sector in their model with the subsequent capital stock being added to the general capital stock in their model. In essence, this means that the additional capital costs required for each Option has been treated as additional capital stock available to the Victorian economy (i.e. capital deepening).

When undertaking modelling such as this, the expected practice would be that the investment costs needed to replace gas-based consumption with electricity-based consumption are isolated from other investment in the economy with the resulting capital stock also being isolated. Such isolation prevents the policy-related capital expenditures being inadvertently added to primary factors in the model. By not isolating the required additional capital expenditures in DAE-RGEM, the CGE modelling has spuriously increased Victorian GSP, when, in reality, it is a net cost to be borne by energy consumers to attain the exact same services intended to be obtained from the energy (i.e. heating, cooling, cooking, etc.)[2].

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[1] Note: In contrast, the standard CBA assumption is that *all* additional capital costs of a policy option represent foregone investment elsewhere in the Victorian economy in the same year of investment and, consequently, with no future income transfer effects associated with paying back any interest payments.

[2] Technically, additional capital expenditures can result in increases in real GSP/GDP due to terms of trade changes and relative local content effects, but in standard CGE models following neoclassical economic theory, any such net positives should be small relative to the size of the additional investment due to it effectively being a reallocation of consumption and not a value-adding or productivity enhancing activity in and of itself. It is the operations phase of the resulting capital stock that should drive any real GSP/GDP increase (such as reverse cycle electricity-based heating/cooling systems being more energy efficient than gas-based systems, for example). Presentation of the two effects (i.e. the investment phase and the operations phase) would help show the relative importance of the two effects in the DAE-RGEM modelling.

Gas to electricity substitution

A strength of CGE modelling is its ability to simultaneously model a range of competing factors. However, despite detailed modelling being undertaken on the relative physical energy demands of fossil gas versus electricity, along with the relative wholesale and retail cost of the energy, the CGE modelling has not used this information. Rather the documentation states that the modelling relied on the default substitution functions within their CGE model. This limitation is mentioned in Appendix E, but given the importance of the RIS it would be expected that specific attention would be given to incorporating the detailed estimates into the modelling. The documentation states that the standard GTAP behavioural parameters have been used. Presumably this also means that the standard fuel substitution functions in the GTAP model (namely, CES, CDE and/or CRESH functions) have also been used in DAE-RGEM. If so, this means that the fuels are treated as imperfect substitutes using stylised functions that are unlikely to correctly reflect the increase the demand for electricity in physical units (i.e. GJ, kWh etc) by the relevant decrease in fossil gas use in physical units. Based on our experience in modelling similar policies, it is important to modify standard CGE models appropriately to ensure that the real world expectations for the changes in physical units are modelled as faithfully as possible to the information underlying the CBA. Not doing so risks misvaluing the real costs (or savings) to consumers and to the economy in general.

Further, Chapter 7 of the RIS presented results of detailed electricity market modelling and gas market analysis. This included analysis of the additional electricity distribution infrastructure, generation requirements, electricity tariff impacts, anticipated Victorian gas imports, gas prices and gas network impacts. None of these effects, however, were included in the CGE modelling, even as a sensitivity analysis. Best practice modelling would expect at least one tool (either the CBA or the CGE) to have brought together the full suite of expected impacts, even if for only the preferred Option.

In the absence of a decomposition of the existing results, it is uncertain how large an impact changing the methodology to more accurately model the energy substitution effects will have on the results (either on a partial basis ignoring the wider electricity and gas market impacts, or on a total basis which includes all of the expected impacts).

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Attachment

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Assumptions review of Victoria's rental standards RIS

Final report

23 August 2024

About ACIL Allen

ACIL Allen is a leading independent economics, policy and strategy advisory firm, dedicated to helping clients solve complex issues.

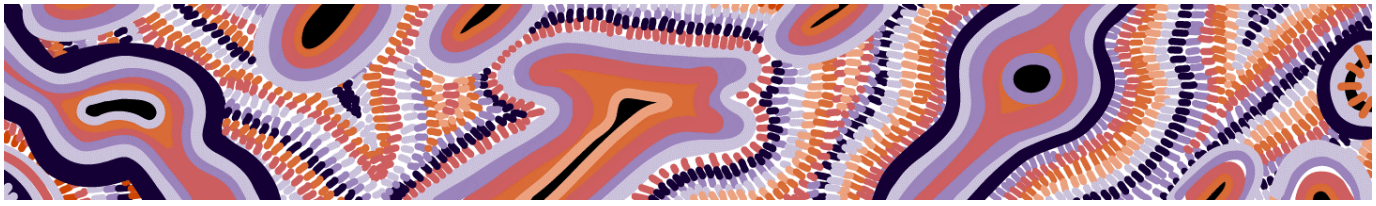
Our purpose is to help clients make informed decisions about complex economic and public policy issues.

Our vision is to be Australia's most trusted economics, policy and strategy advisory firm. We are committed and passionate about providing rigorous independent advice that contributes to a better world.

Report to:

Energy Networks Australia

ACIL Allen acknowledges Aboriginal and Torres Strait Islander peoples as the Traditional Custodians of the land and its waters. We pay our respects to Elders, past and present, and to the youth, for the future. We extend this to all Aboriginal and Torres Strait Islander peoples reading this report.



Goomup, by Jarni McGuire

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Glossary

Abbreviations	Definitions
ABS	Australian Bureau of Statistics
AER	Australian Energy Regulator
CBA	Cost-benefit analysis
DTF	Department of Treasury and Finance (Victorian Government)
ENA	Energy Networks Australia
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
LPG	Liquefied petroleum gas
NPV	Net present value
RCAC	Reverse-cycle air-conditioner
RIS	Regulatory Impact Statement
VER	Value of emissions reduction

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Summary Report

Executive Summary

In May 2024 the Victorian Government released draft analysis by Deloitte Access Economics ('Deloitte') entitled *Minimum energy efficiency and safety standards for rental homes – Regulatory Impact Statement* for consultation. This document, henceforth 'the rental standards RIS' or 'the RIS', is intended to support proposed regulations that would prescribe minimum standards for rental properties.

Several of the proposed measures justified by the analysis in the rental standards RIS affect customer choices around the use of natural gas appliances. In particular, measures relating to heating, cooling and hot water appliances would have a significant effect on the future number of gas appliances in Victoria's housing stock and the overall use of natural gas if implemented. In both of these cases, the preferred regulatory options effectively ban the installation of new gas heating or hot water appliances in rental properties. Clearly, if these options were put into regulation, they would have a significant impact on gas distribution network businesses, represented by Energy Networks Australia (ENA).

ENA has requested that ACIL Allen review the conclusions of the rental standards RIS to understand how the assumptions used may affect the conclusions. Our analysis suggests that a number of assumptions used by Deloitte in the RIS result in the net benefits of the preferred regulatory options being over-estimated. Table ES 1 summarises the factors that contribute to this over-estimate for both the hot water and heating and cooling regulatory options.

Table ES 1 Probability of Deloitte's assumptions materially affecting preferred regulatory option identified in the RIS

	Hot water	Heating and cooling
Deloitte's real discount rate assumption is low	Low-to-medium	Low-to-medium
Deloitte uses retail energy prices rather than underlying economic costs as the basis of estimated avoided energy costs	Uncertain	Medium
Deloitte appears to under-estimate the cost of electric water heaters and over-estimate the cost of gas water heaters	Low	N/A
Deloitte under-estimates the cost of multi-split reverse-cycle air-conditioners	N/A	Uncertain
Deloitte does not adjust appliance capital costs to reflect supplier profit margins	Low*	Negligible*
Deloitte may not be undertaking a true 'apples-for-apples' comparison of multi-room gas heating and single room electric heating options	N/A	High
Deloitte's assumptions on water heater efficiency appear reasonable.	None	N/A
Deloitte does not publish energy use assumptions for gas heating	N/A	Uncertain
Deloitte's carbon prices are too high	Low	Low
Deloitte underestimates gas service abolishment costs but overestimates the probability of them being incurred	Low	Low
Cumulative effect of Deloitte's assumptions	Low-to-medium	Medium-to-high

Note: adjustments marked with an asterisk (*) would tend to improve the net benefits of the preferred regulatory options.

Source: ACIL Allen

In the case of the preferred heating and cooling regulatory option, which would require landlords to install cooling appliances in rental properties and replace gas heaters with electric heaters at the end of their life, a number of assumptions contribute to this over-estimate:

— discount rates

— carbon prices

— gas service abolishment costs.

Further, Deloitte appears to make two fundamental conceptual errors, and these errors materially alter the RIS conclusions:

— Deloitte uses retail energy prices rather than avoided economic costs as the basis for estimating avoided energy costs, which over-estimates this benefit category for the preferred regulatory option

— Deloitte may not undertake a true apples-for-apples comparison when assessing the impacts of moving from gas to electric heating, as it appears to ignore the lost heating amenity by moving from multi-room gas heating to single room electrical heating but include the additional running costs and greenhouse gas emissions of multi-room gas heating.

Finally, we note that Deloitte does not publish assumptions on energy use by gas heaters for comparison with their assumptions on electric heaters. Without this assumption it is not possible to analyse the relative efficiency of electric and gas heating options, and therefore to assess whether Deloitte's assumptions in this area are reasonable.

In our view, the cumulative effect of these assumptions, errors and omissions has a medium-to-high probability of changing the preferred regulatory option in the RIS conclusions. This implies that the heating and cooling regulatory options require a fundamental reassessment, and there is a realistic chance that properly revised analysis would not justify any regulatory change in relation to heating appliances in rental properties.

In the case of the preferred hot water regulatory option, which would require landlords to install the most efficient electric water heaters in rental properties a number of assumptions contribute to this over-estimate:

— discount rates

— water heater appliance costs

— carbon prices

— gas service abolishment costs.

Deloitte also erroneously uses retail energy prices rather than avoided economic costs as the basis for estimating avoided energy costs for the hot water regulatory measures, but the effect of changing this assumption on these measures is hard to quantify.

In our view, the cumulative effect of these assumptions has a low-to-medium probability of changing the preferred regulatory option in the RIS conclusions. If revised analysis did lead to a change in the preferred regulatory option for hot water, this would mean that landlords could continue to install efficient gas water heaters, including gas-boosted solar water heaters, in rental properties.

Overall, the RIS conclusions are highly questionable and there is a strong case for a complete reassessment of the costs and benefits of the proposed measures.

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Main Report

1 Context and scope of our work

1.1 Victorian RIS processes

In May 2024 the Victorian Government released draft analysis by Deloitte Access Economics ('Deloitte') entitled *Minimum energy efficiency and safety standards for rental homes – Regulatory Impact Statement* for consultation. This document, henceforth 'the rental standards RIS' or 'the RIS', is intended to support proposed regulations that would prescribe minimum standards for ceiling insulation, draughtproofing, hot water systems, colling and the uplift of current standards for heating and shower roses in rental properties, amongst other things.

The rental standards RIS and draft proposed regulations have been subject to consultation and are expected to be implemented by the Victorian Government by October 2024.

1.2 Our assignment

Several of the proposed measures justified by the analysis in the rental standards RIS affect customer choices around the use of natural gas appliances. In particular, measures relating to heating, cooling and hot water appliances would have a significant effect on the future number of gas appliances in Victoria's housing stock and the overall use of natural gas if implemented. It follows that these proposed measures have a significant impact on gas distribution network businesses, represented by Energy Networks Australia (ENA).

ENA has requested that ACIL Allen review the conclusions of the rental standards RIS to understand how the assumptions used may affect the conclusions. In broad terms, our assignment is to:

- identify any issues with assumptions used by Deloitte
- use evidence and our own expert judgement to identify a more appropriate assumption or range of assumptions for the same purposes
- assess the materiality of these assumptions on the RIS analysis.

1.3 This report

This report summarises the RIS findings and preferred options of greatest importance to gas distribution network businesses (section 2) and analyses the validity of Deloitte's key assumptions (section 3).

2 Summary of RIS analysis of key proposed measures

2.1 Hot water

The RIS assesses 4 options for regulating the replacement of inefficient hot water systems in rental properties at the end of their life (Table 2.1).

Table 2.1 Summary of RIS regulatory options for hot water systems

Regulatory option	Option description	Compliant systems	Non-compliant systems
1	Least efficient systems replaced at end-of-life with more efficient systems	Electric off-peak storage Solar electric Heat pump Existing gas systems, including solar gas can be replaced like-for-like	Electric peak storage (continuous) Electric instantaneous
2	Systems with below average efficiency replaced at end-of-life with more efficient systems	Solar electric Heat pump Existing gas systems, including solar gas, can be replaced with >5 Star gas systems or solar gas systems	Gas instantaneous (< 5 Star) Gas storage (<5 Star) Electric storage (controlled or continuous) Electric instantaneous
3	All but the highest-performing systems replaced at end-of-life with more efficient systems	Solar electric Heat pump Existing gas systems, including solar gas, can be replaced with >6 Star gas systems or solar gas systems	Gas instantaneous (< 6 Star) Gas storage (<6 Star) Electric storage (controlled or continuous) Electric instantaneous
4	All but the highest-performing systems replaced at end-of-life with more efficient systems, which must be electric	Solar electric Heat pump	All gas systems, including solar gas Electric peak storage (continuous) Electric instantaneous

Source: Rental Standards RIS, Table 6.1.

For the purpose of the analysis, Deloitte assumes that all existing hot water systems would be replaced like-for-like at the end of their life in the absence of the proposed regulations.

Option 4 is identified in the RIS as the preferred regulatory option. This means that the RIS effectively supports a ban on installing gas hot water systems in rental properties.

That said, the RIS proposes some exemptions to the regulation, including where:

— complying installations in Class 2 (multi-dwelling) buildings would have higher than average cost
— for centralised systems in Class 2 buildings
— where the system being replaced uses LPG (bottled gas)

— if a system is being replaced under warranty

— if a temporary water heater is being installed for no more than 50 days.

Table 2.2 summarises the costs and benefits of the hot water regulatory options as assessed by Deloitte. These results show that avoided energy costs (benefits) are the key driver of the cost-benefit analysis (CBA) in the RIS, followed by avoided greenhouse gas (GHG) emissions (benefits) and capital costs (costs). Avoided energy costs for each regulatory option are over twice the value of the avoided GHG emissions, and three-to-five times the capital costs. It follows that, in broad terms, adjustments to energy cost assumptions will be the most likely to materially change the RIS conclusions, followed by changes to assumptions on GHG emissions and capital costs.

Table 2.2 Costs and benefits of hot water regulatory options

	Option 1	Option 2	Option 3	Option 4 (preferred option)
Capital costs (including installation and decommissioning costs)	5	41	65	150
Quote/admin costs	0	4	7	8
Total costs	5	45	71	157
Avoided energy costs	24	307	397	512
Avoided GHG emissions	3	53	86	212
Avoided air pollution costs	0	4	5	4
Total benefits	28	365	489	727
NPV (20 years)	23	320	417	570

Note: Numbers may not add due to rounding. ACIL Allen rounded published figures to whole numbers for simplicity.

Source: Deloitte (2024), Table 6.3.

2.2 Heating and cooling

The RIS assesses 4 options for regulating the heating and cooling appliances in rental properties. The RIS builds on existing regulations that require rental properties to have a functioning heater that meets a set of basic requirements (Box 2.1).

Box 2.1 Existing requirements for heating appliances in rental properties

Existing Victorian regulations require rental properties to have one of the following heaters installed and in good working order in the main living area:

— a non-ducted reverse-cycle air-conditioner with a 2 Star or better efficiency rating

— a gas heater with a 2 Star or better efficiency rating

— a ducted heating or hydronic heating system with an outlet in the main living area

— a solid fuel burning appliance such as a fireplace or wood burning stove.

Source: Rental Standards RIS, p.52.

All 4 regulatory options require landlords to install a cooling appliance in the main living area of rental properties. If a cooler is not currently in place, this appliance must be installed for any new lease commencing after 30 October 2025, or by 30 October 2027 (whichever is earlier). The 4 options impose different requirements on the efficiency of cooling appliances.

As well as requiring the installation of a cooling appliance, the regulatory options consider different requirements on the type of heating appliances that must be installed in the main living area of rental properties. As rental properties are already required to have a functioning heater in the main living area, the heating aspects of the regulatory options focus on what type of heater must be installed, rather than whether a heater must be installed. Reflecting the cost of replacing working appliances before the end of their life, the regulatory options under consideration only apply when an appliance is being replaced, that is, it does not force landlords to replace working heaters before the end of their life.

Table 2.3 summarises the 4 regulatory options under consideration for heating and cooling appliances in the RIS.

Table 2.3 Summary of RIS regulatory options for heating and cooling appliances

Regulatory option	Option description	Compliant heating appliances	Compliant cooling appliances
1	2 Star heating and cooling standards	Electric, gas or solid fuel appliances that meet the existing standard	Reverse-cycle air-conditioner (RCAC*) with 2 Star or greater efficiency rating
2	Electric-only appliances to meet 2 Star heating and cooling standard	Electric heaters with 2 Star or greater efficiency rating	RCAC* with 2 Star or greater efficiency rating
3	Electric-only appliances to meet 3 Star heating and cooling standard	Electric heaters with 3 Star or greater efficiency rating	RCAC* with 3 Star or greater efficiency rating
4	Electric-only appliances to meet 2 Star heating and 3 Star cooling standard	Electric heaters with 2 Star or greater efficiency rating	RCAC* 3 Star or greater efficiency rating

Note: *while the cooling standard requires installation of RCAC rather than evaporative air-conditioners, rental properties with existing evaporative air-conditioners would be allowed to retain these systems.
Source: Rental Standards RIS, Table 6.1.

To compare the effects of the regulatory options, Deloitte assumes that, in the absence of them:

— 20% of rental properties would continue to not have a cooler and, in these properties, renters would use portable air-conditioners at their own expense

— landlords would continue to comply with the existing heating standard.

Option 1 effectively adds a cooling standard to the existing heating standard, without amending the heating standard. As gas heaters are allowed under the existing standard, this Option 1 would result in a 'business-as-usual' outcome for gas distribution networks, and so for the purposes of our analysis this option is equivalent to the Base Case.

Options 2, 3 and 4 mandate that heating systems must be electric, and so effectively ban the installation of new gas heaters in rental properties, including like-for-like replacement at end of life.

That said, the RIS proposes some exemptions to the regulation, including:

— where complying installations would have significantly higher than average cost
— where owners corporation rules prohibit the installation of complying systems
— if a system is being replaced under warranty
— if regulatory or other unspecified barriers mean that it is not allowed or practicable to replace an appliance.

Further, properties with existing LPG, wood or hydronic systems would be exempt, meaning that gas hydronic and LPG heaters would be allowed to be replaced like-for-like.

Table 2.4 summarises the costs and benefits of the heating and cooling regulatory options as assessed by Deloitte. These results show that, as for the hot water regulatory options, avoided energy costs (benefits) are the key driver of the CBA results. For the preferred option, capital costs are over twice the value of the avoided GHG emissions, and about twice the capital costs. It follows that, in broad terms, adjustments to energy cost assumptions will be the most likely to materially change the RIS conclusions, followed by changes to assumptions on capital costs and GHG emissions costs.

Table 2.4 Costs and benefits of heating and cooling options

	Option 1	Option 2	Option 3	Option 4 (preferred option)
Capital costs (including installation and decommissioning costs)	523	660	810	698
Quote/admin costs	12	13	14	13
Total costs	565	673	825	711
Avoided portable air-conditioner costs for renters	175	175	175	175
Avoided energy costs	402	1,314	1,504	1,367
Avoided GHG emissions	69	552	581	560
Avoided air pollution costs	7	12	14	12
Total benefits	654	2,052.6	2,275	2,119
NPV (20 years)	89	1,380	1,450	1,404

Note: Numbers may not add due to rounding. ACIL Allen rounded published figures to whole numbers for simplicity.
Source: Deloitte (2024), Table 7.3.

The RIS also examines options that affect heating options in rooming houses, but due to low number of rooming houses the overall size of costs and benefits is very small compared to the general residential heating and cooling measures. For that reason, we do not examine the rooming house measures in detail in this review, but we note that the same methodological issues identified in the analysis of rental properties will generally apply in relation to rooming houses.

3 Analysis of RIS assumptions

In this section we assess a range of RIS assumptions for their impact on the heating and cooling and hot water measures, as these are of most importance to gas distribution networks. These assumptions will also affect conclusions on other measures (for example, shower roses, ceiling insulation and draughtproofing), but analysis of their impact on these regulatory measures is beyond the scope of this analysis.

3.1 Discount rates

Deloitte adopts a 4% discount rate for the RIS.[3] It is not clearly stated in the RIS whether this discount rate takes into account the effects of inflation (a 'real discount rate') or does not (a 'nominal discount rate'). As the core cost estimates, such as electricity and gas prices, are presented on a real (inflation-adjusted) basis[4], we assume this is a real discount rate, and treat it as such for the purposes of this analysis.

A real discount rate of 4% is at the low end of the range of discount rates used as the central case for CBAs of this type. Central rates of 5% or 7% are more commonly used, with sensitivity testing often being used to test the implications of using lower (3%) and higher (10%) values (Table 3.1).

Table 3.1 Central discount rates recommended by key government agencies

Government	Agency	Central discount rate	Notes
Commonwealth	Office of Impact Analysis	7%	
Commonwealth	Infrastructure Australia	7%	
NSW	Treasury	5%	
Victoria	Department of Treasury and Finance (DTF)	7%	'Category 2' assessment, where 'benefits are more easily translated to monetary terms'

Source: Office of Impact Analysis (2023), Cost Benefit Analysis Guideline; Infrastructure Australia (2021), Guide to Economic Appraisal; NSW Treasury (2023), NSW Government Guidebook to Cost-Benefit Analysis; DTF (2013), Economic Evaluation for Business Cases.

While the Victorian DTF guidelines recommend a rate of 4 per cent for 'Category 1' assessments where benefits are not easily translated to monetary terms, we do not consider this to be applicable in the case of the rental standards RIS, where benefits can be readily monetised (consisting primarily of appliance and energy costs). As the DTF guideline indicates, Category 1 projects would typically involve services such as schools, hospitals, police stations and civic open spaces. We consider these types of evaluations to be very different to one focused on household appliance choices.

Adopting a 5% or 7% discount rate rather than 4% would materially change the conclusions of the RIS, for both the hot water and heating and cooling proposed regulations. These regulations typically involve the Victorian Government mandating more efficient appliances with higher upfront costs, which gives a benefit stream of lower energy and emissions costs over time. A higher discount rate would reduce the 'present value' of that stream of benefits, relative to the upfront costs of the measure, and tend to reduce the net present value of the measure.

[3] Deloitte (2024), Minimum energy efficiency and safety standards for rental homes – Regulatory Impact Statement, Appendix A, Table A.1.

[4] See Deloitte (2024), p. 26.

As Deloitte does not publish annual series of costs and benefits, we cannot precisely estimate the effect of changing discount rates on the CBA. We have estimated indicative effects by assuming that the costs of each measure are incurred at a constant level for the first 7 years of the measure, and benefits are incurred at a constant level for 20 years (assessing the full costs and benefits over a 20-year period consistent with Deloitte).

Using these stylised assumptions, Table 3.2 illustrates the indicative effect of changing the discount rate on the relative net benefits of the preferred hot water regulatory option and the next best option. While this change does not eliminate the difference in net benefits on its own, moving to a 5% discount rate reduces the difference by $17 million (11%), and moving to a 7% discount rate reduces it by $44 million (29%). In combination with adjustments to other assumptions, this change could affect RIS conclusions on the preferred hot water regulatory option.

Table 3.2 Indicative effect of changing discount rate on hot water regulatory options

Regulatory option	Discount rate	Benefits ($m)	Costs ($m)	Net benefits ($m)
Option 4 (preferred option)	4% (Deloitte)	727	157	570
	5% (low alternate case)	667	152	515
	7% (high alternate case)	567	141	426
Option 3	4% (Deloitte)	489	71	417
	5% (low alternate case)	448	69	379
	7% (high alternate case)	381	64	317
Difference (Option 4 minus Option 3)	4% (Deloitte)	239	86	153
	5% (low alternate case)	219	83	136
	7% (high alternate case)	186	77	109
Change in present value difference between Option 4 and Option 3 due to move from 4% to 5% discount rate		-20	-3	-17
Change in present value difference between Option 4 and Option 3 due to move from 4% to 7% discount rate		-53	-9	-44

Source: ACIL Allen

Similarly, adjusting discount rates under the stylised assumptions used above materially closes the difference between heating and cooling regulatory options 1 and 4. We have compared Option 1 and Option 4 because Option 1 does not amend the existing heating standard and so is effectively a Base Case from the point of view of gas distribution network businesses. Moving from a 4% discount rate to a 5% discount rate narrows the difference between these options by $116 million, or 9%, and moving to a 7% discount rate narrows the difference by $307 million, or 23% (Table 3.3). As for the hot water regulatory options, this change, in combination with adjustments to other assumptions, could affect RIS conclusions on the preferred heating and cooling regulatory option.

Table 3.3 Indicative effect of changing discount rate on heating and cooling regulatory options

Regulatory option	Discount rate	Benefits ($m)	Costs ($m)	Net benefits ($m)
Option 4 (preferred option)	4% (Deloitte)	2,115	711	1,404
	5% (low alternate case)	1,939	686	1,254
	7% (high alternate case)	1,649	639	1,010
Option 1 (cooling standard added to existing heating standard)	4% (Deloitte)	654	565	89
	5% (low alternate case)	599	545	55
	7% (high alternate case)	510	507	2
Difference (Option 4 minus Option 1)	4% (Deloitte)	1,461	146	1,315
	5% (low alternate case)	1,340	141	1,199
	7% (high alternate case)	1,139	131	1,008
Change in present value difference between Option 4 and Option 1 due to move from 4% to 5% discount rate		-121	-5	-116
Change in present value difference between Option 4 and Option 1 due to move from 4% to 7% discount rate		-322	-15	-307

Source: ACIL Allen

Finding 1 Deloitte's real discount rate assumption is low

Deloitte uses a 4% real discount rate for the central case in its CBA. Adopting a 5% real discount rate for the central case in the rental standards RIS CBA, as recommended by the NSW Treasury, or a 7% real discount rate as recommended by the Office of Impact Analysis, Infrastructure Australia and Victoria's Department of Treasury and Finance, would reduce the net present value of benefits under the preferred hot water and heating and cooling regulations.

The effect on this assumption on the conclusions of the RIS is likely to be material. We consider it to have a low-to-medium chance of affecting the preferred regulatory option for the hot water and heating and cooling proposed regulations. While our analysis suggests that this change would not change the RIS conclusions on its own, it could do so in combination with changes to other assumptions.

3.2 Energy prices

Basis of estimation

Deloitte uses retail electricity and gas prices to estimate benefits from changes in energy use.[5] In our view this represents a fundamental error in the basis of estimation of costs and benefits in the RIS. We set out the logic for this argument below.

The purpose of undertaking a CBA as part of a regulatory impact analysis is to understand the change in economic welfare as a result of a change in regulation. The change in economic welfare is the net effect of the costs and benefits imposed by that change on the community, whether or not those costs are monetised or experienced as a change in prices by particular groups in society (such as, in this case, tenants that use hot water or heating and cooling appliances in rental properties).

[5] Deloitte (2024), Appendix A, Table A.1.

Applying this perspective to the rental standards RIS, using retail electricity and gas prices as a measure of how energy supply costs will change as a result of the RIS is erroneous. Retail energy prices are not particularly cost-reflective, and certainly do not reflect the underlying economic costs (also known as 'resource costs') that would be avoided by a marginal change in consumption due to a regulatory change. This error is common in RISs of this type, as it tends to increase the net benefits of proposed regulatory changes, for example measures that mandate higher energy efficiency standards for buildings or appliances.

In broad-[90 terms, retail electricity and gas prices consist of the following major components:

— Wholesale energy costs, which comprise variable costs (such as fuel and variable operating and maintenance costs) that will change as the energy use changes and fixed costs (such as capital costs and fixed operating and maintenance costs) that will not change as energy use changes.
— Network costs, which primarily consist of costs that are either sunk (reflecting historic capital expenditure) or insensitive to the volume of energy transported through the network (for example, management and maintenance overheads). Changes in energy consumption only reduce the cost of operating networks if investment is deferred or avoided. Generally, changes in energy consumption do not significantly change the cost of providing network services, but primarily redistribute who pays for these services.
— Environmental costs, which reflect government policy objectives to achieve, for example, a particular volume of renewable energy or energy efficiency activities. Broadly speaking, these costs are fixed at the time the policy objective is determined, and changes in energy usage simply redistribute who pays these costs but does not change their overall level.
— Retail costs, such cost associated with call centres, revenue and billing collection, customer acquisition and retention, and IT systems. These costs are driven by the number of customers, not by the volume of energy consumption. As for network and environmental costs, changes in energy consumption primarily redistribute retail costs rather than changing their total volume.

In the case of the regulatory options under consideration in the RIS, underlying economic or resource costs are best estimated by:

— using wholesale electricity prices as a proxy for the resource cost of wholesale energy supply. These two concepts are not identical, as there are unavoidable or sunk capital expenditures recovered within forward-looking wholesale prices, but wholesale costs are a reasonable proxy for resource costs.
— estimating the change in investment that would occur due to reductions or increases in peak demands on either gas or electricity networks. In broad terms, investment will only be deferred or avoided if a network is approaching capacity. In this context, additional electricity demand may necessitate additional expenditure on electricity networks, as electricity demand is likely to grow in future. Conversely, reducing demand for gas is unlikely to avoid material capital expenditure on existing gas networks, as network-level gas demand is generally expected to decline and so significant capacity-induced augmentation expenditure is unlikely.

If the RIS used the more robust approach of estimating the avoided underlying economic costs of energy supply rather than avoided retail energy costs, we would expect that outcomes will be materially different, especially because avoided energy costs are the largest benefit category for the preferred regulatory options for both hot water and heating and cooling.

In this analysis we focus on wholesale costs as a proxy for resource costs. We note that the potential for additional expenditure on electricity networks under the RIS preferred options makes our assessment below conservative, because including incremental network costs into the assessment would reduce the net benefits of the preferred option further than what we assess below.

Adjusting avoided energy costs

Based on the analysis above we would expect the avoided energy costs for all assessed options to be significantly lower than presented in the RIS. This will tend to reduce the net benefits of the preferred regulatory options relative to other options or the base case, as the preferred regulatory options are modelled as having the highest avoided energy costs.

Arithmetically, if electricity and gas costs fall by the same proportion then we can assume that overall avoided energy costs would also fall by that proportion. However, as the level of avoided electricity and gas costs are not presented separately in the RIS, if these costs fall by different amounts it is not possible for us to estimate the effect of this on the CBA.

Our own analysis suggests moving from retail prices to underlying economic costs as the basis of estimating avoided energy costs would see avoided electricity and gas costs both fall by roughly half for the heating and cooling regulatory options, but electricity costs may fall proportionally more for the hot water regulatory options. Our reasons for this assessment are set out below.

Wholesale component of retail gas tariffs

We have analysed retail outcomes for major publicly-listed major gas retailers (Table 3.4) and this analysis suggests that wholesale gas costs are typically around half of retail prices, whether for smaller customers (in the AGL results) or all retail customers (in the Origin results). Wholesale gas costs will generally be a larger portion of retail gas prices for larger customers, so it is not surprising that the cost share estimated for Origin is higher than for AGL. This analysis supports a broad conclusion that wholesale gas costs comprise about 50% of household gas bills.

Table 3.4 Retail gas cost of sales for AGL and Origin, 2023-24

Retailer	Basis/series	Units	Revenue	Network costs	Margin and other costs	Energy procurement costs/ residual
AGL	Consumer customers	$m	1,762	518	404	840
		%	100%	29%	23%	48%
Origin Energy	All retail customers	$m	3,244	784	680	1,780
		%	100%	24%	21%	55%

Note: AGL's term 'consumer customers' excludes the 'large business' segment, and so appears to include both households and small businesses. Energy procurement costs estimated as a residual for AGL and directly reported for Origin.

Source: AGL 2024 Annual Report, Origin Energy 2024 Annual Report.

Wholesale component of retail electricity tariffs

ACIL Allen regularly models the wholesale National Electricity Market and has used in-house projections of Victorian wholesale electricity prices to assess the level of wholesale electricity costs associated with an increase in electricity consumption. Further, we have recently undertaken a number of analyses of the time-of-use profile of a range of gas appliances, with a view to understanding their impact on the electricity market if they convert to electricity.

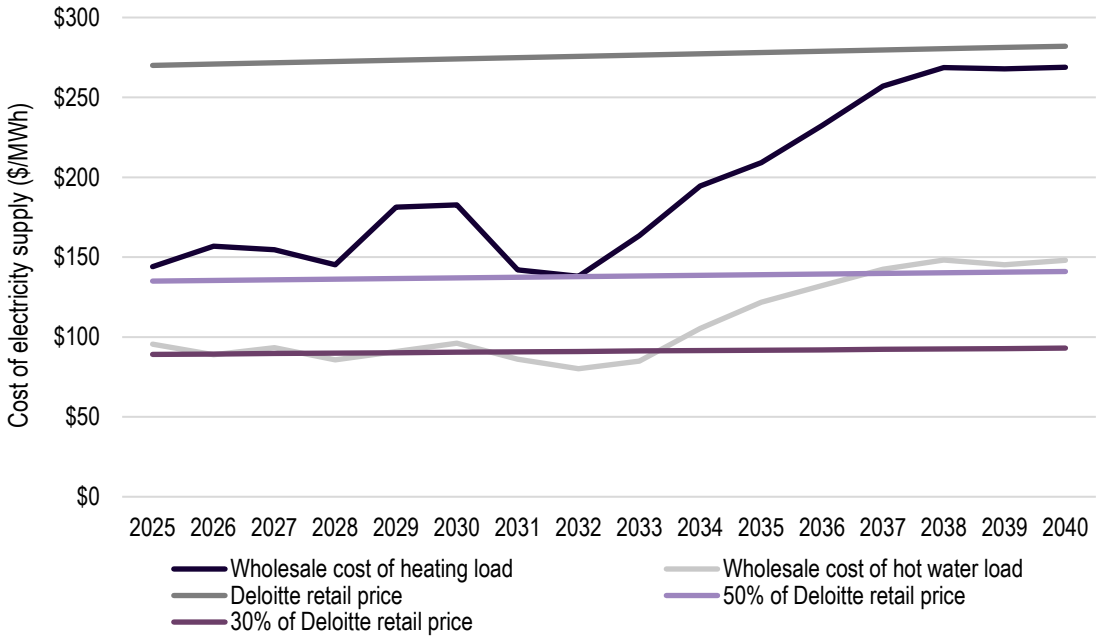
Putting these pieces of analysis together allows us to estimate the average cost of electricity supplied to serve heating load in Victoria. This cost will typically be higher than the average Victorian wholesale electricity price across the year because heating load is:

— peaky, with higher demand typically occurring during high-priced morning and evening periods
— seasonal, with load concentrated in winter, which we project to be a season with higher-than-average electricity prices due to consistently high demand and seasonally low solar generation output.

By contrast, hot water loads are spread fairly evenly throughout the year and can be shaped through the day (using tank storage) to moderate consumption during high-priced morning and evening periods.

Based on these characteristics, Figure 3.1 summarises our analysis of the wholesale electricity cost of serving heating and hot water loads.

Figure 3.1 Wholesale electricity cost of serving heating and hot water loads, compared to Deloitte retail electricity prices



Note: wholesale costs for heating and hot water loads includes a notional 10% contract premium on modelled spot prices. Heating load costs are weighted based on ACIL Allen's estimated heating load profile; hot water load costs reflect annual average electricity prices.
Source: ACIL Allen, Deloitte (2024), Appendix A, Table A.1.

We model the wholesale cost of electricity to supply heating loads as being about one-half or more of Deloitte's estimated retail electricity price series used in the RIS during the early years of the analysis. The early years of a RIS are of greatest importance to the CBA, as the present value impact of changes in energy costs in early years will be relatively larger than those in later years, given the effect of discounting. The wholesale electricity cost of supplying heating load is likely to increase to levels well above one-half of Deloitte's retail series in the medium-to-long run, indicating that our assumption that the true cost of wholesale electricity to serve heating load as being one-half of Deloitte's retail electricity cost estimate is conservative.

We model the wholesale cost of electricity to supply hot water loads as being about one-third or more of Deloitte's estimated retail electricity cost series used in the RIS for the early years of the analysis. As noted above, the early years of a RIS are of greatest importance to the cost-benefit analysis, as the present value impact of changes in energy costs in early years will be relatively larger than those in later years, given the effect of discounting. The wholesale electricity cost of supplying hot water load is likely to increase to levels above one-third of Deloitte's retail series in the medium-to-long run, indicating that our assumption the true cost of wholesale electricity to serve hot water load as being one-third of Deloitte's retail electricity cost estimate is conservative.

Overall effect

Hot water regulatory options

The analysis in Table 3.4 and Figure 3.1 together suggests that the wholesale cost of gas supply to serve hot water loads would be about one-half of the level assumed by Deloitte, whereas the wholesale cost of electricity supply would be about one-third of the level assumed by Deloitte.

As these proportions are different and we do not know the volume of electricity and gas costs in each scenario, we cannot reliably estimate the effect of this change in assumptions on the RIS conclusions.

However, we note that the preferred regulatory option (Option 4) bans new gas water heaters in rental properties, and has significantly higher avoided energy costs than the other options considered. It follows that Deloitte's analysis must find that the avoided cost of retail gas supply in the Base Case is materially higher than the additional cost of retail electricity supply under Option 4. This being the case, it is mathematically possible for the overall level of avoided energy costs to reduce, even if electricity costs reduce by proportionately more than gas costs – as shown by the worked example in Table 3.5.

Table 3.5 Worked example of a proportionately larger fall in electricity costs than gas costs

	Avoided gas costs	Additional electricity costs	Net avoided energy costs
Base estimate	400	150	250
Adjustment	Reduce by half	Reduce by two-thirds	
Adjusted outcome	200	50	150
Effect of adjustment on net avoided energy costs			Reduced by 100

Note: numbers are indicative and presented for illustrative purposes only

Source: ACIL Allen

Heating and cooling regulatory options

The analysis in Table 3.4 and Figure 3.1 together suggests that the wholesale cost of gas supply to serve heating loads would be about one-half of the level assumed by Deloitte, while the wholesale cost of electricity supply is likely to be at least one-half of the level assumed by Deloitte (if not higher).

Given this, we can conservatively assume that the avoided wholesale costs of both electricity and gas are approximately half the level of the retail prices assumed by Deloitte, and in turn we can re-estimate the net benefits of each regulatory option by halving Deloitte's estimated value of avoided energy costs. As noted above, the estimate here likely overstates the benefits of the preferred regulatory option (which mandates electric heating) for two reasons:

— the wholesale cost of electricity to supply heating loads is likely to be more than one-half of Deloitte's estimate

— mandating electric heating is likely to lead to additional resource costs from electricity network augmentation, which we have not estimated in this analysis.

Table 3.6 examines the indicative effect of halving Deloitte's avoided energy cost estimates for heating and cooling appliances, to reflect a wholesale (resource costs) rather than retail basis of estimating avoided energy costs. While this change does not eliminate the difference in net benefits between Option 1 and Option 4 on its own, it does significantly reduce it. The difference in net benefits between Option 4 and Option 1 reduces by $482 million in present value terms, from $1,315 million to $979 million (37%). In combination with adjustments to other assumptions, this change could affect the RIS's conclusions about the preferred regulatory option.

Table 3.6 Indicative effect of adjusting Deloitte avoided energy cost assumptions to reflect wholesale (resource) costs rather than retail prices – heating and cooling regulatory options

	Option 1	Option 4 (preferred option)	Difference (Option 4 minus Option 1)
Costs	565	711	146
Benefits			
Avoided energy costs (Deloitte estimate)	402	1,367	964
Avoided energy costs (halving Deloitte estimate to reflect wholesale rather than retail basis of estimation)	201	683	482
Avoided GHG costs	69	560	491
Avoided portable air-conditioner costs	175	175	0
Avoided air pollution	7	12	6
Total benefits			
Deloitte energy costs	654	2,115	1,461
ACIL Allen energy costs	453	1,431	979
Net present value			
Deloitte energy costs	89	1,403	1,315
ACIL Allen energy costs	-113	720	979
Effect of change in energy cost assumptions	-201	-683	-482

Source: ACIL Allen

Finding 2 Deloitte uses retail energy prices rather than underlying economic costs as the basis of estimated avoided energy costs

Estimating avoided energy costs using underlying economic costs rather than retail prices would broadly halve the level of this benefit for each heating and cooling regulatory option considered.

The effect on this change on the conclusions of the RIS is likely to be material. We consider it to have a medium chance of affecting the preferred regulatory option for the heating and cooling proposed regulations. While our analysis indicates that this change would not change the RIS conclusions on its own, it could do so in combination with changes to other assumptions.

The level of avoided gas and electricity costs for hot water regulatory options are not likely to fall in the same proportion (this is different to heating and cooling because of the different time profile and average electricity price for the different activities). Therefore, it is not possible to make an indicative estimate of the effect of the change on the RIS conclusions on hot water. That said, we consider that this change would be likely to have a material effect on the RIS conclusions.

3.3 Appliance capital costs

The RIS includes appliance capital cost assumptions for hot water, heating and cooling appliances. These costs vary based on:

— the appliance type, including whether the appliance is electric or gas

— whether the appliance is installed in a 'Class 1' (standalone or semi-detached) dwelling or a 'Class 2' (apartment) dwelling

— in some cases depending on the efficiency star rating of the appliance.

Although it is not explicitly stated, we assume that the quoted appliance costs include purchase and installation. However, appliance costs are not expressed as varying depending on whether the appliance is being replaced like-for-like or not, for example, whether a gas appliance is being replaced by another gas appliance or by an electric appliance.

These aspects matter because many of the hot water and heating regulatory options under consideration require customers to replace gas appliances with electric appliances. When this occurs, the appliance will often incur additional electrical work (typically involving an isolator switch and dedicated circuit) that would not occur when replacing either gas or electric appliances like-for-like.

Replacing a gas appliance with an electric appliance could incur further additional costs that would not occur in a like-for-like replacement. For example, in some cases, a new electrical appliance could not be located in the same place as the existing gas appliance -- for example due to noise issues with heat pump location, egress and space issues with replacing a gas instantaneous system with a tank-based electric heat pump, or issues (more common in Class 2 dwellings) where an instantaneous gas system is wall-mounted well above ground level, which is not possible for tank-based electric systems. In this case, significant additional costs including new water piping and concrete footings will be incurred. These costs will be somewhat site-specific and cannot be meaningfully estimated within the scope of this study, but we note that this indicates that our conclusions below are broadly conservative (that is, outcomes for a gas-to-electric switch will generally be worse than what we have indicated).

It is also not clear whether Deloitte's appliance costs quoted include removal and rectification costs for the original appliance. We assume that they do not, but these costs will generally be incurred whether replacing gas-to-electric or gas-to-gas, and so including them within the study is less likely to be material to the analysis than the issues discussed above.

While there are a range of potential sources of appliance cost data, including Frontier Economics' study for the Gas Appliance Manufacturers Association of Australia, we have focused our comparison on GHD's 2022 study for the Victorian Government on the cost of appliances in new homes. This provides a detailed breakdown of costs, with estimates for gas pipework, electrical wiring and incremental electrical connection costs detailed separately.

As this is a recent study undertaken for the Victorian Government, where the assumptions adopted here are not consistent with that study it is reasonable to question why Deloitte chose to use the Energy Efficient Strategies assumptions rather than GHD's.

Hot water systems

Table 3.7 compares the RIS assumptions with those from GHD's assessment of appliance costs in new homes. Where a number in the table is positive, it indicates that the RIS assumption is higher than GHD's assessment from 2022, noting that:

— we have adjusted GHD's estimates to reflect inflation between the time that analysis was published and now

— we have added $300 to electric appliances to reflect additional wiring costs associated with a gas-to-electric appliance switch

— as GHD's assessment applies to new homes, it does not include removal and rectification costs associated with pre-existing appliances.

We can see from Table 3.7 that, compared to GHD, the RIS generally over-estimates gas appliance costs (by up to 32%) and consistently under-estimates electric appliance costs (by 7% to 32%).

Table 3.7 Comparison of hot water appliance costs – RIS and GHD analysis for Victorian Government

Appliance type	Specification	RIS assumption	GHD assumption	Difference (RIS minus GHD)	Difference (%)
Gas instant	5 star, Class 1 dwelling	$2,556	$2,675	-$119	-5%
	6+ star, Class 1 dwelling	$3,235	$2,675	$560	17%
	5 star, Class 2 dwelling	$2,124	$2,025	$99	5%
	6+ star, Class 2 dwelling	$2,622	$2,025	$597	23%
Solar gas boost	Class 1 dwelling	$7,537	$4,832	$2,705	32%
Electric resistive	Off-peak, Class 1 dwelling	$2,197	$2,347	-$150	-7%
	Continuous, Class 1 dwelling	$1,777	$2,347	-$570	-32%
Electric heat pump		$4,518	$5,286	-$768	-17%

Note: GHD assumptions increased by 10% on the published value to reflect inflation between the time of publication (June quarter 2022) and now (June quarter 2024). GHD costs for electric appliances adjusted by $300 to reflect additional wiring costs for a gas-to-electric switch.

Source: Deloitte (2024), Table A.4; GHD (2022), All-electric new homes: cost assessment, Appendix B; ABS Consumer Price Index, June Quarter 2024.

If appliance cost assumptions were aligned with GHD's work the cost of gas-to-electric switching relative to a base case of gas-to-gas switching would increase significantly. If we assume that most gas hot water systems are gas instant units in Class 1 dwellings, and most installed electric systems are heat pumps, we can conservatively assume that the additional capital costs under the policy scenario relative to the base case will be at least 10% higher than estimated by Deloitte. This would reduce the net benefit of the preferred option (Option 4) by about $15 million, or about 2.6%. This assumption is conservative because of the risk of higher-than-expected costs for gas-to-electric appliance switches (for example, due to the existing hot water location not being suitable for the new system), the risk of higher removal and rectification costs, and larger differences in the estimated costs of other appliances (for example, solar gas systems and resistive electric systems).

Finding 3 Deloitte appears to under-estimate the cost of electric water heaters and over-estimate the cost of gas water heaters

Based on previous analysis for the Victorian Government undertaken by GHD, we consider that Deloitte may have under-estimated the cost of electric water heaters and over-estimated the cost of gas water heaters. This will increase the capital cost of the preferred hot water regulatory option and reduce its net benefit.

Adjusting assumptions in line with GHD's previous analysis would have a material effective on the conclusions of the RIS, but only a low chance of affecting the preferred regulatory option. While this adjustment would not change the RIS conclusions on its own, it could do so in combination with changes to other assumptions.

Heating and cooling appliances

We have also compared the RIS assumptions on the cost of space heating appliances to those published in GHD's assessment for the Victorian Government. Below we list some key observations from this comparison:

- The RIS assumptions indicate that the cost of single room reverse-cycle air-conditioners (RCACs, better known as split systems) varies significantly based on the efficiency (star) rating of the appliance. However, our review of market quotes indicates that cost is far more sensitive to size (kilowatt rating) than star rating. Without transparency on the assumed size of units in Class 1 (detached and semi-detached) and Class 2 (apartment) dwellings, we cannot meaningfully assess the credibility of this assumption.
- There is a significant range in costs for ducted RCAC depending on the efficiency (star) rating. Without knowing what star model is most prevalently selected in the model or the assumed size (kilowatt rating) of the assumed systems, it is difficult to assess the credibility of the capital cost assumptions. We note that the RIS costs quoted range from significantly lower than GHD's analysis to significantly higher, and so they broadly appear plausible.
- The cost of multi-split RCAC systems are significantly lower than GHD's. Whereas the RIS estimates the cost of these units to be between $6,531 and $7,644 in a Class 1 dwelling, GHD estimates indicate a cost of over $13,000 (adjusting for inflation) – broadly twice the RIS estimate.
- The cost of gas ducted heaters and evaporative coolers appear to be slightly lower than GHD's inflation-adjusted estimates, but not to the same degree as the multi-split RCAC:
  - Gas ducted heaters cost $4,943 in the RIS, but GHD's inflation-adjusted estimate is $6,351 (28% higher than the RIS)
  - Evaporative coolers cost $5,631 in the RIS, but GHD's inflation adjusted estimate is $7,309 (30% higher than the RIS).

Finding 4 Deloitte under-estimates the cost of multi-split reverse-cycle air-conditioners

Based on previous analysis for the Victorian Government undertaken by GHD, we consider that Deloitte has significantly under-estimated the cost of electric multi-split reverse-cycle air-conditioners. GHD's estimate (adjusted for inflation) is about double Deloitte's.

In general this will increase the capital cost of the preferred regulatory option and reduce its net benefit. However, it is not possible to meaningfully estimate the materiality of these assumption, as it is not clear to what extent multi-room heaters such as this are installed in the RIS analysis.

Appliance supplier profit margins

Consistent with our discussion above on the correct basis for estimating avoided energy costs, capital costs should also be estimated based on the underlying economic costs of supplying and installing appliances, not on their retail price to consumers. Economic profit will be achieved within the appliance supply chain, and those profits do not reflect economic costs (as they are captured by the suppliers as 'producer surplus').

For this reason, in CBAs of this kind ACIL Allen has previously applied a discount of 10% to the retail price of appliances to better reflect their underlying economic costs.[6]

[6] See for example, ACIL Allen (2022), *National Construction Code: Decision Regulatory Impact Statement for a proposal to increase residential building energy efficiency*, p. 115.

Unlike other adjustments identified to Deloitte's assumptions in this report, this change would increase the net benefit of the preferred regulatory options for both hot water and heating and cooling. In both cases, the preferred regulatory options incur higher capital costs than the base case, but this is offset by lower energy costs and greenhouse gas emissions costs. It follows that reducing the total level of capital costs will increase the net benefit of the preferred regulatory options.

That said, we consider this impact to be low to negligible. Our assessment in Table 3.8 shows that this adjustment increases the net benefit of the preferred hot water option by $8 million (5%), which we consider to have only a low probability of affecting the RIS conclusions, and increases the net benefit of the preferred heating and cooling option by only $15 million (1%), which we consider to have a negligible probability of affecting the RIS conclusions.

Table 3.8 Adjusting net benefits to reflect appliance supplier profit margins ($m)

Measure	Regulatory option	Benefits	Costs	Net benefits	Adjusted costs	Adjusted net benefits
Hot water	Option 4	727	157	570	142	585
	Option 3	489	71	417	64	424
	Difference			153		161
	Change in net benefits					8
Heating and cooling	Option 4	2,115	711	1,403	641	1,473
	Option 3	654	565	89	510	144
	Difference			1,315		1,329
	Change in net benefits					15

Source: ACIL Allen

Finding 5 Deloitte does not adjust appliance capital costs to reflect supplier profit margins

A cost-benefit analysis should assess costs using the underlying economic resource cost of appliance supply and installation, not their retail price. Appliance retail prices include a profit margin, and so are higher than their underlying economic cost by about 10%. Adjusting for this profit margin will tend to increase the net benefit of the preferred hot water and heating and cooling regulatory options, but we assess the effect of this adjustment on the RIS conclusions to be low in the case of hot water, and negligible in the case of heating and cooling.

3.4 Comparison of single room and multi-room heaters

We have examined a potential problem with the RIS relating to the treatment of single room and multi-room heaters. Clearly, a single room heater will have lower capital costs, greenhouse gas emission costs and running costs than a multi-room heater, but will deliver lower heating amenity. These different appliances need to be compared on an 'apples-for-apples' basis to draw robust policy conclusions.

It is not clear from the RIS the extent to which multi-room or single room heating and cooling options are deployed under the various regulatory options, and comparing regulatory options 1 and 2 indicates that the RIS may not be undertaking a true apples-for-apples comparison.

Regulatory options 1 and 2 use the same efficiency ratings for electrical appliances, but Option 2 bans gas heaters whereas Option 1 allows them. Given that all cooling appliances considered are electric, and the Base Case includes the existing heating standard, our starting presumption would be that the difference in

costs and benefits between these two options would be modest. However, as Table 3.9 shows, while the difference in capital costs is modest ($107 million or 19%), as expected, shifting from Option 1 to Option 2 is modelled as resulting in an extremely large increase in avoided energy costs, which more than triple from $402 million to $1,314 million. This shift results in a similarly disproportionate increase in avoided greenhouse gas emissions, which increase almost eight-fold.

Table 3.9 Comparing the costs and benefits of heating and cooling Option 1 and Option 2

	Option 1 – heating and cooling standard	Option 2 – heating and cooling standard, electric only	Difference (Option 2 minus Option 1)	Difference (%)
Capital costs	$553	$660	$107	19%
Quote/admin costs	$12	$13	$1	6%
Total costs	$565	$673	$108	19%
Avoided portable cooler costs	$175	$175	$0	0%
Avoided energy costs	$402	$1,314	$91	227%
Avoided GHG emissions	$69	$552	$483	696%
Avoided air pollution costs	$7	$12	$5	76%
Total benefits	$654	$2,053	$1,399	214%
Net benefits	$89	$1,380	$1,291	1,459%

Source: ACIL Allen

This comparison indicates that the basis of comparing the options may be problematic and, in our view, the most likely cause of this is a failure to properly compare multi-room gas ducted heating (the most prevalent heating option in place in Victorian homes currently) with the requirements of RIS options 2, 3 and 4 to install a single room (main living area) electric heating option. If this error has occurred, the small capital cost difference between Option 1 and Option 2 makes sense, as installing a single room RCAC to provide cooling in the main living area will, by definition, also provide electrical heating in that main living area and so actions to comply with Option 1 will generally result in compliance with Option 2.[7] The most likely explanation of the disproportionately large difference in running costs and greenhouse gas emissions is that the full running cost and emissions impact of multi-room ducted gas heating is included in Option 1 and is compared to the running cost of single room electrical heating under Option 2. This conceptual error, if present, would extend to all the regulatory options, including the preferred Option 4, and would distort their comparison to the Base Case (which would include gas ducted heaters being replaced like-for-like).

If this error has been made, then the RIS is not undertaking a true comparison, Instead, the RIS should apply one of the following approaches:

— require multi-room gas heaters to be replaced with multi-room electrical heaters, and also cost in the added amenity of any additional cooling capability provided

— allow a multi-room gas heater to be replaced with a single room electrical heater, but explicitly cost in the lost heating amenity in other rooms

— allow a multi-room gas heater to be replaced with a single room electrical heater, but adjust the running costs and emissions costs of the gas heaters to reflect only the cost of heating the main living area.

Given the lack of detail on this matter in the published RIS, it is not possible to definitively confirm whether or not the RIS is undertaking a true comparison of the various regulatory options. Nor is it possible to precisely quantify the effects of this error if it has been made. Nevertheless, we think that there is a high probability

[7] The exception, which we presume is what drives the capital cost difference between Option 1 and Option 2, is where a rental property has an existing gas heater and evaporative cooler. The evaporative cooler is deemed to meet the cooling standard, and the gas heater meets the heating standard under Option 1, but not under Option 2. In this circumstance, Option 2 would require the landlord would need to install an RCAC to comply with the heating standard (but not the cooling standard).

that an error of this kind has been made and has materially affected the RIS conclusions, particularly on estimates of avoided energy costs and greenhouse gas emissions. This in turn suggests that the preferred regulatory option being put forward may not be justified if a true comparison is undertaken that includes the heating amenity that is lost when rental properties move from multi-room gas heating to single room electrical heating.

Finding 6 Deloitte may not be undertaking a true 'apples-for-apples' comparison of multi-room gas heating and single room electric heating options

Analysis of the difference in costs and benefits of different regulatory options identifies that Option 2 has comparable capital costs to Option 1, but significantly higher avoided energy costs and avoided greenhouse gas emissions. This indicates strongly that the full running cost and emissions impact of whole-of-home gas heating is included in the Base Case and is compared to the running cost of single room electrical heating under the preferred regulatory option.

This is not a true comparison as it ignores the lost heating amenity by moving from multi-room gas heating to single room electrical heating.

While it is not possible to definitively confirm that the RIS makes this error or precisely quantify its effect, we think that there is a high probability that errors in the RIS analysis have materially affected its conclusions and changed the identified preferred regulatory option.

3.5 Appliance energy use and efficiency assumptions

The RIS details assumptions about the volume of energy used for:

- water heating using gas (RIS Appendix A, Table A.4)
- water heating using electricity (RIS Appendix A, Table A.4)
- cooling using electricity (RIS Appendix A, Table A.5)
- heating using electricity (RIS Appendix A, Table A.5).

The RIS as published omits the volume of energy used for heating using gas, which prevents a comparison of energy consumption by gas and electric heating options. However, such a comparison for gas and electric hot water is possible.

ACIL Allen's analysis indicates that Deloitte's assumptions imply that a heat pump is about 4 times as efficient as a gas storage water heater, depending on the star rating of the gas appliance analysed. Based on our knowledge of these appliances, we consider this ratio to be plausible, and so we do not consider that changes to this assumption would have a material effect on the RIS analysis.

Finding 7 Deloitte's assumptions on water heater efficiency appear reasonable

ACIL Allen's analysis indicates that Deloitte's water heater efficiency assumptions imply that an electric heat pump is about 4 times more efficient than a gas storage water heater.

We consider this assumption to be plausible and changes to this assumption are unlikely to have a material effect on the RIS analysis.

Finding 8 Deloitte does not publish energy use assumptions for gas heating

Without this assumption it is not possible to analyse the relative efficiency of electric and gas heating options, and therefore to assess whether Deloitte's assumptions are reasonable.

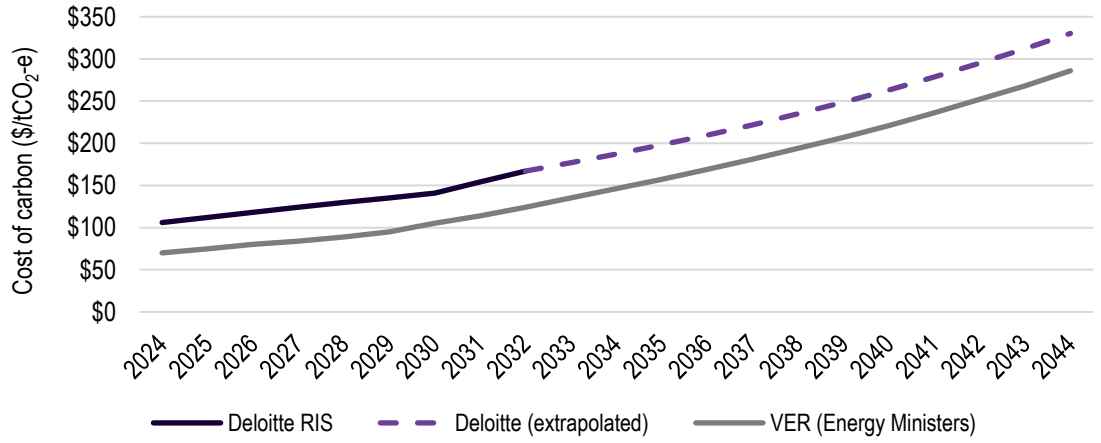
3.6 Carbon prices

The RIS details Deloitte's assumed carbon prices for the years 2024 to 2032 inclusive. It further details this assumption as being from the Intergovernmental Panel on Climate Change's (IPCC's) 6th Assessment Report.

Given that the Deloitte RIS is dated May 2024, it is unclear why the RIS does not adopt the carbon prices set out by Australia's Energy Ministers (including the Victorian Energy Minister) in guidance published in February 2024 and translated to explicit values by the Australian Energy Regulator (AER) in guidance published in March 2024 (these values were confirmed in final AER guidance published in May 2024). These carbon prices (also known as the 'value of emissions reduction', or VER) draw on IPCC analysis as well as the value of Australian Carbon Credit Units, and are noticeably lower than Deloitte's RIS assumption.

Given that the RIS includes benefits over a 20-year period and which therefore include years beyond 2032, for which Deloitte does not publish carbon price assumptions, we have extrapolated Deloitte's series to compare with the Energy Ministers' VER series (see Figure 3.2).

Figure 3.2 Comparing Deloitte and Energy Ministers carbon price series ($/tCO$_2$-e)



Source: Deloitte (2024), Appendix A, Table A.1; AER (2024), Valuing emissions reductions: AER draft guidance.

Adopting carbon prices in line with those put forward by Energy Ministers rather than those used by Deloitte would close the gap between the preferred regulatory options and other options. For the purpose of comparison, we have assumed that greenhouse gas benefits from each option increases linearly over the 20-year period of assessment, and then we have adjusted the series to reflect the Energy Ministers VER series rather than Deloitte's series.

In the case of the hot water regulatory options, this adjustment materially narrows the gap between the preferred option (Option 4) and the next best option (Option 3) by $25 million, or about 17% (Table 3.10). Similarly, changing carbon price assumptions materially closes between the analysed heating and cooling regulatory options. Our analysis (Table 3.11) suggests that this assumption change could reduce the difference between the net benefits of the preferred option (Option 4) and Option 1 by $97 million, or 7%.

Table 3.10 Indicative effect of replacing Deloitte carbon prices assumptions with Energy Ministers VER assumptions – hot water regulatory options

	Option 3	Option 4 (preferred option)	Difference (Option 4 minus Option 3)
Costs	71	157	86
Benefits			
Avoided energy costs	397	512	114
Avoided GHG costs (Deloitte carbon prices)	86	212	114
Avoided GHG costs (VER carbon prices)	69	170	101
Avoided air pollution	5	4	-1
Total benefits			
Deloitte carbon prices	489	727	239
VER carbon prices	472	685	214
Net present value			
Deloitte carbon prices	417	570	153
VER carbon prices	400	528	128
Effect of change in carbon price assumptions	-17	-42	-25

Note: avoided carbon benefits are assumed to increase linearly over the 20-year assessment period for each regulatory option in order to estimate the numbers above
Source: ACIL Allen

Table 3.11 Indicative effect of replacing Deloitte carbon prices assumptions with Energy Ministers VER assumptions – heating and cooling regulatory options

	Option 1	Option 4 (preferred option)	Difference (Option 4 minus Option 1)
Costs	565	711	146
Benefits			
Avoided energy costs	402	1,367	964
Avoided GHG (Deloitte carbon prices)	69	560	491
Avoided GHG (VER carbon prices)	56	449	394
Avoided portable air-conditioner costs	175	175	0
Avoided air pollution	7	12	6
Total benefits			
Deloitte carbon prices	654	2,115	1,461
VER carbon prices	640	2,004	1,364
Net present value			
Deloitte carbon prices	89	1,403	1,315
VER carbon prices	75	1,292	1,218
Effect of change in carbon price assumptions	-14	-111	-97

Note: avoided carbon benefits are assumed to increase linearly over the 20-year assessment period for each regulatory option in order to estimate the numbers above
Source: ACIL Allen

Adopting Energy Ministers' VER series instead of Deloitte's carbon prices does not change the ranking of the preferred options for either hot water or heating and cooling on its own, but in combination with other changes could contribute to changing the RIS conclusions. Therefore we consider the carbon price assumption to have a material effect on the RIS analysis, and to have a low probability of changing the RIS's conclusions about the preferred regulatory option.

Finding 9 Deloitte's carbon prices are too high

Adopting Energy Ministers' VER assumptions for carbon prices would reduce the net present value of benefits under the preferred hot water regulations, and reduce the gap between it and the next best option. Similarly, it would reduce the net present value of benefits under the preferred heating and cooling option, and reduce the gap between it and Option 1 (where the existing heating standard is retained).

The effect on this assumption on the conclusions of the RIS is likely to be material but we consider it to have a low chance of affecting the preferred regulatory option for the proposed regulations on its own. That said, changing this assumption in combination with other assumptions could change the RIS conclusions.

3.7 Gas connection capping cost

Deloitte assumes a $300 cost to cap (abolish) a gas connection in the RIS. This cost is incurred when the proposed regulatory options move customers away from like-for-like replacement of a gas appliance, resulting in the abolishment of their gas connection. In effect, this cost represents a cost of mandating a move away from gas appliances.

In our view, Deloitte has underestimated the cost of capping a gas connection, which in turn means that the cost of moving away from gas appliances is underestimated in the RIS.

It is not entirely clear on what basis a $300 capping cost was chosen, but it appears to broadly reflect the regulated capped cost of service abolishment determined by the AER, which was $220 at the time the RIS was published and is scheduled to increase in line with inflation.

While the assumed cost in the RIS broadly reflects the cash cost to customers, it does not accurately represent the true economic cost of abolishing a gas service. When the AER determined the regulated cost of abolishment it did so on the basis of avoiding an undesirable outcome where customers choose not to abolish a service and leave unused, but uncapped, gas connections outside their home, creating a safety risk. It lowered the regulated cost to the customer of disconnection to avoid this unsafe practice, and allowed networks to recover the remaining abolishment costs from remaining customers. In its assessments of this matter, the AER estimated that the true cost of abolishment was:

— $950 for Multinet and Australian Gas Networks

— $822 for AusNet Services.

This indicates that Deloitte's assumed service abolishment cost is about one-third of the true cost of abolishing a service, which in turn suggests that the economic cost of abolishment is around three times higher than Deloitte's assumption.

As set out in the discussion on energy prices (see section 3.2), using retail prices rather than underlying economic costs or resource costs is an erroneous approach to a regulatory assessment. Even if consumers or other economic agents are shielded from the direct cost of some of their decisions, this cost still exists and is instead incurred by other parties. A classic example of this is environmental costs – even if the true social cost of pollution is not levied on polluters, this cost still exists and should be taken into account in cost-benefit analyses that seeks to identify the best regulatory option for society.

For this reason, we consider that the RIS should assume a gas service abolishment or capping cost of around $800-$1000, rather than the $300 assumed.

Somewhat offsetting this underestimate, Deloitte also appear to over-estimate the frequency with which service abolishment costs will be incurred. Deloitte assumes 100% of gas appliance removals for water heating or space heating will result in service abolishment (see RIS Table A.4, p.89 and Table A.5, p. 92). This could easily result in double-counting, for example when:

— a landlord removes both water heating and space heating appliances under the proposed regulatory options, which would result in only one service abolishment cost
— a landlord removes either a water heating or space heating appliance but retains another gas appliance such as a cooktop, which would avoid any service abolishment costs being incurred.

It is not clear whether the assumption of 100% service abolishment was intended to be conservative to offset the effect of the low service abolishment cost. In any case, given the service abolishment cost is likely to be underestimated by at least three times, we consider that the combined effect of refining these two assumptions would be material to the RIS analysis.

The RIS does not set out the volume of gas disconnection costs as a standalone item in the cost-benefit analysis. The best indication of the materiality of this assumption is to compare it to the cost of new electrical appliances, as the cost of gas disconnection effectively acts as an additional cost to the purchase of an electrical appliance in place of a gas appliance. The cost of electrical appliances in the RIS varies significantly depending on the application, but the lowest cost appliances are non-compliant under the preferred hot water and heating regulatory options. Therefore, most electrical appliances cost over $2,000, meaning that an additional gas service abolishment charge would only increase the cost of the preferred regulatory option modestly, once the likely double-counting of abolishment charges under the current RIS assumptions is also taken into account.

On balance we consider that adjusting for both the true cost of gas service abolishment and the likely double-counting of abolishment charges would only have a low probability of changing the preferred regulatory options.

Finding 10 Deloitte underestimates gas service abolishment costs but overestimates the probability of them being incurred

Deloitte appears to have used the cash cost to consumers of abolishing a gas connection, rather than the underlying economic cost of abolishment. This underestimates the cost of the preferred regulatory options, which require customers to move away from gas appliances to electric appliances.

Somewhat counter-balancing this, Deloitte assumes that 100% of households that switch from a gas appliance to an electric appliance will abolish their gas service. This assumption leads to double-counting, and so tends to overestimate the cost of the preferred regulatory option.

On balance, we still consider that correcting for these two assumptions is material to the RIS analysis, but this would only have a low probability of changing the preferred regulatory options.

3.8 Overall conclusions

Our analysis suggests that a number of assumptions used by Deloitte in the RIS result in the net benefits of the preferred regulatory options being over-estimated. Table 3.12 summarises the factors that contribute to this over-estimate for both the hot water and heating and cooling regulatory options.

Table 3.12 Probability of Deloitte's assumptions materially affecting preferred regulatory option identified in the RIS

	Hot water	Heating and cooling
Deloitte's real discount rate assumption is low	Low-to-medium	Low-to-medium
Deloitte uses retail energy prices rather than underlying economic costs as the basis of estimated avoided energy costs	Uncertain	Medium
Deloitte appears to under-estimate the cost of electric water heaters and over-estimate the cost of gas water heaters	Low	N/A
Deloitte under-estimates the cost of multi-split reverse-cycle air-conditioners	N/A	Uncertain
Deloitte does not adjust appliance capital costs to reflect supplier profit margins	Negligible*	Negligible*
Deloitte may not be undertaking a true 'apples-for-apples' comparison of multi-room gas heating and single room electric heating options	N/A	High
Deloitte's assumptions on water heater efficiency appear reasonable.	None	N/A
Deloitte does not publish energy use assumptions for gas heating	N/A	Uncertain
Deloitte's carbon prices are too high	Low	Low
Deloitte underestimates gas service abolishment costs but overestimates the probability of them being incurred	Low	Low
Cumulative effect of Deloitte's assumptions	Low-to-medium	Medium-to-high

Note: adjustments marked with an asterisk (*) would tend to improve the net benefits of the preferred regulatory options.

Source: ACIL Allen

In the case of the preferred heating and cooling regulatory option, which would require landlords to install cooling appliances in rental properties and replace gas heaters with electric heaters at the end of their life, a number of assumptions contribute to this over-estimate:

- discount rates
- carbon prices
- gas service abolishment costs.

Further, Deloitte appears to make two fundamental conceptual errors, and these errors materially alter the RIS conclusions:

- Deloitte uses retail energy prices rather than avoided economic costs as the basis for estimating avoided energy costs, which over-estimates this benefit category for the preferred regulatory option
- Deloitte may not undertake a true apples-for-apples comparison when assessing the impacts of moving from gas to electric heating, as it appears to ignore the lost heating amenity by moving from multi-room gas heating to single room electrical heating but include the additional running costs and greenhouse gas emissions of multi-room gas heating.

Finally, we note that Deloitte does not publish assumptions on energy use by gas heaters for comparison with their assumptions on electric heaters. Without this assumption it is not possible to analyse the relative efficiency of electric and gas heating options, and therefore to assess whether Deloitte's assumptions in this area are reasonable.

In our view, the cumulative effect of these assumptions and errors has a medium-to-high probability of changing the preferred regulatory option in the RIS conclusions. This implies that the heating and cooling regulatory options require a fundamental reassessment, and there is a realistic chance that properly revised analysis would not justify any regulatory change in relation to heating appliances in rental properties.

In the case of the preferred hot water regulatory option, which would require landlords to install the most efficient electric water heaters in rental properties a number of assumptions contribute to this over-estimate:

— discount rates
— water heater appliance costs
— carbon prices
— gas service abolishment costs.

Deloitte also erroneously uses retail energy prices rather than avoided economic costs as the basis for estimating avoided energy costs for the hot water regulatory measures, but the effect of changing this assumption on these measures is hard to quantify.

In our view, the cumulative effect of these assumptions has a low-to-medium probability of changing the preferred regulatory option in the RIS conclusions. If revised analysis did lead to a change in the preferred regulatory option for hot water, this would mean that landlords could continue to install efficient gas water heaters, including gas-boosted solar water heaters, in rental properties.

Overall, the RIS conclusions are highly questionable and there is a strong case for a complete reassessment of the costs and benefits of the proposed measures.

Melbourne
Suite 4, Level 19, North Tower
80 Collins Street
Melbourne VIC 3000 Australia
+61 3 8650 6000

Sydney
Suite 603, Level 6
309 Kent Street
Sydney NSW 2000 Australia
+61 2 8272 5100

Brisbane
Level 15, 127 Creek Street
Brisbane QLD 4000 Australia
+61 7 3009 8700

Canberra
Level 6, 54 Marcus Clarke Street
Canberra ACT 2601 Australia
+61 2 6103 8200

Perth
Level 12, 28 The Esplanade
Perth WA 6000 Australia
+61 8 9449 9600

Adelaide
167 Flinders Street
Adelaide SA 5000 Australia
+61 8 8122 4965

ACIL Allen Pty Ltd
ABN 68 102 652 148

acilallen.com.au