Building Electrification

Regulatory Impact Statement

VICTORIA State Government
Department of Transport and Planning

Contents

Acknowledgements and limitations

The Department of Transport and Planning acknowledges its responsibility for this regulatory impact statement (RIS) that sets out the impacts of the proposed regulations.

The Department of Transport and Planning acknowledges the assistance of Deloitte in contributing to the preparation of this RIS.

This RIS has been prepared for the express purpose of assessing the proposed regulations and other potential uses of the information contained in the RIS has not been a consideration in its development. No reliance should be placed on this document for any other purpose. The information contained in this RIS has not been subjected to an audit or any form of independent verification.

Glossary

Acronym	Full name
ABS	Australian Bureau of Statistics
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
BCR	Benefit Cost Ratio
CBA	Cost-Benefit Analysis
CBBS	Commercial Building Baseline Study
CBD	Commercial Building Disclosure
CFC	Chlorofluorocarbons
CGE	Computable General Equilibrium
CO	Carbon monoxide
CO_2-e	Carbon dioxide equivalent
CPI	Consumer Price Index
DEECA	Department of Energy, Environment and Climate Action
DTP	Department of Transport and Planning
Fossil gas	Natural gas that is distributed through the reticulated gas network, in accordance with the definition in the *Gas Industry Act 2001*.
FTE	Full time equivalent
GFA	Gross floor area
GHG	Greenhouse gas
GJ	Gigajoule
GPG	Gas powered generation
GSOO	Gas Statement of Opportunities
GSP	Gross state product
GVA	Gross value added
GWh	Gigawatt hour
GWP	Global Warming Potential
HCFC	Hydrochlorofluorocarbons
HFC	Hydrofluorocarbons
HSM	Housing Stock Model

Acronym	Full name
HSPF	Heating seasonal performance factor
IPCC	Intergovernmental Panel on Climate Change
kWh	Kilowatt hour
$ktCo_2$-e	Kilotonnes of carbon dioxide equivalent
LPG	Liquified petroleum gas
MJ	Megajoule
Mt	Megatonnes
$MtCo_2$-e	Megatonnes of carbon dioxide equivalent
MWh	Megawatt hours
NABERS	National Australian Built Environment Rating System
NatHERS	Nationwide House Energy Rating System
NCC	National Construction Code
NPV	Net Present Value
ODP	Optimal Development Pathway
PJ	Petajoule
PV	Present value
RAB	Regulatory asset base
RAC	Refrigeration and air conditioning
RCAC	Reverse Cycle Air Conditioner
REZ	Renewable Energy Zone
RIS	Regulatory Impact Statement
SEC	State Electricity Commission
tCo_2-e	Tonnes of carbon dioxide equivalent
VEU	Victorian Energy Upgrades
VOCs	Volatile organic compounds
VPP	Victoria Planning Provisions
VRE	Variable renewable energy
VRET	Victorian renewable energy target

Executive summary

The purpose of this report

To support and accelerate the pace of electrification of new and existing buildings in Victoria, the Victorian Government is proposing to amend the Building Regulations 2018 and the Plumbing Regulations 2018 (together "the Regulations"), under the *Building Act 1993* (the "Building Act").

This Regulatory Impact Statement (RIS) assesses the potential impacts of the proposed amendments along with several other options, in accordance with the Victorian Guide to Regulation.[1]

Background

Victoria's commitment to a net-zero 2045

To address climate change Victoria has a legislated target of reaching net zero greenhouse gas (GHG) emissions by 2045, with interim targets in 2025, 2030 and 2035. To achieve this, Victoria's Climate Change Strategy calls for decarbonisation of fossil gas[2] use as part of its 5-point plan, including switching to electricity.

The role of fossil gas in Victoria's energy mix

Fossil gas plays a crucial role in meeting Victoria's energy needs, traditionally providing a reliable and cost-effective source of energy for a range of residential and commercial uses. Victoria is Australia's largest user of fossil gas for residential and commercial purposes, with the state accounting for two-thirds of national household and commercial fossil gas consumption.[3] In 2023, Victoria consumed 181 petajoules (PJ) of fossil gas, with residential and small commercial fossil gas users accounting for 64 per cent of this usage.[4] It should be noted 2023 was a particularly low year in fossil gas consumption, partially due to warmer than average winter weather, with Victoria's average consumption of fossil gas between 2019 and 2022 being 220 PJ per annum.[5]

Victoria is also the only state where fossil gas usage is higher than electricity usage in the residential sector, with 104 PJ of fossil gas consumed by households in 2021-22 compared to 54 PJ of electricity (15 terawatt-hours (TWh)).[6] Residential fossil gas usage in Victoria is nearly three times higher than the second highest user (New South Wales). Fossil gas consumption in the residential sector is primarily driven by space heating, making up 60 per cent of total residential fossil gas usage.[7]

The application of fossil gas usage across various uses in the commercial sector typically mirrors the residential sector, with the largest share of fossil gas used in space heating,[8] followed by water heating and cooking. Fossil gas is also a critical input for many industries and manufacturing processes, particularly for generating heat in manufacturing. Industrial use and large commercial users consume 31 per cent of Victoria's total fossil gas supply.[9] Within the industrial sector, 65 per cent of its

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[1] Commissioner for Better Regulation (2024), Victorian Guide to Regulation: A handbook for policy-makers in Victoria. <https://www.vic.gov.au/victorian-guide-regulation>

[2] For the purpose of this RIS, references to historic or current gas usage is referred to as 'fossil gas' while future gas usage may be met in part by alternative gases (such as biomethane) and therefore future references are production source neutral.

[3] Infrastructure Victoria (2021), Towards 2050: Gas infrastructure in a net zero emissions economy. <https://www.infrastructurevictoria.com.au/resources/towards-2050-gas-infrastructure-in-a-net-zero-emissions-economy-final-report>

[4] Australian Energy Market Operator (2024), Victorian Gas Planning Report Update. <https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/vgpr/2024/2024-victorian-gas-planning-report-update.pdf?la=en>. Small commercial users are users who use consume less than 10 terajoules of gas a year and less than 10 gigajoules an hour.

[5] Australian Energy Market Operator (2024), Victorian Gas Planning Report Update. <https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/vgpr/2024/2024-victorian-gas-planning-report-update.pdf?la=en>; Australian Energy Market Operator (2021), Victorian Gas Planning Report. <https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/vgpr/2021/2021-victorian-gas-planning-report.pdf?la=en>

[6] Department of Climate Change, Energy, Environment and Water (2023), Australian Energy Statistics Table K Australian energy consumption in 2021-22, by state and territory, by industry, selected fuels. <https://www.energy.gov.au/publications/australian-energy-update-2023>

[7] Northmore Gordon and Energeia (2021), Gas Infrastructure Advice - Cost benefit analysis of energy efficiency activities in the gas sector. <https://assets.infrastructurevictoria.com.au/assets/Resources/Cost-Benefit-Analysis-of-Energy-Efficiency-Activities-in-the-Gas-Sector.pdf>

[8] For the purposes of this report space heating refers to heating the air in the surrounding environment of a particular space (as opposed to a particular heating system or appliance).

[9] Infrastructure Victoria (2021), Towards 2050: Gas infrastructure in a net zero emissions economy – Final report. <https://assets.infrastructurevictoria.com.au/assets/Resources/Towards-2050-Gas-infrastructure-in-a-net-zero-emissions-economy_FINAL-REPORT.pdf>

energy use is sourced from fossil gas.[10] The largest fossil gas users in the industrial sector are food and beverage manufacturers, pulp and paper manufacturing, and petroleum and coal product manufacturing. Between 2022-23, 25.7 per cent of Victoria's fossil gas supply was consumed by the manufacturing sector.[11]

Fossil gas also plays a small but significant role in electricity generation in Victoria. Although brown coal currently accounts for more than half of electricity generation, gas powered generation (GPG) plants play an important role in providing additional capacity particularly during peak demand periods and stabilising the electricity network during intermittent renewable generation.[12] In 2022-23, approximately 3 per cent of Victoria's electricity was generated with fossil gas.[13] Fossil gas is expected to continue playing a critical grid-balancing role as the Victorian Government accelerates the roll-out of renewable electricity to meet the state's targets of 65 per cent renewable electricity by 2030, and 95 per cent by 2035.

The challenge posed by Victoria's dependence on fossil gas

Fossil gas plays an important part of Victoria's energy mix, however, the level of reliance on fossil gas presents several challenges for the Victorian economy, including:

- the cost of energy for Victorian consumers
- energy security and reliability
- energy sector greenhouse gas emissions.

Cost of energy for consumers from rising fossil gas prices and inefficient appliances

Cost of energy to customers is driven by the price of energy and volume of energy consumed, as well as charges for fixed network infrastructure, retail, and environmental charges. Prior to the commencement of liquified fossil gas exports in 2015, the wholesale price of fossil gas averaged $4 per GJ between 2011-12 and 2014-15.[14] Fossil gas prices doubled to $8 per GJ by 2016.[15] In recent years, a range of global and local factors led to a further increase in Australian wholesale fossil gas price from around $10 per gigajoule (GJ) in January 2022 to a peak of $29 per GJ in June 2022.[16] Although wholesale fossil gas prices have fallen from this peak to around $11 per GJ, they are not expected to return to pre-2015 prices.[17] Fossil gas prices for residential consumers increased by 35 per cent between 2021 and 2023.[7] This increase in price has placed additional financial burden on consumers already experiencing rising cost-of-living pressures, demonstrated by increased consumer price index (CPI) and increased interest rates, among other factors.

Over the next two decades wholesale electricity prices are projected to be slightly higher, on average, than fossil gas wholesale prices on a per GJ basis.[18] Installing electric appliances can however reduce the annual cost of energy bills through lower energy consumption due to higher energy efficiency.[19] Most electric appliances are more energy efficient than their gas counterparts (with improvements in efficiency expected to continue), reducing the overall energy consumed and cost of energy bills.[20] On average, these savings outweigh the incremental upfront costs for Victorian households and many commercial businesses in typical circumstances.

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[10] Engage Victoria (2022), Help build Victoria's Gas Substitution Roadmap: Consultation paper. <https://engage.vic.gov.au/help-us-build-victorias-gas-substitution-roadmap>
[11] Department of Climate Change, Energy, the Environment and Water (2024), Australian Energy Statistics 2024. <https://www.energy.gov.au/publications/australian-energy-statistics-table-o-electricity-generation-fuel-type-2022-23-and-2023>
[12] Department of Climate Change, Energy, the Environment and Water (2023), Australian Energy Statistics Table O: Australian electricity generation by state and territory, by fuel type, physical units. <https://www.energy.gov.au/publications/australian-energy-update-2023>
[13] DCCEEW (2024), Australian Energy Statistics 2024. <https://www.energy.gov.au/publications/australian-energy-statistics-table-o-electricity-generation-fuel-type-2022-23-and-2023>
[14] Australian Energy Regulator (2024), Gas market prices. <https://www.aer.gov.au/industry/registers/charts/gas-market-prices>
[15] Australian Energy Regulator (2024), Victorian gas market average daily weighted average prices <https://www.aer.gov.au/industry/registers/charts/victorian-gas-market-average-daily-weighted-prices-quarter>
[16] Australian Energy Regulator (2024), Victorian gas market average daily weighted average prices <https://www.aer.gov.au/industry/registers/charts/victorian-gas-market-average-daily-weighted-prices-quarter>
[17] The Australian Energy Market Operator projects wholesale gas prices are likely to return close to $11 per GJ in the coming years.
[18] Projected gas wholesale prices are based on AEMO's draft ISP Step Change Melbourne gas price forecast. Projected electricity wholesale prices were modelled by Endgame Economics (2024), with AEMO's draft ISP Step Change model used as a direct basis and current market bidding behaviour overlaid.
[19] Note electric appliances can incur a higher upfront cost to purchase and install than gas appliances. However, several analyses indicate that for many appliances (particularly heating and hot water) the ongoing energy bill savings will more than offset the upfront cost incurred. See Chapter 2 for more details.
[20] This assumes energy consumption does not change as a result of switching to an electric appliance. See section 5.6.10 for a discussion of rebound effects.

Risk to energy security and reliability from falling fossil gas production in Victoria

The Australian Energy Market Operator (AEMO) forecasts that Victoria's total available fossil gas supply, including offshore resources, will almost halve from 2024 (297 PJ) to 2028 (154 PJ). While AEMO also forecasts a slight reduction in fossil gas demand over this period, the reduction in supply is much greater, leading to a supply gap for Victoria from 2028.[21,22]

There are opportunities for new offshore gas fields to produce fossil gas and to import fossil gas from outside Victoria, however, there is still significant uncertainty as to how Victoria's fossil gas demand will be met in the future. Part of the risk of fossil gas shortfall could be addressed by switching residential and commercial buildings from fossil gas to electricity.

While Victoria's electricity sector presents different challenges for energy security and reliability, these can be managed through planned investment in locally produced renewables, storage and fast response generation, alongside network infrastructure. These investments are actively being scoped and managed through a range of Victorian and national measures.

Addressing energy sector greenhouse gas emissions

Victoria recorded total net GHG emissions of 80 megatonnes of carbon dioxide equivalent ($MtCo_2$-e) in 2021.[23] Victoria was the fourth largest state contributor to Australia's total GHG emissions, accounting for 17 per cent of the total national emissions in 2021.[24]

Fossil gas contributes to 16 per cent of Victoria's total GHG emissions.[25] The largest source of Victoria's fossil gas emissions is its direct combustion in residential properties, businesses, and industries, followed by fugitive emissions from leaks or venting of fossil gas throughout its lifecycle.

Although the electricity sector is currently the largest source of emissions in Victoria (accounting for 51 per cent in 2021), state renewable energy targets are anticipated to reduce electricity sector emissions by around 95 per cent by 2035.[26,27]

Relative to other high-emitting sources of emissions,[28] electrification of residential and commercial fossil gas appliances is considered a cost-effective decarbonisation solution. This is because it targets energy efficiency while also enabling buildings to transition towards net zero as the electricity sector decarbonises. In addition, for most sectors the technologies required are already commercially viable and produced at scale.

Government policy to address market failures and drive electrification

Market failures that present barriers to electrification

Despite growing awareness around the challenges presented by fossil gas, market forces often fail to prioritise investment in the electrification of buildings. These market failures include:

- bounded rationality, where future energy bill savings are not fully assessed against the upfront cost of switching to electric appliances
- externalities, where broader emissions benefits are not considered during the purchasing decision of appliances and construction of buildings
- split incentives in commercial rental properties and residential rentals, where financial benefits accrued are not always passed on to those making the purchasing or construction decisions
- information asymmetries on energy performance and benefits of electric appliances between buyers and sellers
- lack of accessible information driven by:
  - low community energy literacy making it difficult to navigate modern energy markets which are increasingly dynamic and complex

[21] Australian Energy Market Operator (2024), 2024 Victorian Gas Planning Report Update. <https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/vgpr/2024/2024-victorian-gas-planning-report-update.pdf?la=en#:~:text=A%20gas%20connection%20ban%20effective,Australia%2C%20Tasmania%20and%20Victoria%20combined.>
[22] Australian Competition and Consumer Commission (2024), Gas Inquiry 2017 – 2030 Interim update on east coast gas market <https://www.accc.gov.au/system/files/gas-inquiry-june-interim-gas-inquiry-report_1.pdf>
[23] Department of Energy, Environment and Climate Action (2023), Greenhouse gas emissions. <https://www.climatechange.vic.gov.au/greenhouse-gas-emissions>
[24] Department of Energy, Environment and Climate Action (2023), Greenhouse gas emissions. <https://www.climatechange.vic.gov.au/greenhouse-gas-emissions>
[25] DEECA analysis of 2022 State and Territory Greenhouse Gas Inventories
[26] Department of Energy, Environment and Climate Action (2023), Greenhouse gas emissions. <https://www.climatechange.vic.gov.au/greenhouse-gas-emissions>
[27] Endgame Economics based on AEMO's 2023 Inputs Assumptions and Options Report Step Change scenario.
[28] For example agriculture, industrial processes, transport and land use, land use change and forestry.

- households (particularly vulnerable households, the elderly or people from culturally and linguistically diverse backgrounds) often face cultural, language or educational barriers to accessing information.

Victorian policies that aim to address market failures and accelerate electrification

In response to the challenges presented by Victoria's dependence on fossil gas and noting these market failures, the Victorian Government released Victoria's Gas Substitution Roadmap in July 2022 (the Roadmap) and a Roadmap Update in December 2023. The Roadmap outlines a pathway for Victoria to reduce its reliance on fossil gas while maintaining reliable supply and keeping downward pressure on energy prices. Building electrification is a key strategy described in the Roadmap.

The Victorian Government has introduced several initiatives aimed at promoting electrification in Victoria. These include:

- amendment VC221 to the Victoria Planning Provisions (VPP) in 2022 which supported Victoria's Climate Change Strategy 2021 and Gas Substitution Roadmap 2022 – at this point, the VPP made connection to the reticulated fossil gas service optional[29]
- amendment VC250 to the VPP in 2023 which stated that from 1 January 2024, new housing developments cannot be connected to the reticulated gas network – specifically, all new residential properties, apartment buildings and residential subdivisions requiring a planning must be all electric (noting that not all residential buildings require a planning permit), and small second dwellings[30] cannot connect to the reticulated gas network[31]
- proposed requirements for fossil gas appliances in residential rental properties to be replaced with electric appliances as part of the minimum energy efficiency and safety standards regulations, currently under consideration through a separate RIS process (the consultation for this process closed in July 2024 with the final decision still pending) [32]
- reforms to the Victorian Energy Upgrades (VEU) program, which provides financial incentives to households and businesses to undertake energy efficiency upgrades, including new incentives for replacing inefficient fossil gas water heaters and space heating with efficient electric alternatives, and the removal of incentives for new fossil gas appliances
- amendments to the National Construction Code NCC) 2022, which strengthened minimum energy performance standards for new residential properties and came into effect in Victoria on 1 May 2024[33]
- a cap on gas network abolishment fees charged by gas distribution network service providers to ensure properties are not disincentivised from abolishing their fossil gas connection[34]
- amendments made in November 2023 to the Plumbing Regulations 2018 to remove barriers to installing efficient electric hot water systems in new residential properties subject to NCC 2019 requirements
- a ban on incentives for fossil gas connections and gas appliances
- implementation of a new Gas Distribution System code of practice, which from 1 January 2025 requires gas distributors to charge the full costs of new connections upfront
- the establishment of the State Electricity Commission (SEC) Victoria with a focus on supporting households to switch to all-electric, along with investing in renewable energy projects and enabling the workforce transition required.[35]

While recent policy measures aim to address some of the market failures, these changes do not cover the full spectrum of buildings in Victoria, with many new and existing residential and commercial buildings likely to continue using gas appliances

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[29] HWL EBSWORTH (2022), Amendment to the Victorian Planning Provisions pushes Victoria towards an environmentally friendly future. <https://hwlebsworth.com.au/amendment-to-the-victorian-planning-provisions-pushes-victoria-towards-an-environmentally-friendly-future/>

[30] According to the Department of Transport and Planning, a small second dwelling is a term in the planning and building regulatory frameworks for what is commonly referred to as a granny flat. <https://www.planning.vic.gov.au/guides-and-resources/strategies-and-initiatives/small-second-dwellings>.

[31] Reticulated gas network refers to the network of pipelines that distributes fossil gas to homes and businesses. See Department of Transport and Planning Victoria (2023), Victoria's Gas Substitution Roadmap. <https://www.planning.vic.gov.au/guides-and-resources/strategies-and-initiatives/victorias-gas-substitution-roadmap>

[32] Deloitte Access Economics (2024), Minimum energy efficiency and safety standards for rental homes – Regulatory Impact Statement. <https://engage.vic.gov.au/new-minimum-standards-for-rental-properties-and-rooming-houses>

[33] Department of Energy, Environment and Climate Action (2023), Fact sheet for homebuyers: New home energy efficiency standards explained. <https://www.energy.vic.gov.au/__data/assets/pdf_file/0033/670299/7-star-new-home-standards-factsheets-home-buyers.pdf>

[34] This relates to the cost of permanent disconnection of the gas service pipe from the street and removal of the meter. Australian Energy Regulator (2023), AER decision supports Victorian gas consumers in energy transition. <https://www.aer.gov.au/news/articles/news-releases/aer-decision-supports-victorian-gas-consumers-energy-transition#:~:text=Ms%20Savage%20said%20the%20AER,haulage%20tariffs%20which%20are%20spread>

[35] State Electricity Commission Victoria (2024), About <https://www.secvictoria.com.au/about#:~:text=Here%20at%20the%20SEC%2C%20we,transition%20and%20deliver%20commercial%20returns.>

in the absence of any intervention.[36] Further action is required to ensure that electrification occurs at a sufficient pace to meet Victoria's GHG emissions targets and assist in alleviating forecast fossil gas shortfalls.

Government objectives

Reducing the state's reliance on fossil gas is an important lever in achieving Victoria's legislated net zero emissions target. The Victorian Government's objectives are to support and accelerate the pace of electrification of new and existing buildings in Victoria and, in doing so, to:

- reduce energy bills for households and businesses
- mitigate potential fossil gas shortfalls
- reduce GHG emissions.

Consideration of viable options to accelerate electrification

Prior to identifying regulatory options for effecting change, several non-regulatory options were considered to achieve the objectives, including the use of renewable gas, education campaigns, mandatory disclosures, and financial incentives. While these non-regulatory options are all critical measures to support the Victorian Government's goals, they alone are not expected to completely address the challenges associated with fossil gas use in Victoria or the barriers to electrification at the scale and pace required to meet the government's GHG emissions reduction targets and assist in mitigating potential fossil gas shortfalls. Therefore, only options that mandate electrification of buildings have been considered in this RIS.

Establishing the Base Case

The Base Case presents the point of reference against which the impact of options is assessed. Under the Base Case, it is assumed that some electrification of buildings occurs as a result of both the proposed and existing policies and regulations already introduced by state and federal governments, as well as changing consumer preferences and behaviours.

The Base Case accounts for all policies identified above, which are anticipated to increase the uptake of electrification in new residential properties and electrification of heating and hot water appliances in residential rental properties. As a result, the majority of new residential properties built in Victoria are expected to be built all-electric under the Base Case.

The costs and benefits associated with the electrification of government buildings and facilities are also being considered under other policy proposals. Government buildings are assumed to electrify under the Base Case.

The Base Case also considers voluntary electrification as a result of changing consumer preferences and behaviours, where a proportion of fossil gas users are expected to switch to electric appliances even in the absence of regulation.

Four options were considered to support and accelerate electrification

The options assessed in this RIS are described in detail below and summarised in Table i:

- **Option 1: Electrification of all new residential and new commercial buildings.** Under this option, all new residential and commercial buildings will be required to be constructed as all-electric. New residential and commercial buildings will not connect to the reticulated gas network and will instead be fully reliant on electric appliances.[37] For new residential buildings, this expands upon recent amendments to the VPP by also covering residential properties that do not require a planning permit.
- **Option 2: Electrification of all new and existing residential buildings and all new and existing commercial buildings, *excluding* existing commercial kitchens.** Option 2 builds on Option 1 by including existing residential and existing commercial buildings (except for existing commercial kitchens). In addition to electrifying new buildings, gas appliances in existing residential and commercial buildings will need to be replaced with electric appliances once the gas appliance reaches end of life. End of life replacement in existing properties is intended to allow a gradual phase out of gas appliances, supporting an orderly transition to a net-zero Victoria. For the purposes of this RIS, commercial kitchens refer to commercial sized kitchens and appliances used for food services. Cooking in commercial settings using non-commercial cooking equipment, such as a standard (residential scale) gas cooktop or a gas oven installed in an office building, will be required to electrify. Only existing commercial kitchens are exempt, new commercial kitchens will be required to be constructed as all electric under this option.
- **Option 3: Electrification of all new and existing residential buildings (*excluding* existing residential cooking) and all new commercial buildings (preferred option).** Under Option 3, all existing residential gas hot water and heating must be

[36] Based on market and consumer research completed for DEECA by JWS Research (2021).
[37] Note that existing VPP amendments only apply to residential dwellings requiring a planning permit.

electrified through replacement at end of life and all new residential and commercial buildings must be built all-electric. This option excludes all existing residential cooking and existing commercial buildings from electrification requirements.

- **Option 4: Electrification of all new and existing residential buildings.** Under this option, only new and existing residential buildings will be required to electrify. The requirement to electrify under this option extends to all residential gas appliances, including cooking. All new and existing commercial buildings will be exempt from electrification.

Table i: Summary of RIS options

	Option 1: New residential and new commercial	Option 2: All new and existing residential and commercial	Option 3: All new and existing residential excluding existing cooking, and new commercial (preferred)	Option 4: All new and existing residential
New residential	Included	Included	Included	Included
Existing residential[1]	Not included	Included	Included[2]	Included
New commercial	Included	Included	Included	Not included
Existing commercial[3]	Not included	Included[4]	Not included	Not included

1. The electrification requirements are also proposed to apply to swimming pool heaters. The electrification of residential swimming pool heaters has not been explicitly included in the cost-benefit analysis. Separate analysis has been conducted for residential swimming pools as their impact is relatively smaller than the impacts from cooking, heating and hot water appliances (see Chapter 7).
2. Option 3 excludes existing residential gas cooking appliances.
3. Due to the top-down approach for hot water analysis in the commercial sector, commercial swimming pools are implicitly captured in the options analysis.
4. Option 2 excludes existing commercial kitchens. Residential scale kitchen appliances used in commercial contexts, for example a standard gas cooktop in a shared office kitchen, are not excluded from the regulations.

Applications outside the scope of the proposed regulations

The following are beyond the scope of this RIS:

- **Liquified Petroleum Gas (LPG) usage.** The regulatory options considered only apply to reticulated fossil gas. Therefore, analysis excludes circumstances of bottled or reticulated LPG usage.[38]
- **Industrial facilities.** The regulatory options considered do not apply to industrial facilities such as factories, manufacturing, and agriculture.[39]
- **Commercial kitchens in existing commercial buildings**. The regulatory options considered do not apply to commercial kitchens for the purposes of food services in existing commercial buildings. Existing commercial kitchens are proposed to be exempted based on industry feedback on retrofit complexity, suggesting that further investigation is required for electric alternatives in existing commercial kitchens. Note the preferred option does not cover existing commercial buildings entirely in any event.

Method to quantitatively assess the economic merits of each option

Options have been assessed using Cost-Benefit Analysis (CBA), which provides a robust, structured, and transparent approach to analysing the economic costs and benefits of each option. Costs and benefits quantified in the CBA include:

- avoided energy costs driven by reduced fossil gas usage (after accounting for offsetting increases in costs associated with increased electricity usage)
- avoided GHG emissions through reduced fossil gas usage (after accounting for offsetting increases in emissions associated with increased electricity usage)
- avoided capital costs of purchasing a cooling appliance where a reverse cycle air conditioner (RCAC) is purchased for heating purposes which can also be used as a cooling appliance[40]

[38] Note LPG only accounts for 1 per cent of total gas usage in Victoria. The exclusion of LPG will allow an alternative where electrification may be more complex or costly, including remote and regional areas. Figure provided by VBA.
[39] Note that the proposed policy will reduce demand for residential and commercial gas which will help alleviate gas shortfall risks for industrial users.
[40] Note this only applies where a property would have had an electric cooler alongside a gas heater under the Base Case. Properties that would not have had an electric cooler are excluded from this benefit.

- avoided gas network costs (including new gas piping infrastructure and gas network operational costs)
- avoided health costs from air pollution
- cost of purchase and installation to replace gas appliance with electric alternative[41]
- cost of upgrading or installing new building infrastructure
- administrative costs in terms of time and effort required for households and businesses to electrify appliances (e.g. time determining the preferred electric appliance to purchase as a replacement for gas, obtaining quotes, etc)
- cost to government to enforce and monitor the regulation.

For the purposes of this RIS, two timeframes over which the proposed regulations are assumed to apply have been adopted (referred to as 'analysis period'):

- a 10-year period from 2026 to 2035, in line with the standard timeframe for new regulations under the *Subordinate Legislation Act 1994*[42]
- a 20-year period from 2026 to 2045, to understand the implications of amending the Regulations for achieving the Victorian Government's net zero target by 2045.

For analytical purposes, both timeframes start in 2026, however this is not government policy and a commencement date for the proposed regulations has not been finalised.

Costs and benefits of reinstallation of appliances after ten years (or 20 years depending on timeframe) are not included in the CBA results.[43] This is because the RIS only relates to impacts within the analysis period of the proposed regulations. This approach is considered conservative, as including future reinstallation of electric appliances after the analysis period is expected to continue to result in a rising net benefit to Victoria.[44]

The modelling assumes that properties will only electrify appliances when required by the regulatory option, such that assumptions on the voluntary uptake of electric appliances under each option remain the same as under the Base Case. In reality, there may be an increase in properties that, having been required to electrify at least one appliance, also choose at that point to electrify all remaining appliances and then disconnect from the gas network.[45] Due to uncertainty around the level of increase in voluntary electrification and subsequent gas disconnection under the various options, this has not been modelled.

Limitations in commercial data

The commercial building sector is highly diverse, encompassing buildings with a wide variety of uses such as retail, offices, hospitals, and schools. This diversity in usage presents challenges and increases complexity around opportunities and technical options for electrification. The transition of commercial buildings from gas to electricity involves significant variability in the technology and infrastructure required, and the associated costs. Based on available data and information, there are several challenges in providing a robust and confident cost estimate for electrification of new and existing commercial buildings due to a lack of comprehensive data regarding the prevalence of gas appliances by sector and the corresponding variation in the costs and complexities of transition to electric alternatives. For example, factors such as the age of existing electrical infrastructure, building layouts and energy demands can greatly influence conversion expenses. Estimating these costs accurately requires detailed information on the specific needs and circumstances of individual businesses, which is not readily available.

[41] For the purposes of this report, replacement of a gas appliance with an electric appliance is referred to as an upgrade due to the improved energy efficiency and required additional costs typically associated with replacement.
[42] This RIS covers proposed amendments to the Building Regulations (2018) and Plumbing Regulations (2018), both of which will sunset in 2028. Under the *Subordinate Legislation Act 1994*, regulatory impact analysis typically focuses on the time period of the life of the proposed regulations. However, given scale of the potential impacts of the proposed regulations, this RIS applies the ten-year period of analysis that would apply to new regulations with a sunsetting date ten years after their creation.
[43] Reinstallation refers to replacing an existing electric appliance with a new one after the first electric appliances has reached end of life.
[44] Under the proposed regulations new buildings would not have gas infrastructure available and therefore would not easily be able to install gas appliances after the analysis period. The impact of the proposed regulations on future option value is discussed qualitatively in Chapter 7.
[45] For example, under Option 3 many properties will have cooktops as their only gas appliance, which may prompt some property owners to voluntarily disconnect due to views that remaining connected to gas is no longer cost effective. In these cases, a property owner's choice to disconnect from the network may be an indirect or second-round impact of the regulatory change (because they may have remained connected to gas if not required to electrify at least some appliances other than cooking appliances).

Given these limitations, the Victorian Government is seeking submissions in response to this RIS from any stakeholders who may be able to provide additional data on the costs or benefits of electrification of commercial buildings, and any technical or other barriers.

CBA results

Option 3 presents the highest net present value

Table ii presents the results of the CBA analysis for all four options across both the 10-year and 20-year period. The results show that Option 3 has the highest net economic benefit over both 10 and 20 years.

Over the 10-year period, the results show that Option 3 has the highest Net Present Value (NPV) of $5.0 billion and the highest benefit-cost ratio (BCR) of 1.85. This is followed by Option 4 with an NPV of $4.2 billion, then Option 2 with an NPV of $1.8 billion. While Option 1 has the lowest NPV, at $0.6 billion, it does have a higher BCR than Option 2. This is because Option 2 has a much higher scale of impact, and therefore greater NPV, but also incurs higher associated costs, resulting in an overall lower BCR.

Over the 20-year period, the results for all four options improve due to more appliances being upgraded as well as greater reductions in GHG emissions and increases in health benefits as the electricity sector decarbonises in the future. Option 3 has the highest net benefit and BCR over the 20-year period, with an NPV of $7.5 billion and a BCR of 1.91.

Table ii: CBA results for each option under the two periods

	10-year period		20-year period	
	NPV ($m)	BCR	NPV ($m)	BCR
Option 1	574	1.26	1,280	1.37
Option 2	1,822	1.13	3,514	1.17
Option 3	5,018	1.85	7,472	1.91
Option 4	4,170	1.74	6,055	1.81

Source: Deloitte analysis

Profile of costs and benefits over time

Figure i below shows the annual net benefit profile for all options over the 10-year period. The chart demonstrates that net costs are incurred in the initial years under all options. Option 2 reaches the highest peak of net benefits over the 10-year period at $1.4 billion in 2037, however a larger profile of costs is incurred in early years.

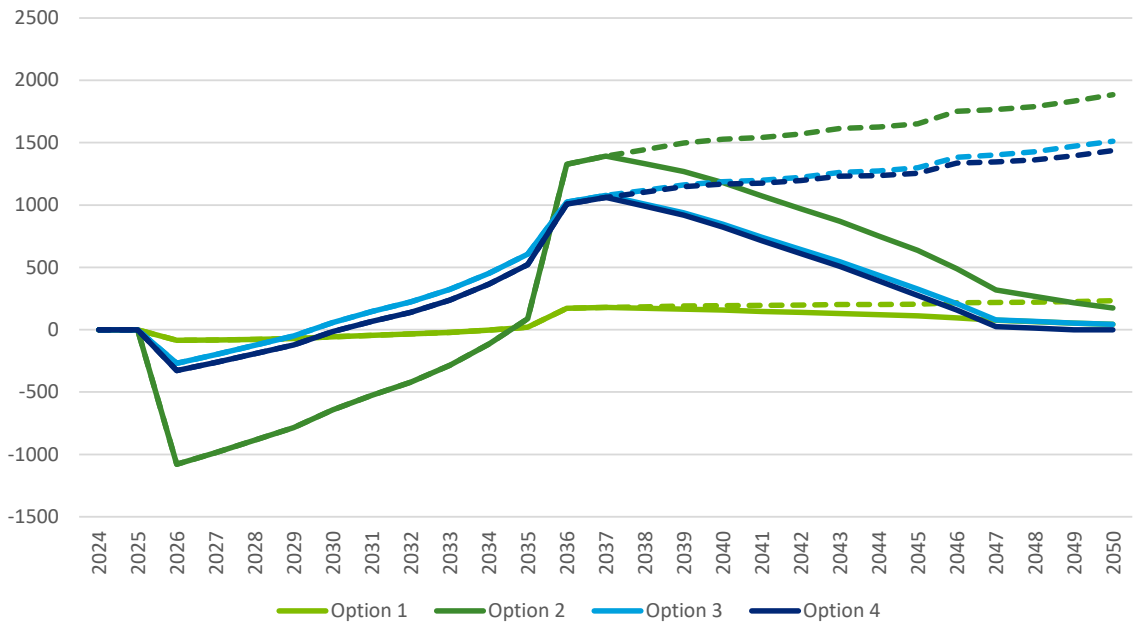
Option 3 and Option 4 follow a similar trajectory, with the net benefits of Option 3 being marginally higher than the net benefits of Option 4. Both options gradually increase in net benefits as benefits of reduced fossil gas usage accumulate and offset upfront capital costs. Both reach a peak of around $1.1 billion in 2037.

Due to the scale of electrification, Option 2 incurs larger economic benefits compared to other options as substantially more buildings are required to electrify. However, the costs associated with electrifying these properties are much larger, indicated by the large net costs in the early years of the analysis period. Costs stop being incurred at the end of the analysis period (2035) as upgrades are no longer required.[46] This leads to a large increase in net benefits from 2036 onwards as benefits continue to accrue over the life of the electric asset.

Under the core CBA modelling, benefits taper off as electric appliances reach their end of life (because the benefits and costs of electric appliances are no longer being accounted for once they have passed end of life). It is likely that a property that has converted from gas to electric would at the end of the electric appliance's life replace it with another electric appliance. This could be due to the ongoing regulatory requirement for electrification, consumer preferences or the additional cost incurred in installing a gas appliance. This would yield ongoing net benefits. To be conservative about the scale of net benefits attributable to the options themselves, these have been excluded from the CBA. The dotted line in Figure i demonstrates the profile if the long-term benefits of sustained electrification were included in the analysis.

[46] Under a 10-year analysis period, not all existing appliances would be upgraded as there may remain a cohort of gas appliances that have not reached end of life by 2035.

Figure i: Net benefit profile for all options for the 10-year period ($ million, per annum)

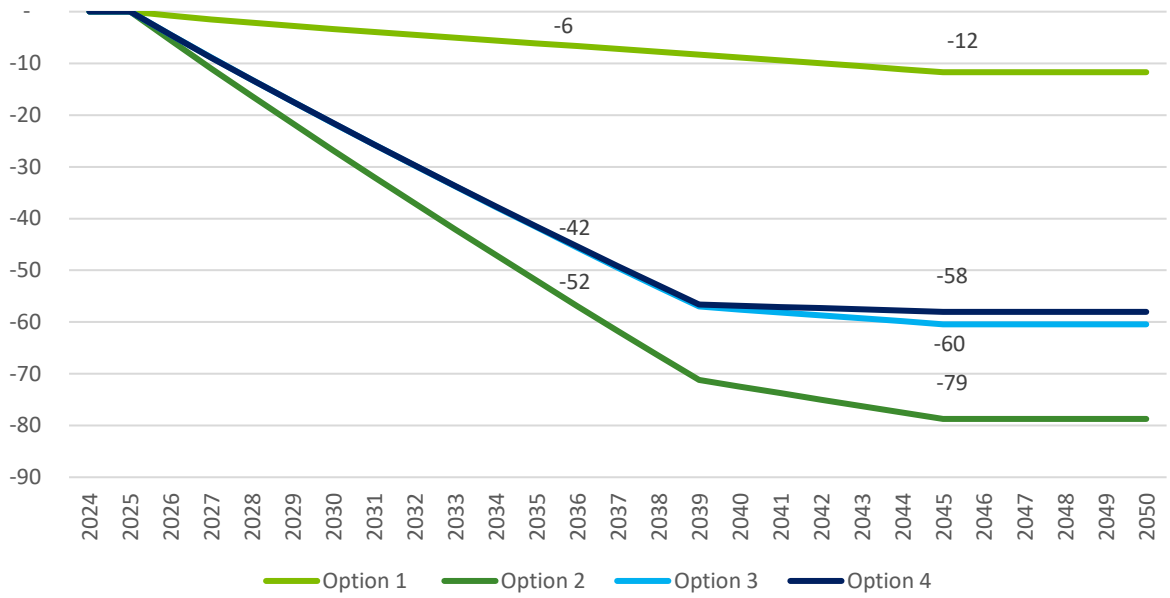


Source: Deloitte analysis. Note: Dotted line represents future benefits if replacement of electric appliances at end of life with electric instead of gas appliances was attributed to the Regulations.

Option 2 achieves the highest reduction in fossil gas usage and greenhouse gas emissions

Figure ii below presents the potential reduction in fossil gas consumption in Victoria under all options over a 20-year period, assuming buildings remain electric after the analysis period. Implementing Option 2 for both the residential and commercial sector could enable reduction in fossil gas consumption of 78 PJ by 2045. Option 3 is projected to reduce fossil gas consumption by 60 PJ in 2045, while Option 4 is slightly lower at 58 PJ. Option 1 has the lowest estimated reduction in fossil gas consumption at 12 PJ by 2045.

Figure ii: Volume of fossil gas reduction for each option, relative to Base Case (PJ)

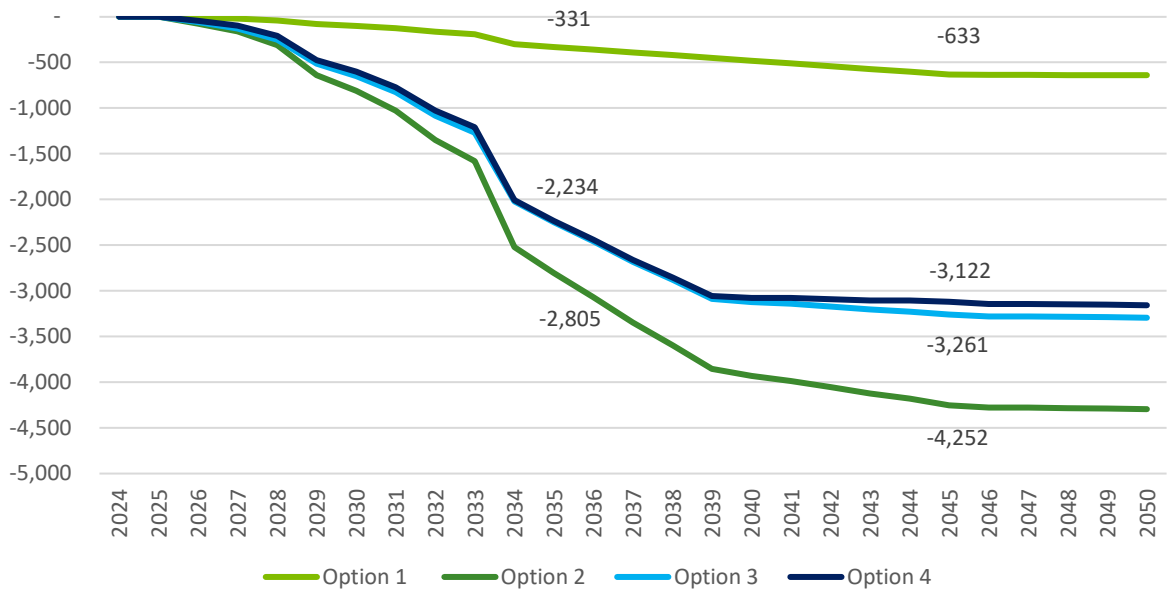


Source: Deloitte analysis. Note: chart demonstrates potential gas reduction over a 20-year period to 2045 with the assumption that buildings continue to adopt electric appliances after 2045.

Option 3 and Option 4 are relatively close in the volume of fossil gas reduction achieved as the fossil gas reduction captured by existing residential cooking under Option 4 (approximately 4 PJ per annum) is roughly equivalent to the projected fossil gas reduction captured by new commercial buildings under Option 3. Fossil gas reduction under Option 4 plateaus from 2039 as existing residential properties are anticipated to be fully electrified by this point and new residential properties are almost entirely electric under the Base Case from 2039. Fossil gas usage from new commercial buildings is projected to continue to grow by approximately 1.2 per cent over the long-term under the Base Case, and therefore avoided fossil gas consumption continues to grow under Option 3. This trend is also observed in the emissions reduction profile.

Figure iii presents the potential emissions avoided in Victoria under all options over a 20-year period, assuming buildings remain electric after the analysis period. Under Option 2, annual emissions could reduce by 4,252 kilotonnes of carbon dioxide equivalent emissions ($ktCo_2$-e) by 2045. For Option 3 and Option 4, annual emissions reduction is estimated at 3,261 $ktCo_2$-e and 3,122 $ktCo_2$-e by 2045, respectively. Option 1 only achieves 633 $ktCo_2$-e in annual emissions reduction by 2045.

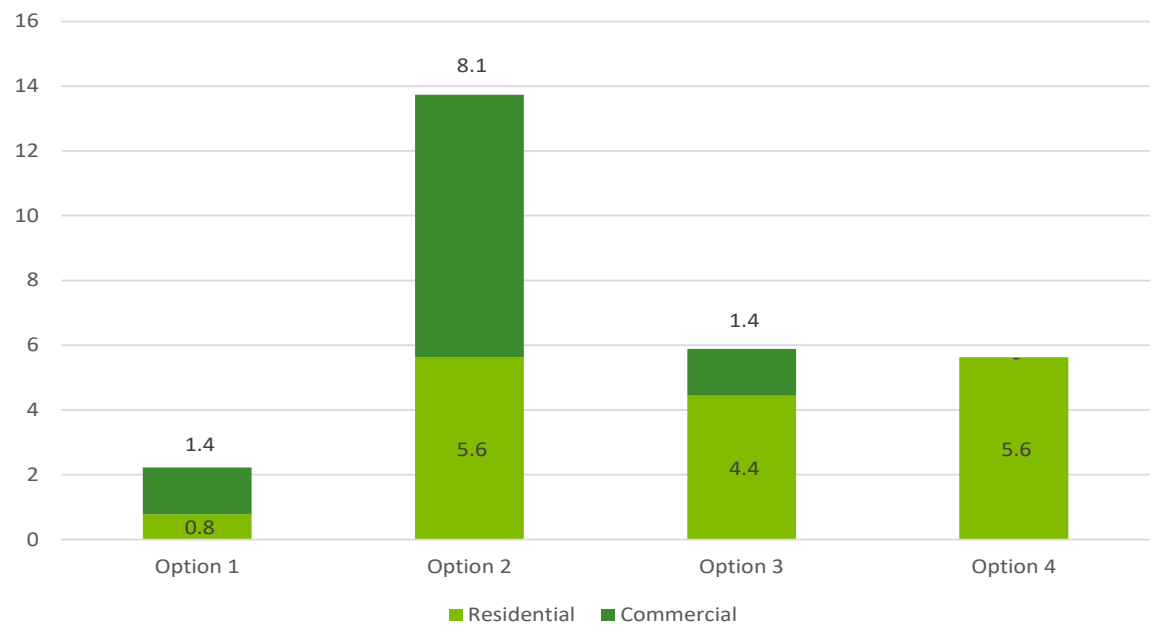
Figure iii: Volume of emissions avoided for each option, relative to Base Case ($ktCo_2$-e)



Source: Deloitte analysis Note: chart demonstrates potential GHG emissions reduction over a 20-year period to 2045 with the assumption that buildings continue to adopt electric appliances after 2045.

Figure iv below shows the breakdown of present value (PV) costs across each option, split by residential and commercial, for the 10-year analysis period. Costs are primarily driven by the capital expenditure required to upgrade commercial buildings and residential properties. Option 2 has the highest PV costs of $13.7 billion, with commercial properties accruing the largest overall costs of $8.1 billion, compared to $5.6 billion for residential properties. Option 1 presents the lowest PV costs across all options, amounting to $2.2 billion, as only new residential and commercial properties are upgraded.

Figure iv: Residential and commercial present value costs for each option ($ million)



Source: Deloitte analysis

Sensitivity testing was conducted to test the CBA results against key assumptions

Sensitivity testing was conducted on the options using the following parameters:

- discount rate
- energy prices
- appliance purchase and installation costs (including labour cost to install appliances)
- switchboard and supply upgrade costs
- cost to abolish the gas connection
- asset life of appliances
- voluntary uptake
- carbon values.

Sensitivity testing demonstrates Option 2 is most sensitive to changes in key parameters, due in part to the uncertainty regarding impacts on commercial buildings as noted above. Option 2 presents a negative NPV under a high discount rate, high electricity price scenario and a high appliance cost scenario. No other options result in a negative NPV under the sensitivity tests conducted. Option 3 is least sensitive to changes in key parameter values, with limited deviation from the core results and all parameter changes maintaining a net benefit of at least $3.2 billion.

Based on CBA results, Option 3 presents the most robust and balanced option

Based on the results of the CBA, the Victorian Government's preferred option is Option 3. The government has identified Option 3 as the preferred option as it provides relatively high economic returns, as evidenced by its BCR and NPV, and the ability to achieve significant reductions in fossil gas usage and GHG emissions.

Impacts assessed outside of the CBA

The CBA is used to assess the direct economic costs and benefits of the proposed regulations but does not assess broader market effects or whole-of-economy impacts. Due to the wide-ranging impacts of the options, additional electricity market modelling, gas market analysis and computable general equilibrium (CGE) modelling was undertaken to assess the impact of the options on key markets.

The options are not anticipated to have a significant impact on the electricity market[47]

Electricity market modelling indicates that the options are anticipated to have a low impact on electricity tariffs relative to the Base Case.[48] However, this assumes additional investment and network expansion already occurs in the future under the Base Case to meet electrification of changing consumer trends (such as uptake of electric vehicles and voluntary electrification) and existing or proposed government policies (such as electrification of residential rental properties and government buildings).

Increased electricity consumption under the options is projected to result in increased GPG generation, and therefore fossil gas consumption from the electricity sector, relative to the Base Case. However, the reduction in reticulated gas usage from electrification is comparatively larger, resulting in an overall reduction in fossil gas consumed across the energy sector and freeing up more fossil gas for GPG to provide reliability support to the electricity market. These trends are consistent with the Victorian Government's legislated target of 95 per cent renewable electricity by 2035.

Overall, the ability of Option 3 to reduce pressure on peak demand and minimise electricity retail tariff impacts relative to Option 2 further supports its ranking as the preferred option.

Gas market analysis indicates that any significant customer disconnection from the gas network will likely create upwards pressure on gas tariffs for remaining gas customers

Analysis of the gas sector indicates that the options can help alleviate potential fossil gas supply shortages in Victoria, proportionate to the volume of fossil gas consumption avoided by each. However, Options 2, 3 and 4 are anticipated to result in fewer customers on the gas network, resulting in fixed infrastructure costs spread across fewer remaining customers, and ultimately higher gas tariffs. This is particularly the case for Option 2 (which sees all residential and in-scope commercial buildings disconnect by 2045) and Option 4 (which sees all residential buildings disconnect by 2039). This is somewhat alleviated by Option 3, where existing residential properties with gas cooking can choose to remain connected to the gas network, helping to support an orderly transition to reduce gas tariff impacts in Victoria.[49] Despite this, an increase in gas tariffs is still anticipated under Option 3, which is explored further in the discussion on the impact of the preferred option (Chapter 8).

The options will generate more economic activity through the transition

CGE modelling indicates that the options would have an overall positive impact on gross state product (GSP) in Victoria, proportionate to the scale of electrification. As the relevant building classes undergo an adjustment away from gas, there will be losses in gross value added (GVA) for certain industries (such as gas distribution). However, these will likely be offset by increases in emerging and in-demand industries, such as clean energy and construction, as a result of the electrification requirements.[50] The findings of this analysis do not change the outcome of the preferred option in the CBA.

Given the scale of electrification required in the regulatory options, additional workers in key occupations (such as electricians) will be required to implement the policy. These key skills and occupations of interest will be in demand across many other sectors of the economy. It is therefore important to consider the state of the labour market. While the modelling undertaken for the RIS did not address potential shortages or gaps within individual occupations, modelling previously undertaken by Deloitte for Jobs and Skills Australia found shortages in key occupations are likely to occur without policy intervention.[51] It is possible that increasing demand for these services under the options, with limited supply available, may put upwards pressure on labour costs and further increase the cost of the proposed regulation. Sensitivity testing of the cost to electrify was conducted in the CBA, demonstrating that Option 3 remains preferred even under a 25 per cent increase in purchase and installation costs (including the labour cost to install appliances).

[47] Deloitte's energy market analysis and modelling of gas and electricity impacts are intended as scenario analysis to help identify the impacts of options assessed in this RIS and should not be interpreted as predictions of Victoria's energy markets or exact estimates of the investment required under each option.

[48] For the purposes of this study, low impact is defined as up to, and including, a 5 per cent increase in electricity bills.

[49] Gas cooking is defined as capturing gas cooktops, gas ovens and integrated gas cooktop with ovens connected to the reticulated gas network.

[50] Construction sector includes both electrical and gas fitting occupations.

[51] Jobs and Skills Australia (2023), The Clean Energy Generation. <https://www.jobsandskills.gov.au/sites/default/files/2023-10/The%20Clean%20Energy%20Generation_0.pdf>

The following impacts were also considered and were not found to change the preferred option:

- Residential swimming pools and spas are also intended to be covered by the electrification requirements. Only a small proportion of existing residential pools are estimated to use fossil gas for heating,[52] with the annual cost of upgrade at end of life representing less than 1 per cent of the average annual cost of Option 3. Moreover, the energy savings from switching to electric heating at end of life is anticipated to result in a financial net benefit on average.
- Refrigerant gases used in heat pumps are often potent GHG. However, regulations and technological advances have helped limit use of potent GHG in Victoria. Analysis undertaken by The Expert Group indicates that potential emissions from refrigerant gases are minor relative to the emissions saved from avoided fossil gas consumption from electrification.[53]
- It is possible that electrification of existing buildings under Option 2 may disrupt productivity of businesses, particularly those that operate around the clock and do not have capability for employees to work from home. Selection of Option 3 as the preferred option eliminates the potential for disruption of business activity.
- Preventing the development of gas network infrastructure for new buildings reduces the future option value if the proposed regulations are removed in the future.[54] However, it is difficult to estimate the cost of lost future option value for Victorians. Moreover, the proposed regulation is only intended to cover a minority of new residential properties built that are not covered by existing government policies, therefore the impact of the proposed regulation is limited primarily to new commercial buildings.

Comparison of impacts of preferred option on residential and commercial sectors

Option 3 is preferred due to its relatively high economic benefits relative to costs. The Option achieves significant reduction in fossil gas usage and GHG emissions while allowing residential property owners to choose whether and how to replace gas cooktops with electric cooktops. Option 3 aims to support an orderly transition to a low-carbon economy by progressively phasing out energy intensive gas appliances (heating and hot water systems) in residential properties over time.

The NPV for residential properties amounts to $4.9 billion over a 10-year period. For the commercial sector, electrification of new buildings results in a NPV of $146 million over a 10-year period.[55]

Costs faced by residential properties under Option 3

On average, residential properties are anticipated to incur an upfront cost of electrification. However, some residential properties may see a net saving in upfront costs due to avoided gas infrastructure or cooling equipment. The total potential cost to upgrade is lower for new properties. This is driven by savings in avoided gas piping within the property and connection to the gas network.

Residential properties that electrify would reduce their ongoing energy bill, enabling upfront capital costs to be recovered over time. The estimated payback period based on the average upfront costs of replacing gas appliances with electric may be as soon as 3 years and as long as 13 years, depending on the class of building and whether the property avoids paying gas network charges by disconnecting from the gas network.

Despite the medium to long term benefits, the upfront capital outlay can be a barrier for households. There are several demographic groups in Victoria that may be less able to afford the costs of replacing gas appliances with electric ones. These demographic groups also often overlap with vulnerable communities, including low-income households, retirees and the elderly, and regional communities.

Low-income or retired households may be more likely to live in older properties or apartments. Older properties may be more likely to require additional infrastructure upgrades, such as switchboard or supply connection upgrades, increasing the cost of electrification. Some existing apartments may have shared heating and hot water services via an owners corporation

[52] Woolcott (2016), Pool Pumps: An investigation of swimming pool pumps in Australia and New Zealand. <https://www.energyrating.gov.au/sites/default/files/2023-04/2016-Pool-Pump-Market-Research-Report_0.pdf>
[53] The Expert Group (2022), Climate risk of heat pumps. <https://expertgroup.com.au/our-publications/>
[54] Option value refers to the value that is placed on private willingness to pay for maintaining or preserving a public asset even if there is a low likelihood of the individual using it.
[55] Commercial sector includes Class 3, Class 5, Class 6, Class 7B and Class 9 buildings.

that makes electrification more complex, and potentially more costly. [56] Moreover, energy usage in apartments is typically lower than average households and therefore the ongoing financial savings from improved energy efficiency may not be sufficient to recover the upfront cost of electrification.[57]

Those living in regional areas of Victoria are more likely to be living in colder climates and therefore may have higher heating and hot water energy requirements than the average Victorian. As a result, regional households may require larger heating and hot water appliances that may be more costly than the average urban household. In addition, regional households are more likely to earn a lower income than those in metropolitan areas.[58] These households may also face barriers to access labour to enable timely replacement or more generally access to infrastructure. These challenges would likely occur without the proposed regulations given that a breakdown in household appliances would require a capital investment in new gas appliances.

Any increase to the incremental cost of appliance replacement could be a challenge for some households. Households may have to adjust or forgo spending on other items or delay the replacement in order to save sufficient funds to afford the upgrade. Noting these potential concerns, potential exemptions for existing residential properties have been proposed and will be further explored through the consultation process of this RIS to minimise risks of impacts to heating and hot water services. However, these communities could also benefit the most from electrification. Low-income households tend to spend a larger proportion of their income on energy bills compared to higher income households. One survey showed that lowest income households spent 14 per cent of their total income on energy costs, which is more than five times higher than the proportion spent by the highest earning households.[59] Due to the energy efficiency savings, switching existing residential properties from gas to electric appliances will have a significant impact on low-income households. Likewise regional communities in cooler climates are also likely to see a greater saving on energy bills. People residing in older homes are also likely to experience greater energy savings, as these homes typically have poorer thermal performance and require more energy for heating.[60]

Victorian Government programs such as Solar Victoria's Solar Homes Program and the VEU program can help homeowners offset a range of costs associated with electrification upgrades. However, the exact amount of the incentive would depend on factors such as eligibility, size of existing and new system, and property types. The Victorian Government intends to amend the VEET Act to clarify the existing head of power for prescribing activities in relation to the 'additionality' requirement, to confirm the VEU program can provide incentives in instances where an upgrade is mandated. Households will be able to better understand the options and available and anticipated costs using the SEC's new digital platform to support consumers in the switch to all-electric.[61] In addition to government support, a growing number of Australian financial institutions offer a range of `green' products which can assist further with upfront costs of electrification.

The Victorian Government is also considering the potential for exemptions in recognition of circumstances where electrification may not be viable, for example where the costs to augment electrical supply are disproportionately high due to a negotiated connection[62] or space constraints make installation of an electric appliance impractical. These exemptions may assist vulnerable cohorts, particularly where they may face a disproportionately high upfront cost to electrify due to living in an older home or more regional location, by providing these properties with greater choice as to how and when they may wish to switch to electric. As part of this RIS, the Victorian Government is seeking advice from stakeholders regarding relevant circumstances in which exemptions may be required.

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[56] Due to limited data on the prevalence of shared gas services in Class 2 buildings and the cost of electrification there is some uncertainty regarding the magnitude of these costs, noting that an additional cost of $1,000 per Class 2 water heating heat pump upgrade (from gas instant) was incorporated in the CBA to reflect the potential higher costs of upgrading shared hot water systems and for instances where limited space may be a barrier in Class 2 buildings. Assumption provided by DEECA.

[57] See Appendix C for assumptions regarding average energy usage for Class 2 properties.

[58] ABS (2023), Employee earnings. <https://www.abs.gov.au/statistics/labour/earnings-and-working-conditions/employee-earnings/latest-release#state-and-territory>

[59] Energy Consumers Australia (2023), How to close the energy divide. <https://energyconsumersaustralia.com.au/news/how-to-close-the-energy-divide#:~:text=Results%20from%20December%202023%20indicate,by%20the%20highest%20earning%20group>.

[60] CSIRO (2022), Keeping your older house warm without breaking the bank. <https://www.csiro.au/en/news/all/articles/2022/june/energy-efficiency-older-houses>

[61] State Electricity Commission Victoria (2024), About. <https://www.secvictoria.com.au/about#:~:text=Here%20at%20the%20SEC%2C%20we,transition%20and%20deliver%20commercial%20returns.>

[62] A negotiated connection is where the augmentation required falls outside of the distribution network service provider's existing standard offers.

Costs faced by commercial buildings under Option 3

Similar to the residential sector, the primary cost drivers for constructing new commercial buildings as all-electric are the incremental upfront costs of purchasing electric appliances and the cost of additional electrical infrastructure in the building.

The incremental cost of installing electric appliances instead of gas appliances in new commercial buildings is uncertain and varies significantly across businesses. Some businesses may make a capital saving from going electric, while many others may bear an additional cost. For new buildings, avoided gas infrastructure may offset the cost of electric appliances and infrastructure. Incentives for limited activities are available under the VEU program for new commercial properties.

Impacts of the preferred option on remaining gas users and on competition

Impact of the preferred option on remaining gas users

The preferred option would require all new properties to install electric rather than gas appliances and would require replacement of gas heating and hot water appliances at the end of their life with electric alternatives in existing residential properties. Residential properties that use gas for heating and water heating but not cooking would therefore disconnect from the gas network once their gas appliances reach the end of their life. As a result, remaining gas users are likely to face increasing gas tariffs as the fixed cost of owning and operating network infrastructure is recovered from fewer customers. This may have different impacts on different user groups, for example:

- **Existing residential properties with gas cooking:** Gas cooking appliances have relatively low gas use, therefore continuing to pay fixed annual supply charges for a low usage appliance may not be attractive for households. This may result in more households voluntarily disconnecting from the gas network which will further drive-up gas tariffs for remaining users. However, not all households may be able to readily switch their cooking appliance, either because they are tenants or because they may not be willing or able to meet the up-front costs of an electric appliance combined with potential infrastructure upgrades.[63] Therefore, the impact of rising gas prices may fall on those groups that do not electrify, which may include more vulnerable community groups such as low-income households.
- **Existing commercial businesses:** Under the preferred option no existing commercial buildings are required to electrify. However, it is possible that rising gas network charges may make it uncommercial to continue using gas appliances. As a result, businesses may be incentivised to voluntarily switch to electric, putting further upwards pressure on gas bill prices for remaining commercial users in Victoria. However, with sustained gas supply shortages projected for Victoria as soon as 2028, which may result in higher gas prices, businesses may face commercial risks regardless of whether the proposed regulations are in place.

The Victorian Government is aware that the proposed regulations will have an impact on residential and commercial gas users remaining on the network. This significant transition of Victoria's fossil gas use will require an evolution of the reticulated transmission and distribution network over time to ensure it continues to meet the needs of future gas users and the Victorian economy. Careful consideration will need to be given to how this transition is managed to ensure Victoria's stringent energy safety and reliability standards are maintained, and the ongoing costs of network operation are shared fairly and affordably between gas users and gas networks.

Impact of the preferred option on market competition

The intention of the competition assessment is to identify if there may be adverse effects for consumers (through reduced choice of products and/or higher prices) and the broader economy (through reduced opportunities or incentives for businesses to invest and innovate, leading to lower productivity and employment growth).

Given the large-scale impacts of the proposed regulations, this RIS includes qualitative consideration of a wide range of potential competition impacts. Key competition impacts have been considered across three broad groups: residential sector, commercial sectors directly impacted by the regulation and the gas industry. Several potential competition impacts were identified through the assessment, including reduced demand for fossil gas leading to increased business exit from fossil gas related industries (such as gas appliance manufacturing, plumbing services, wholesale gas production, gas network services and gas retail services), potentially putting upwards pressure on prices or reducing quality of products and services.

The Victorian Government invites stakeholders to provide feedback on the extent to which these impacts may occur and measures the government may take to limit impacts on consumers. Close monitoring and engagement with these industries will be critical to implementation.

[63] Such as switchboard and connection supply upgrades or removal and decommissioning of existing gas appliances and infrastructure.

Proposed exemptions

Draft exemptions have been developed to address potential limitations for complying with requirements specific to existing Class 1, Class 2 and Class 10b buildings, as shown in Table iii.

Table iii: Proposed exemptions for Class 1, Class 2 and Class 10b buildings

Exemptions	
In an existing Class 1, 2 or 10b building, a person must not install a reticulated gas appliance or replace a reticulated gas appliance with a reticulated gas appliance if that appliance is intended to be used for space heating or water heating, unless:	There is insufficient space to install a non-reticulated gas appliance, or replace a reticulated gas appliance with a non-reticulated gas appliance
	In the case of a Class 2 building, heating or hot water is supplied by a centralised system
	Installing a non-reticulated gas appliance, or replacing a reticulated gas appliance with a non-reticulated gas appliance is unlawful because of any other Act, regulation or law
	Installing a non-reticulated gas appliance, or replacing a reticulated gas appliance with a non-reticulated gas appliance requires augmentation of a transmission system or a distribution system to provide more than a basic connection service or a standard connection service
	A reticulated gas appliance is being temporarily disconnected and reconnected in the same building
	A contract was entered into before the commencement of the regulations to install a reticulated gas appliance or replace a reticulated gas appliance with a reticulated gas appliance. A 3-month transition period is provided after the commencement of the regulations to carry out the installation or replacement
	Section 10(1) or (2) of the *Building Act 1993* applies

Source: DTP.

To the extent that exemptions reduce the number of gas appliances switched to electric as a result of the proposed regulations, this is anticipated to have a neutral or potentially positive impact on the BCR of Option 3 CBA results. This is because the exemptions intend to exclude circumstances where the cost of switching may be higher than average and therefore by definition would reduce the relative cost of the proposed regulation.

Next steps

The first step to ensuring appropriate design and implementation of the proposed regulations will involve undertaking consultation and reviewing submissions in response to this RIS. The Victorian Government invites all stakeholders to provide input on how the proposed regulations may impact them or their industry during the public submission process for subsequent consideration by the government.

DTP will oversee the introduction of the proposed regulations and will work with the Victorian Building Authority (VBA) and DEECA will work with Energy Safe Victoria (ESV) to prepare industry, businesses and consumers during the transition period in preparation for the commencement of the new requirements. This will involve ensuring regulatory readiness to deliver the new requirements, communicating the changes and preparing for monitoring and evaluation.

Evaluation strategy

The proposed regulations will require a mid-term evaluation. Given the proposed regulations will require amendments to the Building Regulations and the Plumbing Regulations, both of which are due to sunset in 2028, mid-term evaluation of the

proposed regulations will be incorporated into the broader sunsetting review and remaking of the regulations by DTP over 2027-2028. As the proposed regulations form part of the Victorian Government's broader gas substitution agenda, DEECA will support DTP in evaluating the effectiveness of the electrification requirements over the forward period. This will be a holistic evaluation, taking into consideration the economic, environmental and social impacts, as well as any unintended consequences, arising from the introduction of the electrification requirements.

DTP will work with VBA to assess compliance with the proposed regulations, as well as data from AER and AEMO to gauge whether the reforms are delivering the intended reduction in fossil gas consumption. DTP will also undertake stakeholder consultation with relevant government agencies and industry bodies to collect information regarding:

- stakeholders' understanding of, and interaction with, the electrification requirements
- understanding of any issues encountered in implementation, or unintended consequences
- monitoring reasons for rates of non-compliance, such as financial costs, labour shortages, availability of appliances
- understanding of administration, compliance and enforcement costs.

Questions to stakeholders

There are a range of sources of uncertainty regarding the potential impacts of the proposed regulations due to data gaps and the likelihood that the impacts for any given household or business may deviate substantially from the average expected impact. The Victorian Government therefore invites all stakeholders with input on how the proposed regulations may impact them or their industry to make a submission during the public submission process for subsequent consideration by the government.

The Victorian Government seeks advice and input from all stakeholders regarding:

1. any data available related to prevalence and energy usage of gas and electric appliances in commercial sectors, including both take up in new buildings and usage in existing buildings
2. any data related the asset lives of both gas and electric appliances in both the residential and commercial settings
3. any data available related to prevalence of gas commercial kitchen appliances in commercial sectors, or any related data regarding the proportion of buildings in Victoria that use a reticulated gas network connection solely for heating or hot water purposes
4. any data available related to prevalence of shared gas services in Class 2 buildings and views on relevant costs associated with electrification of shared gas services, including the potential need for exemptions
5. any data available related to the administrative time required by residential homeowners to assess alternative options for the purchase and installation of an electric appliance and any additional infrastructure such as switchboard or connection supply upgrade
6. any data available related to the purchase and installation costs of electrifying residential buildings, including ancillary costs for labour, switchboard and supply connection upgrades, etc.
7. any data related to the proportion of homes which require switchboard, supply connection or broader wiring upgrades
8. any data available related to the purchase and installation costs of electrifying new and/or existing buildings in relevant commercial sectors, including estimated cost differentials between small, medium and large commercial buildings
9. any data available related to the prevalence of small and large buildings in Victoria for relevant commercial sectors
10. any data available related to the prevalence of commercial kitchens in Victoria and costs associated with electrifying or utilising LPG in commercial and non-commercial kitchens in various commercial sectors
11. key cost factors and considerations that may impact the cost of electrifying new or existing buildings in commercial settings that have not been identified
12. any data available related to the administrative time and associated cost of planning for and implementing electrification in commercial buildings
13. any data available related to barriers to adoption of RCACs and considerations required around potential exemptions

14. any data available regarding historical or future forecasted improvements in the energy efficiency and/or cost of electric and gas appliances

15. the potential scale of and costs involved in undertaking building modifications when installing an electric appliance

16. any potential exemptions that may be required in recognition of barriers to electrify as a result of physical or regulatory constraints

17. differences in timing and cost of maintenance of electric and gas appliances in both residential and commercial sectors

18. anticipated impact on cost of owning and operating the gas network as a result of the regulatory options, and how costs may be recovered through a changing customer base

19. any data available related to potential disproportionate impacts on key stakeholder groups or demographics as a result of the proposed regulation

20. the need for hardship exemptions for existing residential buildings in recognition of barriers that may be faced by particular stakeholder groups.

21. any data related to key costs and considerations that may be a barrier to electrifying new commercial buildings

22. how the proposed regulations may impact small businesses due to limited resources to interpret compliance requirements, or to keep pace with regulatory changes

23. any data that is available on stakeholders who may be particularly affected by the preferred option and where identified:
    a. proposed exemptions to address this acute impact.
    b. proposed delays to the commencement of the regulations to enable more time for adjustment

24. how the proposed regulations may impact competition in the gas appliance manufacturing market and potential adverse impacts on consumers, including any data or analysis indicating the scale of potential consumer impact

25. how the proposed regulations may impact competition in Victoria's gas plumbing industry and potential adverse impacts on consumers, including any data or analysis indicating the scale of potential consumer impact

26. how the proposed regulations may impact competition in wholesale gas production and potential adverse impacts on consumers, including any data or analysis indicating the scale of potential consumer impact

27. how the proposed regulations may impact the provision of gas network services and potential adverse impacts on consumers, including any data or analysis indicating the scale of potential consumer impact

28. any data available related to potential impacts on the business industry or sector, including disproportionate impacts on small businesses or market competition

29. the timing and potential need for any transitional arrangements to ensure the implementation of any regulations occurs smoothly.

1 Background

This chapter outlines the purpose of the proposed regulations and the requirement for a Regulatory Impact Statement (RIS).

1.1 Introduction and purpose of this RIS

Fossil gas currently plays a fundamental role in meeting Victoria's energy needs. Over 2 million Victorian residential properties and businesses use fossil gas and around three quarters of Victorian residential properties are connected to the reticulated gas network.[64] Victoria is the largest user of fossil gas for residential and commercial purposes among Australia's states and territories, accounting for approximately two-thirds of national household and commercial fossil gas usage.[65]

Notwithstanding the important role fossil gas has played in Victora's economy to date, the sector is facing a number of significant challenges in the future. This includes increases in the price of fossil gas, projected shortfalls in fossil gas supply and the high volume of greenhouse gas (GHG) emissions from fossil gas.

Recognising the importance of reducing fossil gas usage to help navigate the pathway to net zero emissions, the Victorian Government introduced the Gas Substitution Roadmap (the "Roadmap"). A key pillar under the Roadmap is the electrification of residential and commercial buildings in Victoria to reduce energy bills, manage the risk of potential fossil gas supply challenges and cut GHG emissions.

To support and accelerate the pace of electrification of new and existing buildings in Victoria, the Victorian Government is proposing to amend the Building Regulations 2018 and the Plumbing Regulations 2018 ("the Regulations"), under the *Building Act 1993* (the "Building Act").

This RIS has been prepared to assess the impact of amending the Regulations to support the electrification of residential and commercial buildings in Victoria.

The RIS has been prepared in accordance with the Victorian Guide to Regulation, which provides a best practice approach to analysing any proposed regulatory intervention.[66] This RIS estimates the impact of the proposed regulations on Victorian businesses and community. Key steps in the process to introduce the proposed regulations are:

- preparation of the RIS (this document)
- independent assessment by Better Regulation Victoria (BRV)
- public comment on the proposed regulations
- review of responses from public consultation
- consideration of and response to issues raised through public consultation
- provision of notice of final decision.

1.2 Relevant Victorian Government policies and strategies

The Victorian Government has introduced a suite of polices and strategies to address climate change and reduce GHG emissions in Victoria. These are outlined below.

1.2.1 Victoria's net zero emissions target

The *Climate Change Act 2017* legislates Victoria's target of reaching net zero GHG emissions by 2045. It also legislates 5-yearly interim GHG emissions reduction targets to provide a clear path to net zero emissions. Victoria exceeded its first

[64] Analysis based on Victorian gas distribution network provider's final Access Arrangements. Australian Energy Regulatory (2023), Access arrangements. <https://www.aer.gov.au/industry/registers/access-arrangements>
[65] Infrastructure Victoria (2021), Towards 2050: Gas infrastructure in a net zero emissions economy. <https://www.infrastructurevictoria.com.au/resources/towards-2050-gas-infrastructure-in-a-net-zero-emissions-economy-final-report>
[66] Commissioner for Better Regulation (2024), Victorian Guide to Regulation: A handbook for policy-makers in Victoria. <https://www.vic.gov.au/victorian-guide-regulation>

emissions reduction target of a 15-20 per cent reduction below 2005 levels by 2020, achieving almost 30 per cent in emissions reductions.[67] The following interim emissions reduction targets are legislated out to 2035:

- 28 to 33 per cent below 2005 levels by 2025
- 45 to 50 per cent below 2005 levels by 2030
- 75 to 80 per cent below 2005 levels by 2035.

Interim emissions reduction targets for 2040 and 2045 must be set by 31 March 2028 and 31 March 2033, respectively.

1.2.2 Victoria Climate Change Strategy

Victoria's Climate Change Strategy sets out the Victorian Government's plan for achieving the above-mentioned GHG emissions reduction targets.[68] The Climate Change Strategy outlines the following actions to cut GHG emissions in Victoria:

- transition Victoria's energy grid towards renewable energy
- invest in innovative technologies such as zero emission vehicles and hydrogen
- safeguard the role of the natural environment in emissions reduction
- support Victorian businesses and communities to cut emissions.

The Climate Change Strategy calls for decarbonisation of gas use, "including switching to electricity", as part of its 5-point plan.

1.2.3 Victorian Renewable Energy Target

The *Renewable Energy (Jobs and Investment) Act 2017* legislates Victoria's renewable energy targets (VRET) to incorporate renewable energy into Victoria's electricity generation grid. The renewable energy targets are set at:

- 25 per cent by 2020
- 40 per cent by 2025
- 65 per cent by 2030
- 95 per cent by 2035.

The *Renewable Energy (Jobs and Investment) Act 2017* legislates offshore wind generation targets of at least 2 gigawatts (GW) by 2032, 4 GW by 2035 and 9 GW by 2040. The *Renewable Energy (Jobs and Investment) Act 2017* also legislates Victorian energy storage targets of at least 2.6 GW of energy storage capacity by 2030 and at least 6.3 GW by 2035. Burning fossil fuels for energy is the largest source of GHG emissions in Victoria. Therefore, incorporating cleaner fuel sources presents a significant source of GHG emissions reductions for Victoria.

1.2.4 Gas Substitution Roadmap

In 2022, the Victorian Government released the Roadmap to help Victoria navigate the path to net zero emissions while reducing energy bills. The Roadmap outlines how the state will leverage energy efficiency, electrification, biomethane and renewable hydrogen to lower energy bills and decrease carbon emissions. The Roadmap emphasises a dual approach: promoting electrification and developing renewable gas alternatives. It advocates for a rapid transition to electric appliances in residential properties and businesses. This is most evident in the ban on gas connections for new housing developments requiring planning permits, which took effect from 1 January 2024 (see section 3.1.2). Financial incentives, such as discounts for electric appliances through the VEU program (see section 3.1.4), further encourage this transition.

Beyond electrification, the Roadmap acknowledges the continued need for fossil gas usage in some sectors, particularly industries where electric alternatives are not yet or are not likely to be feasible. To address this, the Roadmap advocates for the development of a renewable gas sector and includes the release of Victoria's Renewable Gas Consultation Paper which explores policy options to scale up investment in this space. Renewable gas includes supporting the production and use of biomethane, a biogas derived from organic waste, and hydrogen produced from renewable sources.

1.2.4.1 Gas Substitution Roadmap Update

The Gas Substitution Roadmap Update (the "Update") was released in December 2023 to outline Victoria's progress in implementing the key commitments from the Roadmap. The Update identified rapid electrification as the "central force

[67] Victorian Government (2023), Victoria's 2035 Emissions Reduction Target. <https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0028/635590/Victorias-2035-Climate-Target_Driving-Real-Climate-Action.pdf>

[68] Victorian Government (2021), Victoria's Climate Change Strategy. <https://www.climatechange.vic.gov.au/victorias-climate-change-strategy>

propelling Victoria's decarbonisation journey".[69] The Update also committed to exploring options for electrifying new and existing buildings through a RIS.

1.3 Legislative and regulatory frameworks

To achieve some of the policy objectives set out in section 1.2, amendments are required to existing legislative and regulatory frameworks in Victoria. The following section summarises the legislative and regulatory frameworks governing building work (section 1.3.1) and the gas sector (section 1.3.2), which may require amending to support electrification. For more detail on the objectives of key legislative and regulatory frameworks see Appendix A.

1.3.1 Legislative and regulatory frameworks governing building work

The Building Act is the primary legislation responsible for governing building and plumbing works, and the conduct of building and plumbing practitioners in Victoria. It also sets the legislative framework for building standards and maintenance of specific building safety features.

The Minister for Planning is responsible for administering the Building Act and its supporting regulatory frameworks, such as the Building Regulations and the Plumbing Regulations.

The Minister for Planning is supported by the Department of Transport and Planning (DTP), which is responsible for the Regulations, and consequently for this RIS.

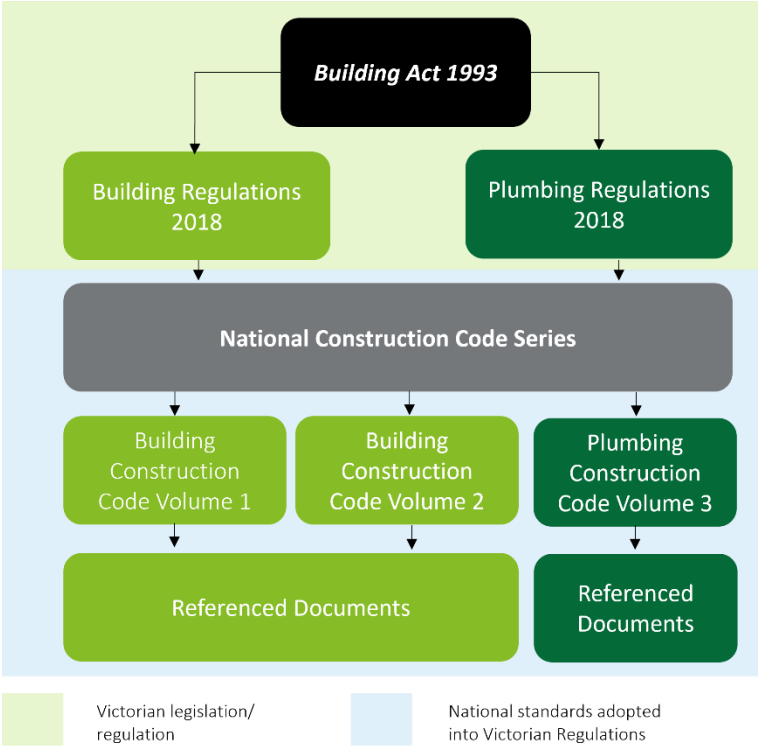
The Building Act is underpinned by a combination of regulations, the National Construction Code (NCC), and reference documents such as standards prescribed by Standards Australia (see Figure 1.1). For example:

- The Building Regulations prescribe the standards for design, construction and use of buildings and places of public entertainment in Victoria.
- The Plumbing Regulations prescribe the scope of work for plumbing work, qualification and licensing requirements, fees payable for licensing and additional technical requirements for specified classes of plumbing in Victoria.
- The NCC combines both building and plumbing construction requirements into a single code for Australia. The NCC consists of the Building Code of Australia (BCA) (Volumes One and Two), and the Plumbing Code of Australia (PCA) (Volume Three). The NCC is maintained by the Australian Building Codes Board (ABCB) which is a joint initiative of federal, state and local governments:
    - The BCA contains technical provisions for the design and construction of buildings and other structures throughout Australia. Volume 1 relates to Class 2 to 9 buildings while Volume 2 mainly relates to Class 1 and 10 buildings. The BCA is adopted by, and forms part of the Building Regulations (with modifications).
    - The PCA sets out the technical provisions for design, construction, installation, replacement, repair, alteration, and maintenance of plumbing related work associated with all building classes. The PCA is adopted by, and forms part of the Plumbing Regulations.

Appendix A provides more detail on the objectives of each of these.

[69] Victorian Government (2023), Gas Substitution Roadmap Update. <https://www.energy.vic.gov.au/__data/assets/pdf_file/0027/691119/Victorias-Gas-Substitution-Roadmap-Update.pdf>

Figure 1.1: Governance framework for the Victorian building sector



1.3.2 Legislative and regulatory framework governing gas supply in Victoria

The *Gas Safety Act 1997* (Gas Safety Act) regulates the safety of gas supply and its usage in Victoria. It provides for the safe conveyance, sale, supply, measurement, control and use of gas in Victoria, and regulates gas safety in Victoria. The Minister for Energy and Resources is responsible for the Gas Safety Act. The Act mandates standards for the design, installation and maintenance of gas systems, ensuring that only qualified and licensed professionals undertake all gas-related work. The Gas Safety Act also encompasses consumer protection, with the requirement for all gas appliances sold and installed in Victoria to meet safety standards and be approved by relevant authorities.

The following regulations are made under the Gas Safety Act:

- **The Gas Safety (Gas Installation) Regulations 2018.** These Regulations provide the standards for gas fitting work, procedures relating to the acceptance of appliances and gas installations, and provide for safety of gas appliances, gas installations and work on gas appliances and installations.
- **Gas Safety (Safety Case) Regulations 2018**. These Regulations provide for safety cases in relation to facilities, gas installations and appliances, the reporting of gas incidents, and prescribe safety standards for the quality of gas and testing of natural gas conveyed through a transmission pipeline.

1.3.3 Agencies responsible for building and gas works in Victoria

The Victorian Building Authority (VBA), Energy Safe Victoria (ESV) and the Essential Services Commission (ESC) are three key agencies responsible for overseeing the building and delivery of gas works in Victoria:

- The VBA is the state's primary regulator for building and plumbing works. It enforces building and plumbing practitioners' compliance with legislative requirements and building codes. The VBA regulates licences for Type A and Type B gas work in Victoria. Type A gas work refers to gas-related tasks involving domestic and light commercial gas appliances such as cookers, space heaters, central heaters and water heaters .[70] Type B gas work relates to works on appliances with gas consumption of more than 10 megajoules an hour.[71] Type B appliances are typically used in industrial settings and include appliances such as furnaces and boilers.

[70] EnergySafe Victoria, Type A and Type B appliances. <https://www.energysafe.vic.gov.au/industry-guidance/gas/appliances-equipment-and-manufacturers/type-and-type-b-appliances>
[71] EnergySafe Victoria, Type A and Type B appliances. <https://www.energysafe.vic.gov.au/industry-guidance/gas/appliances-equipment-and-manufacturers/type-and-type-b-appliances>

- ESV is the regulator responsible for the safe generation, supply and use of electricity, gas and pipelines in the state. ESV also regulates complex gas installations in Victoria. Installations of Type B appliances are deemed complex gas installation and require the gasfitter to obtain approval from ESV before the installation can be commissioned.[72]
- ESC is the regulator for Victoria's energy, water and transport sectors, and administers the rate-capping system for the local government sector. ESC regulates electricity generators, and gas and electricity distributors, retailers, and transmission services.

[72] Energy Safe Victoria, Gas acceptance scheme. <https://www.energysafe.vic.gov.au/industry-guidance/gas/complex-applications-and-compliance/gas-acceptance-scheme>

2 Problem

This chapter outlines the extent of fossil gas usage in Victoria and the challenge this poses to Victoria's economy in terms of cost to consumers, energy security, greenhouse gas emissions and health.

The Roadmap emphasises the electrification of buildings as a pivotal strategy for reducing GHG emissions and transitioning to a more sustainable energy system. This chapter discusses the challenges facing the fossil gas sector in Victoria and positions electrification as the preferred option for addressing those challenges. The benefits presented by electrification include:

- **Electrification can offer cost savings on energy bills**. Victorian fossil gas prices are influenced by volatility in the global gas market. While electricity prices are currently higher than fossil gas prices on a per megajoule (MJ) basis, fossil gas prices have increased sharply over the last two years relative to electricity prices. Electric appliances are typically more efficient to run, consuming less energy than equivalent gas appliances, and remove the need for gas network infrastructure, generally leading to lower energy bills for consumers.[73,74] The cost implications from electrification are discussed in section 2.2.
- **Mitigates fossil gas supply challenges**. The available fossil gas supply is forecast to reduce by half between 2024 and 2028 due to a reduction in offshore gas field production capacity in the Gippsland Basin and the planned closures of gas plants in Longford. However, fossil gas demand is estimated to fall by only 10 per cent during this period, giving rise to potential fossil gas shortfalls. The impact of this shortfall on Victoria's energy security and reliability is discussed in detail in section 2.3.
- **GHG emissions reduction**. Higher appliance energy efficiency means that switching to electric reduces household emissions now,[75] with these reductions growing as the state's electricity grid gradually decarbonises in line with the VRET and planned closures of coal-fired power plants in Victoria. A cleaner energy grid combined with the higher efficiency of electric appliances will result in lower GHG emissions in Victoria. This is discussed in section 2.4.

Electric appliances can also reduce health risks associated with gas appliances and infrastructure, including risk of fires, asphyxiation and carbon monoxide (CO) poisoning.

2.1 Fossil gas usage in Victoria

Fossil gas has traditionally been a key component of Victoria's energy mix, providing a reliable and cost-effective source of energy for a range of residential and commercial uses. Victoria consumed a total of 181 petajoules (PJ) of fossil gas in 2023, with residential and small commercial fossil gas users accounting for 64 per cent of this usage.[76] However, 2023 was a particularly low year in fossil gas consumption, partially due to warmer than average winter weather, with Victoria's average consumption of fossil gas between 2019 and 2022 being 220 PJ per annum.[77] In 2022-23 fossil gas made up 18 per cent of Victoria's total energy consumption, the third largest source of energy after coal and oil.[78]

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[73] Victorian Government (2023), Gas Substitution Roadmap Update. <https://www.energy.vic.gov.au/__data/assets/pdf_file/0027/691119/Victorias-Gas-Substitution-Roadmap-Update.pdf>

[74] Grattan Institute (2023), Getting off gas. Why, how and who should pay. <https://grattan.edu.au/report/getting-off-gas/>

[75] Victorian Government (2023), New all-electric homes emission forecast fact sheet. <https://www.energy.vic.gov.au/__data/assets/pdf_file/0021/680313/new-all-electric-homes-emission-forecasts-factsheet.pdf.> New homes typically result in the lowest emissions savings due to better performing thermal shells and more efficient new appliances. Electrification of existing homes typically results in higher emissions reductions than quoted in the fact sheet from greater energy efficiency savings.

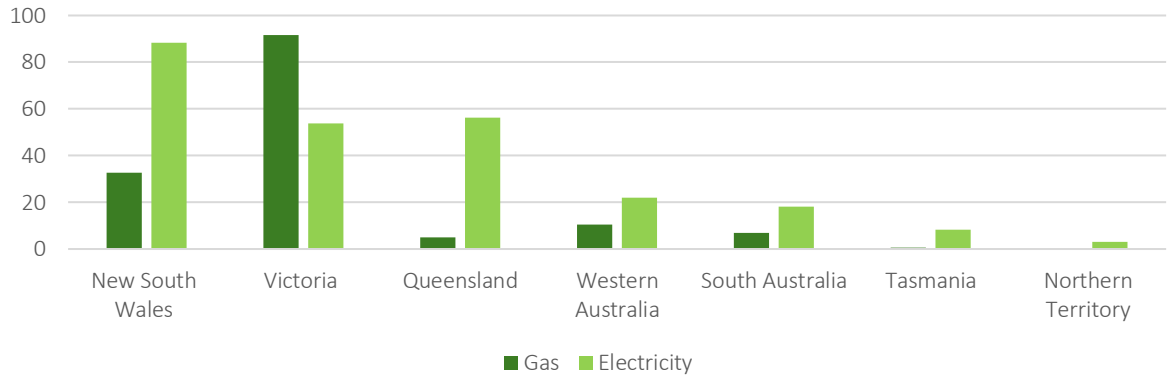
[76] AEMO (2024), Victorian Gas Planning Report (VGPR) 2024 Update. <https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/vgpr/2024/2024-victorian-gas-planning-report-update.pdf?la=en>

[77] Australian Energy Market Operator (2024), Victorian Gas Planning Report Update. <https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/vgpr/2024/2024-victorian-gas-planning-report-update.pdf?la=en>; Australian Energy Market Operator (2021), Victorian Gas Planning Report. <https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/vgpr/2021/2021-victorian-gas-planning-report.pdf?la=en>

[78] Department of Climate Change, Energy, the Environment and Water (2024), Australian Energy Statics Table C: Australian energy consumption, by state and territory, by fuel, energy units. <https://www.energy.gov.au/publications/australian-energy-update-2024>

While Victoria was the third largest user of fossil gas overall in Australia in 2022-23, it was the largest user of fossil gas for residential and commercial purposes. Figure 2.1 shows that residential fossil gas usage in Victoria is nearly three times higher than the second highest residential user (New South Wales). Victoria is also the only state where fossil gas usage is higher than electricity usage in the residential sector. Victoria's reliance on fossil gas stems from its historical abundance and relatively low-price supply from offshore gas fields.[79] Prior to 2022, under the Victoria Planning Provisions (VPP) new developments were encouraged or required to be connected to the reticulated gas network,[80] further encouraging reliance on fossil gas.

Figure 2.1 Fossil gas and electricity usage in the residential sector by state/territory in 2022-23 (in PJ)



Note: Data for NSW includes data for the Australian Capital Territory. Gas consumption in the residential sector in the Northern Territory was 0 PJ in 2022-23.
Source: Australian Energy Update 2024.

The gas system in Victoria comprises:[81]

- gas fields and processing facilities that extract and process gas
- high-pressure pipelines that transport gas around the state
- low-pressure distribution pipelines that deliver gas to customers
- appliances at the customer's property that transform gas into useful energy for space heating, hot water and cooking.

There are three gas distributors who own and manage the reticulated distribution pipelines that supply gas to residential properties and businesses in Victoria. Each distributor is responsible for a separate geographic region as follows:[82]

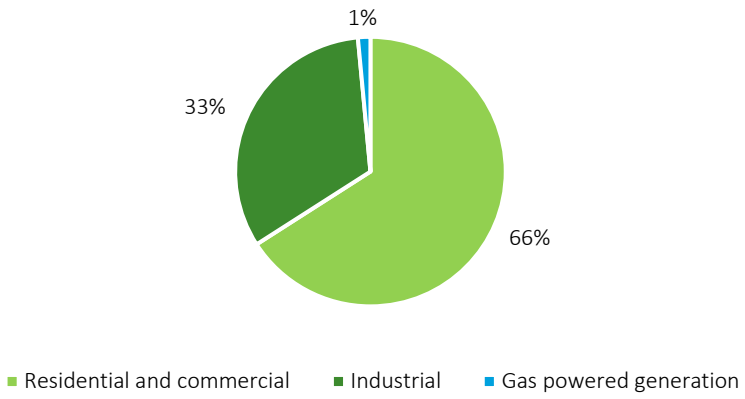
- Australian Gas Network covering north and south-eastern Melbourne, and northern and eastern Victoria
- AusNet Services servicing central and western Victoria
- Multinet Gas supplying to inner and outer east Melbourne, the Yarra Ranges and South Gippsland.

In addition, Solstice Energy services several compressed natural gas networks in regional Victoria, including Marong, Swan Hill and Lakes Entrance.[83]

Fossil gas is used in over 2 million households and businesses in Victoria with the residential and business sector accounting for the largest share of fossil gas use (see Figure 2.2).

[79] Infrastructure Victoria (2021), Towards 2050: Gas infrastructure in a net zero emissions economy – Interim Report. <https://www.parliament.vic.gov.au/49c2fb/contentassets/9ec88705959e47c3b763303cadb222cf/attachment-documents/044_attach-2_infrastructure-victoria.pdf>
[80] Victorian Government Gazette (2022), Victoria Planning Provisions: Notice of Approval of Amendment VC221. <https://www.gazette.vic.gov.au/gazette/Gazettes2022/GG2022S388.pdf>
[81] Department of Energy, Environment and Climate Change (2023), About the gas sector. <https://www.energy.vic.gov.au/about-energy/about-the-gas-sector>
[82] Energy Safe Victoria (2023), Gas emergencies. <https://www.esv.vic.gov.au/community-safety/emergencies/gas-emergencies>
[83] Solstice Energy, About us. <https://www.solsticeenergy.com.au/solstice-energy-group>. Consideration of the implications of the proposed regulation on these networks will be undertaken at a later date.

Figure 2.2: Breakdown of projected fossil gas usage in Victoria in 2024



Source: AEMO Gas Forecasting Data Portal.

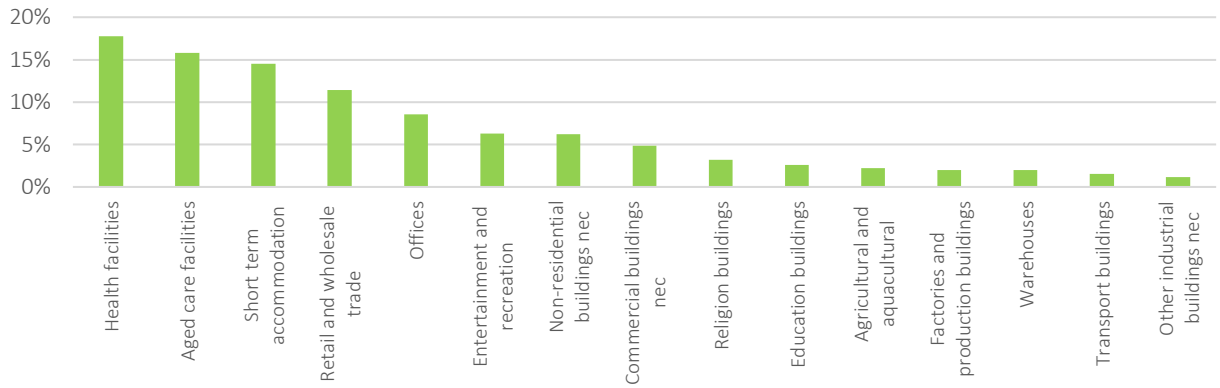
In 2023-24, 2.2 million households in Victoria were connected to the reticulated gas network, approximately 76 per cent of all households.[84] Fossil gas represents a greater share of household energy use in Victoria than electricity, with 92 PJ of fossil gas consumed by households in 2021-22 compared to 54 PJ (15 terawatt hours) of electricity.[85] For households, space heating is the largest component of fossil gas use (60 per cent), followed by water heating (36 per cent) and cooking (4 per cent).[86] Victoria's cold winters, coupled with the high prevalence of fossil gas heating, lead to winter peak demand for fossil gas being three times higher than summer.[87]

Fossil gas usage in the commercial sector mirrors residential usage, with the largest share of fossil gas used in space heating, followed by water heating and cooking. Exceptions to this usage trend are restaurants, hotels and hospitals, with fossil gas primarily used for cooking, pool heating and power generation and equipment sterilisation, respectively.[88] The largest users of fossil gas in the commercial sector are health facilities, aged care facilities and short-term accommodation buildings (see Figure 2.3 below).

Fossil gas is also a critical input for many industries and manufacturing processes, with most fossil gas used in this sector for generating heat and as an input in some manufacturing processes.[89] Fossil gas accounts for 65 per cent of Victoria's industrial energy use.[90] The largest fossil gas users in the industrial sector are food and beverage manufacturers, pulp and paper manufacturing, and petroleum and coal product manufacturing.[91]

[84] Analysis of 2023-28 Gas Access Arrangements for Australian Gas Network, AusNet and Multinet Gas.
[85] Department of Climate Change, Energy, Environment and Water (2023), Australian Energy Statistics Table K Australian energy consumption in 2021-22, by state and territory, by industry, selected fuels. <https://www.energy.gov.au/publications/australian-energy-update-2023>
[86] Northmore Gordon and Energeia (2021), Gas Infrastructure Advice - Cost benefit analysis of energy efficiency activities in the gas sector. <https://assets.infrastructurevictoria.com.au/assets/Resources/Cost-Benefit-Analysis-of-Energy-Efficiency-Activities-in-the-Gas-Sector.pdf>
[87] Infrastructure Victoria (2023), Towards 2050: Gas infrastructure in a net zero emissions economy – Final report. <https://assets.infrastructurevictoria.com.au/assets/Resources/Towards-2050-Gas-infrastructure-in-a-net-zero-emissions-economy_FINAL-REPORT.pdf>
[88] Northmore Gordon and Energeia (2021), Gas Infrastructure Advice - Cost benefit analysis of energy efficiency activities in the gas sector. <https://assets.infrastructurevictoria.com.au/assets/Resources/Cost-Benefit-Analysis-of-Energy-Efficiency-Activities-in-the-Gas-Sector.pdf>
[89] Infrastructure Victoria (2022), Towards 2050: Gas infrastructure in a net zero emissions economy – Final Report. <https://assets.infrastructurevictoria.com.au/assets/Resources/Towards-2050-Gas-infrastructure-in-a-net-zero-emissions-economy_FINAL-REPORT.pdf>
[90] Engage Victoria (2022), Help build Victoria's Gas Substitution Roadmap: Consultation paper. <https://engage.vic.gov.au/help-us-build-victorias-gas-substitution-roadmap>
[91] Infrastructure Victoria (2021), Towards 2050: Gas infrastructure in a net zero emissions economy. <https://assets.infrastructurevictoria.com.au/assets/Resources/Towards-2050-Gas-infrastructure-in-a-net-zero-emissions-economy_FINAL-REPORT.pdf>

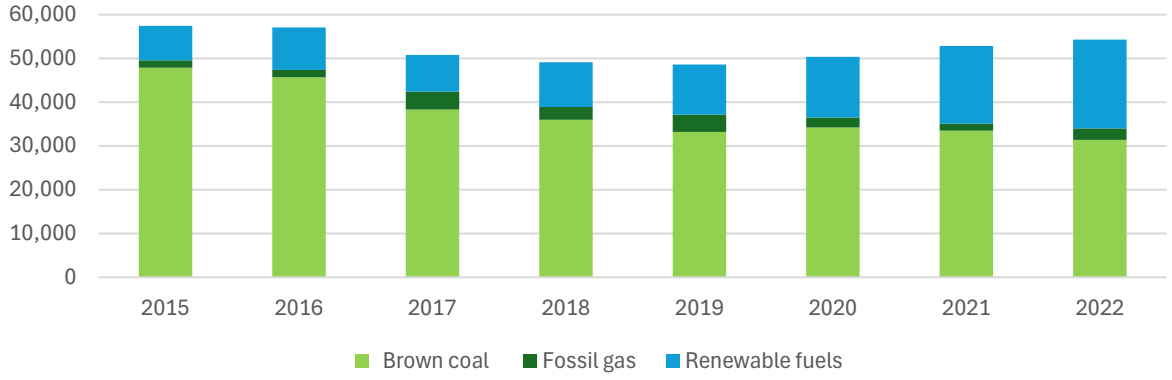
Figure 2.3: Share of fossil gas in Victoria's commercial and industrial sector, 2022



Source: Commercial Building Baseline Study 2022.

Fossil gas plays a small but significant role in electricity generation in Victoria (see Figure 2.4). Although brown coal accounts for more than half of electricity generation (58 per cent of generation in 2022),[92] gas power generation (GPG) plants play an important role in providing additional capacity, particularly during peak demand periods. Fossil gas provides flexibility to the energy system, as fossil gas fired power plants can ramp their production up or down quickly to match fluctuations in demand and intermittent renewable energy generation. There are 6 fossil gas fired power plants in Victoria that supply electricity in the National Electricity Market (NEM).[93] In 2022, fossil gas contributed to 5 per cent of the total electricity generated in Victoria.[94] Further discussion of the impact of electrification on future GPG requirements is discussed in Chapter 7.

Figure 2.4: Victoria's historical electricity generation fuel mix



Source: Department of Climate Change, Energy, the Environment and Water. Note – a very small proportion of electricity (0.06 per cent in 2022) is also generated using oil.

2.2 Cost of energy for consumers

Cost of energy to customers is driven by the price of energy and volume of energy consumed, as well as charges for fixed network infrastructure. Sections 2.2.1 and 2.2.2 consider the price of energy and the volume of energy used by gas and electric appliances, respectively. Section 2.2.3 considers network infrastructure costs.

[92] Department of Climate Change, Energy, the Environment and Water (2023), Australian Energy Statistics Table O: Australian electricity generation by state and territory, by fuel type, physical units. <https://www.energy.gov.au/publications/australian-energy-update-2023>
[93] Australian Energy Market Operator (2024), Generation information. <https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/generation-information>
[94] Department of Climate Change, Energy, the Environment and Water (2023), Australian Energy Statistics Table O: Australian electricity generation by state and territory, by fuel type, physical units. <https://www.energy.gov.au/publications/australian-energy-update-2023>

2.2.1 Energy prices

Victoria has historically had access to a relatively cheap, plentiful supply of fossil gas. In the early 2000s, the market benefited from abundant supply and little export pressure, as well as a relatively stable economic climate, with wholesale fossil gas prices averaging $3.8 per GJ between 2011-12 and 2014-15.[95] After international fossil gas export began in 2015 Australia's domestic fossil gas price has been influenced by fluctuations in global LNG prices as well as increasing production costs. Wholesale prices approximately doubled to $8 per GJ by 2016.[96]

As shown in Figure 2.5, the price of fossil gas has increased post 2016 due to global and domestic volatility and the increasing cost of production in Australia. International sanctions on Russian energy following the invasion of Ukraine contributed to increased global energy prices in recent years, including the price of Australian LNG.[97] At times this has coincided with closure of coal fired generators or extensive flooding in Australia's eastern states which has constrained electricity output from coal fired power plants, leading to increased demand for gas-fired electricity.[98] These events contributed to an increase in the Australian wholesale fossil gas price from around $10 per gigajoule (GJ) in January 2022 to a peak of $29 per GJ in June 2022.[99] This increased pressure on cost of living and business operations, particularly for Victorians given the scale of fossil gas usage. There was an exception to this trend through 2020-21 where the impacts of COVID-19 resulted in large scale disruption to global gas markets and short-term low oil and gas prices.

While prices have fallen from the peak in 2022, they have not returned to their previous pre-2016 levels. AEMO projects fossil gas prices of approximately $10 per GJ in the late 2020s, rising to just over $12 per GJ in the late 2040s. While this is well below the peak in 2022, it remains more than double the prices seen before 2016. Due to the changing wholesale gas market conditions (described in section 2.3), there is significant uncertainty around the future of fossil gas prices in Victoria. As Victoria's fossil gas supply challenges result in a higher reliance upon interstate and international sources, there will be increasing exposure to international gas market volatility which may result in wholesale prices increasing above forecasts. This is discussed in section 2.3.1.

Figure 2.5: Historical and forecast Victorian wholesale gas prices ($/GJ)

Source: Australian Energy Regulator (AER) and AEMO IASR.

Comparison of Figure 2.5 above to Figure 2.6 below demonstrates that electricity prices are higher than fossil gas prices on a per GJ basis and have increased in volatility over the past decade with recent spikes in 2018-19 and 2021-22, driven by coal plant outages and high fossil gas prices. Electricity prices are predicted to stabilise around $15 per GJ over the coming

[95] Australian Energy Regulator (2024), Gas market prices. <https://www.aer.gov.au/industry/registers/charts/gas-market-prices>
[96] Australian Energy Regulator (2024), Victorian gas market average daily weighted average prices. <https://www.aer.gov.au/industry/registers/charts/victorian-gas-market-average-daily-weighted-prices-quarter>
[97] The Australia Institute (2022), War gains: LNG Windfall Profits 2022. <https://australiainstitute.org.au/wp-content/uploads/2022/10/P1289-War-gains-LNG-windfall-profits-2022-Web.pdf>
[98] Department of Energy, Environment and Climate Change (2023), Gas Substitution Roadmap Update. <https://www.energy.vic.gov.au/__data/assets/pdf_file/0027/691119/Victorias-Gas-Substitution-Roadmap-Update.pdf>
[99] Australian Energy Regulator (2024), Victorian gas market average daily weighted average prices. <https://www.aer.gov.au/industry/registers/charts/victorian-gas-market-average-daily-weighted-prices-quarter>

decade and increase in the late 2030s, in part driven by greater reliance on gas peaking generation.[100] Despite the higher price of electricity, electrification can reduce overall cost of energy bills through lower energy consumption due to higher energy efficiency of appliances, explored in section 2.2.2. However, remaining gas customers may face increased network costs as fixed costs are passed onto fewer remaining customers, this is discussed in Chapter 7.

Figure 2.6: Historical and forecast Victorian wholesale electricity prices ($/GJ and $/MWh)

Source: AER and Endgame Economics.

2.2.2 Gas appliances consume more energy than electric alternatives

Despite higher electricity prices, many electric appliances are now more efficient and cheaper to operate than gas appliances.[101] A study conducted by the Australian National University found that households in the Australian Capital Territory that switched to electric appliances experienced large reductions in fossil gas consumption, with only modest increases in electricity consumption, thereby reducing the household's total energy consumption.[102]

Separate research conducted by the Grattan Institute, IEEFA,[103] Monash University[104] and others found all-electric residential properties are cheaper to run, with the added benefit of being better for people's health.

Table 2.1 demonstrates the potential annual volumetric and cost saving available for an existing Class 1 property in Victoria from switching gas heating and hot water appliances to electric.[105] It also demonstrates that electrifying cooking may result in a small increase in annual energy cost. The figures provided are based on assumptions adopted in the CBA – see Chapter 5 for further details on methodology and Appendix C for detailed assumptions.

[100] Projected electricity wholesale prices were modelled by Endgame Economics (2024), with AEMO's draft ISP Step Change model used as a direct basis and current market bidding behaviour overlaid.
[101] Grattan Institute (2023), Getting off gas. Why, how and who should pay. <https://grattan.edu.au/report/getting-off-gas/>
[102] Hammerle, M and Burke, P (2022), From natural gas to electric appliances: Energy use and emissions implications in Australian homes. *Energy Economics*, Volume 110. <https://www.sciencedirect.com/science/article/pii/S0140988322002183>
[103] IEEFA (2023), Managing the transition to all-electric homes. <https://ieefa.org/resources/managing-transition-all-electric-homes>
[104] Monash University (2024), Switching On: Benefits of Household Electrification in Australia>
[105] Figures are based on an average property size of 151 m^2 (2-3 bedroom house) with a NatHERS rating of 3 stars.

Table 2.1: Example of potential annual energy cost saving for a Class 1 property

		Heating	Hot water	Cooking
Common gas appliance		Ducted gas	Mains gas instant	Gas cooktop
Energy usage of gas appliance	Annual gas usage (MJ)	31,103	14,050	1,583
	Annual electricity usage (MJ)	1,364	144	-
Energy usage of alternative electric appliance[1]	Annual electricity usage (MJ)[1]	5,998	4,116	706
Annual gas appliance running cost at 4 cents per MJ of gas ($) and electricity prices at 10 cents per MJ of electricity[2]		1,381	576	63
Annual electric appliance running cost at 10 cents per MJ of electricity ($)[2]		600	412	71
Net annual saving ($)[3]		781	165	-7

Source: Analysis based on data collated in the CBA, see Appendix C for detailed assumptions.

Notes: 1. Annual electricity usage based on weighted average electricity usage of common electric alternatives in line with CBA methodology (see Chapter 5).
2. Electricity price is based on total retail bill price of 37 cents per kWh. Costs include network supply costs which is likely to be passed on to remaining gas customers as properties disconnect from the gas network. 3. The table only presents ongoing costs and does not consider upfront costs to switch.

When fossil gas is combusted, some of the heat generated can be lost to the surroundings rather than the appliance being heated. Appliances which burn fossil gas typically release exhaust gas into the air along with the heat energy generated, thereby wasting energy, and reducing the appliance's energy efficiency, as well as increasing the running cost for consumers.[106] Electric appliances fully transfer the heat generated to the appliance in use, with some electric appliances such as heat pumps generating more heat energy than they consume.[107,108] For example, heat pumps (which includes RCAC systems) absorb energy from inside or outside to operate heating and cooling functions, rather than generating heat directly.[109] This process makes them highly energy efficient. Heat pumps can produce several units of heating for each unit of electricity consumed, resulting in significant energy savings over time. While electricity power plants also experience energy losses and therefore are not 100 per cent energy efficient, this is accounted for in the overall wholesale electricity sector's price and emissions intensity per joule of energy delivered.

Heating accounts for the largest portion of household energy consumption, so utilising energy efficient heaters can significantly reduce energy use, lowering both energy bills and GHG emissions. Gas heaters, which rely on combustion of gas to generate heat, are inherently less energy efficient due to the energy losses in the combustion process, as described above. In contrast, multi-split air conditioning systems can be up to five times more efficient in delivering the same amount of heat compared to gas ducted systems.[110] Multi-split systems allow for individual room control, heating multiple rooms as needed, providing greater flexibility and energy savings. Ducted heating systems, which utilise centralised heating to distribute air through ducts, may be more suitable for larger spaces but tend to experience greater heat losses, particularly where older ducts are degraded or have poor insulation. Split systems also offer the advantage of providing both heating and cooling, making them efficient for year-round use.

For water heating, electric heat-pump hot water systems are the most energy efficient appliance, using around 60 to 75 per cent less energy than conventional electric resistance hot water systems.[111] Heat-pump hot water systems do not produce

[106] Monash University Climate Change Communications Research Hub (2023), Switching on: Benefits of household electrification in Australia. <https://www.monash.edu/__data/assets/pdf_file/0005/3433550/Switching-On_Benefits-of-household-electrification-in-Australia_report.pdf>
[107] Monash University (2023), Switching on: Benefits of household electrification in Australia. <https://www.monash.edu/__data/assets/pdf_file/0005/3433550/Switching-On_Benefits-of-household-electrification-in-Australia_report.pdf>
[108] While electricity power plants also experience energy losses and therefore are not 100 per cent energy efficient, this is accounted for in the overall wholesale electricity sector's price and emissions intensity per joule of energy delivered.
[109] AGL (2023), What's the most energy efficient way to heat or cool my home? <https://www.agl.com.au/discover/lifestyle/air-conditioner-efficiency#:~:text=What%20makes%20reverse%2Dcycle%20air,making%20it%20very%20energy%20efficient.>
[110] Victorian Government (2023), Gas Substitution Roadmap Update. <https://www.energy.vic.gov.au/__data/assets/pdf_file/0027/691119/Victorias-Gas-Substitution-Roadmap-Update.pdf>
[111] Sustainability Victoria (2024), Heat-pump hot water systems. <https://www.sustainability.vic.gov.au/energy-efficiency-and-reducing-emissions/save-energy-in-the-home/water-heating/choose-the-right-hot-water-system/heat-pump-water-heaters#:~:text=These%20systems%20typically%20use%20around,water%20directly%20with%20an%20element.>

any direct carbon dioxide and can be approximately 40 to 50 per cent cheaper to run than a gas hot water storage system.[112] Low-quality heat pumps can be a potential risk to safety and effectiveness. However, the VEU program, which has installed over 95,000 residential heat pumps to date, has found no evidence of failure from these appliances.[113]

Some cooktops, namely electric induction, are over two times more efficient than gas cooktops.[114] Induction cooktops utilise electromagnetic technology to directly heat pots and pans, rather than relying on a flame or heating element as with gas stoves. This minimises heat loss and keeps the kitchen cooler, reducing overall energy consumption. Compared to gas stoves, induction cooktops offer faster heating times and precise temperature control, allowing for more efficient cooking.[115] Induction cooktops also offer a range of other benefits over their gas counterparts such as avoiding the release of indoor pollutants and eliminating the risk of accidental gas leaks.[116]

While electric appliances offer the efficiencies described above, upgrading from a gas appliance to an electric appliance can sometimes involve higher capital costs than installing a replacement gas appliance.[117] There may also be upfront costs required to upgrade electrical infrastructure and building modifications. Some upgrades, like switchboard upgrades for homes with out-of-date switchboards and wiring, must occur to be compliant with existing regulations. These costs would occur whenever electrical work was required and are not unique to the potential regulations being proposed. Some others, like upgrades to three-phase power, are not essential for an all-electric home, including those with EV chargers. The potential relatively higher upfront cost associated with upgrading to electric appliances can present a barrier, particularly for low-income households, from adopting more efficient appliances. However, once an electric appliance is adopted, it can provide significant energy savings and help recoup the upfront investment. For example, based on the figures shown in Table 2.1 above, an existing Class 1 property could save almost $1,000 per year in annual energy costs after going all-electric.[118] Analysis indicates savings are likely to be even higher for households with solar panels.[119]

Furthermore, incentive schemes such as the VEU program can provide discounts on upgrades to more energy efficient appliances (see section 3.1.4). Despite these energy savings and financial incentives, there are a number of barriers to electric appliance uptake, these are covered in section 3.2.

2.2.3 Network infrastructure costs

In addition to the annual energy saving from appliance efficiencies, there can be potential cost savings by avoiding expansion of the gas network. Given most energy needs can be supplied by entirely electric appliances, it is inefficient to connect customers to two energy distribution networks (both gas and electric), which both require high fixed costs to maintain and operate. Consolidating the energy distribution networks into one may help to reduce costs for Victorians, such as customer service operational costs borne by the networks as well as administrative costs for consumers dealing with multiple entities.

[112] Australian Capital Territory Government, Singing in the shower – a guide to hot water heat pumps. <https://www.climatechoices.act.gov.au/policy-programs/sustainable-household-scheme/buyers-guides/singing-in-the-shower-a-guide-to-hot-water-heat-pumps>

[113] Data provided by Department of Energy, Environment and Climate Action (2024) <https://www.energy.vic.gov.au/__data/assets/pdf_file/0027/691119/Victorias-Gas-Substitution-Roadmap-Update.pdf>

[114] Department of Energy, Environment and Climate Action (2024), Induction cooktops. <https://www.energy.vic.gov.au/households/victorian-energy-upgrades-for-households/induction-cooktops>

[115] Global Cooksafe Coalition (2022), The future of cooking is electric. <https://cooksafecoalition.org/wp-content/uploads/2022/11/23098-GCR-Cooksafe-Report-D10.pdf>

[116] United States Department of Energy (2023), Making the switch to induction stoves or cooktops. <https://www.energy.gov/articles/making-switch-induction-stoves-or-cooktops#:~:text=Faster%20Cook%20Time,gas%20and%20traditional%20electric%20cooktops>

[117] Grattan Institute (2023), Getting of gas: why, how and who should pay. <https://grattan.edu.au/wp-content/uploads/2023/06/Getting-off-gas-why-how-and-who-should-pay.pdf>

[118] This does not account for the capital cost of purchasing a new appliance. Figures are based on an average property size of 151 m2 (2-3 bedroom house) with a NatHERS rating of 3 stars.

[119] Department of Energy, Environment and Climate Action (2023), Save with an all-electric home. <https://www.energy.vic.gov.au/households/save-with-all-electric-home.> Analysis only considered energy savings and does not account for capital cost of purchasing new appliance.

2.3 Energy security and reliability in Victoria

The following sections analyse the security and reliability of energy supply from fossil gas and electricity, respectively.

2.3.1 Future uncertainty of fossil gas supply

Victoria's future gas supply is subject to significant uncertainty. To date, Victoria has supplied its own fossil gas needs and has historically been a net exporter of fossil gas to neighbouring states. Gas from the Gippsland Basin, processed through the Longford Gas Plant is Victoria's largest source of fossil gas, with the Otway Basin providing a smaller magnitude of supply.[120] However, according to AEMO's 2024 Victorian Gas Planning Report Update, the total available fossil gas supply is forecast to reduce from 297 PJ in 2024 to 154 PJ in 2028 (approximately 48 per cent) due to a reduction in offshore field production capacity in the Gippsland Basin and the subsequent planned closure of gas plants in Longford. The report notes that the planned closure of the gas processing plants will reduce redundancy in the system,[121] thereby increasing the probability of fossil gas outages (i.e. disruptions to fossil gas supply).[122]

AEMO also forecasts a 9.6 per cent reduction in fossil gas demand between 2024 and 2028, from 184.4 PJ in 2024 to 166.6 PJ in 2028. However, the reduction in supply is greater than the forecast demand reductions. AEMO's forecast of fossil gas demand takes into account policies announced by federal and state governments, including the Victorian Government. As a result, AEMO fossil gas demand forecasts may also account for the gas reductions proposed in this RIS. The extent to which regulatory options considered in this RIS contribute to the achievement of these forecasts is unknown. AEMO forecasts a consistent fossil gas supply gap for Victoria from 2028, with the state forecast to become a net importer of fossil gas, as consumption will exceed the available fossil gas supply in the absence of additional supply and storage projects.[123] The Australian Competition and Consumer Commission projects a fossil gas shortfall in the southern states of Australia (Victoria, New South Wales, South Australia, and Tasmania).[124]

As Victoria's existing fossil gas reserves reduce over time, it is currently unclear how Victoria will source new supply, whether by drawing on interstate, international or new fossil gas reserves. For example:

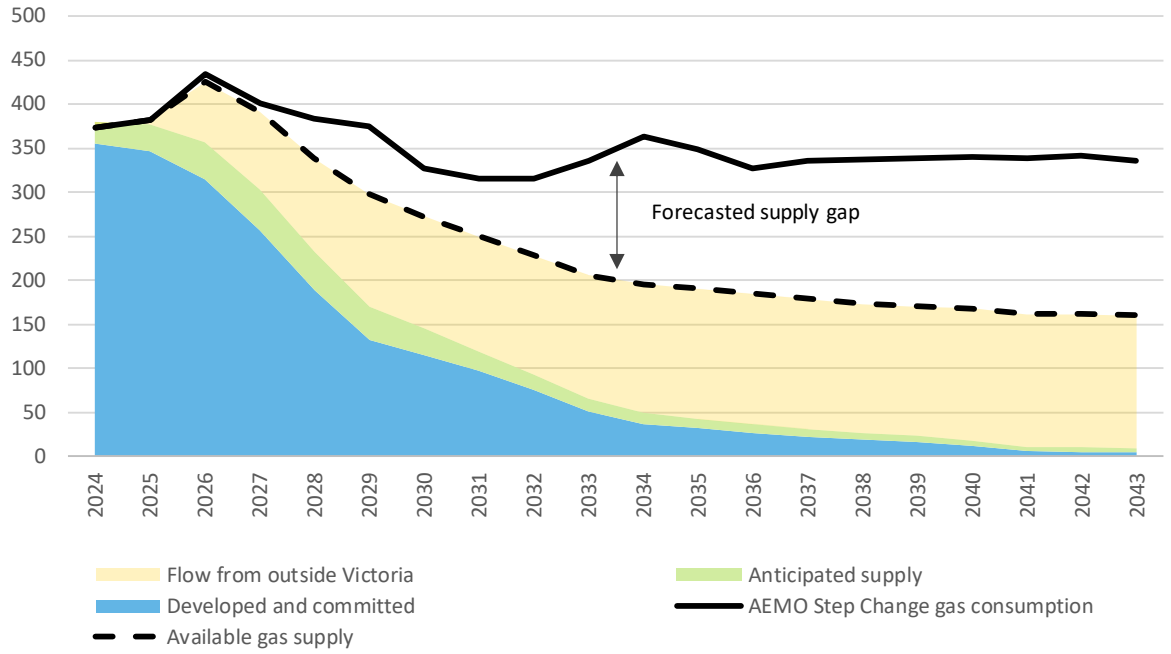
- While AEMO's Gas Statement of Opportunities (GSOO) 2024[125] considers new Victorian reserves will be available (e.g., expansion of current fields or LNG import terminals), the report notes that factors such as cost, regulatory approvals, land use, social license, safety, or operational challenges were not considered. Hence it is yet unclear how the development of new reserves could influence retail fossil gas prices in Victoria.
- As supply in southern states decreases, imports from northern states (combined with deep storage) will be required to meet southern demand. AEMO predict periods where north to south pipelines are at capacity from 2027 onwards, which may present supply adequacy risks and a potential impact on price. However, pipeline upgrades and augmentations are available to increase capacity in these pipelines, which may reduce risk in the short to medium term.

Figure 2.7 illustrates how existing, committed, and anticipated production in the southern states of Australia is expected to fall over the coming decades. Some of this reduced supply can be augmented with supply from the north (i.e., Queensland), however, this is not expected to be sufficient to bring future supply to existing levels of demand.[126] AEMO note that there is further additional 'uncertain' supply from southern gas fields (not shown in Figure 2.7), totalling 274 PJ in 2043.[127] These

[120] Department of Energy, Environment and Climate Change (2023), About the gas sector. <https://www.energy.vic.gov.au/about-energy/about-the-gas-sector>
[121] Redundancy refers to the surplus of fossil gas in the system that can be relied upon as a reserve in case of reductions in supply.
[122] Australian Energy Market Operator (2024), 2024 Victorian Gas Planning Report Update. <https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/vgpr/2024/2024-victorian-gas-planning-report-update.pdf?la=en>
[123] Australian Energy Market Operator (2024), 2024 Victorian Gas Planning Report Update. <https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/vgpr/2024/2024-victorian-gas-planning-report-update.pdf?la=en#:~:text=A%20gas%20connection%20ban%20effective,Australia%2C%20Tasmania%20and%20Victoria%20combined.>
[124] These are point in time projections and may change based on update supply and demand forecasts. Australian Competition and Consumer Commission (2024), Gas Inquiry 2017 – 2030 Interim update on east coast gas market. <https://www.accc.gov.au/system/files/gas-inquiry-june-interim-gas-inquiry-report_1.pdf>
[125] Australian Competition and Consumer Commission (2024), Gas Inquiry 2017 – 2030 Interim update on east coast gas market. <https://www.accc.gov.au/system/files/gas-inquiry-june-interim-gas-inquiry-report_1.pdf>
[126] Note that a range of augmentation projects are already under consideration and at varying stages of progress. AEMO (2024), Gas Statement of Opportunities (GSOO). <https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/gsoo/2024/aemo-2024-gas-statement-of-opportunities-gsoo-report.pdf?la=en>
[127] AEMO (2024), Gas Statement of Opportunities (GSOO). <https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/gsoo/2024/aemo-2024-gas-statement-of-opportunities-gsoo-report.pdf?la=en>

projects represent contingent or prospective resources,[128] and are therefore highly uncertain as to whether they would be a viable source of fossil gas supply.[129]

Figure 2.7: Existing, committed, and anticipated supply in southern states, including projected supply from north (PJ)



Source: AEMO GSOO 2024. Note gas demand represents total across all southern states (Victoria, New South Wales, Tasmania, South Australia).

If uncertain supply projects do not come through, it is possible that supply will not be sufficient to meet Victoria's demand in the late 2020s and early 2030s. If shortfalls occur, this may have significant consequences for the Victorian economy. For example, in 1998 a disruption to a Victorian gas plant led to a gas shortage over 19 days, costing the economy approximately $1.3 billion in 1998 terms ($2.62 billion in 2024 terms).[130] The fossil gas supply gap can be reduced by transitioning residential and commercial buildings from using fossil gas appliances to electric appliances. AEMO deploys an intervention and direction scheme (Gas Load Curtailment and Gas Rationing and Recovery Guidelines) that would be used in the event of a shortfall, in which a range of tools, including curtailment of GPG and industrial users, are used well before restrictions on gas use among households would be considered.

In the long-term, infrastructure may be developed to enable international imports of fossil gas, however, this would increase Victoria's reliance on international markets and exposure to global supply chain risks, such as geopolitical disruption. Transitioning the state to energy that can be supplied locally, such as wind and solar, allows Victoria to maintain energy sovereignty and mitigate risk of disruption from international forces.

Despite the uncertainty and risks associated with Victoria's future fossil gas supply, once gas can be secured in the gas network, it can be stored and distributed with low risk of interruptions, provided available supply meets or exceeds demand.

2.3.2 Electricity security and reliability

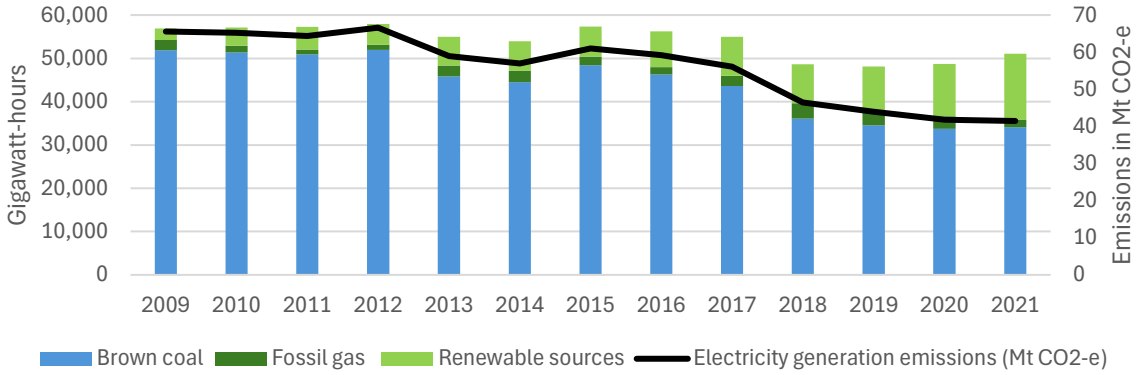
The security and reliability of Victoria's electricity supply chain is dependent on three key components: the source of electricity generation fuel, the generation plants themselves, and the electricity network connecting generators to customers.

[128] As defined by the Society of Petroleum Engineers – Petroleum Resource Management System project maturity sub-classes.
[129] The federal government has finalised new offshore gas exploration permits in the east and west coast markets, however these projects are still uncertain and, if approved, would not be operational for many years. Department of Industry, Science and Resources (2024), Media release: Finalisation of offshore exploration rounds. <https://www.minister.industry.gov.au/ministers/king/media-releases/finalisation-offshore-exploration-rounds>
[130] National Emergency Management Agency and Australian Disaster Resilience Hub, Australian Disaster Resilience Knowledge Hub. <https://knowledge.aidr.org.au/resources/industrial- -gas-explosion/#:~:text=The%20rupture%20led%20to%20the,and%20eight%20sustained%20serious%20injury>

2.3.2.1 Electricity generation

Victoria's electricity has historically been supplied by local coal production, which had provided affordable and reliable electricity to users across the state. However, Victoria's electricity mix is rapidly changing as existing coal plants age and the transition to renewable electricity sources accelerates.

Figure 2.8: Electricity generation fuel and GHG emissions in Victoria, 2009-2021



Source: DEECA.

In line with state targets, Victoria's electricity mix is expected to be primarily fuelled by wind, solar and hydro by 2035. Two of Victoria's three remaining coal plants, Loy Yang A and Yallourn are both planned to retire by the end of 2035.[131] In addition to GHG emissions benefits (discussed further in section 2.4), renewable resources provide a locally supplied low-cost resource of energy, supporting greater energy sovereignty.

However, wind and solar are both variable renewable energy (VRE) sources, meaning their supply fluctuates significantly with changes in weather and cloud cover. Availability of hydro can also be impacted by medium to longer term trends, such as drought. To ensure reliable and secure supply, significant investment in storage and fast response generation is required. This potentially includes a greater need for GPG while meeting the government's legislated renewable energy targets. GPG can provide back-up supply when renewable resources are unavailable. Moreover, there are a number of supply chain constraints resulting from the global energy transition that may slow down deployment of energy infrastructure required in the short to medium term.[132]

Over the coming decade there is expected to be increasing volatility in the electricity market. This is driven both by the changing fuel mix from coal to renewables, and also increasing demand on the electricity sector from broader consumer trends, such as electric vehicle uptake. Greater frequency of reliability events occurring can be mitigated by increased storage and fast response generation, as well as demand side response mechanisms. Further, there are a number of market and policy mechanisms in place to protect consumers from extreme prices, including price caps and long-term contracts.

The proposed regulations may have an impact on future generation capacity and generation fuel mix: this is considered further in Chapter 7.

2.3.2.2 Electricity network

Victoria's electricity network is supplied by one transmission network service provider and five regulated distribution companies, each servicing separate geographic locations. The frequency of the electricity network must be maintained at 50 hertz by ensuring a consistent matching of demand and supply.

Supply interruptions may occur as a result of network damage (such as trees falling on power lines during extreme weather events) or network instability from unexpected changes in demand or supply. The impact of network damage on electricity users depends on the scale and length of an outage. Due to monitoring and management of network frequency and stability by AEMO, outages from network instability are uncommon. More frequent and larger scale damage may occur in the long-

[131] AGL, AGL Loy Yang Power Station. <https://www.agl.com.au/about-agl/how-we-source-energy/loy-yang-power-station?zcf97o=vlx3ap>
[132] Commonwealth Scientific and Industrial Research Organisation (2024), GenCost 2023-24. <https://www.csiro.au/en/research/technology-space/energy/GenCost>

term, however, as climate change leads to more regular extreme weather events. Climate resilience is a key consideration in maintaining and replacing gas appliances with electric ones in the electricity network.

2.4 Greenhouse gas emissions in Victoria

An increase in GHG, such as carbon dioxide and methane in the atmosphere, leads to climate change. Climate change poses significant dangers to both the natural and human environment. Victoria is at risk of multifaceted impacts from climate change that can pose significant challenges to health, environment, economy, and infrastructure. The effects of climate change are already starting to manifest in Victoria. The annual average temperature across Victoria has increased by 1.2 degrees Celsius since 1910. Between 1993 and 2017 there has been a decrease in average rainfall, longer and more severe fire seasons, more frequent heatwaves, and average sea level increases between 1.57 centimetres and 5.31 centimetres per decade.[133] The Victorian Government has legislated targets to reach net zero GHG emissions by 2045 to mitigate impacts from climate change (see section 1.2.1).

Residential and commercial usage makes up almost two thirds of Victoria's total fossil gas usage.[134] If all residential and commercial fossil gas emissions could be displaced by near-zero electricity sector emissions, this could drive significant emissions reduction. Fossil gas accounts for 16 per cent of Victoria's total GHG emissions.[135] Therefore, avoiding fossil gas usage in residential and commercial settings could help reduce Victoria's total GHG emissions by up to 10 per cent. However, this assumes significant decarbonisation of the electricity sector occurs, noting that this does not account for potential flow on impacts on electricity sector generation or economic activity as discussed in Chapter 7. Relative to other high-emitting sources of GHG emissions, electrification of residential and commercial gas appliances is considered a cost-effective decarbonisation solution.[136] This is because electrification targets energy efficiency while also enabling buildings to transition towards net zero as the electricity sector decarbonises. In addition, the technologies required are already commercially viable and produced at-scale.

This compares to many other high-emitting sectors where there are no commercially viable alternatives available to the market. Where technologies are available, they are prohibitively expensive or require significant ancillary infrastructure to enable deployment. For example, to decarbonise industrial businesses would likely require significant investment in bespoke technologies and large-scale infrastructure. Technical challenges and upfront costs of switching were both noted as barriers to the uptake of hydrogen in the Victorian Government's 2021 survey of industrial gas users.[137] While technologies that can use renewable hydrogen and biomethane are being actively explored, they are currently nascent industries with significant costs and infrastructure required to enable large-scale deployment.

The following sections describe:

- the key sources and drivers of GHG emissions in Victoria (section 2.4.1)
- sources of GHG emissions from fossil gas in Victoria (section 2.4.2)
- sources and trends of GHG emissions from Victoria's electricity sector (section 2.4.3).

2.4.1 GHG emissions in Victoria

Victoria recorded total net emissions of 80 $MtCo_2$-e in 2021,[138] making it the fourth largest contributor to Australia's total, accounting for 17 per cent of the national 2021 figure.[139] As Figure 2.9 below depicts, Victoria's largest contributor to GHG emissions is electricity generation, accounting for more than half of the state's total, followed by transport (23 per cent), agriculture (21 per cent) and fuel combustion (20 per cent). The land use, land use change and forestry sector, comprising Victoria's forests and natural systems, absorbed over a quarter of the state's total GHG emissions released in 2021.[140]

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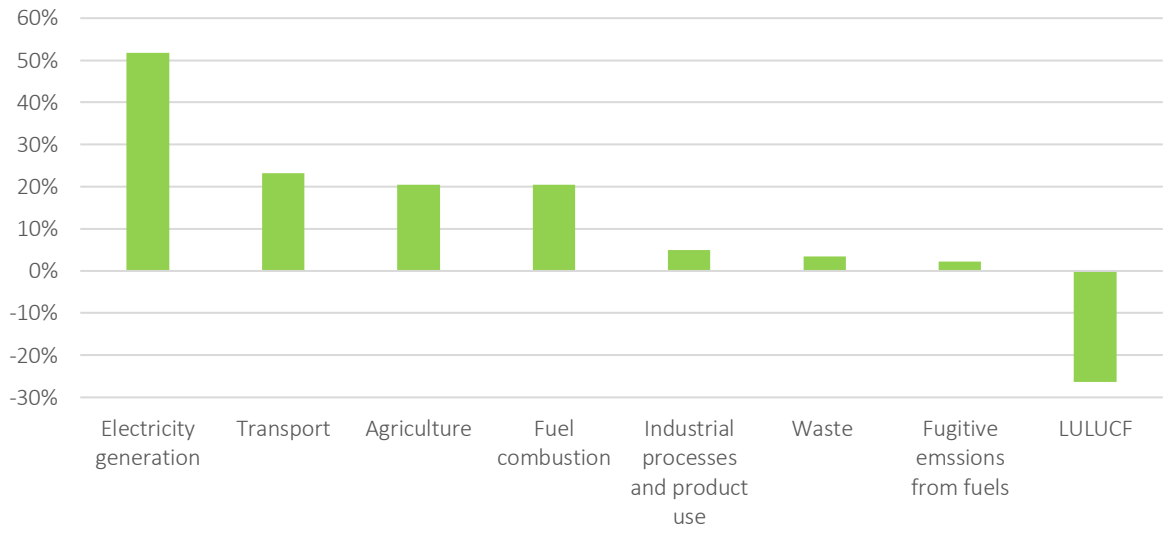
[133] Department of Energy, Environment and Climate Action (2017), Victoria's Climate Science Report 2019. <https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0029/442964/Victorias-Climate-Science-Report-2019.pdf>
[134] Victorian Government (2023), Gas Substitution Roadmap Update. <https://www.energy.vic.gov.au/__data/assets/pdf_file/0027/691119/Victorias-Gas-Substitution-Roadmap-Update.pdf>
[135] Department of Energy, Environment and Climate Action analysis of the 2022 States and Territory Greenhouse Gas Inventory.
[136] International Energy Agency (2021), Net Zero by 2050 – A Roadmap for the Global Energy Sector. <https://www.iea.org/reports/net-zero-by-2050>
[137] Victorian Government (2022), Gas Substitution Roadmap. <https://www.energy.vic.gov.au/__data/assets/pdf_file/0025/586411/Victorias-Gas-Substitution-Roadmap.pdf>
[138] Department of Energy, Environment and Climate Action (2023), Greenhouse gas emissions. <https://www.climatechange.vic.gov.au/greenhouse-gas-emissions>
[139] Department of Energy, Environment and Climate Action (2023), Greenhouse gas emissions. <https://www.climatechange.vic.gov.au/greenhouse-gas-emissions>
[140] Department of Energy, Environment and Climate Action (2023), Greenhouse gas emissions. <https://www.climatechange.vic.gov.au/greenhouse-gas-emissions>

Although electricity generation is currently Victoria's largest contributor, the sector achieved the largest reduction in GHG emissions from 2005 to 2021, accounting for nearly two-thirds of the state's decrease during this period.[141] Investment in renewable generation will further contribute to this trend.

GHG emissions from fuel combustion arise when fuel is burned for activities such as generating heat in residential and commercial settings or for generating pressure and steam in manufacturing. Households are the largest source of fuel combustion GHG emissions, accounting for 37.5 per cent of total Victorian fuel combustion GHG emissions in 2021.[142] Over 90 per cent of residential fuel combustion comes from burning fossil gas for space heating, water heating and cooking.[143] The remaining 10 per cent of residential fuel combustion GHG emissions come from burning wood or LPG.[144]

Figure 2.9: Sources of GHG emissions in Victoria, 2021

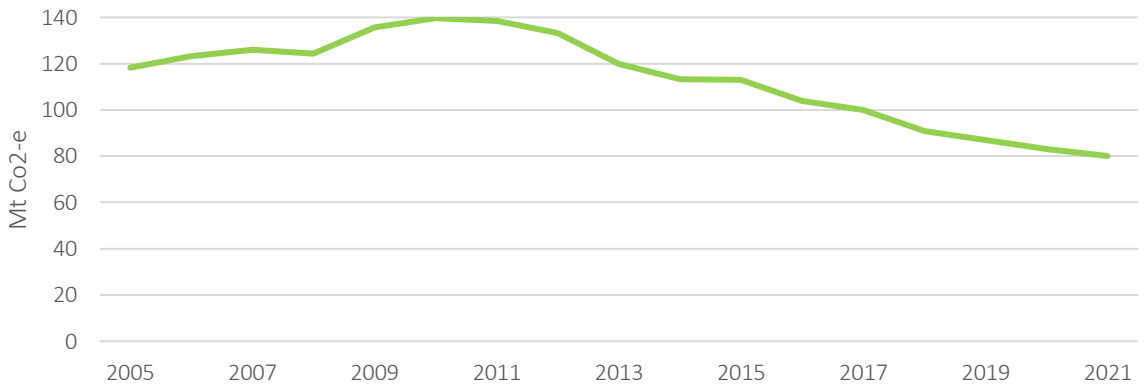


Source: DEECA.

GHG emissions in Victora have been on a downward trajectory since reaching a peak in 2010, as depicted in Figure 2.10. The 80 $MtCo_2$-e emissions in 2021 represent a 32.3 per cent reduction from 2005 levels, which is within the target range for 2025. As discussed in section 1.2, the Victorian Government has introduced a series of targets and policies to reduce GHG emissions in the state, with the 2030 target and the end goal of reaching net zero emissions by 2045 still requiring significant reductions to be met.

[141] Department of Energy, Environment and Climate Action (2023), Victorian Greenhouse Gas Emissions Report 2021. <https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0036/687825/Victorian-Greenhouse-Gas-Emissions-Report-2021.pdf>
[142] Department of Energy, Environment and Climate Action (2023), Victorian Greenhouse Gas Emissions Report 2021. <https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0036/687825/Victorian-Greenhouse-Gas-Emissions-Report-2021.pdf>
[143] Fuel combustion does not include emissions from electricity or transport as this accounted for under the electricity generation and transport categories respectively.
[144] Department of Energy, Environment and Climate Action (2023), Victorian Greenhouse Gas Emissions Report 2021. <https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0036/687825/Victorian-Greenhouse-Gas-Emissions-Report-2021.pdf>

Figure 2.10: GHG emissions in Victoria, 2005-2021



Source: Victorian Greenhouse Gas Emissions Report, 2021.

2.4.2 GHG emissions from fossil gas

Fossil gas poses significant environmental challenges, contributing to air pollution and its associated environmental and health impacts. Fossil gas contributes 16 per cent of Victoria's total GHG emissions.[145] The largest source of Victoria's fossil gas emissions is its direct combustion in residential properties, businesses, and industries, followed by fugitive emissions from leaks or venting of fossil gas throughout its lifecycle.[146] Fugitive emissions from fuels accounted for 2.2 per cent of the total Victorian GHG emissions in 2021.[147] The combustion of fossil gas also releases pollutants such as nitrogen oxides and volatile organic compounds (VOCs).[148]

Methane is a potent GHG. Drilling and extracting fossil gas and transporting it through pipelines often results in the leakage of methane.[149] Methane is 83 times more potent at trapping heat than carbon dioxide over a 20-yearperiod,[150] making it a significant contributor to climate change.

At the household level, analysis commissioned by the Victorian Government in 2023 revealed that GHG emissions from all-electric homes are 16 per cent lower than an equivalent home using both electricity and fossil gas, equating to a saving of 500 kilograms of CO2-e annually.[151] This estimate relates to new homes without solar. The installation of solar panels would result in even more emissions savings as more on-site energy would be generated by solar.

Fossil gas accounts for 10 to 30 per cent of the GHG emissions from a commercial building, which can be reduced through electrification.[152] The remaining commercial building emissions are primarily attributed to electricity use.[153] These statistics highlight the significant environmental benefits that can be achieved from reducing fossil gas usage in Victoria.

2.4.3 GHG emissions from electricity

As discussed in section 2.4.1, electricity generation is the largest source of GHG emissions in Victoria, producing 41.4 $MtCO_2$-e in 2021.[154] Electricity generation in Victoria has historically heavily relied on coal-fired power plants. Nearly 40 $MtCO_2$-e of

[145] Department of Energy, Environment and Climate Action analysis of the 2022 States and Territory Greenhouse Gas Inventory.
[146] Accenture Strategy (2021), Gas infrastructure: international comparisons. <https://assets.infrastructurevictoria.com.au/assets/Resources/Accenture-Gas-Infrastructure-Advice-International-Comparisons.pdf>
[147] The report notes that most of the fugitive emissions come from fossil gas but the exact share was not specified. Department of Energy, Environment. Climate Action (2023), Victorian Greenhouse Gas Emissions Report 2021. <https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0036/687825/Victorian-Greenhouse-Gas-Emissions-Report-2021.pdf>
[148] Natural Resource Defence Council (2021), Natural Gas 101. <https://www.nrdc.org/stories/natural-gas-101#whatis>
[149] Union of Concerned Scientists (2014), Environmental Impacts of Natural Gas. <https://www.ucsusa.org/resources/environmental-impacts-natural-gas>
[150] CSIRO (2023), Methane levels and the role of science in mitigation. <https://www.csiro.au/en/news/all/articles/2022/november/methane-levels-and-the-role-of-science-in-mitigation>
[151] Victorian Government (2023), New all-electric homes emission forecast fact sheet. <https://www.energy.vic.gov.au/__data/assets/pdf_file/0021/680313/new-all-electric-homes-emission-forecasts-factsheet.pdf.>
[152] Green Building Council of Australia, A practical guide to electrification for new buildings. <https://www.cefc.com.au/media/v21jesrl/a-practical-guide-to-electrification.pdf>
[153] Department of Climate Change, Energy, the Environment and Water (2022), Commercial Building Baseline Study. <https://www.dcceew.gov.au/energy/publications/commercial-building-baseline-study-2022>
[154] Department of Energy, Environment and Climate Action (2023), Victorian Greenhouse Gas Emissions Report 2021. <https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0036/687825/Victorian-Greenhouse-Gas-Emissions-Report-2021.pdf>

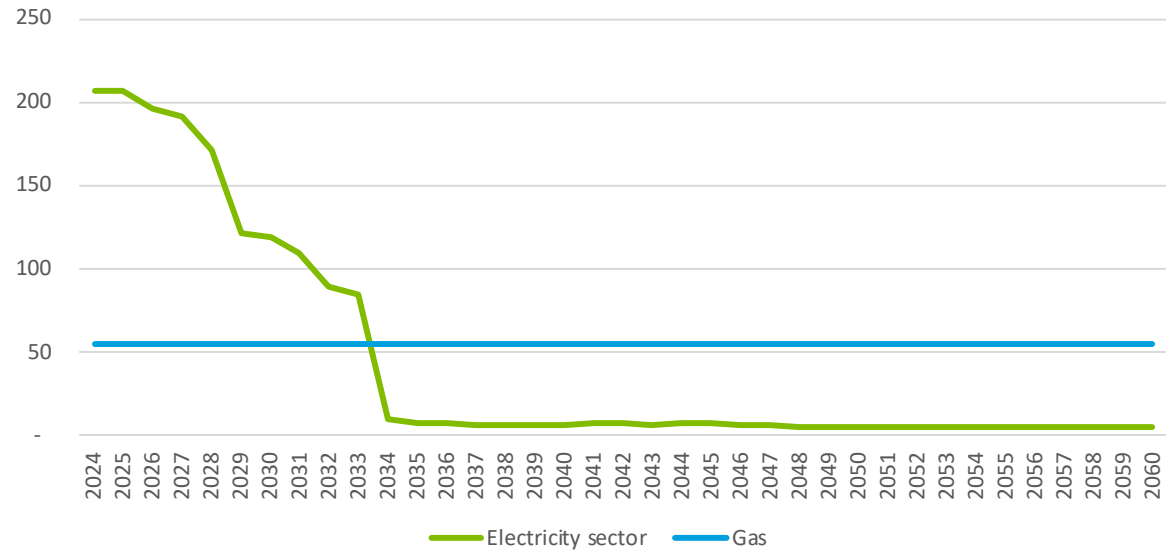
the GHG emissions came from Victoria's coal-fired power stations, with large and medium gas-fired power stations emitting 0.8 $MtCO_2$-e.[155] Victoria's dependence on brown coal, which is more carbon intensive than black coal, significantly impacts its emissions profile. Every GJ of brown coal consumed in electricity generation results in 93.82 kg of CO_2-e compared to 90.24 kg of CO_2-e for black coal.[156] In addition to carbon dioxide, electricity generation in Victoria also produces other GHG such as methane and nitrous oxide, though in smaller quantities than carbon dioxide.

The electricity generation sector in Victoria is undergoing a transition towards more renewable sources including hydro, solar and wind. The share of renewable fuel sources increased from 5 per cent in 2009 to nearly 30 per cent in 2021, while the share of coal declined from 91 per cent to 67 per cent in the same period.[157] The electricity sector recorded the largest decrease in GHG emissions between 2005 and 2021, with GHG emissions from the electricity sector decreasing by nearly 35 per cent from 63.5 Mt CO_2-e in 2005 to 41.4 Mt CO_2-e in 2021.

Victoria's electricity grid is projected to become less emissions intensive over time due to the VRET and the planned closure of Victoria's coal-fired power plants. As introduced in section 1.2.3, the VRET sets targets for the incorporation of renewable energy into Victoria's electricity grid. Under the VRET, 95 per cent of Victoria's electricity would be generated using renewable sources by 2035. Two of Victoria's three brown coal-fired power plants have also announced an intention to close by 2035.[158]

Electric appliances are more efficient than gas appliances which means that electrification will lead to an overall decrease in net energy GHG emissions. Moreover, in the long-term, GHG emissions from electricity generation will decline with coal-plants exiting the system and more renewable energy being generated, as depicted in Figure 2.11.

Figure 2.11: Forecasted GHG emissions intensity of electricity and gas (kg CO2e per GJ)



Source: DEECA based on AEMO and National Greenhouse and Energy Reporting. Forecasted electricity sector GHG emissions intensity accounts for future use of GPG.

[155] Department of Energy, Environment and Climate Action, (2023), Victorian Greenhouse Gas Emissions Report 2021. <https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0036/687825/Victorian-Greenhouse-Gas-Emissions-Report-2021.pdf>
[156] Department of Climate Change, Energy, the Environment and Water (2023), Australian National Greenhouse Accounts Factors. <https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-factors-2023>
[157] Department of Energy, Environment and Climate Action (2023), Victorian Greenhouse Gas Emissions Report 2021. <https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0036/687825/Victorian-Greenhouse-Gas-Emissions-Report-2021.pdf>
[158] Resources Victoria, Latrobe Valley coal mines. <https://resources.vic.gov.au/community-and-land-use/key-site-updates/latrobe-valley-coal-mines#:~:text=In%202021%2C%20Energy%20Australia%20announced,to%20continue%20production%20to%202048.>

2.5 Health costs of air pollution associated with use of gas appliances and electricity generation

2.5.1 Health impacts from gas appliances

Indoor gas appliances have been implicated in various health concerns, particularly regarding respiratory issues in children. A 2018 study revealed that approximately 12 per cent of childhood asthma cases in Australia could be attributed to harmful particles emitted by gas stoves.[159] Moreover, research has shown a direct correlation between exposure to open-flued gas space heaters in classrooms and increased incidences of coughing and wheezing among children.[160] The removal of such appliances have been shown to result in noticeable improvements in children's asthma symptoms and reduced school absences, indicating the significant impact of indoor air quality on respiratory health in educational settings.[161]

Furthermore, studies conducted by Harvard University shed light on additional health risks associated with gas appliances, with studies showing that gas appliances also introduce toxic chemicals such as VOCs into indoor environments.[162] Exposure to certain VOCs has been linked to heightened risks of asthma, cancer, and other illnesses, underscoring the broader health implications of indoor air pollution from gas appliances. Additionally, gas space heating and cooking are significant sources of nitrogen dioxide, a respiratory irritant that can exacerbate asthma symptoms and contribute to respiratory distress in individuals exposed to elevated levels over time.[163]

2.5.2 Health impacts from electricity generation

The burning of fossil fuels, such as coal for electricity generation, is a major source of harmful air pollutants in Victoria, including sulfur dioxide, oxides of nitrogen and fine particulate matter ($PM_{2.5}$ and PM_{10}).[164] Exposure to these pollutants is linked to various health impacts, including effects on respiratory and cardiovascular conditions, asthma and increased risk of premature mortality.[165] Economic analysis undertaken for Victoria's Climate Change Strategy found that reduced local air pollution through decreased coal-fired electricity generation could result in health benefits of approximately $2 billion by 2050 (in 2019 dollar terms).[166] Coal-fired electricity generation produces more extensive and concentrated air pollution, which affects larger populations compared to the more localised pollutants associated with home gas use.

While electrification of appliances will lead to an increase in air pollution produced from electricity generation in the short term, as the Victorian grid decarbonises with the planned closure of coal-fired power stations and the VRET target of 95 per cent renewables by 2035, the costs associated with air pollution from electricity generation will diminish over time.

[159] Knibbs et al (2018), Damp housing, gas stoves, and the burden of childhood asthma in Australia, Medical Journal of Australia, 208: 299-302. <https://pubmed.ncbi.nlm.nih.gov/29642816/>
[160] Marks GB et al (2010), Respiratory health effects of exposure to low Nox unflued gas heaters in the classroom: A double-blind cluster randomised crossover study, Environmental Health Perspectives. <https://pubmed.ncbi.nlm.nih.gov/20663737/>
[161] Pilotto et al (2004), Randomised controlled trial of unflued gas heater replacement on respiratory health of asthmatic schoolchildren, International Journal of Epidemiology. <https://pubmed.ncbi.nlm.nih.gov/15075170/>
[162] Harvard Health Publishing (2022), Have a gas stove? How to reduce pollution that may harm health. <https://www.health.harvard.edu/blog/have-a-gas-stove-how-to-reduce-pollution-that-may-harm-health-202209072811>
[163] Ewald et al (2022), Health risks from indoor gas appliances, Australian Journal of General Practice. <https://pubmed.ncbi.nlm.nih.gov/36451320/>
[164] Victorian Government (2022), Clean air for all Victorians – Victoria's Air Quality Strategy. <https://www.environment.vic.gov.au/__data/assets/pdf_file/0032/603977/Victorias-air-quality-strategy.pdf>
[165] World Health Organisation (2016), Ambient air pollution: A global assessment of exposure and burden of disease <https://www.who.int/publications/i/item/9789241511353>; Environment Protection Authority Victoria (2018), Air Pollution in Victoria – A summary of the state of knowledge. <https://www.epa.vic.gov.au/-/media/epa/files/publications/1709.pdf>
[166] Victorian Government (2021), Victoria's Climate Change Strategy Economic Analysis. <https://climatechange.vic.gov.au/__data/assets/pdf_file/0023/521357/Victorias-Climate-Change-Strategy-Economic-Analysis.pdf>

3 Government interventions to drive electrification

This chapter describes the initiatives already introduced by the Victorian Government to date to drive electrification. It also describes why further government intervention is required to increase the rate of electrification in Victoria.

3.1 Victorian policy actions to date

Given the prevalence of fossil gas usage in Victoria and the factors outlined in Chapter 2, the Victorian Government has identified minimisation of fossil gas usage in residential and commercial settings as a pivotal measure toward achieving the state's net zero emissions targets and maintaining energy security.[167]

The Victorian Government has introduced several initiatives aimed at reducing fossil gas usage in Victoria. These are outlined in sections 3.1.1 to 3.1.6.

3.1.1 Removing requirement for properties to be connected to the gas network

In 2022, the Victorian Government introduced Amendment VC221 to the VPP and all planning schemes in Victoria. Under this amendment, new residential developments are no longer required to be connected to the reticulated gas network. The amendment also removed the requirement for subdivision applications on certain types of land to be referred to the gas supply authority for comment. Only subdivisions proposed to be connected to the reticulated gas network now require a comment from the gas authority.

3.1.2 All new residential properties requiring a planning permit required to be all-electric from 1 January 2024

Victoria constructs over 50,000 new residential properties annually, with the majority of new residential properties previously relying on gas connections. Under Amendment VC250 to the VPP, from 1 January 2024 all new residential properties, apartment buildings and residential subdivisions requiring a planning permit are prohibited from connecting to the reticulated gas network and are required to be built as 'all-electric'.[168] Under this policy, all new homes and apartment complexes requiring a planning permit will only be connected to the electricity network. These amendments to the VPP also ensure that no gas connections can be installed upon completion of the construction of these new residential properties. The prohibition on new connections only applies to the use of reticulated gas. It does not apply to the use of LPG. This amendment does not capture all new residential properties to be built in Victoria as not all new residential properties require a planning permit. New residential properties that do not require a planning permit are not required to be built as all-electric.

3.1.3 Transitioning to electric appliances in rental properties

Residential rental properties play an important role in accommodating the housing needs of many Victorians. Nearly one in three households rent their homes,[169] with over 700,000 residential rental properties in Victoria in 2023.[170] Transitioning gas appliances in residential rental properties to electric is an important step in achieving Victoria's net zero emissions targets. The Residential Tenancies Regulations 2021 and Residential Tenancies (Rooming House Standards) Regulations 2023 prescribe the minimum standards for residential rental properties. Amendments to the Residential Tenancies Regulations are currently being considered to introduce minimum energy efficiency standards for, among other things, hot water systems and to revise minimum standards for heating appliances. Under the proposed amendments, existing gas hot water systems

[167] Victorian Government (2021), Victoria's Climate Change Strategy. <https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0026/521297/Victorian-Climate-Change-Strategy.pdf>
[168] Department of Transport and Planning (2024), Victorian Planning Provisions and all planning schemes Amendment VC250 Explanatory Report. <https://planning-schemes.app.planning.vic.gov.au/Victoria%20Planning%20Provisions/amendments/VC250>
[169] Commissioner for Residential Tenancies, The rental sector. <https://www.rentingcommissioner.vic.gov.au/the-rental-sector>
[170] Estimated using Australian Bureau of Statics Census 2021 and lease growth rate from Department of Families, Fairness and Housing rental reports.

and heating appliances in residential rental properties must be replaced with efficient electric appliances upon reaching end of life.[171] Gas cooking appliances are not covered under the proposed rental property amendments and therefore are considered in this RIS.

Inclusion of residential rental properties in the analysis would not change the selection of the preferred option. It would generally result in more positive BCRs as residential rental properties typically have lower thermal performance than owner-occupied properties,[172] which drives greater benefits, particularly when replacing gas heating.

3.1.4 Victorian Energy Upgrades program

The VEU program is a Victorian Government initiative that provides incentives to households and businesses to improve their energy efficiency.[173] Under the program, discounts are provided to Victorian households and businesses to upgrade to energy efficient products. In May 2023, the program was expanded to include new incentives of up $5,880 for switching from gas to efficient electric heating and cooling appliances, and hot water systems.[174] Incentives for gas heating and cooling appliances, and hot water systems were phased out.[175]

The *Victorian Energy Efficiency Target Act 2007* (VEET Act), under which the VEU program operates, specifies that in order to be eligible for a discount, an activity must "result in a reduction in GHG emissions that would not otherwise have occurred if the activity was not undertaken". This is known as the 'additionality' requirement. This means the VEU program may be unable to provide incentives for upgrades to meet regulatory requirements, including any potential mandated electrification upgrades under the Roadmap. The Victorian Government intends to amend the VEET Act to clarify the existing head of power for prescribing activities in relation to the 'additionality' requirement, to confirm the VEU program can provide incentives in instances where an upgrade is mandated.

3.1.5 Cap on gas disconnection fees

Customers looking to disconnect from the gas network have three options for disconnection:[176]

- Service abolishment: This involves a permanent disconnection of the gas service pipe from the street and removal of the meter.
- Disconnection: This includes temporarily locking and installing a plug in the meter outlets. Disconnection enables the gas connection to be reinstated at a later time.
- Meter removal: Under this option, the meter is removed but the gas pipes are left in place.

Historically, service abolishment has attracted a higher fee than the temporary disconnection of service leading to some customers opting to disconnect rather than abolish their gas service.[177] This poses safety risks as gas remaining in the line can escape and accumulate within the property.[178] Furthermore, changes in property ownership can lead to new owners being unaware of existing gas lines in the property.[179] In order to incentivise customers to safely remove their gas lines, the Australian Energy Regulator (AER) ruled in 2023 to narrow the price differential between permanent and temporary service

[171] Deloitte Access Economics (2024), Residential Tenancies and Residential Tenancies (Rooming House Standards) Amendment (Minimum Energy Efficiency and Safety Standards) Regulations 2024. <https://engage.vic.gov.au/new-minimum-standards-for-rental-properties-and-rooming-houses>

[172] Energy Consumers Australia (2024), Minimum energy efficiency standards for rental properties. <https://energyconsumersaustralia.com.au/wp-content/uploads/submission-doc-act-gov-minimum-energy-efficiency-standards-rental-properties.pdf>

[173] Department of Energy, Environment and Climate Change (2024), About the VEU program. <https://www.energy.vic.gov.au/households/victorian-energy-upgrades-for-households/about-the-veu-program>

[174] Department of Energy, Environment and Climate Action, Heating and cooling discounts. <https://www.energy.vic.gov.au/victorian-energy-upgrades/products/heating-and-cooling-discounts> Note $5,810 is the maximum amount of incentive a household can receive under the VEU program for upgrading both gas heating and gas hot water systems to electric systems. The maximum incentive for upgrading a gas heating system is $5,180 and $700 for upgrading a gas hot water system.

[175] Victorian Government (2023), Gas Substitution Roadmap Update. <https://www.energy.vic.gov.au/__data/assets/pdf_file/0027/691119/Victorias-Gas-Substitution-Roadmap-Update.pdf>

[176] Department of Energy, Environment and Climate Change, Disconnection from fossil gas. <https://www.energy.vic.gov.au/__data/assets/pdf_file/0042/673989/disconnecting-from-fossil-gas-factsheet.pdf>

[177] Australian Energy Regulator (2023), AusNet Gas Services Gas distribution access arrangement 1 July 2023 to 30 June 2028. <https://www.aer.gov.au/system/files/AER%20-%20AusNet%202023-28%20-%20Final%20Decision%20-%20Overview%20-%20June%202023.pdf>

[178] Energy Safe Victoria (2023), Abolishment of gas connection due to electrification. <https://www.aer.gov.au/system/files/Energy%20Safe%20Victoria%20-%20Abolishment%20of%20gas%20connection%20due%20to%20electrification%20-%20April%202023_1.pdf>

[179] Energy Safe Victoria (2023), Abolishment of gas connection due to electrification. <https://www.aer.gov.au/system/files/Energy%20Safe%20Victoria%20-%20Abolishment%20of%20gas%20connection%20due%20to%20electrification%20-%20April%202023_1.pdf>

disconnection. The AER set service abolishment fees at $220 (excluding GST) over the current gas regulatory period to 2028, with the remaining cost to be shared across remaining gas customers.[180]

3.1.6 Prohibition on incentives for gas connection and appliances

The Victorian Government's prohibition on gas companies from providing incentives for gas connections and appliances came into effect on 27 June 2024.[181] Under this prohibition, gas distributors are no longer permitted to offer cash incentives or rebates to households and small businesses for connecting to the gas network or for installation or replacement of a gas appliance.

3.2 Why further government intervention is needed

Despite the growing awareness of environmental issues and increasing government activity, market forces often fail to prioritise investment in electrification of buildings. There exist a number of market failures and barriers in the energy efficiency space which require the need for government intervention, including:

- recent regulatory changes do not cover the full spectrum of buildings in Victoria
- bounded rationality
- externalities
- split incentives
- information asymmetries
- lack of accessible information.

3.2.1 Recent regulatory changes do not cover the full spectrum of buildings in Victoria

VPP amendment VC250, which prevents all new residential properties, apartment buildings and residential subdivisions requiring a planning permit from connecting to the reticulated gas network, only applies to a subset of new residential properties (see section 3.1.2). With the proposed amendments to the Residential Tenancies Regulations 2021 currently under consideration, rental properties would be required to upgrade their space heating and hot water gas appliances to electric appliances at the end of the gas appliance's life (see section 3.1.3).

The VPP amendment VC250 does not capture all residential buildings, as not all new builds require a planning permit. As a result, only 40 per cent of new builds are estimated to be captured under the VPP amendments by 2026. Permitting ongoing gas usage in new buildings not currently covered by the all-electric requirements would require a continued expansion of the gas network. Therefore, capturing the full spectrum of new buildings in Victoria is essential to making a meaningful reduction in fossil gas usage and avoiding the continued expansion of the gas network.

There are currently no requirements for existing owner-occupied residential properties, or new and existing commercial properties to electrify. This leaves approximately 2.2 million residential properties connected to the gas network and approximately 1.7 million owner-occupied residential properties with no requirement to electrify any gas appliances. Noting that some existing properties may voluntarily electrify,[182] at least 1.9 million households (both rentals and owner-occupied) are expected to continue to use gas appliances without further intervention. Likewise, there are approximately 55,000 commercial buildings connected to the gas network with no requirement to electrify and low rates of voluntary electrification anticipated.

In light of the factors discussed in Chapter 2, government intervention is required in order to achieve meaningful electrification of buildings in Victoria. Buildings and gas appliances have a long life, with a gas appliance installed today expected to last for 14 to 20 years, and may be extended beyond this with regular maintenance. In absence of government intervention, buildings will be locked into the use of gas for a long time.

3.2.2 Bounded rationality

Bounded rationality and the use of heuristics can often lead to an under-investment in energy-efficient products. Bounded rationality refers to the limitations in human decision-making caused by factors such as limited time, information overload and cognitive capability. As a result, individuals often rely on heuristics or mental shortcuts to make decisions quickly and

[180] Australian Energy Regulator (2023), AER decision supports Victorian gas consumers in energy transition. <https://www.aer.gov.au/news/articles/news-releases/aer-decision-supports-victorian-gas-consumers-energy-transition#:~:text=Ms%20Savage%20said%20the%20AER,haulage%20tariffs%20which%20are%20spread>

[181] Victorian Government Gazette (2024), Gas Industry Act 2001. <https://www.gazette.vic.gov.au/gazette/Gazettes2024/GG2024S184.pdf>

[182] Voluntary electrification off existing appliances is expected to range between 0% to 3% per annum depending on the sector and appliance type.

efficiently. However, these heuristics can sometimes lead to biases and errors in judgment, including underestimating the long-term benefits of energy-efficient products.

For instance, when purchasing appliances, consumers often focus more on the purchase prices rather than consider the lifetime energy costs of using the appliance as this may not be evident at the time of purchase.[183] As discussed in section 2.2.2, electric appliances tend to have higher up-front purchase costs than gas appliances. This, along with potential financial constraints faced by low-income households, can lead to a bias towards cheaper and less energy-efficient gas appliances.

Bounded rationality can lead to resistance to change, particularly when it comes to long-term investments in building electrification. Economic literature shows that individuals tend to display a status-quo bias whereby people have the tendency to either keep their current appliances or replace their appliances with similar appliances, without considering more energy efficient products.[184] Fossil gas usage, particularly for cooking is highly prevalent in Victoria with 76 per cent of households using gas cooktops.[185] This preference for gas cooking can create resistance against electrification, as homeowners may be reluctant to switch to electric stoves or induction cooktops due to concerns about performance, cooking experience, and perceived additional expenses such as the need to buy new compatible cookware.[186] Similarly for space heating, one survey found that two-thirds of Victorians who replaced a gas heating system between 2015 to 2020 replaced it with the same type of system.[187] Another study stated that many households, particularly low-income households with capital constraints, typically choose a like-for-like replacement for their hot water systems even though the replacement is not often the optimal upgrade.[188] Furthermore, households replacing a broken-down appliance such as a hot water system will likely choose a like-for-like replacement to speed-up decision making and restore the appliance's use quickly. This status-quo bias can also cause people to use their inefficient appliances as much as possible in order to make their initial investment worthwhile.[189]

The wide range of available products and their constantly evolving features can add complexity to decision making as consumers need to invest time and effort to understand the different available options and make informed choices. The process of electrifying a building involves making a number of complex and highly technical decisions. When faced with difficult choices, individuals may opt for the path of least resistance and avoid behaviour change.[190] Small businesses and buildings without dedicated facilities managers may be more vulnerable to this bias. Inertia[191] and status quo bias may therefore delay or hinder the widespread adoption of electrification solutions in buildings and residential properties.

3.2.3 Externalities

The combustion of fossil gas for space and water heating and cooking in residential and commercial buildings generates harmful GHG emissions, including carbon dioxide, nitrogen oxides and particulate matter, which contribute to air pollution and climate change. These external costs are often not fully accounted for in market transactions, leading to under-pricing of gas.[192] As a result, consumers may not fully recognise the environmental and public health impacts of their energy choices, creating a disincentive to transition to cleaner, electrified alternatives. Furthermore, the positive externalities from

[183] Andor et al (2017), Consumer inattention, heuristic thinking, and the role of energy labels. <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2795579>
[184] Blascj, J and Daminato, C (2018), Behavioural anomalies and energy-related individual choices: The role of status-quo bias. The Energy Journal, Vol. 41, No. 6.
[185] Energy Networks Australia (2021), Reliable and clean gas for Australian homes. <https://www.energynetworks.com.au/resources/fact-sheets/reliable-and-clean-gas-for-australian-homes-2
[186] There are some relatively low-cost options available for purchasing induction compliant cookware.
[187] JSW Research (2021), Household energy preferences: Research Report. <https://engage.vic.gov.au/download/document/27749>
[188] Department of Industry, Innovation and Science and Brotherhood of St. Laurence (2016), Home Energy Efficiency Upgrade Program Final Report. <https://library.bsl.org.au/bsljspui/bitstream/1/10184/1/Sullivan_Home_Energy_Efficiency_Upgrade_Program_final_report_2016.pdf>
[189] Blascj, J and Daminato, C (2018), Behavioural anomalies and energy-related individual choices: The role of status-quo bias. The Energy Journal, Vol. 41, No. 6.
[190] European Environment Agency (2022), Behavioural factors influencing the uptake of energy efficiency in residential buildings. <https://cedelft.eu/wp-content/uploads/sites/2/2023/08/Behavioural_factors_influencing_the_uptake_of_energy_efficiency_in_residential_buildings.pdf>
[191] In behavioural economics, inertia refers to the tendency for individuals to maintain their current course of action even in the face of new information or environmental changes. <https://www.thebehavioralscientist.com/glossary/inertia#:~:text=In%20behavioral%20economics%2C%20the%20term,or%20changes%20in%20their%20environment>
[192] Monash University (2023), Switching on: Benefits of household electrification in Australia. <https://www.monash.edu/__data/assets/pdf_file/0005/3433550/Switching-On_Benefits-of-household-electrification-in-Australia_report.pdf>

electrification such as reduced GHG emissions are often not considered by residential properties or building owners as these may not immediately translate into financial returns. This leads to under-investment in electrification measures.

In recognition of the presence of externalities, the Victorian Government has legislated GHG emissions reductions targets. Electrification of buildings is a key step in achieving these targets, in line with Victorian Government's Climate Change Strategy (see Chapter 1).

3.2.4 Split incentives

Split incentives refer to the situation where the party bearing the cost for the activity does not obtain some or all of the benefits of the activity.[193] The split incentives between owners and renters of both commercial properties and residential properties present a significant barrier to electrification efforts. Typically, property owners are responsible for making long-term investment decisions regarding building upgrades and retrofits, including transitioning to electric heating, cooling and other appliances. However, the financial benefits of these upgrades, such as reduced energy bills, primarily accrue to the tenants who directly consume the energy. Consequently, rental providers may be reluctant to invest in electrification measures, especially if they cannot pass on the full cost to renters through increased rent. On the other hand, renters may lack the incentive or ability to invest in electrification themselves, particularly if they have short lease terms or limited financial resources. The RIS for Residential Tenancies and Residential Tenancies (Rooming House Standards) Amendments considered the split incentives present in residential tenancies relating to electrification of hot water and heating systems in residential rental properties.[194] As commercial tenancies and cooking in residential tenancies are within the scope of this RIS, split incentives present a relevant barrier to electrification.

3.2.5 Information asymmetries

Information asymmetry arises when one party to a transaction has better information than the other party. Information asymmetry between buyers and sellers of residential and commercial buildings pose significant challenges to electrification efforts in real estate transactions. Buyers often lack access to detailed information about a building's energy performance, infrastructure and potential for electrification, which can hinder their ability to assess the long-term costs and benefits of electrification upgrades. Furthermore, buildings and appliances are long-lived assets and therefore decisions taken at key milestones, such as at the time of construction, renovation and end of life, can have long-term consequences for energy efficiency that may not be known to buyers. This information asymmetry can result in adverse selection whereby a buyer is unable to differentiate between more energy efficient and less energy efficient buildings, as the energy efficiency attributes of a building are hard to observe without expert advice.[195] Therefore, buyers may be unwilling to pay the expected value for the property.[196] This may, in turn, disincentivise potential sellers from replacing gas appliances with electric ones in their properties as they may not be able to recoup their investment.

Programs such as the Commercial Building Disclosure (CBD) program are aimed at reducing information asymmetry. This program requires energy efficiency information, including the building's National Australian Built Environment Rating System (NABERS) rating, to be disclosed when a commercial property is available for sale or lease.[197] However, this is only required for commercial properties of 1,000 square metres or more. Similarly, NABERS ratings are only mandatory when spaces within office buildings of 1,000 square metres are offered for sale or lease.[198] There are no mandatory disclosures for properties smaller than 1,000 square meters. Therefore, information asymmetries are likely to exist in this sector. Information asymmetries in this sector are compounded by other barriers such as mid-tier buildings largely being occupied by small tenants that may not be able to demand for better environmental performance due to lack of awareness or corporate environmental policy.[199]

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[193] Split incentives have been documented in other jurisdictions, for example see Petrov, I and Ryan, L (2021), The landlord-tenant problem and energy efficiency in the residential rental market. Energy Policy, Vol. 157. <https://www.sciencedirect.com/science/article/pii/S0301421521003281>

[194] Deloitte Access Economics (2024), Minimum energy efficiency and safety standards for rental homes – Regulatory Impact Statement. <https://engage.vic.gov.au/new-minimum-standards-for-rental-properties-and-rooming-houses>

[195] Acil Allen (2015), Commercial Building Disclosure Program Review. <https://www.cbd.gov.au/sites/default/files/2020-09/cbd_program_review_final_report.pdf>

[196] Gerarden et al (2015), Assessing the energy efficiency gap. <https://www.hks.harvard.edu/sites/default/files/centers/mrcbg/files/mrcbg.fwp.2015-04.Stavins.efficiency.pdf>

[197] Australian Government, Commercial Building Disclosure Program Overview. <https://www.cbd.gov.au/#:~:text=The%20Commercial%20Building%20Disclosure%20%28CBD%29%20Program%20is%20a,or%20more%20is%20offered%20for%20sale%20or%20lease.>

[198] NABERS, Why NABERS? <https://www.nabers.gov.au/why-nabers>

[199] City of Melbourne (2023), Retrofit Melbourne: Framework to enable mid-tier commercial buildings to transition to be zero carbon ready. <https://www.melbourne.vic.gov.au/SiteCollectionDocuments/retrofit-melbourne.pdf>

3.2.6 Lack of accessible information

Many households, particularly vulnerable households, the elderly or people from culturally and linguistically diverse communities also face cultural, language or education barriers to accessing information. This can lead to these households missing out on assistance programs because they may be unaware that these programs exist, or they do not have the capacity to access them. Lack of accessible information is a barrier to adoption of energy efficient appliances. Factsheets containing a lot of information or employing complex language and technical terminology can be difficult to understand for people with low literacy levels or for whom English is not a first language.[200]

3.3 Phasing out reticulated fossil gas usage in other jurisdictions

The challenges posed by fossil gas usage in buildings are not unique to Victoria. There are several jurisdictions within and outside Australia that also recognise the need for government regulation to support and accelerate electrification in buildings. These policies are discussed in section 3.3.1 to 3.3.3 below.

3.3.1 Australian Capital Territory

The Australian Capital Territory (ACT) government has introduced regulation under its *Climate Change and Greenhouse Gas Reduction Act 2010* restricting gas network connections in certain circumstances. Effective from 8 December 2023, the regulations prohibit new gas network connections in the following areas:[201]

- all residential, commercial and community facility land-use zones
- all residential use buildings in non-residential zones (Class 1 to 4 buildings, as classified under the NCC (see Table 4.1)).

As a result, all new buildings falling under these regulations must be designed and built as all-electric. The regulations also apply to extensive renovation or construction projects where a gas connection has been decommissioned for safety during the construction activities. However, residential properties and businesses with existing gas connections are permitted to continue using them. The ACT government aims to transition away from all fossil gas in the territory to renewable electricity by 2045.[202]

The ACT's Home Energy Support Scheme provides rebates for homeowners to assist with installing energy efficient products. This includes reverse cycle heating and cooling, hot water heat pumps, electric stove and ovens and ceiling insulation. These products favour electrification and incentivise phasing out fossil gas usage.[203]

The ACT Government's Integrated Energy Plan includes several similar incentives for business and industry. For example, the Commercial Kitchen Trial program, which provides rebates of up to 50 per cent of the total cost for businesses to transition commercial kitchens to all electric. This plan generally recommends the ACT Government ban new gas connections and plan to decommission the network.[204]

3.3.2 New South Wales

In September 2024, the New South Wales (NSW) Government announced the NSW Consumer Energy Strategy, which commits $290 million in new funding for households and businesses to access energy saving technologies. This strategy will include a rebate scheme, new home energy ratings and the first targets in Australia for solar and battery uptake.[205]

Lane Cove Council in Sydney voted to adopt a new Development Control Plan which bans the use of gas appliances in all new developments from 1 October 2023 (including pool heaters).[206] Newcastle Council is also exploring a similar ban on residential properties (indoor only).[207] Waverley Council's Development Control Plan 2022 prohibits the installation of gas

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[200] Department of Industry, Innovation and Science, and Environment Victoria (2016), The Future Powered Families Report. <https://www.dcceew.gov.au/sites/default/files/documents/environment-victoria-future-powered-families_1.pdf>
[201] Australian Capital Territory Government, Preventing new gas network connections. <https://www.climatechoices.act.gov.au/energy/canberras-electrification-pathway/preventing-new-gas-network-connections>
[202] Australian Capital Territory Government, Switching from gas. <https://www.climatechoices.act.gov.au/energy/switching-from-gas>
[203] Climate Choices, Home Energy Support: Rebates for Homeowners. <https://www.climatechoices.act.gov.au/policy-programs/home-energy-support-rebates-for-homeowners>
[204] ACT Government (2024), The Integrated Energy Plan. <https://www.climatechoices.act.gov.au/__data/assets/pdf_file/0003/2509464/integrated-energ-plan-executive-summary-2024.pdf>
[205] NSW Government (2024), NSW Consumer Energy Strategy to save money and power across NSW. <https://www.nsw.gov.au/media-releases/nsw-consumer-energy-strategy-to-save-money-and-power-across-nsw>
[206] Lane Cove Council (2023), Ordinary Council Meeting Minutes 24th August 2023. <https://lanecove.infocouncil.biz/Open/2023/08/CNL_24082023_AGN_AT.PDF>
[207] Newcastle Council (2023), Minutes of Ordinary Council Meeting. <https://newcastle.nsw.gov.au/getattachment/87e8d2aa-2291-4667-9911-fed19576ef24/ECM_8105172_v3_Public-Minutes-for-Ordinary-Council-Meeting-Tuesday,-12-December-2023.pdf>

cooktops, gas ovens and gas heating systems in new residential developments.[208] While the plan does not prohibit the installation of gas hot water systems in new residential properties, it strongly encourages the installation of an electric hot water system. The plan provides design guidelines for new properties where a gas hot water system is proposed to be installed to enable retrofitting of an electric hot water system in the future.[209] Paramatta Council's Development Control Plan also provides for all-electric buildings with the plan requiring all new buildings (both residential and commercial) to use only electricity for all energy requirements associated with normal operations.[210] Fossil fuels can only be used for purposes that cannot be serviced by electricity.

The City of Sydney passed a motion in August 2023 to update its Development Control Plan and other relevant planning documents to incorporate planning provisions requiring all new residential and non-residential development in the local government area be all-electric and gas free.[211] The City of Canada Bay also passed a similar resolution in September 2023[212] while the City of Ryde passed a motion to investigate the opportunities for planning changes to achieve all-electric new residential and commercial buildings in the municipality.[213]

As part of the NSW Consumer Energy Strategy, the NSW Government have committed to introduce mandatory disclosure of home energy performance ratings at point of sale and/ or lease. This will start as a voluntary program in 2025.[214] The program also includes the following targets:

- 2035 and 2050 targets for electrification and higher energy efficiency of homes
- developing energy efficiency performance standards for rental housing
- $15.8 million investment to the quality and safety of energy performance upgrades in NSW.

3.3.3 International policies for electrification

A number of jurisdictions, particularly in Europe and North America, are undertaking policies to limit and phase out gas usage in buildings.

The European Union has proposed a suite of measures to phase out fossil fuel heating in existing buildings.[215] In anticipation of these measures several European countries have implemented national policies to phase out fossil gas, for example:

- Austria: Austria aims to be carbon neutral by 2040. As part of this ambition, the Austrian Government introduced the *Oil Boiler Installation Prohibition Act 2019* which came into effect from 2020. The Act prohibits the installation of central heating systems using liquid fossil or solid fossil fuels in new buildings. The *Renewable Heat Act 2024*, extended this existing ban to cover all systems that can be operated with fossil fuels, including decentralised gas heating systems in all new buildings.[216] The Act aims to limit the growth in the number of systems in Austria that run on fossil fuels, with the installation of gas heating systems prohibited from 2023 (applies to new residential and commercial buildings).
- Ireland: Ireland introduced a Climate Action Plan in 2019 which outlined measures for decarbonising energy use in the built environment. The plan committed not to install fossil fuel heating systems in new public sector buildings (including those undergoing major renovations after 2023). The Nearly Zero Energy Building regulations introduced in Ireland in 2019 have led to the effective phase out of fossil fuel boilers in new homes, with only 5 per cent of new residential

[208] Waverley Council (2022), Waverley Development Control Plan 2022. <https://www.waverley.nsw.gov.au/__data/assets/pdf_file/0015/234042/Waverley_DCP_2022_Full_Version.pdf>
[209] Waverley Council (2022), Waverley Development Control Plan 2022. <https://www.waverley.nsw.gov.au/__data/assets/pdf_file/0015/234042/Waverley_DCP_2022_Full_Version.pdf>
[210] Paramatta Council (2023), Development Control Plan 2023. <https://www.cityofparramatta.nsw.gov.au/sites/council/files/2024-08/Parramatta_DCP_2023-BOOK_VERSION-as_published_2_August_2024.pdf>
[211] City of Sydney (2023), Decision details: End new gas connections in the City of Sydney. <https://meetings.cityofsydney.nsw.gov.au/ieDecisionDetails.aspx?ID=4524>
[212] City of Canada Bay (2023), Ordinary Council Meeting Minutes. <https://www.canadabay.nsw.gov.au/sites/default/files/Final%20Minutes%20-%2019%20September%202023.pdf>
[213] City of Ryde (2023), Minutes of Meeting no. 9/23. <https://www.ryde.nsw.gov.au/files/assets/public/v/2/council-meetings/2023/minutes-council-meeting-22-august-2023.pdf>
[214] Department of Climate Change, Energy, the Environment and Water (2024), NSW Consumer Energy Strategy - Powering our people and communities. <https://www.energy.nsw.gov.au/sites/default/files/2024-09/NSW_Consumer_Energy_Strategy_2024.pdf>
[215] European Council (2024), Fit for 55. <https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55/>
[216] Parliament of Austria (2023), National Council seals end to gas heating in new buildings. <https://www.parlament.gv.at/aktuelles/pk/jahr_2023/pk1416#XXVII_I_02268>

properties installing them in 2023.[217] The government is now planning for a phase out of fossil fuel boilers in existing residential properties and has committed to the phase out of fossil heating in all sectors.

- **Netherlands:** Netherlands prohibited gas connections for new residential homes and small commercial buildings from July 2018.[218] The country has also proposed to prohibit new installation of fossil fuel-based heating systems from 2026, requiring households, shops, schools and offices to replace their boiler with a hybrid heat pump.[219]
- **Norway:** Norway has also banned the use of mineral oil for heating in new and existing buildings, and existing boilers since 2020.[220]

A number of jurisdictions within North America have also initiated measures restricting the use of fossil gas. The City of Montreal introduced a ban on GHG emitting combustion devices for cooking, laundry, water heating and space heating that use gas or oil in new buildings in the residential, commercial and institutional sector, with existing buildings exempt from the ban.[221] The ban came into effect from 1 October 2024 for small buildings (up to three floors and 600 square meters per floor) and from 1 April 2025 for all other buildings.

The State of New York has also introduced legislation banning gas stoves and furnaces in most new buildings, except for large commercial and industrial buildings such as hospitals and food establishments. The ban will come into effect in a phased approach with compliance required for new buildings under seven stories from 2026, and for taller buildings from 2029.[222]

3.4 Objectives

The Victorian Government has set a target to achieve net zero emissions by 2045, with interim emissions reduction targets for 2025, 2030 and 2035. Reducing the state's reliance on fossil gas is an important lever in achieving net zero emissions. The Gas Substitution Roadmap Update identifies rapid electrification as a key priority and explains that electrification and energy efficiency offer the cheapest opportunities to reduce fossil gas consumption and reduce cost of living pressures.[223]

The Building Act provides the framework for regulating building work in Victoria. The Building Regulations and Plumbing Regulations, made under the Building Act, provide the Victorian Government with the lever to introduce electrification requirements for residential and commercial buildings in Victoria through its oversight over building and plumbing works.

The objectives of amending the Regulations to require building electrification are to:

- reduce energy bills for households and businesses
- mitigate potential fossil gas shortfalls
- reduce GHG emissions.

[217] Department of Housing, Local Government and Heritage, Ireland (2024), Fossil fuel boilers effectively phased out in new dwellings. <https://www.gov.ie/en/press-release/b368f-fossil-fuel-boilers-effectively-phased-out-in-new-dwellings/#:~:text=the%20introduction%20of%20Nearly%20Zero,phased%20out%20in%20new%20dwellings>
[218] Government of Netherlands (2019), Climate Agreement. <https://www.government.nl/documents/reports/2019/06/28/climate-agreement>
[219] Government of Netherlands, Heat pumps mandatory when replacing a boiler. <https://business.gov.nl/amendment/hybrid-heat-pump-mandatory/>
[220] Oeko (2021), Phase-out regulations for fossil fuel boilers at EU and national level. <https://www.oeko.de/fileadmin/oekodoc/Phase-out_fossil_heating.pdf>
[221] Ville de Montreal (2023), Ban on combustion heating devices in new buildings. <https://montreal.ca/en/articles/ban-combustion-heating-devices-new-buildings-61223>
[222] Reuters (2023), New York State bans natural gas in some new constructions. <https://www.reuters.com/world/us/new-york-state-bans-natural-gas-some-new-construction-2023-05-03/>
[223] Victorian Government (2023), Gas Substitution Roadmap Update. <https://www.energy.vic.gov.au/__data/assets/pdf_file/0027/691119/Victorias-Gas-Substitution-Roadmap-Update.pdf>

4 Options development

This chapter outlines the approach for developing viable options to address the identified objectives.

4.1 Option design and scope of analysis

A range of non-regulatory options were included in consideration of options to achieve the objectives of the proposed regulations, including use of renewable gases, information and education campaigns, mandatory disclosures, and financial incentives. Appendix B provides an overview of each of these non-regulatory options.

Noting the barriers to uptake (as described in section 3.2) and limitations of alternative non-regulatory options (as outlined in Appendix B), amending regulations is considered to be the only viable approach to achieve the necessary scale, and meet the timeframes required, under Victoria's legislated emissions reductions targets, and help mitigate the impacts of climate change. As such, only options relating to mandating the electrification of buildings have been assessed in this RIS. The options considered for analysis in this RIS were designed by DTP and the Department of Energy, Environment and Climate Action (DEECA). The focus of the options is on replacing gas appliances connected to reticulated gas. Therefore, the analysis excludes bottled and reticulated LPG usage. The following are also beyond the scope of this RIS:

- **Industrial facilities.** The regulatory options considered do not apply to industrial facilities such as factories and manufacturing and agricultural facilities.
- **Commercial kitchens in existing commercial buildings**. The regulatory options considered do not apply to commercial kitchens for the purposes of food services in existing commercial buildings. Existing commercial kitchens have been exempt based on industry feedback on retrofit complexity. Excluding existing commercial kitchens at this stage will also allow the commercial cooking sector to become more acquainted with all-electric alternatives utilised in new commercial buildings.

In addition to the above exemptions, heating and hot water appliances in residential rental properties and government buildings were also beyond the scope of the analysis conducted in the supporting cost-benefit analysis (CBA).

While residential rental properties would also be subject to the proposed regulations, the costs and benefits of electrifying heating in residential rental properties and rooming houses and hot water appliances in residential rental properties are attributable to proposed amendments to the Residential Tenancies Regulations 2021 and Residential Tenancies (Rooming House Regulations) 2023, rather than to the options analysed in this RIS. As a result the costs and benefits of electrifying heating and hot water in residential rental properties is accounted for in the Minimum Energy Efficiency and Safety Standards for Rental Homes RIS and have been excluded from this RIS to avoid double-counting.

Under existing policy, all new government buildings that haven't yet reached design stage must be built all electric,[224] so the impacts of electrification of new government buildings is not within the scope of analysis in this RIS. Agencies are also encouraged to consider opportunities to remove gas when undertaking construction activities at existing buildings and sites with requirements to include an electrification option in business cases for government construction projects. While one option considered in this RIS would in principle affect existing government buildings (see Option 2 as defined in section 4.3), the costs and benefits associated with the electrification of existing government buildings are being considered by other policy proposals, and so electrification of existing government buildings is assumed as having occurred under the Base Case in this RIS. As outlined in Chapters 6, 7 and 8, the selection of Option 3 as the preferred option is consistent with existing government policy. Section 6.3 outlines why excluding electrification of existing government buildings from the analysis would not affect the choice of the preferred option. Section 4.2.2 considers the potential cumulative effects of existing government building electrification on broader markets, such as energy and labour markets.

No exemptions besides the ones listed above have been modelled into the CBA, however several exemptions have been proposed by government in the RIS, these are outlined in Table 9.3. A summary of building class types covered by the analysis is provided in Table 4.1 below. Under the options, new mixed-use buildings will be required to be all-electric, while

[224] Lily D'Ambrosio (2023), New Victorian Homes to Go All Electric From 2024. < https://www.lilydambrosio.com.au/media-releases/new-victorian-homes-to-go-all-electric-from-2024/>

for existing buildings, each building class in a mixed-use building will be treated independently. Building permits will trigger a requirement for electrification where those permits are for new buildings. While renovations and extensions typically also require a building permit, permits issued for renovations and extensions will not trigger the electrification requirement.

Table 4.1: NCC building classes captured under the regulatory options

Building Class	Description	Required to electrify?
Class 1	Domestic or residential buildings that are either single standalone houses or horizontally attached houses such as terrace houses, row houses or townhouses. Class 1 has two sub-classes: • Class 1a: Single residential properties such as a detached house, or a part of attached dwellings such as rowhouses or townhouses. • Class 1b: boarding house, guest house or hostel with a floor area of less than 300 m2.	Yes, however the costs and benefits of electrifying government owned and operated housing are being considered through other policy proposals but will not be exempt from regulations.
Class 2	Domestic apartment buildings where people live above, below or beside each other.	Yes, however the costs and benefits of electrifying government owned and operated housing are being considered through other policy proposals but will not be exempt from regulations.
Class 3	Residential buildings other than Class 1 and Class 2 buildings that provide long-term or transient accommodation for a number of unrelated people such as hotels and student accommodation.	Yes, excluding existing commercial kitchens.
Class 4	Sole properties or premises within a non-residential property such as a caretaker's residence in a storage facility.	Yes, excluding existing commercial kitchens.
Class 5	Office buildings for professional and/or commercial purposes.	Yes, excluding existing commercial kitchens.
Class 6	Buildings where retail goods and services are provided to the public such as a shopping centre, hairdressing salon.	Yes, excluding existing commercial kitchens.
Class 7	Class 7a: Carparks Class 7b: Warehouses, storage buildings or displaying wholesale goods.	Class 7b only. Class 7a excluded.
Class 8	Buildings used for production, assembling, altering, packing, etc of goods or produce such as mechanic workshops, laboratories.	No.
Class 9	Public buildings. Class 9 has the following sub-classifications: • Class 9a: healthcare buildings (such as hospitals, day surgery clinics) • Class 9b: buildings where people assemble for social, political, theatrical, religious or civic purposes such as schools, universities, and sports facilities • Class 9c: aged care facilities.	Yes, however only costs and benefits of privately owned facilities such as private hospitals, aged care and private schools were in scope for the CBA. Publicly owned Class 9 buildings are to be considered through other policy proposals but will not be exempt from regulations. Existing commercial kitchens are exempted.
Class 10	Non-habitable structures. There are three sub-classifications: • Class 10a: sheds, carports and private garages • Class 10b: fences, masts, antennas, retaining wall, swimming pools • Class 10c: private bushfire shelter.	Class 10a and 10b only. Class 10c excluded. Gas use in Class 10a buildings is anticipated to be immaterial and was not modelled in the analysis.

Source: Victorian Building Authority, Building classes. Note: The classes of buildings required to electrify has been informed by DEECA's advice on the scope of the Regulations.

According to the Victorian Guide to Regulation, options must be designed such that there are meaningful differences in their effects or outcomes.[225] As such, options for the RIS have been designed using the following parameters:

- **appliance type**: space heating, hot water (including swimming pools and spas) and cooking[226]
- **building type:** residential (Class 1 and Class 2) and commercial (Class 3, Class 4, Class 5, Class 6, Class 7b, Class 9 and Class 10a and 10b)
- **building age**: new and existing.

4.2 Base Case

The Base Case presents the point of reference against which the impact of new regulations is assessed. It identifies what would be expected to happen if the Victorian economy were to continue under 'business as usual', without specific interventions proposed under the options. Under the Base Case, it is assumed that some electrification of buildings occurs because of policies and regulations already introduced or being considered by state and federal governments, as well as changing consumer preferences and behaviours. These assumptions are detailed below and in Appendix C.

As discussed in section 3.1.2, the Victorian Government has introduced measures to phase out fossil gas in new residential buildings from 1 January 2024. These requirements only apply to new properties, apartment buildings and residential subdivisions requiring a planning permit. Under the Base Case, it is assumed that new residential properties requiring a planning permit will electrify. Existing residential and commercial buildings, new commercial buildings and new residential buildings that do not require a planning permit are not required to electrify under the Base Case.

The requirement for residential rental properties to transition to electric appliances is proposed to be prescribed through amendments to the minimum standards for residential rental properties under the Residential Tenancies Regulations 2021 and the Residential Tenancies (Rooming House Standards) Regulations 2023. Under the proposed amendments, residential rental properties will be required to install energy-efficient electric hot water systems and heating systems once existing gas appliances reach the end of their life. Rooming houses will also be required to upgrade to energy-efficient electric heating when their current heating system reaches end of life. These amendments will complement the electrification requirements analysed in this RIS. The impacts of transitioning from gas to electric heating and hot water appliances in residential rental properties and rooming houses have been analysed through a separate RIS.[227] Therefore these impacts have been excluded from analysis in this RIS to avoid double counting.

At the national level, amendments to the NCC 2022 strengthened minimum performance standards for new residential properties. Under the requirements, the minimum energy efficiency of new residential properties will increase from 6 Stars to 7 Stars NatHERS equivalent.[228] The new standards will also require new residential properties to meet a Whole of Home annual energy use budget. This budget can be met through "a flexible combination of type and efficiency rating of specific fixed appliances such as hot water, heating and cooling, lighting and pool and spa pumps, and through installing rooftop solar to offset energy usage".[229] The new requirements came into effect in Victoria from 1 May 2024 and are expected to result in increased electrification of new residential properties. Plumbing Regulations were also amended in November 2023 to remove barriers to installing efficient electric hot water systems for new residential properties subject to NCC 2019 requirements. The impacts of NCC 2022 and the Plumbing Regulations amendments have been accounted for in the Base Case, based on the proportion of new residential buildings expected to be impacted by both the NCC 2022 and gas connection prohibition, as presented in Table 4.2 below.

The ABCB is currently working on NCC 2025. This will focus on potential changes to energy efficiency in commercial buildings.[230] The NCC is exploring mandatory solar photovoltaic at the same time, which can increase energy savings from electric appliances by reducing electricity consumption from the network. Any impacts of NCC 2025 are not accounted for in the Base Case as the proposed changes have not yet been finalised. To the extent that changes under NCC 2025 may end up

[225] Department of Treasury and Finance (2016), Victorian Guide to Regulation. <https://www.vic.gov.au/victorian-guide-regulation>
[226] Reticulated and bottled LPG is exempted. Therefore, regulations only apply to cooking appliances connected to the reticulated gas network. Outdoor kitchens or barbecues connected to the reticulated gas network would be required to electrify. Barbecues supplied by LPG would be exempt.
[227] Engage Victoria (2024), Minimum standards for rental properties and rooming houses. <https://engage.vic.gov.au/new-minimum-standards-for-rental-properties-and-rooming-houses>
[228] Department of Energy, Environment and Climate Action, 7 Star energy efficiency building standards. <https://www.energy.vic.gov.au/households/7-star-energy-efficiency-building-standards>
[229] Department of Energy, Environment and Climate Action (2023), Fact sheet for homebuyers: New home energy efficiency standards explained. <https://www.energy.vic.gov.au/__data/assets/pdf_file/0033/670299/7-star-new-home-standards-factsheets-home-buyers.pdf>
[230] Australian Building Codes Board, Energy efficiency. <https://www.abcb.gov.au/initiatives/energy-efficiency>

requiring electrification of buildings, then the CBA would overstate the benefits and costs of electrification that can be solely attributed to the proposed regulatory change, however would not likely impact the BCR as benefits and costs would likely scale proportionately.[231]

Table 4.2: Projected uptake of electrification in new residential properties under the Base Case as a result of existing policies

Year	2026	2030	2035
Proportion of new residential buildings	74%	94%	99.6%

Source: DEECA.

Recognising how important it is to limit reliance on fossil gas, the Victorian Government announced in July 2023 that all new government buildings and facilities that have not yet reached design stage will be built as all-electric. The costs and benefits of electrifying existing government buildings and facilities will be considered under other policy proposals so were included within the Base Case, however existing government building are not proposed to be exempt from any regulations.

The Base Case also considers voluntary electrification as a result of changing consumer preferences and behaviours, where a proportion of gas users are expected to switch to electric appliances, even in the absence of regulation. Consumer preference and purchasing behaviour studies commissioned by DEECA and by external stakeholders indicate that Victorians are increasingly interested in adopting electric appliances in both residential and commercial settings.[232]

Remaining properties and buildings that do not electrify under the Base Case are assumed to replace their gas appliances like-for-like at end of life.

4.2.2 Cumulative effects of electrification under the Base Case

The focus of the regulatory options relates to one segment of total gas and electricity usage. There is electrification potential across the whole market. The full impact of broader market electrification under the Base Case is not directly analysed in the assessment of the options as it is outside the scope of the proposed regulations (either because it is captured under other government policy assessments or a result of voluntary market behaviour). This includes existing or proposed gas policies identified in section 3.1 and 4.2, as well as broader electrification trends such as uptake of electric vehicles or industrial electrification.

Underlying trends in the Base Case may have cumulative effects that could exacerbate the impact of the regulatory options, particularly impacts to electricity tariffs, gas tariffs and availability and cost of labour and materials. The directional impact of trends under the Base Case has been qualitatively considered in relevant sections, namely:

- impact on electricity market (section 7.1)
- impact on gas tariffs (section 7.2)
- impact on access to labour and materials (section 7.3.3).

To the extent that these factors may impact the benefits or costs estimated in the CBA, additional sensitivity analysis has been conducted to test the robustness of the CBA results, including:

- 33 per cent increase in electricity and gas prices
- 25 per cent increase in purchase and installation cost, which includes cost of labour to install an electric appliance.

See section 6.3 for details on the sensitivity analysis.

4.3 Options

The options assessed in this RIS are as follows:

Option 1: Electrification of all new residential and new commercial buildings

Under this option, all new residential and commercial buildings will be required to be constructed as all-electric. New residential and commercial buildings will not connect to the reticulated gas network and will instead be fully reliant on

[231] If this is the case, the benefits and costs of electrification would occur regardless of the instrument that electrification is attributed to.
[232] JWS Research (2021), Household energy preferences: Research report [Confidential report] and Energy Consumers Australia (2023), Energy Consumer Behaviour Survey. <https://energyconsumersaustralia.com.au/publications/surveys-energy-consumer-sentiment-behaviour>

electric appliances. For new residential properties, this expands upon recent amendments to the VPP by also covering residential properties that do not require a planning permit.

Option 2: Electrification of all new and existing residential buildings and all new and existing commercial buildings, *excluding* existing commercial kitchens

Option 2 builds on Option 1 by including existing residential and many commercial buildings. In addition to electrifying new buildings, gas appliances in those existing residential and commercial buildings that are in-scope will need to be replaced with electric appliances once the gas appliance reaches the end of its life. End of life replacement in existing properties is intended to allow a gradual phase out of gas appliances, supporting an orderly transition to a net zero Victoria. Under this option, existing commercial kitchens are excluded from the electrification requirement. For the purposes of this RIS, commercial kitchens refer to commercial scale kitchens and appliances for food services. Non-commercial scale cooking equipment used in commercial building classes, such as a standard gas cooktop or a gas oven installed in a shared office kitchen, will be required to electrify at end of life. Only existing commercial kitchens are exempt, new commercial kitchens will be required to electrify under this option.

Option 3: Electrification of all new and existing residential buildings (excluding residential cooking) and all new commercial buildings

Under Option 3, all existing residential gas hot water and heating must be electrified through replacement at end of life and all new residential and commercial buildings must be built all-electric. This option excludes all residential cooking and existing commercial buildings from electrification requirements. Section 9.1 contains more details on this option and the proposed exemptions.

Option 4: Electrification of all new and existing residential buildings

Under this option, only new and existing residential buildings will be required to electrify. The requirement to electrify under this option extends to all gas appliances, including cooking. All new and existing commercial buildings will be exempt from electrification.

These options are summarised in Table 4.3.

Table 4.3: Summary of RIS options

	Option 1: New residential and new commercial	Option 2: All new and existing residential and commercial	Option 3: All new and existing residential excluding existing cooking, and new commercial	Option 4: All new and existing residential.
New residential				
Heating	Included	Included	Included	Included
Hot water	Included	Included	Included[2]	Included
Cooking	Included	Included	Included	Included
Existing residential[1]				
Heating	Not included	Included	Included	Included
Hot water	Not included	Included	Included	Included
Cooking	Not included	Included	Not included	Included
New commercial				
Heating	Included	Included	Included	Not included
Hot water	Included	Included	Included	Not included
Commercial kitchens	Included	Included	Included	Not included
Residential kitchens*	Included	Included	Included	Not included
Existing commercial[2]				
Heating	Not included	Included	Not included	Not included
Hot water	Not included	Included	Not included	Not included
Commercial kitchens	Not included	Not included	Not included	Not included
Residential kitchens*	Not included	Included	Not included	Not included

*Residential scale kitchen appliances used in commercial contexts, for example a standard gas cooktop in a shared office kitchen, is not excluded from the regulations.

5 Methodology

This chapter outlines the methodology for analysis of the impacts of the identified options.

5.1 Methodology overview

As part of this RIS, CBA modelling was conducted to quantify and compare the NPV and BCR of the regulatory options. The outcomes of the CBA are presented in Chapter 6.

Further quantitative analysis of impacts not typically captured in a CBA was then subsequently conducted, using energy market analysis (to test the potential impact of regulations on the electricity and gas market) and computable general equilibrium (CGE) modelling (to test the potential impact of regulations on broader economic outcomes). See Chapter 7 for the outcomes of this analysis.

5.1.1 Cost-benefit analysis

CBA provides a robust, structured, and transparent approach to analysing the different impacts, using modelled illustrations of the economic costs and benefits. Calculating the incremental costs and benefits to society of an intervention relative to a Base Case, a CBA determines whether additional benefits outweigh the additional costs over the analysis period. NPV and the BCR are two outputs commonly used to interpret results from a CBA.

NPV measures the benefits of an intervention (relative to the Base Case), minus the costs of the intervention (also calculated relative to the Base Case). The NPV is expressed in PV dollar terms. A discount rate is applied in calculating the NPV to place less weight on future costs and benefits than present costs and benefits. A positive NPV (greater than 0) indicates that the benefits of pursuing the intervention outweigh its costs.

The BCR considers the scale of benefits relative to the costs, expressed as a ratio. A BCR greater than 1 indicates that the outcomes of an intervention are positive and outweigh the costs incurred due to the intervention. A BCR less than 1 indicates that the outcomes of an intervention are negative and outweigh the benefits of intervention. For instance, a BCR of 0.5 can be interpreted as 'for every dollar of cost incurred as result of the modelled change, 50 cents in benefits will be received in return'. A BCR of 1.5, on the other hand, implies that every dollar of cost incurred provides a return of $1.50. The larger the BCR, the greater the relative return to the modelled option.

The CBA has been prepared in accordance with the requirements in the Victorian Guide to Regulation. An overview of the CBA methodology is provided below, with Appendix C summarising the CBA parameters and sources.

5.1.2 Analysis period

For the purposes of this RIS, two timeframes over which the proposed regulations were assumed to apply were adopted (referred to as 'analysis period'):

- a 10-year period ranging from 2026[233] to 2035, in line with the standard timeframe for new regulations under the *Subordinate Legislation Act 1994*[234]
- a 20-year period ranging from 2026 to 2045, to understand the implications of the regulatory options for achieving the Victorian Government's net zero target by 2045.

Costs were calculated over both the 10-year and 20-year timeframes. The ongoing benefits of switching from gas to electric appliances will continue to be accrued beyond the lifetime of the Regulations. This is to recognise the flow-on benefits of the regulation over the lifetime of an appliance upgraded in the final year of the Regulations. For instance, a residential electric appliance with a lifespan of 12 years installed in 2035 will continue to provide benefits, such as avoided gas costs and GHG

233 For analytical purposes, the proposed regulations were assumed to start in 2026 however this is not government policy and a commencement date has not been finalised.

234 This RIS covers proposed amendments to the Building Regulations (2018) and Plumbing Regulations (2018), both of which will sunset in 2028. Under the *Subordinate Legislation Act 1994*, regulatory impact analysis typically focuses on the time period of the life of the proposed regulations. However, given scale of the potential impacts of the proposed regulations, this RIS applies the ten year period of analysis that would apply to new regulations with a sunsetting date ten years after their creation.

emissions savings, until 2047. Similarly, a commercial electric appliance with a lifespan of 15 years installed in 2035 will provide benefits until 2050. End of life replacement in existing buildings is intended to allow a gradual phase out of gas appliances, supporting an orderly transition to a net-zero Victoria.

It was assumed that no costs will be incurred in 2025 (the year the proposed regulations would be made) as compliance with the new requirements will be required from 2026 onward. Costs and benefits of reinstallation of appliances after the 10-year analysis period are also not included in the CBA results. This approach is conservative as including future reinstallation of electric appliances after the analysis period is expected to continue to incur a rising net benefit to Victoria, in perpetuity. Under the proposed regulations, new buildings would not have gas infrastructure available and therefore would not easily be able to install gas appliances after the analysis period. The impact of the proposed regulations on future option value is discussed qualitatively in Chapter 7.

5.2 Estimating the rate of electrification each year

5.2.1 Residential sector

Benefits and costs for the residential sector are linked to the number of gas appliances upgraded relative to the Base Case.

The number of gas appliances requiring upgrade each year was calculated for heating, hot water and cooking appliances based on the number of existing and new properties estimated to use a gas appliance under the Base Case. The propensity of existing and new properties with gas appliances for heating, hot water and cooking was based on Oxford Economics Australia[235] and 2021 Residential Energy Baseline Study data.[236] See A.1.1.2Table C.3 in Appendix C.

The existing stock of owner-occupied properties for Class 1 and Class 2 properties was determined using Australian Bureau of Statistics (ABS) data from the 2021 Census[237]. The number of new owner-occupied properties impacted by the proposed regulations was forecast out to 2045 using growth rates from Victoria in Future housing projections.[238] See A.1.1.2Table C.2.

For the purposes of CBA modelling, major renovations (defined as renovations of more than 50 per cent of the building volume) that require a building permit were treated as new buildings and assumed to electrify at point of renovation.[239] To account for this, the number of new properties was adjusted for renovations and demolitions based on historical building permits and ABS data respectively, which assumed that 0.5 per cent of the owner-occupied housing stock will undergo major renovations and a further 0.4 per cent will be demolished and rebuilt each year.[240] These were assumed to be captured as 'new' buildings under the options. The existing stock of properties impacted in future years was diminished in line with the number of renovations and demolitions.

A literature scan was undertaken by DEECA to determine an appropriate asset life assumption. Available data was limited, however Oxford Economics Australia, appliance warranty data and other sources point to an average operating life of gas appliances of 8 to 14 years.[241,242] It was assumed that a constant proportion of the existing gas appliance stock will reach end of life each year based on the lifetime of the appliance and will then need to be replaced. Residential gas appliances were assumed to have an asset life of 14 years. Therefore, just over 7 per cent of existing properties with a gas appliance were

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[235] Oxford Economics Australia (2022), multiple reports including The Climate Control Market in Australia, the Hot Water System Market in Australia, and the Whitegoods Market in Australia – cookers.

[236] Energy Consult for former Department of Industry, Science, Energy and Industry on behalf of the Trans-Tasman Equipment Energy Efficiency (2021), 2021 Residential Baseline Study for Australia and New Zealand 2000 to 2040. < https://www.energyrating.gov.au/industry-information/publications/report-2021-residential-baseline-study-australia-and-new-zealand-2000-2040>

[237] Australian Bureau of Statistics (2021), Census of Population and Housing in Australia. <https://www.abs.gov.au/census/find-census-data>

[238] Department of Transport and Planning (2023), Victoria in Future. <https://www.planning.vic.gov.au/guides-and-resources/data-and-insights/victoria-in-future>

[239] In practice the proposed regulations would not trigger electrification at the point of renovation (see Chapter 9). This is not anticipated to materially change the results of the CBA as it would this would simply defer the timing of the electrification from at the point of renovation to the point at which the existing appliance has reached end of life.

[240] Demolition data was from building permits between 2017 and 2023 while renovations data was from building permits from 2022 to 2023. These figures are based on a period of low interest rates in Australia and therefore future rates of demolition or renovation may be lower than in this period. To the extent future demolitions or renovations are lower than this rate, this would reduce the costs and benefits attributed to the options proportionately, but unlikely to materially change the BCR as this would simply defer the timing of the electrification.

[241] Department of Energy, Environment and Climate Action (2018), Victorian Energy Upgrades Specification 2018- version 15. <https://www.energy.vic.gov.au/__data/assets/pdf_file/0018/636201/Victorian-Energy-Upgrades-Specifications-2018-Version-15.0.pdf>

[242] Australian Building Code Board (2021), NCC 2022 Update Whole of Home Component V03. <https://consultation.abcb.gov.au/engagement/consultation-ris-proposed-ncc-2022-residential/supporting_documents/NCC%202022%20Update%20%20Whole%20of%20House%20Component%20Energy%20Efficient%20Strategies.pdf>

estimated to require replacement each year. Some gas appliances, however, can be in service for greater than 14 years while some may fail earlier as well. The effects of extending the assumed appliance life to 15-20 years was assessed through sensitivity analysis in section 6.3.2.

5.2.1.1 Property disconnections from gas network

In addition to the timing of appliance upgrade, the timing of total property electrification was projected to determine the impact of full building disconnection from the gas network. In order to disconnect from the gas network, all gas appliances must be replaced within the property. As a result, the probability that households with two or more appliances all reaching end of life increases over time, and therefore a larger proportion of households will not disconnect until later in the analysis period.[243] Figure 5.1 below shows the projected proportion of disconnections of existing residential gas customers over time for Option 2, 3 and 4. Note, Option 1 does not apply to existing properties and therefore is not presented in Figure 5.1, while Option 2 and 4 follow the same pathway as they apply to the same cohort of existing residential appliances.

Under Option 2 and 4, it was assumed all residential properties are disconnected by 2039, which is based on the assumed gas appliance lifetime of 14 years. Under Option 3 it was assumed only 12.6 per cent of properties disconnect from the gas network, with the remaining households continuing to use gas cooking.[244,245]

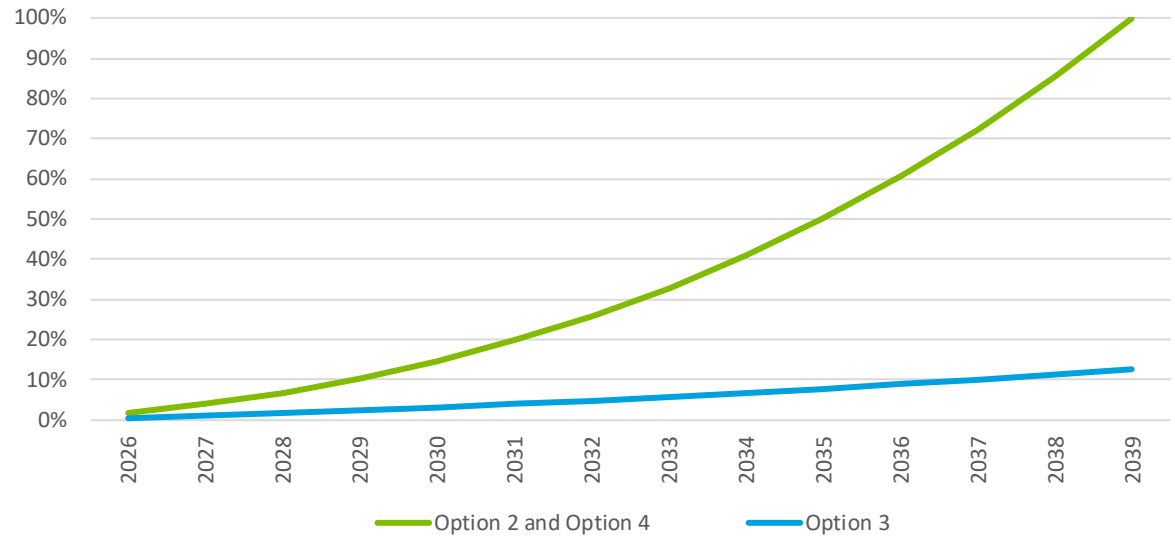
The modelling assumed that, beyond the assumptions about voluntary uptake of electric appliances under the Base Case, properties will only electrify appliances under each option when specifically required by the regulatory option. In reality, there may be an increase in properties that, having been required to electrify at least one appliance, also choose at that point to electrify all remaining appliances and then disconnect from the gas network when in the Base Case they may have chosen to remain connected to gas. For example, under Option 3 many properties that replace gas hot water and heating appliances with electric appliances will have cooktops as their only gas appliance that are not required by the regulations to be replaced. This may prompt some property owners to voluntarily disconnect and avoid paying gas supply charges for that appliance over time. In these cases, a property owner's choice to disconnect from the network may result in indirect or second-round impact of the regulatory change, as higher than predicted disconnections would result in gas supply charges being spread over a smaller number of users. Due to uncertainty around the level of increase in voluntary electrification and subsequent gas disconnection under options, this was not modelled. Any increased voluntary electrification and disconnection from the gas network under options would increase the impact of distribution supply charges for remaining gas customers. See section 7.2 for further consideration of impacts to the gas network.

[243] Profiles were calculated for each combination of heating, water heating and cooking appliances and combined to a weighted average annual disconnection profile based on the number of properties with one, two or all three appliances. Note there is limited data regarding the prevalence and combination of gas appliances in Victoria and therefore a degree of uncertainty around these figures, further research and/or stakeholder engagement is required to validate the assumptions adopted. Energy Consumers Australia (2023), Behaviour Survey October 2023. <https://energyconsumersaustralia.com.au/publications/surveys-energy-consumer-sentiment-behaviour#:~:text=Energy%20Consumers%20Australia&text=The%20Energy%20Consumer%20Behaviour%20Survey,way%20they%20use%20their%20energy>.

[244] Gas cooking is defined as capturing gas cooktops, gas ovens and integrated gas cooktop with ovens connected to the reticulated gas network.

[245] Energy Consumers Australia (2023), Behaviour Survey October 2023. <https://energyconsumersaustralia.com.au/wp-content/uploads/ECBS-October-2023-Household-Toplines.pdf>

Figure 5.1: Proportion of residential gas disconnections (% of total removed gas connections)



Source: Deloitte analysis

5.2.2 Commercial sector

Due to limited data on the prevalence of gas appliances in the commercial sector, the rate of electrification was estimated based on the volume of gas avoided for each sector. Given the limited information available on commercial sector gas usage the total impact of the proposed regulations is uncertain. Sensitivity testing was conducted and discussed in section 6.3 to test the robustness of results to key assumptions.

The existing volume of gas was determined using the total gas usage per square metre gross floor area (GFA) based on data from the Commercial Building Baseline Study (CBBS) conducted by the Commonwealth Department of Climate Change, Energy, the Environment and Water in 2022. The volume of gas for each sector was then distributed across the three use types – heating, hot water and cooking – based on data supplied from Sustainability Victoria.[246] See Table C.16 in Appendix C.

The total GFA of new commercial buildings impacted was forecasted out to 2045 using growth rates in GFA from the CBBS. For the purposes of CBA modelling, major renovations that require a building permit were treated as new buildings and assumed to electrify at point of renovation.[247] Therefore, the area of new commercial buildings was then adjusted for a 0.68 per cent annual rate of renovations and demolitions each year.[248] The existing commercial building GFA impacted in future years was diminished in line with the estimated number of renovations and demolitions. See Table C.14A.1.1.2Table C.14 in Appendix C.

As there is no data available on when commercial gas appliances will reach end of life, it has been assumed that existing gas use is displaced at a constant rate in line with the expected end of life of existing gas appliances. Commercial heating and hot water gas appliances were assumed to have an asset life of 20 years, therefore 5 per cent of gas usage is displaced each year.[249] Cooking gas appliances were assumed to have an asset life of 14 years,[250] therefore 7 per cent of cooking gas usage is displaced each year.[251] Businesses may more frequently replace appliances before end of life as businesses may open and close more frequently than the life of the asset, particularly for cooking appliances where appliance upgrades may be determined based on kitchen preferences, rather than the age of the appliance.

[246] EMET Consultants Pty Ltd for Sustainability Victoria (2008), Energy Efficiency Improvement in the Victorian Commercial Sector (unpublished).
[247] This is a modelling assumption and not government policy.
[248] Centre for International Economics (2018), Decision Regulation Impact Statement Energy Efficiency of Commercial Buildings. <https://static1.squarespace.com/static/5df9aa078642f943ece6a0b3/t/5f589c857e871053b87e5a58/1599642806533/Final_RIS_Energy_efficiency_of_commercial_buildings_PDF.pdf>
[249] DeltaQ (2024), NCC 2025 Energy Efficiency – Advice on the technical basis – Electrification Report <https://www.abcb.gov.au/sites/default/files/resources/2024/REP01080-B-006-Electrification-Report.pdf>
[250] Noting only residential style cooking appliances in existing commercial buildings are required to electrify under Option 2.
[251] Provided by DEECA based on multiple sources, including Oxford Economics Australia and market research.

Stakeholder questions:

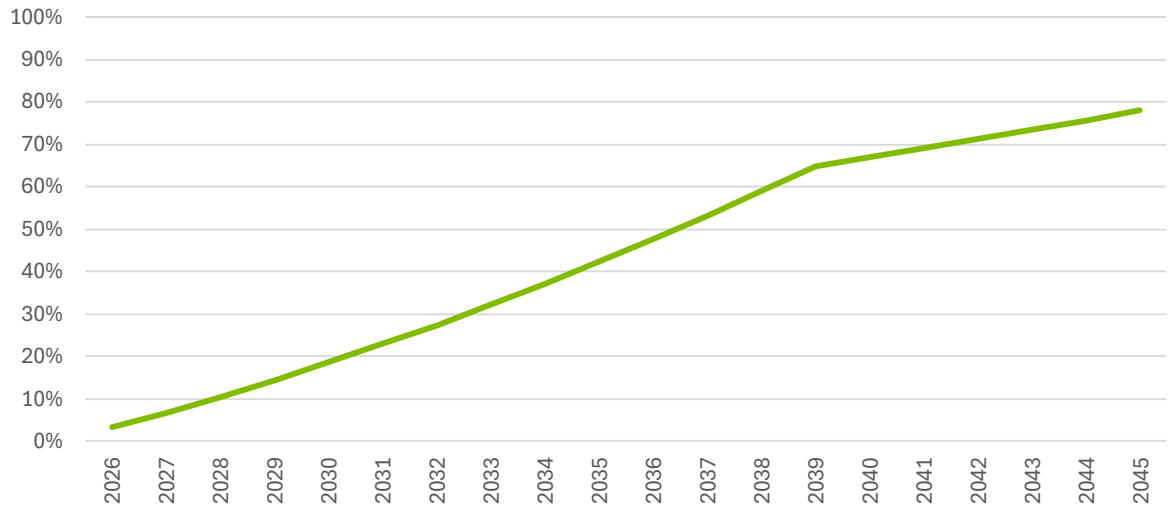
The Victorian Government seeks advice from stakeholders on any data related to:

- prevalence and energy usage of gas and electric appliances in commercial sectors, including both take up in new buildings and usage in existing buildings.
- asset lives of both gas and electric appliances in both residential and commercial settings.

5.2.2.1 Building disconnections from gas network

Similarly to residential properties, the rate of disconnection of commercial buildings was based on a probabilistic curve of multiple appliances reaching end of life. The profile, as shown in Figure 5.2, recognises that residential cooking appliances used in commercial contexts were assumed to have an asset life of 14 years while heating and hot water appliances were assumed to have an asset life of 20 years. Due to the exemption of existing commercial kitchens, only 78 per cent of buildings are projected to disconnect from the gas network by 2045.[252] Note that the rate of electrification reduces from 2039 as residential style cooking appliances are assumed to be electrified by this point (14 year asset life) and only heating and hot water appliances remain (20 year asset life).

Figure 5.2: Proportion of commercial gas disconnections under Option 2 (% of existing gas connections)



Source: Deloitte analysis

Stakeholder questions:

- The Victorian Government seeks advice from stakeholders on any data available related to prevalence of gas commercial kitchen appliances in commercial sectors, or any related data regarding the proportion of buildings in Victoria that use a reticulated gas network connection solely for heating or hot water purposes.

5.3 Costs and benefits estimated in the analysis

Following the determination of the impacted stock of residential and commercial buildings in each year of the analysis period, the monetary impact of the electrification requirement was calculated. This was based upon the expected and quantifiable costs and benefits that may result from the amendments.

[252] It was estimated 78 per cent of commercial buildings do not have a gas commercial kitchen based on the sum of buildings in each sector applied to an assumed proportion of buildings with commercial kitchen used in each sector. Note that there is limited data regarding the prevalence of commercial kitchens in commercial buildings across Victoria.

Costs estimated in the analysis for each option include costs associated with:

- the purchase and installation of appliances, including ancillary infrastructure where required, such as switchboard and connection capacity upgrades
- decommissioning of gas appliances, including abolishment of incoming gas lines
- administrative time spent by homeowners and businesses to understand obligations, obtain quotes and undertake logistical arrangements for the installation and decommissioning of appliances
- the cost to government to enforce and monitor the program.

There are three direct benefits incurred from electrification: benefits associated with change in energy usage, benefits resulting from avoided gas connection services and benefits resulting from avoided cooling appliance capital cots.

The overall impact on energy usage is measured by reduced fossil gas usage, offset by increased electricity demand. Electric appliances are overall more efficient than gas appliances (see section 2.2.2), resulting in an overall decrease in energy demand in buildings. As such, the overarching benefits estimated in the analysis for each option include reduced/avoided:

- energy expenditure
- GHG emissions
- health cost of air pollution
- gas network augmentation costs.

RCAC systems are available in a range of configurations, including single splits (for a single room), multi-splits (multiple rooms) or ducted central systems (whole house). The CBA analysis assumed that people replacing gas appliances would replace their system with an equivalent electric system that provides the same level of amenity. For example, it was assumed that a gas ducted heating system would be replaced with a central ducted or multi split RCAC, meaning that the costs of upgrading to similar appliances was also accounted for.

Furthermore, it was assumed that some properties with gas heating would no longer need to purchase a standalone cooling appliance as their gas heating appliance is replaced by a RCAC that provides both heating and cooling benefits.[253] Therefore, the benefit of avoided capital expenditure on cooling appliances was also included in the benefits analysis. This benefit only applies to households that would have had a cooling appliance under the Base Case (see section 5.5.5). Some properties may be constrained by building layout or regulation (such as heritage overlays) which prevent installation of an RCAC. See section 5.6.3 for further consideration around building modifications and Chapter 9 with regards to potential exemptions under consideration.

Table 5.1 describes the potential impacts from electrification requirements (relative to the Base Case) and their method of analysis.[254] The full methodology to estimating costs and benefits in the CBA is provided in section 5.4 and 5.5 respectively. The impacts from the energy market modelling and the CGE analysis are discussed in Chapter 7 with the method undertaken for each provided in Appendix D and Appendix E respectively.

[253] It was assumed residential properties with ducted gas would upgrade to whole of property RCAC, either through ducted, multi-split or installation of multiple RCAC systems. This was accounted for in the incremental cost assumptions (see Table C.2 for details on assumed upgrade pathways). Note the CBA does capture increased electricity consumption from heating (assuming no change in behaviour as a result of the switch, see section 5.6.10) but does not capture increase in electricity consumption from cooling. It also does not account for the improved consumer benefit of better cooling and therefore it is assumed that any increase in cost from more cooling usage is in line with the value of consumer preference for cooling.

[254] The CBA does not capture impact of electrifying gas heated residential swimming pools. While there are estimated to be only a small number of residential gas heated swimming pools, they would incur a cost to upgrade to electric. The impact of regulation on residential swimming pools is assessed in section 7.4.

Table 5.1: Potential impacts of the options relative to the Base Case

Impact	Impact type	Party bearing the cost/benefit	Analysis
Direct impact of option(s) on buildings			
Appliance and installation costs for electric appliance upgrade	Cost	Homeowners and businesses	CBA
Costs of removing and decommissioning gas appliances	Cost	Homeowners and businesses	CBA
Building infrastructure costs, including switchboard and connection capacity upgrades and gas disconnection cost	Cost	Homeowners and businesses	CBA
Administrative costs involved in identifying new electric appliances	Cost	Homeowners and businesses	CBA
Government costs of implementation and monitoring reform	Cost	Government	CBA
Lost productivity as a result of interrupted businesses operations	Cost	Businesses	Qualitative
Energy cost savings from reduced gas usage, offset by increased electricity usage	Benefit	Homeowners and businesses	CBA
Reduced carbon emissions from reduced gas usage partially offset by increased electricity consumption	Benefit	State-wide	CBA
Reduced health impacts from reduced gas air pollution partially offset by increased electricity consumption	Benefit	State-wide	CBA
Avoided capital expenditure on cooling appliances as a result of electric heating appliances that can be used for cooling purposes	Benefit	Homeowners and businesses	CBA
Avoided gas network costs, including capital cost to connect new buildings and operational costs as buildings disconnect from the network.	Benefit	Homeowners and businesses	CBA
Additional GHG emissions from heat pump refrigerant gases	Cost	Homeowners and businesses	Qualitative, see Chapter 7.
Lost productivity as a result of interrupted business operations	Cost	Businesses	
Lost future option value	Anticipated cost	Homeowners and businesses	
Indirect impact on Victorian electricity and gas markets			
Change in electricity tariffs due to change in: 1. generator fuel 2. capital expenditure 3. network capacity upgrades.	Anticipated cost	Homeowners and businesses	Qualitative, informed by energy market modelling. See Chapter 7
Change in wholesale electricity market carbon emissions due to change in generator fuel mix as a result of the options	Anticipated cost	State-wide	

Impact	Impact type	Party bearing the cost/benefit	Analysis
Change in reliability in gas supply for users who do not electrify due to lower demand	Anticipated benefit	Homeowners and businesses	
Change in gas tariffs for users who do not electrify due to: • rising network chargers per customer • wholesale gas prices who do not electrify due to lower demand.	Anticipated cost	Homeowners and businesses	
Change in gross state product (GSP) and gross value added (GVA) to the economy	Impact	State-wide	Qualitative, informed by CGE. See Chapter 7.
Impact on access to labour and materials	Anticipated cost	State-wide	Qualitative, see Chapter 7.

Source: Deloitte analysis

5.4 Approach to estimating costs in the CBA

Following determination of the impacted stock of residential and commercial buildings in each year of the analysis period, the monetary impact of the electrification requirement was calculated, based upon the expected and quantifiable costs and benefits that may result from the amendments.

Expected costs estimated in the analysis for each option include costs associated with:

- the purchase and installation of appliances, including ancillary infrastructure where required, such as switchboard and connection capacity upgrades
- decommissioning of gas appliances, including abolishment of incoming gas lines to a premises
- administrative time spent by homeowners and businesses to understand obligations, obtain quotes and undertake logistical arrangements for the purchase and installation of required appliances and decommissioning of gas
- the cost to government to enforce and monitor the program.

5.4.1 Residential sector

5.4.1.1 Purchase and installation capital costs

For new buildings and appliances replaced at end of life, purchase and installation costs were calculated as the incremental capital expenditure of adopting electric appliances instead of gas appliances. The analysis recognises that residential properties may have multiple electrical upgrade options available to replace the existing gas appliance ('upgrade pathways'). For the residential sector, the cost to upgrade an existing gas appliance was based on a weighted average cost of purchasing and installing new electric appliances. Sources used to estimate the cost of purchasing and installing new electric appliances are included in Appendix C (see Table C.4 to Table C.7).

Exemptions from meeting the electrification requirement have been proposed for Class 1,Class 2 and Class 10b buildings where cost of installation is disproportionately higher than average. Exemptions are also proposed for existing Class 1, Class 2 and Class 10b buildings where space constraints make the installation of an electric appliance impractical. See Chapter 9 for more details on proposed exemptions.

Gas heating appliances in existing properties incur an additional cost to decommission and remove, with the assumption that 20 per cent of properties that electrify their heating would require additional removal of the heating system relative to the Base Case. In this case, removal is defined as the complete removal of an existing gas heating appliance (such as removal of ductwork).[255]

[255] In many cases, the existing gas appliances can remain in-situ as the electric appliance may be installed in a separate location. However, there may be cases where the existing gas appliance will need to be removed completely in order to install an electric appliance in the same location. It was assumed that 20 per cent of properties that upgrade heating encounter this situation (assumption provided by DEECA). Complete removal of the gas appliance is not required under the proposed regulations.

5.4.1.2 Building infrastructure and upgrade costs

All gas lines that are no longer in use were assumed to incur a cost to cap the gas line to prevent gas from leaking.[256] These costs were applied only to existing buildings and renovations.

Switchboard and connection capacity upgrades would also be needed in some instances to accommodate the increased electrical load. It was estimated that 19 per cent of residential properties that upgrade their cooking appliances will require switchboard and connection capacity upgrades.[257,258,259] The switchboard and connection capacity upgrade costs are only applicable to existing residential properties as new residential properties are already built to a higher specification. It is proposed that an exemption apply where the installation of an electric appliance requires augmentation of a distribution system to provide more than a basic or standard connection service. Electricity Distribution Businesses are required to offer basic and standard connection services below a threshold applying to "the average size of the customers connected to the network."[260] Where a connection exceeds the criteria set in the approved connection policy, additional costs may be incurred, with these situations proposed to be exempt from the regulations.

A low and high cost of switchboard and connection capacity upgrade was tested in the sensitivity analysis (see section 6.3). The upper end of this sensitivity is intended to cover the costs associated with a basic or standard connection upgrade, in addition to other potential ancillary costs such as new wiring pathways.

It is important to note that some existing Class 2 properties may have shared heating and hot water services via an owners corporation that makes electrification more complex, and potentially more costly. Due to limited data on the prevalence of shared gas services in Class 2 buildings and the cost of electrification there is some uncertainty regarding the magnitude of these costs. An additional cost of $1,000 per Class 2 property for replacing a gas instant hot water system with a heat pump hot water system was incorporated in the CBA to reflect the potential shared costs for Class 2 buildings and for instances where limited space may be a barrier, based on an assumption provided by DEECA.

Exemptions have been proposed for existing Class 1, Class 2 and Class 10b buildings where the costs to augment the electrical supply to the property are disproportionately high. Costs associated with upgrading switchboard are considered as part of the normal cost associated with the upgrade and no exemptions are available on this basis. Exemptions are also proposed for buildings with centralised services. Section 9.1contains more details on the proposed exemptions.

Once fully electrified, residential properties would also incur a $242 gas abolishment cost to disconnect from the gas network, based on the AER's final decision on the charge for disconnecting customers. Gas distribution network providers may face an additional cost above the $242 per customer which would be passed on to the broader customer base. This additional cost was tested in the sensitivity analysis (see section 6.3) and considered as part of the energy market analysis (see section 7.2).

The cost of disconnection was applied to the number of gas customer disconnections each year as described in section 5.2.1.1.

For new buildings electrifying as a result of the proposed regulations, the CBA included an avoided cost for gas piping which is partially offset by an additional electrical wiring cost, based on estimates from GHD.[261]

Stakeholder questions:

- The Victorian Government seeks advice from stakeholders on any data available related to prevalence of shared gas services in Class 2 buildings and views on relevant costs associated with electrification of shared gas services, including the potential need for exemptions.

[256] ACT Government (2023), Switching off your gas connection – What you need to know. <https://energy.act.gov.au/wp-content/uploads/2023/06/Switching-off-your-gas-Fact-sheet.pdf>.
[257] Where cooking appliances are exempted under Option 3, 19 per cent was applied to the number of gas heating appliances replaced (noting this figure is higher than the number of hot water appliances replaced each year and therefore more conservative).
[258] Solar Victoria, Home Heating and Cooling program data.
[259] Frontier Economics (2022), Cost of switching from gas to electric appliances in the home. <https://gamaa.asn.au/wp-content/uploads/2022/07/Frontier-Economics-Report-GAMAA.pdf>. Appendix D contains the list of sources consulted for the market analysis.
[260] Australian Energy Regulator (2024), Connection charge guidelines for electricity customers. <https://www.aer.gov.au/system/files/2024-10/Connection%20charge%20guidelines%20-%20updated%20October%202024.pdf>
[261] GHD (2022), All-electric new homes: Cost assessment. <https://engage.vic.gov.au/help-us-build-victorias-gas-substitution-roadmap>.

5.4.1.3 Administrative costs

Administrative costs associated with time spent by homeowners and businesses to understand obligations, obtain quotes and undertake logistical arrangements for the purchase and installation of required appliances under each option were included in the analysis.

For new residential properties, it was assumed that property owners will incur no additional administrative burden relative to the Base Case, as homeowners will need to make decisions about appliances to be installed in their new building under both cases.[262]

For existing properties, it was anticipated that homeowners will incur higher administrative costs than under the Base Case due to the additional time required to research electric alternatives for existing gas appliances and to arrange for decommissioning of gas appliances. Relative to the Base Case, in which property owners would already spend time and effort identifying potential replacement appliances, it was assumed that it would take homeowners one additional hour to undertake administrative tasks associated with meeting the requirements at the end of an appliance's life. It is possible that some homeowners may incur additional time and effort to research additional upgrade infrastructure such as switchboard and/or connection supply. However, it is unknown to what extent additional time may be required noting that while options for upgrades are relatively standardised, property owners may wish to collect several quotes before proceeding. SEC Victoria has also introduced a free digital platform to support households in identifying suitable appliances and indicative costs and rebates available, which may reduce the potential administrative costs.[263]

Administrative costs for residential properties were based on an average value of leisure time of $36 in Australia for homeowners, based upon average weekly earnings.[264] See Table C.1 in Appendix C.

Stakeholder questions:

The Victorian Government seeks advice from stakeholders regarding any data available related to the:

- administrative time required by residential homeowners to assess alternative options for the purchase and installation of an electric appliance and any additional infrastructure such as switchboard or connection supply upgrade.
- purchase and installation costs of electrifying residential buildings, including ancillary costs for labour, switchboard, and supply connection upgrades.
- proportion of homes which require switchboard, supply connection or broader wiring upgrades.

5.4.2 Commercial sector

The transition of commercial buildings from gas to all-electric involves significant variability in the technology and infrastructure required and associated costs. Based on available data and information, there are several challenges in providing a robust and confident cost estimate for electrification of commercial buildings.

First, there are no publicly available resources providing a comprehensive breakdown of the capital cost of commercial building electrification in Australia for specific sectors and industries. There are a handful of international reports focused on office buildings within specific regions of the United States. While product costs in these reports may be similar, there are a range of factors which can drive significant variation, such as local construction and safety laws, so the applicability of these reports in the Australian context is unclear.

Second, the costs of electrification depend on a range of factors, such as the number of buildings currently using fossil gas, the type and scale of operations, the age and condition of the building, specific technologies being implemented, and the

[262] Some homeowners may require a marginally more time to consider electric alternatives for gas appliances for developing new buildings, but there may also be time savings from avoided research for gas related appliances and infrastructure (e.g., having a gas connection and piping installed).
[263] State Electricity Commission (2024), SEC Helps Households Switch to Electric and Save. <https://www.premier.vic.gov.au/sec-helps-households-switch-electric-and-save>
[264] The Office of Impact Analysis (2023), Regulatory Burden Measurement Framework. <https://oia.pmc.gov.au/sites/default/files/2023-09/regulatory-burden-measurement-framework.pdf>.

existing infrastructure. For example, the capital cost of a commercial induction fryer can be cheaper than a gas fryer,[265] while retrofitting heating in a large office can cost upwards of $2 million.[266]

The local climate (such as temperature) also can have a significant impact on the economics of commercial electrification. A study in the United States assessed the potential NPV of electrifying an existing medium sized office building across four different cities. The study demonstrated that local environment has a significant influence on the economic outcome, with overall results ranging from USD -74,662 (net present value cost) to USD 2,883 (net present value benefit), with 7 out of 8 scenarios resulting in a net economic cost. However, it is unclear if the study included the value of emissions reduction and other non-financial benefits in the NPV calculation.[267]

Third, variation in methodologies employed by publicly available studies complicates cost comparisons. For example, some studies only consider the cost of the product, while others consider broader costs such as additional electrical infrastructure, avoided gas infrastructure in new builds or avoided capital costs for cooling systems.

5.4.2.1 Purchase and installation costs

Heating and hot water costs were set at the weighted average cost of large and small commercial buildings based on the volume of avoided gas usage.

The purchase and installation costs for large buildings were based on analysis of selected building archetypes undertaken by DeltaQ.[268] The cost analysis considered two archetypes for heating, a multi storey office and large hospital, and three archetypes for hot water, office, hospital and aged care. The purchase and installation costs also incorporated incremental ancillary costs, including additional building modification costs (i.e. plantroom cost), electrical infrastructure upgrades, as well as removal and decommissioning of gas appliances in existing buildings. Costs were based on a weighted average of climate zone 4, climate zone 6 and climate zone 7, weighted by proportion of Victoria's population in each climate zone. See Table C.19 to Table C.20 in Appendix C.

Due to limited cost data available for other sectors and building sizes, these costs were estimated based on the MJ of gas avoided per upgrade for known sectors (offices and hospitals) and applied to other sectors as shown in Table 5.2. This approach assumed upgrade costs are linearly linked to the volume of gas used, noting that costs of electrification are in practice driven by a number of variables besides gas volume.

Table 5.2 below presents the large building cost archetype that was applied to each sector. The archetype allocated to each sector was based on anticipated similarities in energy usage behaviour for the sector, for example where heating is typically used in 24-hour operations (and therefore a hospital archetype was adopted) compared to heating for only key periods of the day (e.g. 8am to 5pm and therefore an office archetype was adopted). While total upfront cost to electrify was estimated to be marginally higher for a hospital archetype than for an office archetype, the cost per MJ of energy required is higher for an office building than a hospital. This reflects the lower energy usage, and therefore reduced economies of scale, in office buildings relative to hospitals.

See section 5.6.1 for further discussion on limitations of commercial sector analysis.

[265] Green Building Council of Australia and Cundall (2022), A practical guide to electrification: for new buildings. <https://www.cefc.com.au/media/v21jesrl/a-practical-guide-to-electrification.pdf>
[266] DeltaQ (2024), NCC 2025 Energy Efficiency – Advice on the technical basis – Electrification Report <https://www.abcb.gov.au/sites/default/files/resources/2024/REP01080-B-006-Electrification-Report.pdf>
[267] RMI (2022), Medium-size commercial retrofits: how to electrify mid-size office buildings to save energy, money, and carbon. <https://rmi.org/insight/economics-of-electrifying-buildings-medium-size-commercial-retrofits/>
[268] DeltaQ (2024), NCC 2025 Energy Efficiency – Advice on the technical basis – Electrification Report <https://www.abcb.gov.au/sites/default/files/resources/2024/REP01080-B-006-Electrification-Report.pdf>

Table 5.2: Large building cost archetype applied to each sector

CBBS commercial sectors	Building Class	Electrification cost archetype	
		Heating	Hot water
Short term accommodation buildings	Class 3	Hospital	Aged care
Offices	Class 5	Office	Office
Commercial buildings not elsewhere categorised[1]	Class 6	Office	Office
Entertainment and recreation buildings[1]	Class 9	Office	Office
Retail and wholesale trade buildings[1]	Class 6	Office	Office
Warehouses	Class 7B	Office	Office
Education buildings	Class 9	Office	Office
Religion buildings	Class 9	Office	Office
Aged care facilities	Class 9	Hospital[2]	Aged care
Health facilities	Class 9	Hospital	Hospital
Non-residential buildings not elsewhere categorised	Class 10	n/a	n/a

Source: Deloitte analysis. 1. Some building types (such as retail or entertainment buildings) may operate longer than a standard office building. For the purposes of this analysis the cost was based on office archetype as the cost per MJ of gas avoided is higher than the hospital archetype (due to the significantly lower gas consumption on office buildings relative to hospitals) and therefore is more conservative in the estimation of cost to electrify these sectors. 2. Aged care building archetype was only provided for hot water system.

Recognising that many businesses operate in small buildings, the cost of large buildings was blended with an estimated cost for small buildings. The costs for small buildings were estimated using the residential cost of an upgrade per MJ of gas taken out of the energy system in Victoria, under the assumption that smaller businesses are more likely to use residential gas appliances. Method for estimating residential cost of electrification is provided in section 5.4.1 and further assumptions provided in Table C.5 to Table C.7.

As there is no data on the proportion of small or large buildings in Victoria, the weighting of the commercial cost was based on the proportion of small and large businesses based on ABS Count of Australian Businesses.[269] It was assumed all small businesses in Melbourne CBD and half of small businesses in surrounding inner suburbs of Melbourne or regional cities (e.g. Ballarat) operate in large-shared buildings. Small businesses in outer suburbs and regional areas were assumed to occupy small buildings only. There may be a number of small businesses operating out of single occupancy/small buildings in the CBD, therefore the approach is more conservative in the estimated cost of electrification as a result (noting the relative cost is expected to be higher for a large building than a small building). The proportion of small to large buildings in Victoria for each sector is provided in Table C.17.

The methodology for calculating the purchase and installation costs associated with replacing gas cooking appliance with electric alternatives in new buildings involved a weighted average cost for commercial kitchens and non-commercial kitchens.[270] Similar to the approach taken for residential heating and hot water, the cost of non-commercial kitchens was based on the residential cost of replacing gas appliances with electric, per MJ of gas energy saved.[271] Costs associated with commercial kitchens were based on a case study of a Sydney cafe reported by the Green Building Council Australia and adjusted to account for additional electrical infrastructure costs.[272] These costs were then multiplied by the proportion of gas use attributed to non-commercial and commercial kitchens in new buildings, respectively. Noting this is a point estimate of costs, it is recognised there is likely significant variability in the cost of electrification of new commercial kitchens due to the types of appliances currently in use and operational factors.

[269] For the purpose of this analysis a small business is defined as a business with up to 19 employees and a large business is defined as a business with 20 or more employees.
[270] Non-commercial kitchen refers to a standard residential gas stove and oven used in a commercial business, such as an office.
[271] See section 5.4.1 regarding the approach to estimating costs for the residential sector.
[272] Green Building Council Australia (2022), A practical guide to electrification for existing buildings. <https://gbca-web.s3.amazonaws.com/media/documents/electrification-guide---existing-buildings-final.pdf> Additional electrical infrastructure cost based on ratio of electrical cost to mechanical cost from DeltaQ (2024), NCC 2025 Energy Efficiency – Advice on the technical basis – Electrification Report < https://www.abcb.gov.au/sites/default/files/resources/2024/REP01080-B-006-Electrification-Report.pdf>

There is no publicly available data on the proportion of commercial and non-commercial kitchens across commercial sectors in Victoria. While there is high variability in annual gas use of commercial kitchens, data indicates a standard residential kitchen uses less than 0.5 per cent of annual gas required by a commercial kitchen. Therefore, it was assumed that gas for cooking in the commercial sector is primarily driven by commercial kitchens rather than non-commercial kitchens. The proportion of cooking energy usage attributed to commercial kitchens and non-commercial kitchens is presented for each sector in Table C.18 (noting that existing commercial kitchens are exempt from the proposed regulations).

It is also noted that buildings replace a gas heating system with an RCAC system would also receive cooling from the appliance and therefore would avoid paying additional costs to replace their cooling system in the future. This dynamic is detailed further in section 5.5.5.

Stakeholder questions:

The Victorian Government seeks advice from stakeholders regarding any data available related to the:

- purchase and installation costs of electrifying new and/or existing buildings in relevant commercial sectors, including estimated cost differentials between small, medium and large commercial buildings.
- prevalence of small and large buildings in Victoria for relevant commercial sectors.
- prevalence of commercial kitchens in Victoria and costs associated with electrifying or utilising LPG in commercial and non-commercial kitchens in across various commercial sectors.

5.4.2.2 Building infrastructure and upgrade costs

Building costs for the commercial sector capture the cost for existing buildings to abolish their gas connection.[273] The number of buildings abolishing gas each year was based on projected disconnections as described in section 5.2.2.1. Additional infrastructure costs such as electrical and appliance removal were captured in the purchase and installation cost for commercial buildings.

For new buildings electrifying, an avoided cost for gas piping infrastructure was included as a benefit.[274] For small buildings a cost in line with Class 1 buildings was adopted. The cost of gas piping is much more variable for large buildings depending on the size and operations of the building. Due to limited data available in the Australian context, an average cost of $21,000 per commercial building was assumed, based on studies published in the United States.[275] It is possible that rising labour cost in Australia may mean construction costs are higher than the United States. To the extent this is the case, the avoided gas piping cost may be understated, leading to a more conservative assumption around the potential benefits of the proposed regulations. However, there is insufficient evidence to indicate this is the case and therefore no adjustment has been applied. See Table C.23 in Appendix C.

5.4.2.3 Administrative costs

Commercial properties are likely to incur higher administration time and effort to upgrade their gas appliances compared to residential properties.

The precise time and effort that would be required by various businesses to consider electrification options is unknown. Many medium to large businesses would likely be already considering electrifying certain appliances even in the Base Case due to recent volatility in gas energy costs and the increased corporate focus on net zero emissions commitments and Environmental, Social and Governance (ESG) reporting.

For existing building's end-of-life replacement, it is expected that many businesses would already undertake work to review their appliances at end of life. The level of effort to consider electric options is likely linked to the scale of the business' operations and the extent to which a business is already reviewing emissions reduction alternatives as part of ESG practices. Given there is limited information regarding how long it would take to organise the replacement of a gas appliance at end of life (and likely significant variability across businesses), an assumption of one week of additional administrative effort relative to the Base Case was applied to all buildings based on the following considerations:

[273] Average gas abolishment cost based on data provided by AusNet Services. Note the AER determination to cap the cost of gas abolishment only applies to small customer abolishments.
[274] An additional cost for greater electrical wiring in new buildings was also accounted for, see section 5.4.2.1.
[275] Group14 Engineering (2020), Electrification of Commercial and Residential Buildings. New Buildings Institute (2022) Cost Study of the Building Decarbonization Code.

- large commercial buildings are likely to have a building manager that would already be responsible for reviewing options and organising logistics once the existing appliance reached end of life, and therefore, any administrative time associated with replacement is likely to be captured within their existing business-as-usual cost
- small to medium buildings that do not have a building manager are likely less complex to switch to electric and therefore would require a few days to collate and review options and a few days to organise and plan logistics, noting that this is additional to what would have already been required to replace a gas appliance at end of life.

The administration cost for commercial buildings has been based on the standard wage of facilities managers in Victoria, as reported in the 2021 Census, and an additional factor of 75 per cent applied to account for overheads and on-costs in line with guidance from the Department of Treasury and Finance.[276] See Table C.23 in Appendix C.

Stakeholder questions:

The Victorian Government seeks advice from stakeholders on

- the key cost factors and considerations that may impact the cost of electrifying new or existing buildings in commercial settings that have not been identified
- any data available related to the administrative time and associated cost of planning for and implementing electrification in commercial buildings.

5.4.3 Cost to government

The costs to Victorian Government associated with electrification of existing buildings are associated with the cost of enforcing and monitoring the program, namely from the requirement to audit plumbing compliance certificates. Under the *Building Act 1993*, licensed plumbers in Victoria are required to issue a compliance certificate upon completing certain plumbing works to certify that the plumbing work undertaken complies with prescribed plumbing standards.[277] Plumbing works requiring a compliance certificate includes the installation, relocation, replacement or conversion of any gas using appliance or consumer gas piping.[278] Therefore, it was assumed all gas appliances replaced with electric appliances in existing buildings would require a plumbing certificate. The VBA audits 2 per cent of compliance certificates each year, therefore, an average cost of $656 per audit was applied to 2 per cent of upgrades each year.[279]

The cost to conduct audit and inspection of compliance certificates is partially covered by the revenue collected from the sale of compliance certificates. Therefore, some of the audit cost to implement the proposed regulations will be borne by the plumbers and property owners undertaking the work, rather than funded through the government's broader consolidated pool of revenue.

The electrification of new buildings would not impose audit costs on government and would in fact present savings to government as new buildings would no longer require gas appliances, and by extension, plumbing certificates. These savings were not quantified.

5.5 Approach to estimating benefits in the CBA

There are three direct benefits incurred: benefits associated with change in energy usage, benefits resulting from avoided gas network costs and avoided cooling appliance costs.

The overall impact on changed energy usage was measured by reduced fossil gas usage, offset by increased electricity demand. Electric appliances are overall more efficient than gas appliances and therefore result in an overall decrease in energy demand for buildings. Therefore, the overarching expected benefits estimated in the analysis for each option include reduced/avoided:

- energy expenditure
- GHG emissions

[276] Victorian Department of Treasury and Finance (2018), Victorian Regulatory Change Measurement Manual. <https://www.dtf.vic.gov.au/reducing-regulatory-burden/regulatory-change-measurement-manual>
[277] Victorian Building Authority, Issuing compliance certificates. <https://www.vba.vic.gov.au/plumbing/renewals-other-requirements/compliance-certificates>
[278] Victorian Building Authority, Plumbing compliance certificates. <https://www.vba.vic.gov.au/consumers/home-renovation-essentials/plumbing-compliance-certificates>
[279] The average cost of certificate audit was provided by the VBA and applies to all building and appliance types.

- health costs of air pollution.

In addition, buildings that electrify would save costs related to gas network infrastructure and operations, as well as avoid the costs of having to upgrade or install new cooling appliances due to dual functionality of RCACs.

5.5.1 Reduced energy expenditure

Savings on energy expenditure were calculated based on the average annual fossil gas energy usage of a gas appliance minus the average annual electricity usage of the upgraded electric appliance.

Change in energy usage was monetised by applying a dollar per MJ gas price or per kilowatt-hour (kWh) electricity price. The price applied reflects variable components of retail bills (wholesale and retail costs). It excludes fixed network component which may be considered a transfer rather than change in cost to Victoria as they are primarily made up of fixed infrastructure costs and therefore a change in energy consumption does not directly result in a change in network costs. Specifically in the gas sector, fixed costs avoided by those who disconnect from the network would be transferred to customers remaining connected to the gas network (assuming the current regulatory framework applies). However, potential savings in operational costs as a result of gas network providers servicing fewer customers is considered in section 5.5.4.[280]

Forecasted wholesale gas prices projections are from AEMO's 2023 Inputs Assumptions and Options Report Step Change scenario. Due to changing wholesale gas market conditions, there is significant uncertainty around the future of gas prices in Victoria. Change in wholesale gas prices were tested as a sensitivity and further discussion on wholesale gas market changes is considered in section 7.2.

Electricity wholesale prices were modelled by Endgame Economics (2024), with AEMO's Draft 2024 ISP Step Change model used as a direct basis and current market bidding behaviour overlaid. Forecasted wholesale gas and electricity prices adopted in the CBA are shown in Figure 2.5 and Figure 2.6 (Chapter 2), respectively. See Table C.1 for further details.

Some electricity consumption is also required to run gas appliances and ancillary infrastructure in buildings. This avoided electricity consumption as a result of electrification was captured in the net energy cost savings. An additional benefit of avoided cooling appliance energy as a result of electrification of heating in large buildings is included for the commercial sector. Potential reduction in cooling appliance energy was based on analysis of the DeltaQ case study of a large office and hospital building heating upgrade, which indicated that one MJ in avoided gas usage for heating enabled a 0.12 MJ reduction in electricity required for cooling.[281]

Significant electrification under the regulatory options may have an impact on energy markets, resulting in changes in electricity or gas prices. The impact of this flow on effect was not captured in the CBA but is discussed in Chapter 7.

Finally, the combined impact of solar PV on rooftops of properties that electrify is out of scope for the CBA. However, for properties that already have solar PV (or would intend to install for a new build under the Base Case), this is expected to increase the energy savings for buildings that switch to electric as a result of a reduction in the energy required to purchase from the grid.

The climate zones modelled for the CBA were the NCC climate zones 4 (hot, includes Mildura), 6 (moderate [includes Melbourne]) and 7 (cold, includes Ballarat). The energy used for heating a typical residential property in each of these climate zones was identified by DEECA, with a volume weighted average then obtained depending on the number of residential properties within that climate zone. Given that most residential properties are in climate zone 6 (this zone contains 85 per cent of Class 1 and 96 per cent of Class 2 residential properties),[282] the volume weighted average is largely aligned to climate zone 6. In climate zone 7, more heating energy would be required to maintain a comfortable indoor temperature during winter. The benefits of switching from gas to a more efficient electric alternative would be higher in this region. Conversely, less heating would be required in climate zone 4 due to the warmer weather, thereby offering lower benefits from switching to an electric alternative compared to the volume weighted average.

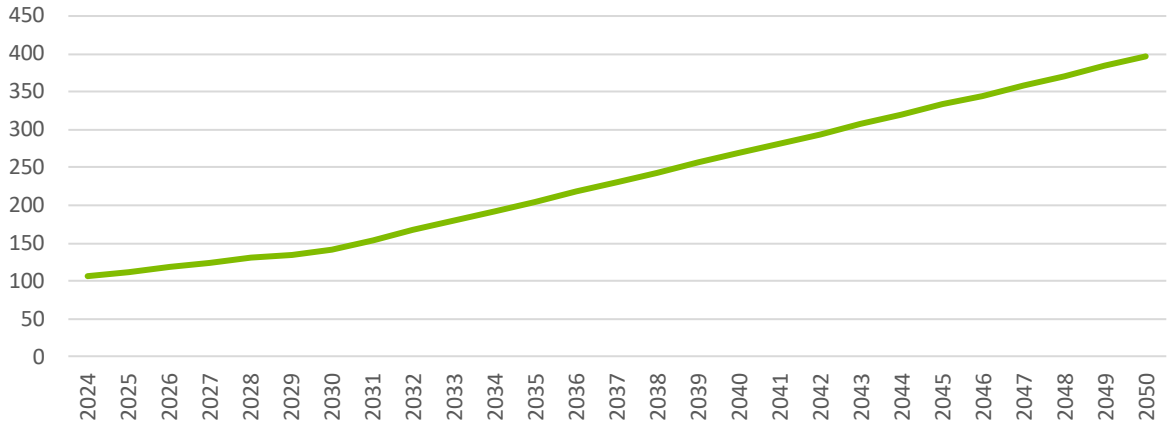
[280] See section 7.2.2 for further consideration of potential implications of the options on gas networks and section 8.5 for consideration of impacts on remaining gas users as a result of the preferred option.
[281] DeltaQ (2024), NCC 2025 Energy Efficiency – Advice on the technical basis – Electrification Report <https://www.abcb.gov.au/sites/default/files/resources/2024/REP01080-B-006-Electrification-Report.pdf>
[282] Energy Efficient Strategies (2022) for DEECA, Options analysis for minimum energy efficiency standards for rented premises.

5.5.2 Reduced greenhouse gas emissions

Estimation of the monetary value of avoided GHG emissions under each option was also determined based on the estimated reductions in energy usage. Energy usage was converted from kWh and MJ into tonnes of GHG emissions, by applying a gas and electricity emissions intensity factor. The emissions intensity of Victoria's electricity market was provided by Endgame Economics, based on AEMO's 2023 Inputs Assumptions and Options Report Step Change scenario (for consistency, the same scenario is used for analysis of electricity wholesale prices). As described in Chapter 2, the future emissions intensity of the electricity sector is anticipated to decrease in line with Victoria's renewable energy targets. Gas emissions intensity factors were sourced from the National Greenhouse Accounts Factor (2023).[283] Comparison of forecasted emissions intensity of electricity and gas is presented in Figure 2.11 (see Chapter 2). See Table C.1 for further details.

GHG emission quantities were converted to monetary units by applying a dollar per tonne value of carbon. Carbon values were provided by DEECA and based upon targets-based carbon values in the IPCC Sixth Assessment Report. Sensitivity of CBA results to carbon values is tested in section 6.3.1.8.

Figure 5.3: Forecasted carbon value ($/tCo$_2$-e)



Source: Provided by DEECA based on IPCC Sixth Assessment Report

5.5.3 Reduced health costs of air pollution associated with use of gas appliances and electricity generation

The reduced negative impact on health was measured by applying a monetary value to decreased fossil gas and increased electricity usage, which represents the avoided cost of air pollution. For change in reticulated fossil gas consumption, a health cost of $0.29 per GJ was adopted.[284] For electricity usage, a weighted average was applied based on the health cost of coal fired electricity generation[285] and fossil gas combustion from gas-fired electricity generation in line with the forecast mix of coal and gas generation in the electricity market.[286] Health costs of air pollution from electricity decline over time in line with the electricity emissions intensity, as detailed in section 2.5.2.

5.5.4 Avoided gas network costs

Buildings that switch to electricity would no longer require connection to the gas network and therefore enable savings in gas network costs, including:

- avoided gas augmentation costs for connecting new buildings to the network
- avoided operational costs for new and existing gas connections as customers disconnect from the network.

As new residential and commercial buildings would no longer need to connect to the gas network, gas distributors will not need to expand their network for new customers. This represents savings through avoiding the expenses associated with

[283] Department of Climate Change, Energy, the Environment and Water (2023), National Greenhouse Accounts Factors 2023. <https://www.dcceew.gov.au/sites/default/files/documents/national-greenhouse-account-factors-2023.pdf>.
[284] Ward and Power (2015), Cleaning up Victoria's power sector: The full social cost of Hazelwood power station. Harvard Kennedy School of Government.
[285] Ward and Power (2015), Cleaning up Victoria's power sector: The full social cost of Hazelwood power station. Harvard Kennedy School of Government.
[286] Australian Technological Sciences and Engineering (ATSE) (2009), The Hidden Costs of Electricity: Externalities of Power Generation in Australia. <https://www.atse.org.au/wp-content/uploads/2019/01/the-hidden-costs-of-electricity.pdf>

augmenting the gas network. The value of the avoided augmentation cost was based on the average cost of a new gas connection for residential and commercial buildings.[287] See Table C.2 and Table C.23 for details.

It is anticipated that gas networks would reduce some of their operating expenditure as a result of fewer customer numbers. The two broad drivers of gas network operating expenditure are customer numbers and length of gas network. An annual saving for avoided operational expenditure related to servicing customer numbers was applied to the number of disconnections under each option.[288] See Table C.2 and Table C.23 for details. Other potential impacts on Victoria's gas network as a result of customer disconnection are considered in Chapter 7 and Chapter 8.

5.5.5 Avoided capital expenditure on cooling appliances

As mentioned in section 5.5.5, it was assumed that some buildings with gas heating would no longer need to purchase a standalone cooling appliance as their gas heating appliance is replaced by an RCAC that provides both heating and cooling capability.

Not all residential properties would have purchased a standalone cooling appliance under the Base Case. For the purposes of the CBA it was assumed 12 per cent of residential properties would not have a cooling appliance and therefore would not receive the benefit.[289] An average cost per heating upgrade was adopted based on the property class and type of gas heating appliance replaced, as well as a weighted average cost of alternative cooling appliance that would have been adopted under the Base Case. Further detail on approach and sources used to develop these average costs is provided in Table C.24 to Table C.28 in Appendix C.

For the commercial sector, similar to the approach adopted in section 5.4.2, a weighted average cost was determined based on small and large buildings. The avoided capital expenditure on cooling appliances for small buildings was based on the average residential avoided capital expenditure on cooling appliances. For large buildings, avoided costs of cooling appliances were based on analysis of a water-cooled chiller system for building archetypes undertaken by DeltaQ, in line with the approach adopted in section 5.4.2.1.[290] It was assumed that the avoided capital expenditure on cooling appliances would be proportionate to its heating capability, noting there would be a range of other factors that would influence the cost of cooling appliances in large buildings in practice. See Table C.22 for details.

RCACs can require substantial space and in practice some buildings may be physically constrained or otherwise face regulatory barriers to installing an RCAC (such as heritage overlays). As a result some properties may require significant building modification[291] or may not be possible to install an RCAC at all. However, it is uncertain to what extent this may be the case across Victorian buildings. Recognising this may be an issue for some residential properties DTP have drafted potential exemptions to the proposed regulation (see Chapter 9 for further details). Further feedback on the extent to which adoption properties may face barriers to the adoption of RCACs is requested as part of this RIS.

Stakeholder questions:

- The Victorian Government seeks advice from stakeholders on any data available related to barriers to adoption of RCACs and considerations required around potential exemptions.

5.6 Limitations

Some potential impacts have not been quantified in the CBA due to gaps in the available data and evidence. Key impacts not quantified in the CBA, and the rationale for their exclusion, are detailed below. This includes:

- limitations in estimating impacts for the commercial sector due to data deficiencies around gas usage, as well as heterogeneity and cost variability across the commercial sector
- energy efficiency and capital cost of future appliances is assumed to remain the same as current day appliances noting uncertainty around future technology design and efficiency
- building modifications have not been accounted for in residential properties due to limited data available

[287] Essential Services Commission (2023), Reviewing the Gas Distribution System Code of Practice. <https://www.esc.vic.gov.au/electricity-and-gas/codes-guidelines-and-policies/gas-distribution-system-code-practice/reviewing-gas-distribution-system-code-practice#tabs-container2>.
[288] Based on analysis of Australian Energy Regulator, Victorian Gas Network Access Arrangements.
[289] Provided by DEECA based on Oxford Economics Australia and the JWS Research (2021), Household energy preferences: Research report.
[290] DeltaQ (2023), NCC2025 Energy Efficiency – Advice on the technical basis.
[291] Due to data limitations building modifications for residential properties have not been accounted for in the CBA (see section 5.6.3).

- additional cost of induction compatible cookware under Option 2 and Option 4 has not been accounted for due to limited data available
- cost of broader electrical wiring upgrades in existing residential properties (separate to wiring required to install the appliance) due to uncertainty regarding the prevalence and underlying reason triggering the wiring upgrade
- change in maintenance costs have not been included due to limited data or evidence regarding the extent to which switching to electric appliance may change maintenance frequency or magnitude of costs
- changes in behaviour prior to commencement of the proposed regulation has not been accounted for due to uncertainty regarding the extent that this may occur
- a 100 per cent compliance rate was assumed in order to represent the upper bound of feasible costs and benefits that the proposed electrification requirement will impose
- it was assumed no change in appliance usage behaviour would occur after switching to an electric appliance due to limited evidence that this would occur.

Where limitations in data are identified, the Victorian Government invites stakeholder input on available data or evidence that may help to address existing data gaps.

5.6.1 Limitations in estimating impacts for the commercial sector

In assessing the benefits and costs of mandating a transition from gas to electric appliances for commercial appliances, several key limitations emerge due to the scarcity of data and the variability in energy use and costs:

- **Data deficiency**: There is a lack of comprehensive data regarding the prevalence of gas appliances within the commercial sector. Without precise figures on the current usage of gas appliances across various industries and business sizes, it is difficult to accurately gauge the scope of the policy's impact. Consultation via this RIS provides an opportunity to obtain stakeholder input that may help fill these data gaps.[292]
- **Heterogeneity and cost variability**: Commercial businesses encompass a wide range of sectors and operations, each with their unique setups and requirements for gas appliances. This introduces uncertainty in estimating the costs and complexities associated with transitioning to electric alternatives. Factors such as the age of existing infrastructure, building layouts and energy demands can greatly influence conversion experiences. Estimating these costs accurately requires detailed information on the specific needs and circumstances of businesses, which is not readily available.

These challenges apply both to new and existing commercial buildings but are more prevalent for existing buildings. Given these limitations, the Victorian Government is seeking submissions in response to this RIS from any stakeholders who may be able to provide additional data on the costs and benefits of electrification of commercial buildings.

5.6.2 Improved energy efficiency and capital cost of appliances

The CBA model does not account for improved energy efficiency of appliance types (both gas and electric) in the future. It does however consider improvements in energy intensity for heating in new buildings compared to existing buildings in the future. As identified in section 4.2, under the NCC 2022 requirements, new residential properties will be built to a 7 NatHERS Star (or equivalent) efficiency standard. This means new properties will require less energy to heat compared to existing residential properties.

While some improvements in energy efficiency of gas appliances is possible in the future, the Victorian Government expects that on average improvements in electric appliances will likely match, if not exceed, gas efficiency improvements. However, there is significant uncertainty regarding future improvements in technology design and efficiency and therefore has not been included in the CBA modelling.

In addition, improvements in technology design and manufacturing can reduce the future capital cost of appliances, known as the technological learning rate. The model does not account for technological learning rates. This is a conservative approach as new technologies tend to have a higher learning rate relative to established technologies, as there is greater potential for improvements in design and manufacturing processes. Therefore, newer electric appliance technologies, such as induction cooktops, may reduce in cost more quickly than gas appliances and therefore the incremental cost gap may fall in the medium to long term.

These trends have not been accounted for in the CBA. This ensures the CBA analysis remains technology neutral and makes no assumptions about relative efficiency improvements of gas and electric appliances.

[292] Note that existing commercial buildings are not intended to be captured under the preferred option (Option 3).

Stakeholder questions:

- The Victorian Government seeks advice from stakeholders regarding any data related to historical or future forecasted improvements in the energy efficiencyand/or cost of electric and gas appliances.

5.6.3 Building modifications

It is recognised that some residential properties may incur costs associated with structural building modifications when replacing gas appliances with electric ones. These may include modifications such as reconfiguring some areas to ensure adequate clearance for a new appliance or modifications to cabinetry to install a new cooktop. Currently there is no data available on the proportion of households that would require such modification or the extent of modifications required. It is also likely that some building modification costs may be incurred in the Base Case when households purchase a new gas appliance. The costs of building modifications have not been quantified in the CBA. Recognising that properties may be limited in adopting appliances as a result of barriers to building modifications, the Victorian Government is proposing potential exemptions for residential properties in these circumstances (see Chapter 9).

Building modification costs were considered in the estimated cost of electrification of large buildings based on analysis by Delta Q and is incorporated in the CBA for the commercial sector (see section 5.4.2.1).

Stakeholder questions:

The Victorian Government seeks advice from stakeholders on:

- the potential scale of and costs involved in undertaking building modifications when installing an electric appliance.
- any potential exemptions that may be required in recognition of barriers to electrify as a result of physical or regulatory constraint.

5.6.4 Additional costs to upgrade new electric cooking appliances

Not all cookware is compatible with electric cooktops (namely induction). Therefore, there may be additional costs associated with purchasing new cookware for some households and businesses required to upgrade to new electric cooking appliances. This additional cost will only be incurred for some households and businesses under Option 2 and Option 4, where existing residential kitchen appliances must be upgraded. However, due to limited data regarding the proportion of residential kitchens that do not have compatible cookware, this cost was not included in the CBA.

In addition, it is possible that electric appliances may not be compatible with the size of the existing gas appliance and kitchen benchtop space. As such some properties may incur additional cost to remodel or procure a new benchtop. Due to limited data regarding the extent of this occurring and variability of costs involved,[293] this has not been accounted for in the CBA.

It is also noted that reticulated and bottled LPG has been exempted from the proposed regulations and could be used as alternative to electrification, if necessary, in some circumstances.

5.6.5 Cost of supply connection upgrades

The CBA accounts for 19 per cent of properties incurring a cost of $4,700 to upgrade switchboard and connection capacity to the distribution network.[294] Noting there is significant variability in costs this is further tested in a sensitivity analysis in Chapter 6.

It is possible that in switching to electric appliances, some properties may require a significant upgrade to augment their connection to the distribution network. For example, where the augmentation required falls outside of the distribution network service provider's existing standard offers (known as a 'negotiated connection'). This would likely involve a higher cost to undertake than a standard supply connection upgrade. There is significant uncertainty regarding the extent to which

[293] While there are a large range of shapes and sizes available to the market, it is uncertain whether electric cooktops are typically sized to be equivalent to existing gas cooktop sizes.

[294] Frontier Economics (2022), Cost of switching from gas to electric appliances in the home. <https://gamaa.asn.au/wp-content/uploads/2022/07/Frontier-Economics-Report-GAMAA.pdf>. Appendix D contains the list of sources consulted for the market analysis.

this may occur as a result of the proposed regulations and the scale of costs that may be involved in such instances. As part of this RIS, the Victorian Government is considering potential exemptions for properties where the cost of network augmentation may be disproportionately high, for example in the case of a negotiated connection (see Chapter 9 for details on proposed exemptions).

5.6.6 Cost of broader wiring upgrades in existing residential properties

The CBA accounts for dedicated electrical wiring required to be installed to service an electric appliance, this is captured under purchase and installation costs (see sections 5.4.1.1 and 5.4.2.1). Additional electrical wiring required for a new build is also captured under building infrastructure and upgrade costs (see section 5.4.1.2). The costs of switchboard and connection capacity upgrades have been quantified and sources used are provided in Appendix C.

It is possible that when an electrician services a property to replace their gas system, they may identify that broader electrical wiring across the property is not able to handle new appliances or does not meet current safety standards.[295] In particular, older residential properties may need wiring upgraded if they have unsafe or outdated wiring. Moreover, insulation surrounding the wiring can also degrade over time, increasing the risk of electric shocks or fires.[296] Costs for electrification that may trigger an internal wiring upgrade in existing residential properties (from wiring required to install the electric appliance, a connection capacity or switchboard upgrade) were not quantified in the CBA, due to:

- uncertainty regarding the prevalence of unsafe or old electrical wiring across Victorian properties
- uncertainty regarding the underlying reason triggering the wiring upgrade; while the proposed regulation may have identified the issue, the trigger for the upgrade is associated with other building safety standards and the proposed regulation would only bring forward the upgrade
- uncertainty regarding the cost associated with such upgrades and to what extent the upgrade would have been brought forward as many other activities may have identified the issue, such as renovations or other electrical works
- the benefits associated with identifying and upgrading unsafe wiring (such as reduced risk of fire and loss of life) have not been accounted for in the CBA.

Sensitivity testing was conducted for a higher cost of switchboard and connection capacity upgrade. This sensitivity can also be useful to test other uncertainties, such as the cost of additional broader electrical wiring (see section 6.3.1.4).

As noted above, the Victorian Government is also consider applying exemptions to the proposed regulation where the cost to electrify and augment the electrical supply to the property are disproportionately high (see Chapter 9). Therefore if the cost to upgrade electrical wiring across the property is particularly high, home owners may seek an exemption from the proposed regulation.

5.6.7 Maintenance costs

Maintenance costs were not quantified in the CBA due to data limitations. While electric appliances such as heat pumps in commercial settings may incur higher maintenance costs as a result of increased complexity in their operation compared to gas alternatives, there is insufficient evidence to suggest that the cost differences between maintaining gas and electric appliances are material.

Both gas and electric appliances are recommended to undergo regular servicing, typically advised at two-yearly intervals. However, in the absence of legal requirements for servicing and maintaining appliances, the cadence of maintenance work conducted on appliances in residential and small business settings largely rests on decisions made by residential and small business owners.[297,298] Those who adhere to regular appliance servicing routines will likely continue their maintenance schedules irrespective of their appliance types, while those that do not prioritise such maintenance are expected to continue this practice.

Despite the assumption in this analysis that electric appliances have shorter lifespans than gas appliances, there exists insufficient evidence to suggest a higher frequency of breakdowns in electric appliances relative to their gas counterparts. Therefore, costs associated with appliance maintenance were not quantified in the CBA.

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[295] Hornsby Electric, Rewiring can be a necessity for older homes. <https://www.hornsbyelectric.com.au/rewiring-can-be-a-necessity-for-older-homes/>
[296] Jim's Test and Tag, Are exposed wires dangerous? <https://www.jimstestandtag.com.au/are-exposed-wires-dangerous/>
[297] Victorian Building Authority, Carbon Monoxide. <https://www.vba.vic.gov.au/consumers/guides/carbon-monoxide>
[298] Consumer Affairs Victoria (2023), Rental providers: gas and electrical safety. <https://www.consumer.vic.gov.au/housing/renting/repairs-alterations-safety-and-pets/gas-electrical-and-water-safety-standards/rental-providers-gas-and-electrical-safety>

Stakeholder questions:

- The Victorian Government seeks advice from stakeholders regarding differences in timing and cost of maintenance of electric and gas appliances in both residential and commercial sectors.

5.6.8 Behaviour change prior to commencement of the proposed regulations

Evidence from countries, such as Germany, demonstrates that some consumers may proactively take measures ahead of implementation of regulations to extend their access to gas appliances. Germany experienced a spike in sales for new oil gas and heating systems in 2023, prior to the commencement of a legislated ban on installation of fossil heating systems by 2024.[299]

There is a possibility that some households and businesses may bring forward planned renovations to before the proposed regulations come into effect to avoid mandatory electrification. However, this is considered to have a small impact over the lifetime of the Regulations and the exact scale of behaviour change is difficult to quantify. Given general consumer trends towards more energy efficient buildings, as evidenced by voluntary electrification, current challenges in the construction industry, such as labour and building material shortages, high interest rates and cost of living pressures, it is unlikely that a significant proportion of homeowners will be able to bring forward planned renovations to prolong the use of gas appliances.[300] Decisions by households or businesses about whether or not to bring forward planned renovations may also be influenced by the prospect of higher energy bills for the life of those gas appliances.

5.6.9 Compliance rate

It was assumed that 100 per cent of residential and commercial buildings will comply with the requirements. This assumption provides a conservative estimate of the upper bound of feasible costs that the proposed electrification requirement will impose. It also means that the net benefit under any of the options should be regarded as the maximum potential net benefit. In the event the compliance rate is lower than 100 per cent, the total costs and magnitude of benefits would scale relatively linearly with the level of non-compliance, as would the net benefits.[301] Assuming compliance rates would be consistent across options, a compliance rate of less than 100 per cent would not influence the choice of preferred option.

5.6.10 Rebound effect

The rebound effect can occur when improvements in the thermal performance of a building that reduces spending on energy, results in increased consumption of energy elsewhere (of either the same good or of other goods and services). Efficiency improvements or energy saving measures have the potential to partially offset their energy savings benefits due to increased energy consumption. At the appliance level, the rebound effect can manifest when consumers replace older, less efficient appliances with newer, more energy-efficient models. For instance, a household may replace their 14-year-old gas heating system with an efficient reverse cycle air-conditioner. While the upgraded appliances may consume less energy per use, consumers may be inclined to use them more frequently or for longer durations due to the perceived cost savings or increased convenience.

The rebound effect was not included in the CBA as there is limited evidence in practice to demonstrate this effect when improving the energy efficiency of appliances. For instance, in 2018 Sustainability Victoria undertook a Comprehensive Retrofit Trial under which 14 existing residential properties in Melbourne were given comprehensive building shell and heating system upgrades.[302] The trial found minimal changes in the participating houses' heating profile and thermostat temperature settings before and after the trial. Furthermore, the rebound effect was not applied to the energy bill savings

[299] Clean Energy Wire (2023), Oil and gas boiler sales are soaring in Germany in anticipation of 2024 ban. <https://www.cleanenergywire.org/news/oil-and-gas-boiler-sales-are-soaring-germany-anticipation-2024-ban#:~:text=New%20oil%20and%20gas%20heating,fossil%20heating%20systems%20by%202024>

[300] Master Builders Victoria (2024), Victorian building forecast outlook remains tight, with major changes urgently needed to address workforce shortages and ballooning build times. <https://www.mbav.com.au/news-information/media-release/victorian-building-forecast-outlook-remains-tight-major-changes?housing>

[301] Government costs may increase with non-compliance, however the estimated government costs are small relative to the broader costs of the options.

[302] Sustainability Victoria (2019), Comprehensive Energy Efficiency Retrofits to Existing Victorian Houses. <https://assets.sustainability.vic.gov.au/susvic/Report-Energy-Comprehensive-Energy-Efficiency-Retrofits-to-Existing-Victorian-Houses-PDF.pdf>

accrued to individual households and businesses because regardless of whether the money is saved because of the regulation, they still derive new and additional value from those savings.

6 CBA impact analysis

This chapter details the CBA results for each option, the estimated gas and GHG emissions savings and high-level sensitivity analysis of results.

6.1 Summary of CBA results

6.1.1 Primary results

Table 6.1 demonstrates the results of the CBA for all four options across both a 10-year and 20-year period.[303] Over the 10-year period, the results show that Option 3 has the highest NPV of $5.0 billion and BCR of 1.85. This is followed by Option 4 with a NPV of $4.2 billion, then Option 2 with a NPV of $1.8 billion. While Option 1 has the lowest NPV, at $0.6 billion, it does have a higher BCR than Option 2. This is because Option 2 has a much higher scale of impact, and therefore greater NPV, but also incurs higher associated costs, resulting in an overall lower BCR.

Over the 20-year period, the results for all four options improve. This is driven by more appliances being upgraded and greater GHG emissions reductions and health benefits increasing as the electricity sector decarbonises in the future. Similar to the 10-year period, Option 3 has the highest NPV and BCR over the 20-year period, with $7.5 billion in net benefits and a BCR of 1.91.

Table 6.1: CBA results for each option under the two analysis periods

	10-year period		20-year period	
	NPV ($m)	BCR	NPV ($m)	BCR
Option 1	574	1.26	1,280	1.37
Option 2	1,822	1.13	3,514	1.17
Option 3	5,018	1.85	7,472	1.91
Option 4	4,170	1.74	6,055	1.81

Source: Deloitte analysis

6.1.2 Profile of costs and benefits

Table 6.2 presents the breakdown of costs and benefits for all four options over the 10-year analysis period. Across all options, appliance upgrade and installation costs are the highest contributor to overall costs. Benefits are primarily driven by avoided energy costs and avoided GHG emissions costs for all four options. Avoided capital costs of cooling appliances also drive a significant portion of benefits across the options. This reflects that some buildings with gas heating would no longer need to purchase a standalone cooling appliance as their gas heating appliance is replaced by an RCAC that provides both heating and cooling capability (see section 5.5.5 for more details on methodology).

Option 3 has the highest NPV of $5.0 billion and BCR of 1.85, driven by $4.2 billion in avoided energy costs and $3.3 billion in benefits associated with avoided GHG emissions. These benefits are partially offset by $4.8 billion in appliance upgrade and installation costs, as well as $1.1 billion in building upgrade costs.

Option 2 has the highest total benefits compared to the other options at $15.6 billion, but this is offset by $13.7 billion in total economic costs, primarily driven by $11.7 billion in appliance upgrade and installation costs. These combined factors lead to Option 2 having the lowest BCR of 1.13.

Option 1 has the lowest NPV at $0.6 billion. This is due to the small scale of impact it achieves by only electrifying new buildings, which are a minority of the total building stock. Option 1 is expected to impose no additional cost to government. It is possible that Option 1 may present savings to government as new buildings will no longer require gas appliances, and by extension, plumbing certificates and associated audits, however, these savings are not anticipated to be material to the overall NPV and have therefore not been quantified. The main costs to the government under Option 1 will be costs

303 For analytical purposes, the proposed regulations were assumed to start in 2026 however this is not government policy and a commencement date has not been finalised.

associated with communicating the changes to practitioners and the community. This activity is considered a business-as-usual activity for government, and therefore the associated costs have not been attributed to Option 1.

Table 6.2: CBA NPV results for 10-year period ($million)

	Option 1	Option 2	Option 3	Option 4
Appliance upgrade and installation costs	2,021	11,713	4,766	3,771
Building upgrade costs	199	1,751	1,051	1,734
Administrative cost	-	254	53	110
Costs to government	-	18[1]	11	18[1]
Total costs	**2,221**	**13,736**	**5,882**	**5,633**
Avoided energy cost	791	5,750	4,226	3,547
Avoided GHG emissions cost	573	4,455	3,282	3,107
Avoided air pollution costs	8	67	49	43
Avoided capital cost of cooling appliances	830	4,146	2,664	2,139
Avoided gas network cost	592	1,139	678	968
Total benefits	**2,795**	**15,558**	**10,900**	**9,803**
NPV	**574**	**1,822**	**5,018**	**4,170**
BCR	**1.26**	**1.13**	**1.85**	**1.74**

Source: Deloitte analysis

Note: 1. The government cost for auditing commercial buildings is less than $1 million and therefore no difference is shown between government cost for Option 2 (with existing commercial buildings) and Option 4 (no existing commercial buildings). This is because the number of residential properties requiring an audit is substantially higher than the number of commercial buildings.

Table 6.3 presents the breakdown of costs and benefits for all 4 options over the 20-year analysis period. Similar to the 10-year period, across all options, appliance upgrade and installation costs are the highest contributor to overall costs, and benefits are driven by avoided energy costs and avoided GHG emissions.

Option 3 has the highest net benefit of $7.5 billion and BCR of 1.91, driven by $5.8 billion in avoided energy costs and $5.1 billion in benefits associated with avoided GHG emissions. These benefits are partially offset by $6.7 billion in appliance upgrade and installation costs, as well as $1.4 billion in building upgrade costs.

Table 6.3: CBA NPV results for 20-year period ($million)

	Option 1	Option 2	Option 3	Option 4
Appliance upgrade and installation costs	3,170	17,380	6,726	4,985
Building upgrade costs	285	2,337	1,383	2,313
Administrative cost	-	360	68	140
Costs to government	-	23	14	23
Total costs	**3,455**	**20,100**	**8,191**	**7,461**
Avoided energy cost	1,341	8,346	5,783	4,631
Avoided GHG emissions cost	1,193	7,342	5,132	4,645
Avoided air pollution costs	18	115	81	70
Avoided capital cost of cooling appliances	1,374	6,135	3,724	2,800
Avoided gas network cost	808	1,675	943	1,369
Total benefits	**4,735**	**23,614**	**15,663**	**13,516**
NPV	**1,280**	**3,514**	**7,472**	**6,055**
BCR	**1.37**	**1.17**	**1.91**	**1.81**

Source: Deloitte analysis

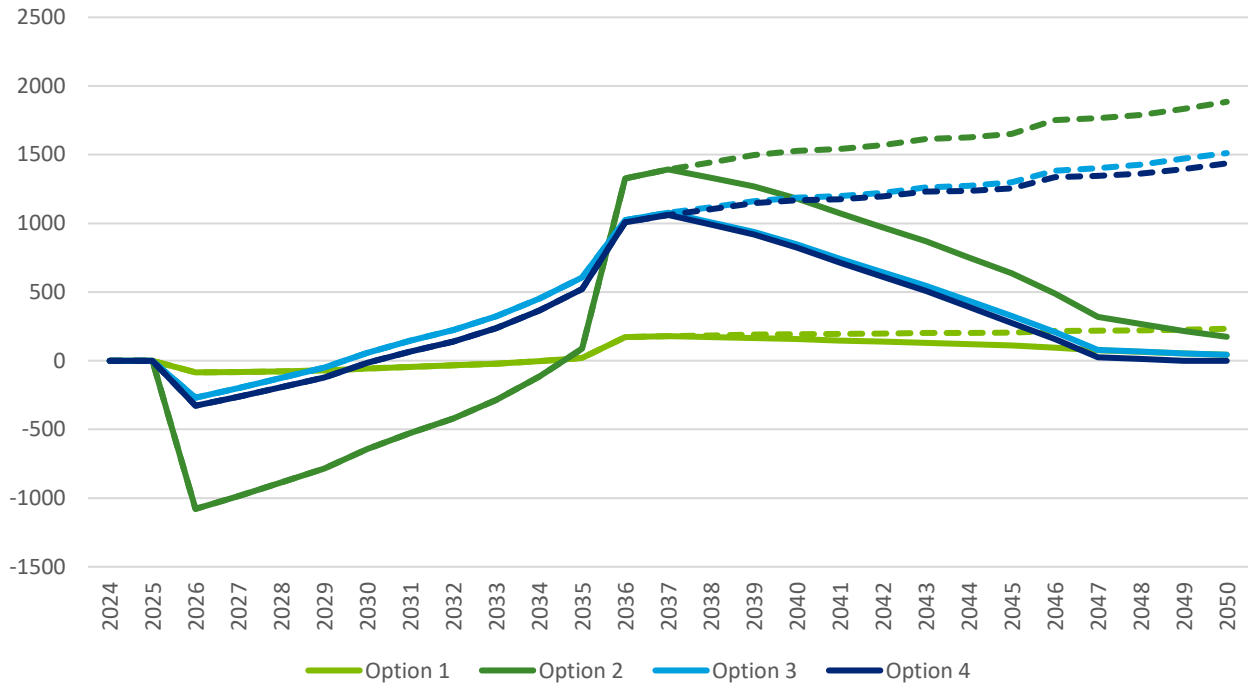
Figure 6.1 below shows the annual net benefit profile for all options over the 10-year period. The chart demonstrates that costs are incurred in the initial years. Option 2 reaches the highest peak of benefits over the 10-year period at $1.4 billion in 2037, however a larger profile of costs is incurred in early years.

Option 3 and Option 4 both follow a similar trajectory, with Option 3 being only marginally higher than Option 4. Both options gradually increase in net benefits as benefits of reduced gas usage accumulate and offset upfront capital costs. Costs stop being incurred at the end of the analysis period (2035) as upgrades are no longer required. As a result, both options reach a peak of around $1.1 billion in 2037. These benefits taper off as electric appliances reach their end of life.

Due to the scale of electrification, Option 2 incurs larger economic benefits compared to other options as substantially more buildings are required to electrify. However, the costs associated with these properties is much larger, indicated by the large net costs in the early years of the analysis period. As costs are no longer incurred after 2035, Option 2 net benefits rapidly increase in 2036, reaching a peak of $1.4 billion in 2037.

Under the core CBA modelling, benefits taper off as electric appliances reach their end of life. However, the creation of a regulation to electrify may result in sustained behaviour such that properties would continue replacing their appliance with electric after the analysis period has ended. The benefits extend from the date of the last year of upgrade during the regulatory period in 2035, to the end of life of that appliance which is assumed to be 2055 for commercial appliances, and 2047-2049 for residential appliance, therefore the benefits extend beyond 2035. The dotted line in Figure 6.1 demonstrates the profile if the long-term benefits of sustained electrification were included in the analysis.[304]

Figure 6.1: Net benefit profile for all options for the 10-year period ($ million, per annum)



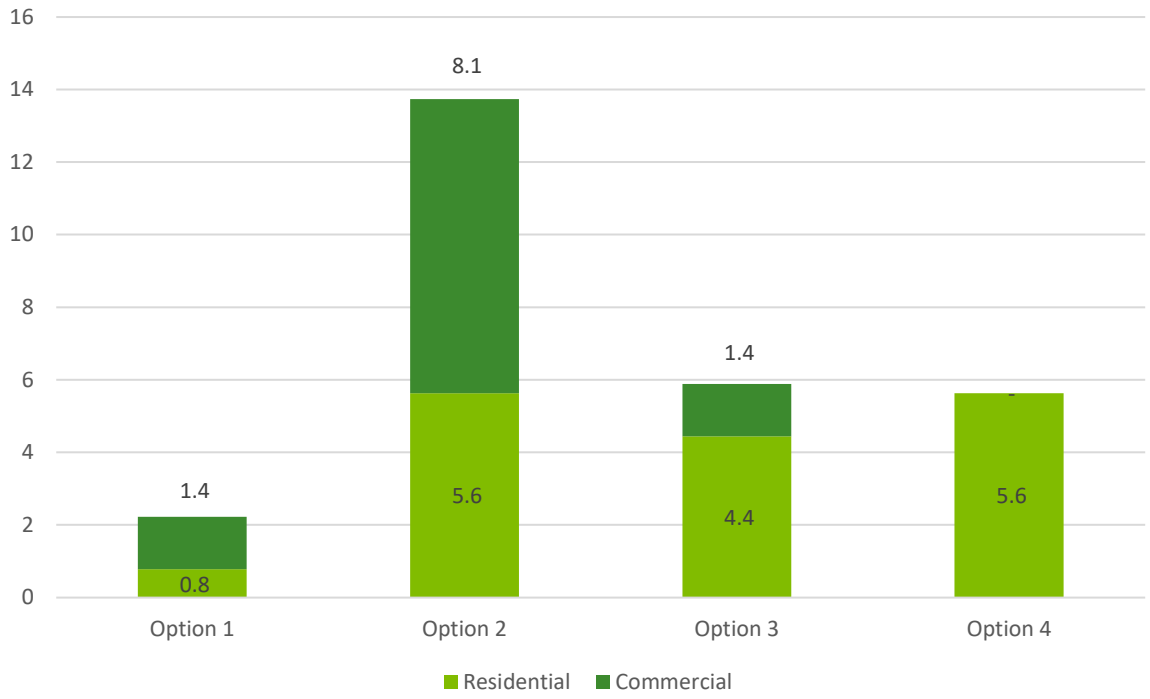
Source: Deloitte analysis. Note: Dotted line represents future benefits if replacement of electric appliances at end of life with electric instead of gas appliances was attributed to the proposed regulations.

Figure 6.2 below shows the breakdown of PV costs across each option, split by residential and commercial, for the 10-year analysis period. Costs are primarily driven by the capital expenditure required to upgrade commercial buildings and residential properties. Option 2 has the highest PV costs of $13.7 billion, with commercial properties accruing the largest overall costs amounting to $8.1 billion, compared to $5.6 billion for residential properties. The high costs under Option 2 are driven by the inclusion of existing properties for both the residential and commercial sectors, which are more costly to

[304] Option 2 and Option 4 result in large-scale disconnections from the reticulated gas network (see section 5.2.1) and therefore it would be quite difficult or costly to replace an electric appliance with a gas appliance in existing buildings after the analysis period has ended. However, this approach has been adopted to avoid attributing additional benefits to the intervention (see section 5.1.2).

retrofit and may require additional works compared to new properties. Option 1 presents the lowest costs across all options, amounting to $2.2 billion, as only new residential and commercial properties are upgraded. New properties will incur a total cost of $781 million, while commercial properties will incur a total cost of $1.4 billion.

Figure 6.2: Residential and commercial costs for each option ($billion)

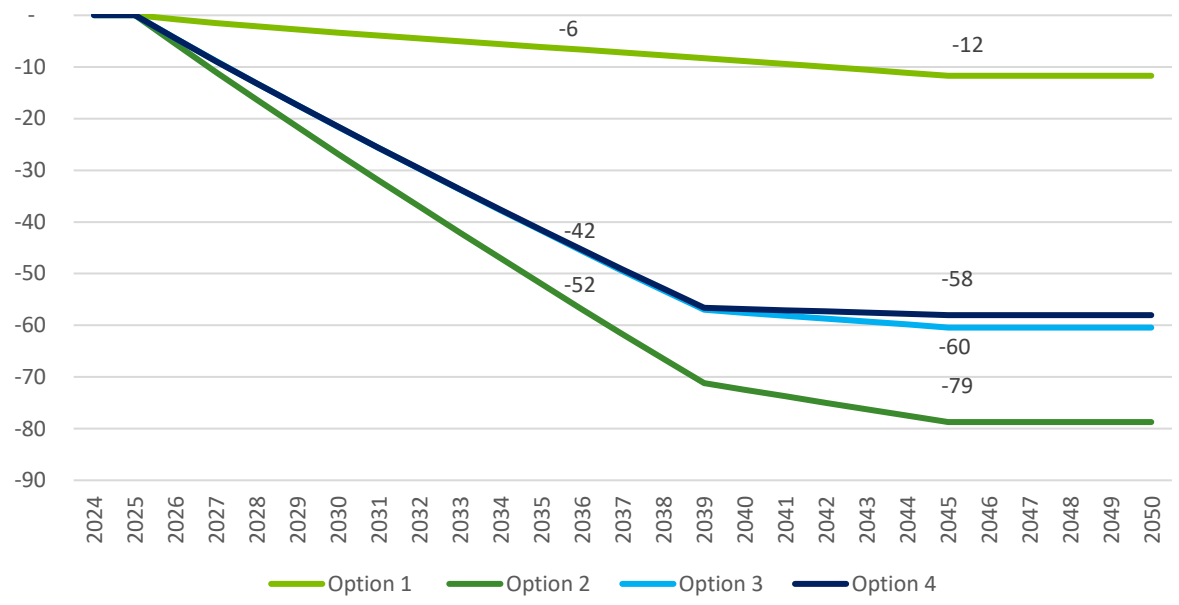


Source: Deloitte analysis.

6.2 Gas consumption and GHG emissions savings

Figure 6.3 presents the potential fossil gas savings to Victoria under all options over a 20-year period, assuming buildings remain electric after the analysis period. Implementing Option 2 could enable reduction in fossil gas consumption of 78 PJ by 2045. Option 3 is projected to reduce fossil gas consumption by 60 PJ in 2045, while Option 4 is slightly lower at 58 PJ. For Option 3, the exclusion of existing residential cooking is offset by electrification of new commercial buildings. Option 1 has the lowest reduction in fossil gas consumption estimated at 12 PJ by 2045. The figure shows a progressive increase in the volume of fossil gas consumption avoided over time, reflecting the gradual phase-out of gas appliances to align with Victoria's objective of an orderly transition towards a low-carbon economy.

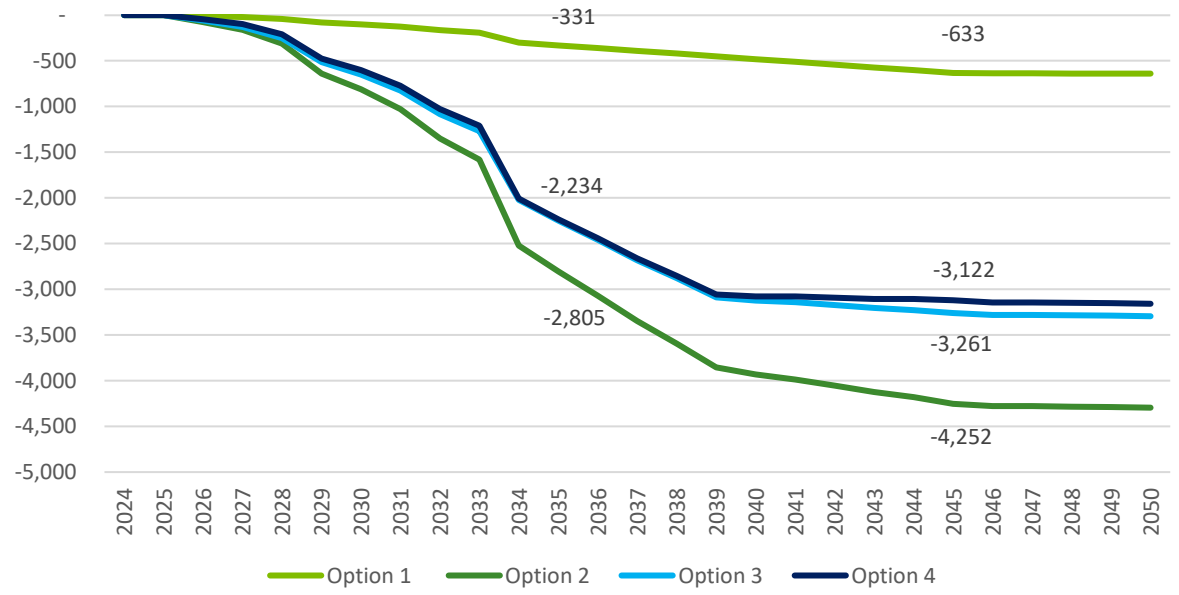
Figure 6.3: Volume of fossil gas reduction for each option relative to Base Case (PJ)



Source: Deloitte analysis. Note: chart demonstrates potential gas reduction over a 20-year period to 2045 with the assumption that buildings continue to adopt electric appliances after 2045.

Figure 6.4 presents the potential GHG emissions reduction in Victoria under all options over a 20-year period and assuming buildings remain electric after the analysis period. It is shown that under Option 2, annual GHG emissions could reduce by 4,252 kilo tonnes of emissions ($ktCo_2$-e) by 2045. For Option 3 and Option 4, annual GHG emissions reduction is estimated at 3,261 $ktCo_2$-e and 3,122 $ktCo_2$-e by 2045, respectively. Option 1 only achieves 633 $ktCo_2$-e in annual GHG emissions savings by 2045.

Figure 6.4: Volume of GHG emissions saved for each option relative to Base Case ($ktCo_2$-e)



Source: Deloitte analysis Note: chart demonstrates potential GHG emissions reduction over a 20-year period to 2045 with the assumption that buildings continue to adopt electric appliances after 2045

6.3 Sensitivity analysis

Sensitivity analysis was conducted on the options using the following parameters:

- discount rates
- energy prices
- appliance purchase and installation costs (including labour cost to install appliances)
- switchboard and supply upgrade costs
- cost to abolish the gas connection
- asset life of appliances
- voluntary uptake
- carbon values.

The assumptions used in the sensitivity analysis are outlined in section 6.3.1, and results summarised in section 6.3.2.

6.3.1 Sensitivity assumptions

6.3.1.1 Discount rate

The discount rate under the central scenario (4 per cent) was tested with a low discount rate of 2 per cent and high discount rate of 7 per cent. The discount rate of 4 per cent was chosen as the central scenario in line with the Victorian Department of Treasury and Finance's Technical Guidelines.[305]

6.3.1.2 Energy prices

Three energy price scenarios were adopted for sensitivity testing of the options:

- retail gas prices are 33 per cent higher than the core assumption
- retail electricity prices are 33 per cent higher than the core assumption
- retail gas prices are 33 per cent higher than the core assumption and retail electricity prices are 33 per cent higher than core assumption.

Noting significant uncertainty in future energy prices, these scenarios adopt arbitrary percentages for the purposes of sensitivity testing. Breakeven analysis is also conducted on the NPV to determine what magnitude of change in energy prices would result in a net zero NPV (see section 6.3.2).

6.3.1.3 Appliance purchase and install costs (including labour costs)

The impacts of changes in the incremental upfront cost of appliance purchase and installation were tested under two scenarios:[306]

- where incremental appliance costs are 25 per cent higher
- where incremental appliance costs are 25 per cent lower.

Due to uncertainty over future appliance costs, an arbitrary percentage has been used for sensitivity testing. The installation cost includes both the cost of the appliance and the labour cost for installing the appliance.

6.3.1.4 Switchboard and supply upgrade costs

There is significant variability in the potential cost of upgrading switchboard and connection supply to the distribution network. Supply upgrade costs in this instance refers to connection capacity upgrade costs. The core scenario includes an assumption that 19% of properties will require a switchboard and supply connection upgrade cost of $4,700. However, switchboard and supply connection upgrades costs can be higher in some circumstances.

Therefore the impact of changes in the cost of switchboard and supply upgrade were tested under two scenarios based on the best available data source:

- where switchboard and supply upgrade costs align with a 'low' cost of $2,525
- where switchboard and supply upgrade costs align with a 'high' cost of $12,250.

It is proposed that an exemption apply where the installation of an electric appliance requires augmentation of a distribution system to provide more than a basic connection service or a standard connection service (see Chapter 9). Electricity

[305] Department of Treasury and Finance (2013), Economic Evaluation for Business Cases Technical Guidelines. <https://www.dtf.vic.gov.au/investment-lifecycle-and-high-value-high-risk-guidelines/stage-1-business-case>

[306] That is, the incremental upfront cost to replace a gas appliance with an electric appliance, including purchase and installation of the electric appliance as well as the cost to remove the existing gas appliance.

Distribution Businesses are required to offer a basic and standard connection services below a threshold applying to "the average size of the customers connected to the network".[307] Where a connection exceeds the criteria set in the approved connection policy, additional costs may be incurred, with these situations proposed to be exempt from the regulations. Therefore the cost of a basic or standard connection service upgrade and switchboard upgrade is not anticipated to exceed $4,700 on average, as adopted in the core scenario. The upper end of this sensitivity will therefore cover the costs associated with a basic or standard connection upgrade, in addition to other potential ancillary costs such as additional broader wiring upgrades.

The proportion of residential properties requiring switchboard and supply upgrades remains consistent with the core scenario (19 per cent).

6.3.1.5 Cost to abolish the gas connection

The impact of additional costs to gas distribution network providers to abolish gas customer connections was tested under an additional sensitivity of $950 per disconnection. This is based on the total cost for small customer abolishment reported by AGN and Multinet in their 2023 Access Arrangements provided to the AER.[308]

6.3.1.6 Asset life of appliances

The asset life of gas and electric appliances adopted in the CBA are based on average manufacturer lifetimes.[309] However, anecdotal evidence suggests that it is expected that many appliances can last longer, which is not modelled in the core CBA results. To understand the impact of longer lasting appliances, the NPVs of the options were tested with a longer life of appliances. Table 6.4 presents the asset lives adopted under the sensitivity test compared to the core assumptions in the CBA. Anecdotal evidence suggests some appliances may last longer than 20 to 25 years, however, there are limited sources available to support this. Equally, some appliances may have shorter lives than assumed below.

[307] Australian Energy Regulator (2024), Connection charge guidelines for electricity customers. <https://www.aer.gov.au/system/files/2024-10/Connection%20charge%20guidelines%20-%20updated%20October%202024.pdf>

[308] Note AusNet Services reported a lower customer abolishment cost of $822 per customer, therefore the higher value of $950 was adopted for sensitivity testing.

[309] A literature scan was undertaken by DEECA to determine an appropriate appliance life assumption. Available data was limited, however Oxford Economics Australia, appliance warranty data and other sources point to an average operating life of gas appliances of 8-14 years. Department of Energy Environment and Climate Action (2018), Victorian Energy Upgrades Specifications 2018 – Version 15 Victorian Energy Upgrades Specifications 2018 Version 15.0. Australian Building Code Board (2021) NCC 2022 Update Whole-of-Home Component V03 1 (abcb.gov.au).

Table 6.4: Asset lives under the core scenario and sensitivity test (years)

	Core assumption	Sensitivity test
Residential appliances		
Heating appliances		
Ducted Gas	14	20
Room Gas	14	20
Ducted AC	12	15
Multi-split AC	12	15
RCAC	12	15
Hot water		
Mains Gas Instantaneous	14	20
Mains Gas Storage	14	20
Solar Gas	12	15
Solar electric boost	12	15
Electric Instant	12	15
Heat pump	12	15
Cooking		
Gas	14	20
Electric	12	15
Commercial appliances		
Heating appliances		
Gas	20	25
Electric	20	25
Hot water		
Gas	20	25
Electric	15	20
Cooking		
Gas	14	20
Electric	12	20

Source: DEECA; DeltaQ

6.3.1.7 Voluntary uptake

Voluntary uptake is a key assumption used to determine how many existing properties electrify under the Base Case and therefore is not included in the report results. Higher uptake assumptions have a scaling down effect on the directional impact of the regulatory options – benefits are reduced where appliance upgrades provide a net economic benefit overall and vice versa for appliance upgrades that result in a net economic cost. Table 6.5 and Table 6.6 show the voluntary uptake assumption used in the core analysis and those used in sensitivity testing for residential and commercial properties, respectively.

Under the core CBA assumptions, voluntary uptake rates were based on stated preference surveys, with annual rates of uptake halved to reflect that intention typically overstates real behaviour. Due to uncertainty over future uptake rates, an arbitrary percentage has been used for sensitivity testing.

The higher sensitivity testing accounts for an increase in voluntary uptake by a factor of 3. This equates to a 33 per cent increase in the voluntary uptake results from survey data. For low sensitivity testing, a low voluntary uptake was based on 0 per cent per annum.

Table 6.5: Voluntary uptake assumptions for residential properties

Percentage p.a. existing residential properties	Low	Core	High
Heating	0.00%	0.83%	2.5%
Hot water	0.00%	2.25%	6.75%
Cooking	0.00%	1.25%	3.75%

Source: Deloitte analysis

Table 6.6: Voluntary uptake assumptions for commercial properties

Percentage p.a. existing commercial properties	Low	Core	High
Short term accommodation buildings	0.00%	1.05%	3.15%
Offices	0.00%	0.55%	1.65%
Commercial buildings not elsewhere classified	0.00%	0.23%	0.68%
Entertainment and recreation buildings	0.00%	0.23%	0.68%
Hospitality	0.00%	1.05%	3.15%
Retail and wholesale trade buildings	0.00%	0.23%	0.68%
Warehouses	0.00%	0.15%	0.45%
Education buildings	0.00%	0.35%	1.05%
Religion buildings	0.00%	0.43%	1.28%
Aged care facilities (including nursing homes)	0.00%	0.43%	1.28%
Health facilities	0.00%	0.43%	1.28%

Source: Deloitte analysis

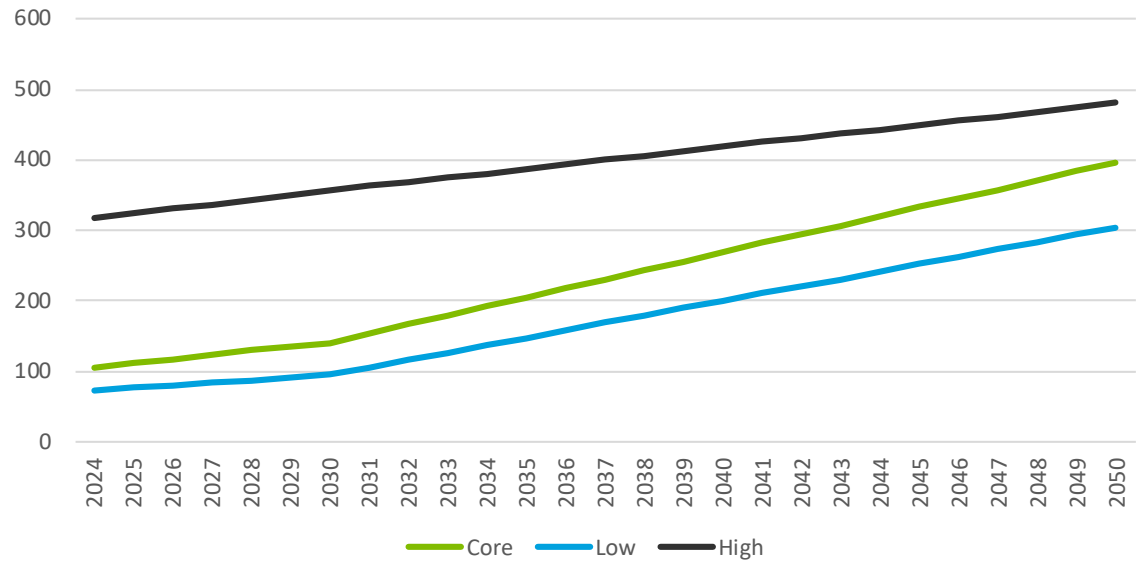
6.3.1.8 Carbon values

Estimates of the cost of carbon on wider society vary depending on the source and method used to estimate costs. These price curves have a substantial impact on the overall results of the analysis. Figure 6.5 below displays the high and low scenarios for the cost of carbon to 2050. The low and core scenarios were taken from the Intergovernmental Panel on Climate Change's (IPCC) Indicative GHG Values for use in economic analysis derived from estimates in the IPCC's 6th Assessment Report (2022). The low scenario used the IPCC's "Low Values", and the core scenario used the IPCC's "Central sensitivity" values.[310] The high scenario was taken from the U.S. Environmental Protection Agency's 2023 Report on the Social Cost of GHG adjusted to Australian dollars.[311]

[310] The IPCC's "Low Values" are lower than the projected value of emissions reduction using the methodology provided by the Ministerial Council of Energy. Australian Energy Regulator (2024), Valuing emissions reduction <https://www.aer.gov.au/system/files/2024-05/AER%20-%20Valuing%20emissions%20reduction%20-%20Final%20guidance%20and%20explanatory%20statement%20-%20May%202024.pdf>

[311] United States Environmental Protection Agency (2023), Report on the social cost of greenhouse gases: Estimates incorporating recent scientific advances. <https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf>

Figure 6.5: Carbon values under the low, core and high scenarios ($/tCo2-e)



Source: Intergovernmental Panel on Climate Change, U.S. Environmental Protection Agency.

6.3.2 Sensitivity results

Table 6.7 below demonstrates the results of the sensitivity testing over a 10-year analysis period. Option 2 results are most sensitive to changes in key parameters. Option 2 presents a negative NPV under a high discount rate, high electricity price and a high appliance cost scenario. In comparison, Option 3 is least sensitive to changes in key parameter values, with limited deviation from the core results and all parameter changes maintaining a net benefit of at least $3.2 billion. Option 3 also maintains the highest NPV relative to other options under all sensitivities tested. Note that the sensitivities for each parameter have been tested in isolation. To the extent that two or more downside scenarios occur simultaneously this may have a cumulative effect on reducing the NPV result.

With the exception of high gas and electricity prices, impacts tested under the sensitivity analysis are not additive. Several negative outcomes could occur at once, however it is possible that several positive outcomes could also occur and offset any negative impacts.

Table 6.7: NPV of options over a 10-year period under sensitivities ($ million)

NPV	Option 1	Option 2	Option 3	Option 4
Core results	574	1,822	5,018	4,170
Low discount rate	925	3,879	6,799	5,736
High discount rate	251	-44	3,215	2,582
High gas prices	1,098	5,968	8,183	7,260
High electricity prices	312	-426	3,249	2,251
High gas prices and high electricity prices	825	3,720	6,413	5,341
Low carbon value	421	625	4,128	3,326
High carbon value	984	5,131	7,568	6,609
Low appliance purchase and install cost (including labour cost)	825	4,230	6,005	5,012
High appliance purchase and install cost (including labour cost)	255	-641	4,013	3,329
Low switchboard and supply upgrade cost	607	2,297	5,315	4,645
High switchboard and supply upgrade cost	458	173	3,988	2,522
High gas abolishment cost	464	1,184	4,824	3,532
Longer asset life	909	3,147	5,080	4,355
Low voluntary uptake	574	1,837	5,058	4,197
Higher voluntary uptake	574	1,791	4,939	4,116

Source: Deloitte analysis

Table 6.8 demonstrates the breakeven point for all options for individual changes in gas and electricity prices. Option 3 requires the highest changes in energy prices to reach a breakeven point, indicating that a positive NPV is robust to large changes in energy prices.

Option 2 is the most sensitive to changes in energy prices, with a 15 per cent reduction in gas prices leading to a NPV of zero, or a 27 per cent increase in electricity prices leading to a NPV of zero. As discussed in section 2.2.1, historical electricity prices are volatile and projected to increase overtime. Future electricity prices as shown in Figure 2.5 is captured in the core CBA, however it is possible that prices may increase by a further 27 per cent noting historical year-on-year fluctuations in prices have exceeded 27 per cent. Noting the potential for local gas supply shortfalls, gas prices are highly uncertain. However, gas prices are not expected to decrease substantially from the core CBA assumption as supply constraints are likely to put upwards pressure on gas prices.

The required change in electricity or gas prices to breakeven have each been assessed in isolation. Analysis of the robustness of the NPV when there are concurrent changes to both electricity and gas prices is considered in Table 6.7 (see section 6.3.1.2 for further detail). Option 3 is the most robust to changes in electricity or gas prices: gas prices would have to fall by 52 per cent or electricity prices would have to increase by 92 per cent in order for the estimated benefits to fall to the same value as the estimated costs. The impact of options on electricity and gas prices are discussed further in Chapter 7.

Table 6.8: Change in gas or electricity price required to break even, over the 10-year period

	Option 1	Option 2	Option 3	Option 4
Gas price change	-36%	-15%	-52%	-45%
Electricity price change	72%	27%	92%	72%

Source: Deloitte analysis

Due to its relatively high economic return (in line with NPV and BCR) and ability to achieve significant reduction in fossil gas usage and GHG emissions while being robust to potential changes in electricity and gas prices, Option 3 is the preferred option.

As noted in section 4.1, electrification of existing government buildings is excluded from the scope of this analysis. If the impacts of electrifying existing government buildings were included in the analysis in this RIS, it would not change the preferred option selected. This is because the only option which would overlap with these other policy proposals and corresponding instruments is Option 2 (because this option would require existing commercial buildings to electrify at end of life, and this would typically capture existing government buildings based on conventional definitions of commercial buildings).[312] However, even if electrification of existing government buildings was attributed to Option 2 (rather than occurring under the Base Case), this is not anticipated to significantly impact the BCR or NPV of Option 2, and may slightly strengthen the preference for Option 3 over Option 2, due to the higher proportion of existing commercial buildings being captured.

Chapter 9 also proposed several exemptions for Class 1, Class 2, and Class 10b properties where it may be impractical or may incur a disproportionately high cost to electrify existing buildings (such as augmentation of the connection between property and distribution network). The exemptions would reduce both total costs and total benefits associated with a lower number of appliance replacements across Option 2, Option 3 and Option 4, which all captured existing Class 1 and Class 2 properties. In cases where costs for exempted properties exceed the benefits (more likely), this would result in higher NPVs and higher BCRs for each option. In cases where the costs for exempted properties were less than the benefits (less likely), this would result in lower NPVs but would still result in high BCRs for each option.

[312] Government buildings were estimated to account for approximately 8 per cent of total in-scope commercial buildings and 6 per cent of total in-scope commercial sector gas consumption. Social and other public housing is captured by the Minimum Energy Efficiency and Safety Standards for Rented Homes RIS, so it has been assumed to electrify under the base case (outlined in Table 4.1). Universities and other public institutions would not be required to electrify under the Base Case if they are not owned by the Victorian Government. The proposed regulations will require buildings owned and operated by the Federal Government to be electrified.

7 Impacts assessed outside the CBA

This chapter presents analysis of the broader impacts not included in the CBA because they are either more appropriately assessed using a different tool, are not able to be quantified, or are of particularly low impact relative to the scale of other changes being considered.

CBA is considered a standard and robust tool to support regulatory proposals, in line with the Victorian Guide to Regulation. However, a CBA approach can be limited where potential impacts are not able to be monetised, are qualitative, or relate to indirect, whole-of-economy impacts.[313]

Given the scale of impacts of the options under consideration, and in line with the Victorian Guide to Regulation's principle of proportionality in analysis, detailed electricity market modelling, gas market analysis and CGE modelling was performed to consider the broader impacts of the options on key sectors. The results of this modelling and the implications for Victoria's electricity market, gas market, as well as GSP and GVA impacts for the whole economy are outlined in section 7.1, 7.2 and 7.3 respectively.

This chapter also contains an analysis of replacing gas pool heaters with electric alternatives at the end of life in residential swimming pools (section 7.4) and refrigerant gases from electric heat pumps (section 7.5), which was not included in the CBA due to the relative low scale of impact estimated.

Section 7.6 and 7.7 also qualitatively consider potential implications for lost productivity under Option 2 and reduced option value under all options, which were not included in the CBA due to limited data to quantify the potential impact; noting that each potential impact is not expected to influence the preferred option.

7.1 Electricity market impacts

This electricity modelling uses annual reduced fossil gas consumption and increased annual electricity consumption under each option from the CBA modelling as an input. The modelling has been completed over a 20-year period from 2026 to 2045. This is to understand the implications of the regulations on Victoria's electricity market to achieving the Victorian Government's net zero target by 2045.

The specific scope of the electricity market modelling developed in conjunction with DEECA is detailed below:

- **All energy market modelling is conducted to estimate the incremental difference between the regulatory options to the Base Case and to each other, to understand the magnitude of change in the context of regulatory change.** The intention of this scenario analysis is to help identify the impacts of the options on Victoria's electricity market. The outcome of this analysis must be interpreted in relation to this purpose, where the insights provided cannot be directly transferred to other studies without appropriate due diligence and further consideration. Since there are a range of other plausible futures, the results should not be interpreted as predictions of Victoria's electricity market or exact estimates of the investment required under each option.
- **The electricity market modelling was informed by the best and most up to date information available at the time the modelling was undertaken.** This included a range of the best and currently available public reports, primarily from AEMO Draft 2024 ISP, 2023 GSOO[314] and regulatory determinations, supported by public third-party expert reports where necessary (see Appendix D for details on key sources used).

[313] Department of Treasury and Finance (2013), Economic Evaluation for Business Cases Technical guidelines

[314] Note GSOO 2024 was released after modelling for analysis in this RIS had commenced. Hence GSOO 2023 underpinned the initial gas modelling definitions as determined in consultation with DEECA.

- **The AEMO ISP and GSOO provided underpinning assumptions for the electricity market modelling**. AEMO does not undertake appliance-level analysis, so a direct methodological comparison was not conducted.
- **The modelling does not include techno-economic modelling of the electricity network or power systems analysis** to determine network reliability requirements. Hence the analysis of the incremental network investment required is high-level and directional.
- **Where applicable, a conservative approach was adopted to avoid overstating the potential benefits of regulatory options**, particularly where there is significant uncertainty. This is line with Better Regulation Victoria's preferred approach and corresponding requirements of a RIS, noting that options should be 'stress tested' where there is significant uncertainty.[315]

For detailed method and assumptions underlying electricity market modelling, see Appendix D.

Results from electricity market modelling and gas market analysis are categorised into low, moderate and high impact, where:

- low impact represents up to, and including, 5 per cent increase relative to Base Case
- moderate impact represents between 5 per cent and 15 per cent increase relative to Base Case
- high impact represents over 15 per cent increase relative to Base Case.

The following sections focus mostly on the impact of Options 2 and 3, given that Option 3 is the preferred option and Option 2 presents the largest energy market impacts.

Electricity market modelling indicates that the options are anticipated to have a low impact on electricity tariffs relative to the Base Case. As outlined within Section 4.2, the Base Case represents a level of electrification that occurs as a result of existing policies in place or proposed as well as trends. This assumes additional investment and network expansion already occurs in the future under the Base Case to meet electrification of changing consumer trends (such as uptake of electric vehicles and voluntary electrification) and existing or proposed government policies (such as electrification of residential rental properties and government buildings). The ability of Option 3 to reduce pressure on peak demand and minimise electricity retail tariff impacts relative to Option 2 further supports its ranking as the preferred option.

7.1.1 Impacts on electricity consumption

The regulatory options result in an increase in total annual electricity consumption in Victoria due to the increased level of electrification relative to the Base Case. As depicted in Figure 7.1, Option 2 results in the highest increase in electricity consumption relative to the Base Case, and Option 1 results in the lowest increase in consumption. The increase in demand under Option 1 and Option 2 present the lower and upper bound of consumption increases respectively, with increases under Options 3 and 4 falling within this range.

The maximum increase in electricity consumption occurs in 2045 for all options.[316] Figure 7.1 shows that the highest increase in electricity demand compared to the Base Case occurs under Option 2 (greater than 4 TWh), followed by Option 4 (less than 4 TWh), Option 3 (around 3 TWh) and Option 1 (less than 1 TWh). The differences in each option are driven by the number of residential and commercial customers incorporated in each option and the types of appliances replaced.

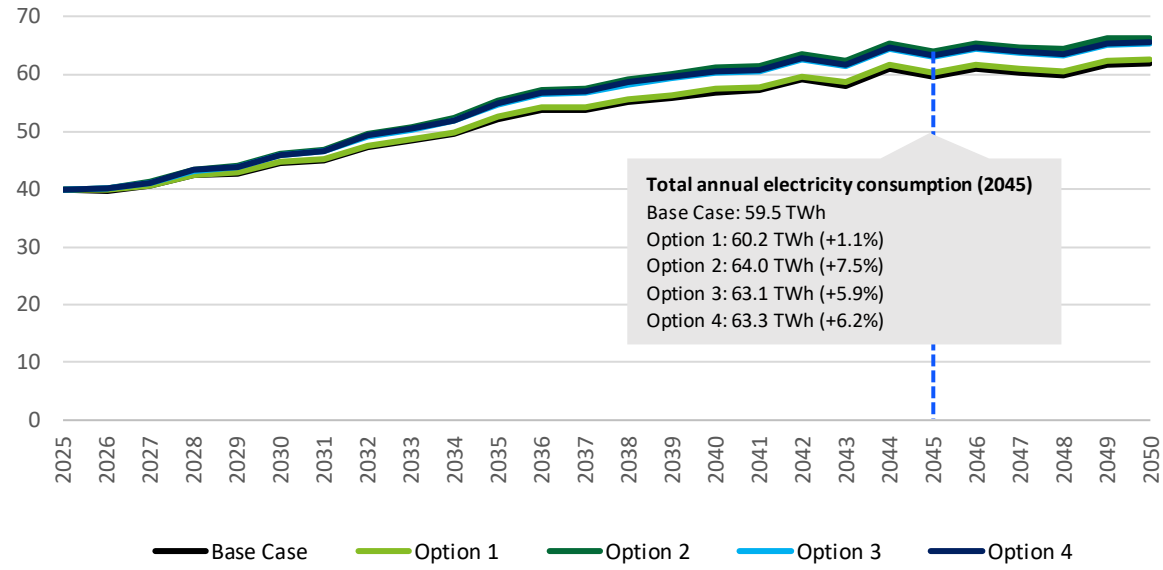
Figure 7.1 also shows growth in Victoria's annual electricity consumption under the Base Case, with drivers of this growth including steady uptake of electric vehicles, population growth, general energy consumption growth, transitioning from gas to electric appliances in rental properties and government buildings, as well as voluntary uptake, based on underlying projections from AEMO's Step Change scenario. That is, annual electricity consumption is expected to increase under the Base Case regardless of the requirements proposed under the regulatory options.

These projections are based on a methodology and assumptions developed to assess the potential impact of the options on the electricity market (see Appendix D for detailed methodology). Because there are a range of other plausible futures, the results should not be interpreted as predictions of Victoria's electricity market or exact estimates of future electricity consumption.

[315] Commissioner for Better Regulation (2024), Victorian Guide to Regulation: A handbook for policy-makers in Victoria. <https://www.vic.gov.au/victorian-guide-regulation>

[316] 2045 the final year of the 20-year analysis period and no further upgrades are accounted for beyond 2045.

Figure 7.1: Total annual Victorian electricity consumption projected under each option and Base Case (TWh)



Source: Deloitte analysis

7.1.2 Increased electricity generation relative to Base Case

The additional electricity required under the options relative to the Base Case is projected to be largely supplied by increased generation from VRE supported by energy storage and GPG.

Victoria's continued expansion of renewable electricity will increase the importance of energy storage and GPG's role in balancing the grid. This role will increase once coal generation exit the market. This role has been well articulated in AEMO's Integrated System Plan and is observed in both the Base Case and proposed options. For Options 2, 3 and 4, modelled additional gas consumption for GPG relative to the Base Case peaks in 2045, increasing by 20 PJ, 17 PJ and 17 PJ respectively. For Option 1, this additional consumption peaks in 2038 by 3 PJ.

While the model indicates increased gas consumption is required for GPG because of increased electrification (particularly under Option 2, 3 and 4), the reduction in reticulated gas usage is much larger, therefore resulting in an overall reduction in gas consumed across the energy sector and freeing up more gas for GPG to provide reliability support to the electricity market.

Changes in electricity generation as a result of the options would also impact wholesale electricity price outcomes. These potential changes are factored into the change in retail electricity tariffs considered in section 7.1.5 below.

7.1.3 Peak electricity demand

As a result of increasing annual electricity consumption, the options are expected to have an impact on peak electricity demand. The impact on the peak demand requirements also depends on the type of appliance switching and time of day usage.

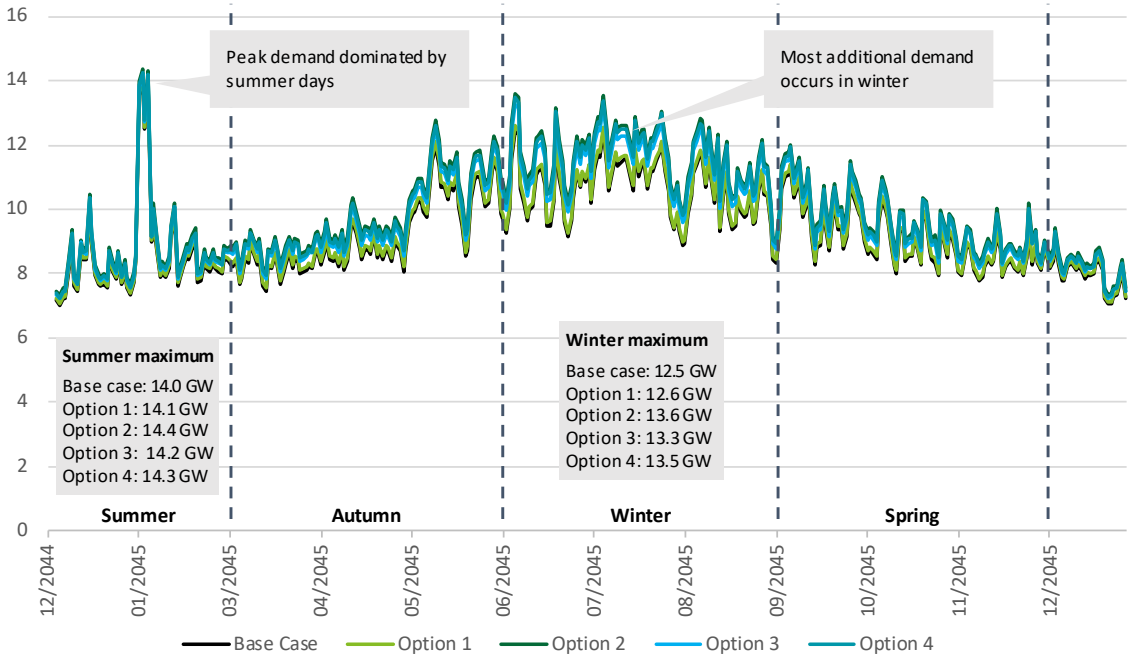
Peak electricity usage in Victoria currently occurs during summer with peak demand of up to 10 GW, while winter peak demand is currently about 8 GW. A significant portion of Victoria's residential and commercial gas usage is for heating and therefore electrification is anticipated to have the largest impact on winter peak demand.

While the options result in a larger impact on winter peak demand levels, they also have impacts on summer peak demand levels. Summer peak demand levels are typically the driver of the annual peak demand levels across most years. This increase in summer peak demand is driven by the electrification of residential cooking and water heating under Options 2 and 4, as well as commercial water heating and cooking (for residential scale appliances) under Option 2.

The impact of the options on peak electricity demand across various seasons is shown in Figure 7.2, which shows half-hourly peak demand across 2045 as a sample year. The figure shows that the trends in peak demand under the options closely follow the Base Case, with the biggest difference observed in winter and only a small relative increase in summer peak demand. When compared to Base Case:

- Option 2 sees a 1.1 GW increase in winter peak demand and 0.4 GW increase in summer peak demand
- Option 3 sees a 0.8 GW increase in winter peak demand and 0.2 GW increase in summer peak demand.

Figure 7.2: Peak half-hourly electricity demand (Victoria) by day in 2045 (GW)



Source: Deloitte analysis, using AEMO ISP2024 and DEECA inputs.

By 2050, peak electricity demand for each regulatory option increases by various scale when compared to Base Case:

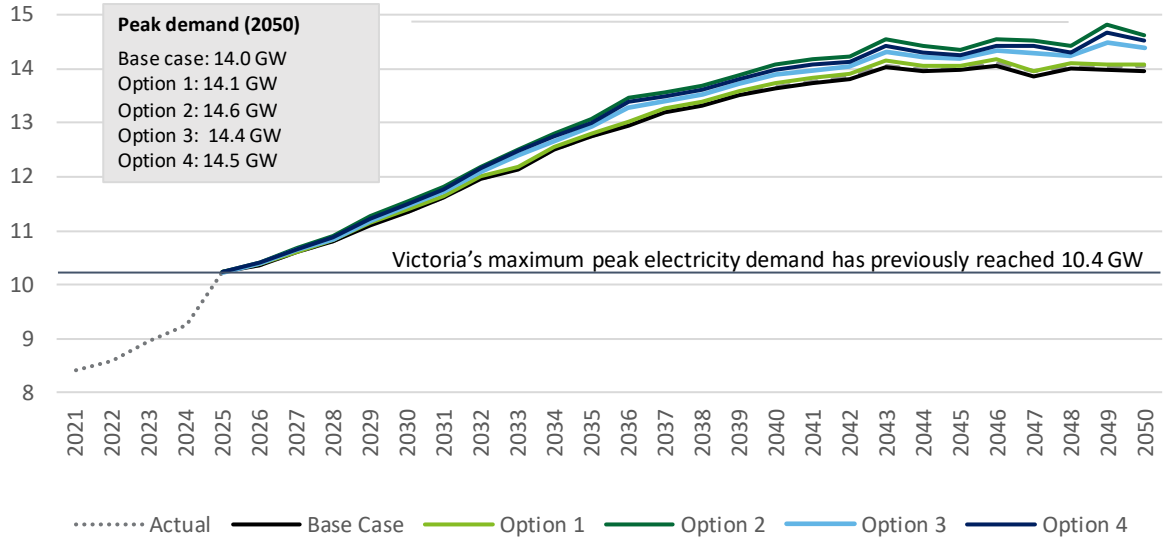
- less than 1 per cent for Option 1
- approximately 6 per cent for Option 2
- less than 4 per cent for Option 3
- less than 5 per cent for Option 4.

Maximum impact on the peak demand would occur under Option 2 compared to the Base Case with overall impact being in the same order of magnitude across all options. Electrification under Option 2 accounts for less than 10 per cent of total electricity consumption in 2045. By comparison, Option 3 would alleviate some of the increase in peak demand relative to Option 2, which further supports choice of Option 3 as the preferred option.

The electrification of residential and commercial buildings under the regulatory options is not the only driver of Victoria's growing electricity consumption. Figure 7.3 shows growth in Victoria's peak electricity demand under the Base Case, the key drivers include steady uptake of electric vehicles, population growth, general energy consumption growth, transitioning from gas to electric appliances in rental properties and government buildings, as well as voluntary uptake. That is, peak demand is expected to increase significantly under the Base Case regardless of the requirements proposed under the regulatory

options. These drivers are already being proactively managed by relevant energy sector agencies and stakeholders to ensure appropriate investment and support is available to enable a smooth transition towards electrification.

Figure 7.3 Victoria's historical and projected peak electricity demand under Base Case and options (GW)



Source: Deloitte analysis

While government buildings were assumed to electrify under the Base Case, they are not exempt from the options. The impact of electrification of existing government buildings is considered in other policy proposals being undertaken by government. Under a hypothetical scenario where Option 2 would result in existing government buildings being required to replace gas appliances with electric appliances that would not have otherwise occurred under the Base Case, this would result in the same overall peak demand outcomes presented in Figure 7.3, however would allocate this electricity demand to Option 2 instead of the Base Case. This further supports Option 3 as the preferred option over Option 2, under which existing commercial buildings (and by extension government buildings) are excluded from the proposed regulation.

Victoria's total electricity demand is expected to consist of multiple emerging segments in the future – including electric vehicle charging, industrial electrification and hydrogen production – each of which has different timing, magnitude, seasonality and time of day assumptions. The electricity demand patterns of these emerging segments (e.g., hydrogen production), and how they interact with distributed energy resources, energy efficiency and demand side management initiatives, remains uncertain. The seasonal pattern of Victoria's peak demand could change in the coming years as these dynamics evolve. Noting that the impact of seasonal availability of solar resources on roof top solar and corresponding demand from the grid is already captured in the model under all options and Base Case. That is, in summer when there is a high chance of solar availability at peak hours, less demand would be required from the grid compared to winter which has more limited solar availability.

7.1.4 Electricity network infrastructure

The electricity network system is made up of transmission and distribution infrastructure.

7.1.4.1 Electricity transmission infrastructure

Significant work is already underway to expand Victoria's transmission network as a result of broader trends towards decarbonisation and other government policies in place outside of the proposed regulations. In particular, AEMO has established an Optimal Development Pathway (ODP) within the Draft 2024 ISP to support linking of states and Renewable Energy Zones (REZs).[317]

The modelling suggests that transmission projects specified under the ODP (both within Victoria and other REZs across the NEM) can support the load requirements of the network for both the Base Case and Option 1. However, the modelling

[317] For more information on the extent of transmission investment proposed under the ODP see AEMO (2024), Appendix 5 Network Investments – Appendix to the 2024 Integrated System Plan for the National Electricity Market <a5-network-investments.pdf>

suggested that some transmission augmentation would be required under slightly earlier timeframes relative to AEMO's Draft 2024 ISP Step Change scenario for both the Base Case and Option 1.

For Option 2, the modelling suggested that existing ODP investment under AEMO's Draft 2024 ISP Step Change scenario would not be sufficient to meet peak demand, therefore some additional investment appears to be required. Option 2 and Option 4 are expected to require a moderate increase in transmission capital investment relative to the Base Case.[318] While Option 3 also requires additional transmission investment, this is relatively lower than Option 2 and Option 4 and appears marginal when compared to the capital expenditure required for Base Case by 2050. This is because Option 3 results in lower peak demand levels compared to Option 2 and 4, hence does not require the same magnitude of transmission investment to support peak loads.

7.1.4.2 Electricity distribution infrastructure

The modelling assumed that Victoria's electricity network has an existing network capacity of 10.4 GW.[319] As a result, it was assumed additional network investment is only required as a result of the regulatory options where peak demand under the options exceeds 10.4 GW and is greater than peak demand under the Base Case. Note that this approach assumes additional peak demand can leverage existing spare capacity in the distribution network, however in practice there are physical and operational constraints that may not allow this.

Due to a significant increase in electricity consumption under the Base Case, peak demand will likely exceed existing network capacity by 2026. Beyond this time additional distribution investment is anticipated to be required under the options to meet rising peak demand.

In total, across the modelled period, the additional capital investment for the distribution network relative to Base Case is projected to be high for Option 2 and Option 4, moderate for Option 3 and low for Option 1.[320]

While this analysis has assumed that the peak demand increase would be met by network augmentation (which would add to network costs), there are other policy options that could be explored to avoid these costs in part or in full, such as Virtual Power Plants, Demand Side Management and Vehicle to Grid Charging.

7.1.5 Electricity tariff impacts

It is projected that the regulatory options will result in relatively small increases in electricity tariffs compared to the Base Case. This is driven by changes in wholesale market dynamics and slightly increased network infrastructure.

Figure 7.4 presents the modelled percentage increase in annual electricity tariffs relative to the Base Case, averaged over 5-year interval periods. As there are a number of anticipated future changes underpinning the electricity market under the Base Case these figures are indicative trends and not intended to be (and should not be) compared to current day tariffs. Estimated tariff impacts represent averages for all customers over the whole electricity network (including for industrial electricity connections) and do not apply to the granularity of any one individual tariff or customer type.

The figure shows the average increase in annual electricity tariffs remains below 4 per cent across all options relative to Base Case. Under Option 2, the annual electricity tariff is anticipated to increase by just over 3 per cent over the period 2041 to 2045, relative to the Base Case. Over the same period, the average annual electricity tariff is anticipated to increase less than 3 per cent under Option 3 relative to the Base Case.

To understand the impact of rising electricity prices on the CBA outcomes, a sensitivity analysis was conducted in section 6.3 by applying a 33 per cent increase in annual electricity prices relative to the core CBA assumption. Adopting a 33 per cent increase in annual electricity prices, results in the preferred option presenting a positive NPV and BCR. This 33 per cent sensitivity is substantially higher than the projected increase in electricity tariffs presented in Figure 7.4 below.

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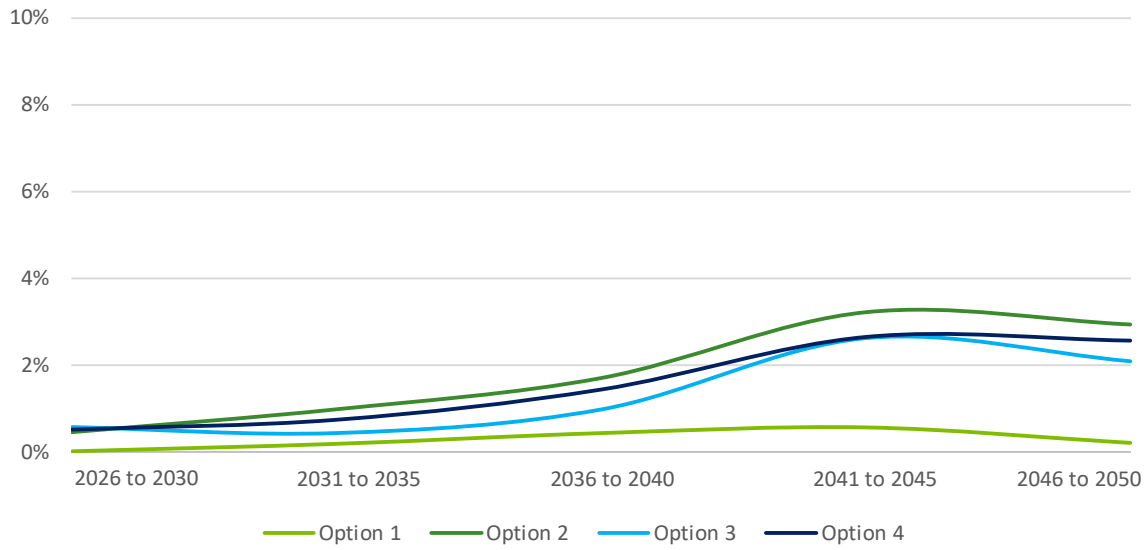
[318] For the purposes of this study, low impact is defined as up to and including 5 per cent above Base Case, moderate impact is defined as between 5 per cent to 15 per cent above Base Case and high impact is defined as greater than 15 per cent above Base Case.

[319] AEMO Quarterly Energy Dynamics Q1 2024 Figure 11 noted that, between 1998 to 2024, Victoria experienced its maximum operational demand in 2009. <https://aemo.com.au/-/media/files/major-publications/qed/2024/qed-q1-2024.pdf?la=en> AEMO's Aggregated Price and Demand Data – Historical for Vic – 2009 – Jan, Feb and Mar confirm Victoria's maximum 30-minute operational demand was 10,415 MW (experienced on 29/01/2009 12:30:00 PM), suggesting Victoria has a network capacity of at least 10.4 GW. <https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/data-nem/aggregated-data>

[320] For the purposes of this study, low impact is defined as up to and including 5 per cent, moderate impact is defined as between 5 per cent to 15 per cent and high impact is defined as greater than 15 per cent.

These projections are based on a methodology and assumptions developed to assess the potential impact of the options on energy tariffs (see Appendix D for detailed methodology). Because there are a range of other plausible futures, the results should not be interpreted as predictions of Victoria's electricity market or exact estimates of future electricity tariffs.

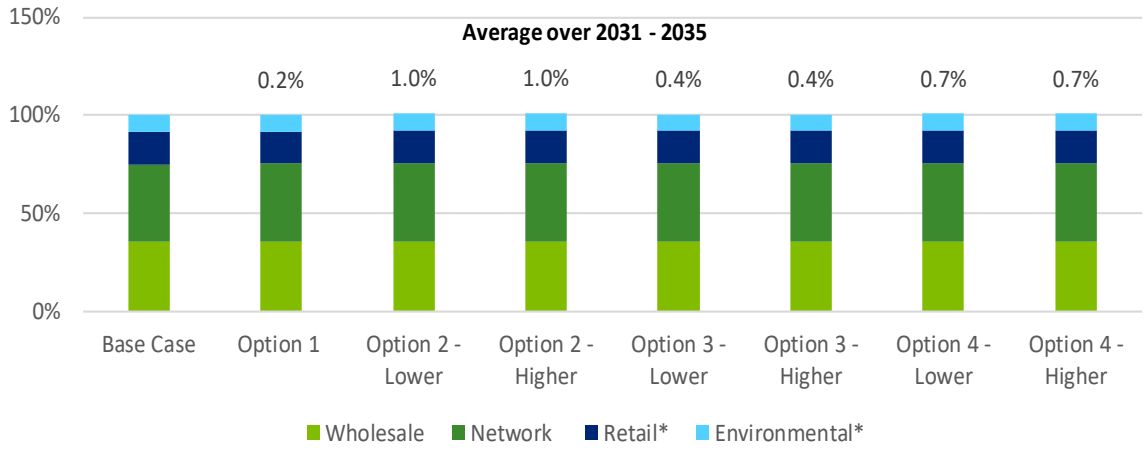
Figure 7.4: Percentage increase in electricity retail tariffs relative to Base Case, averaged over 5-year periods



Source: Deloitte analysis. Note: Under Option 1 the impact on electricity tariffs over 2026 to 2030 is negligible due to underlying investment occurring in the Base Case as part of AEMO's ODP planned network investment. Option 2, Option 3 and Option 4 present tariff impacts under a conservative transmission investment scenario in later years (2040 onwards), that is, only the 'higher' range is presented.

Retail electricity tariffs are comprised of wholesale costs, network costs, retailer margin and environmental costs. For the purposes of the analysis conducted for this report, it was assumed retail and environmental components are steady, on the basis their proportionate costs will not change as a result of the regulatory options under consideration. It is difficult to determine how energy retailers may react or environmental requirements may change in relation to the proposed regulations and therefore uncertain how retail margins and environmental costs may change as a result of the options. Further stakeholder consultation and analysis would be required to assess whether the proportion of retailer margin or environmental costs would change as a result of the options. Therefore, changes in electricity tariffs are assumed to be primarily driven by changes in wholesale market dynamics and network charges. Figure 7.5 presents the estimated breakdown for each component, averaged over 2031 to 2035 period (selected to demonstrate the short to medium term impacts anticipated under a 10-year analysis period, see section 5.1.2). It shows the change in sub-components relative to Base Case is low over this period. Note that both a lower and a higher range is presented for Option 2, 3 and 4, reflecting the potential range in potential transmission investment required. No difference between the lower and the higher range is observed in the period over 2031 to 2035 as the difference in transmission investment occurs in later years (post 2040), where investment options become more uncertain and the impact on peak electricity demand is more pronounced (see section 7.1.3).

Figure 7.5: Change in electricity retail tariffs relative to Base Case, averaged over 2031 to 2035 (% change, 100% = Base Case)



Source: Deloitte analysis based on ESC Victorian Default Offer 2023-24. Note: For the purposes of the analysis, it was assumed the retail and environmental components are based on existing reported margins from the ESC Victorian Default Offer 2023-24, on the assumption their proportionate costs will not change as a result of the regulatory options proposed.

As noted in section 4.2.2, while the impacts of electrification under the Base Case are not directly assessed in the analysis, there may be cumulative effects of broader industry electrification on electricity tariffs (as shown in Figure 7.1). Section 7.1.4 notes that network investment will also be required under the Base Case. Moreover, increasing electricity consumption under the Base Case may also put upwards pressure on wholesale electricity prices. This in turn may result in higher network tariffs under the Base Case. The ability of Option 3 to reduce electricity retail tariff impacts relative to Option 2 further supports its ranking as preferred option.

7.2 Gas market impacts

Gas market analysis considers potential impact of options on wholesale gas supply and demand, as well as the impact on gas tariffs as a result of fewer customers connected to the gas network.

The specific scope of the gas analysis developed in conjunction with DEECA is detailed below:

- **All gas market analysis is conducted to estimate the incremental difference between the regulatory options to the Base Case and to each other, to understand the magnitude of change in the context of regulatory change.** The intention of this scenario analysis is to help identify the impacts of the options on Victoria's gas market. The outcome of this analysis must be interpreted in relation to this purpose, where the insights provided cannot be directly transferred to other studies without appropriate due diligence and further consideration. Since there are a range of other plausible futures, the results should not be interpreted as predictions of Victoria's gas markets or exact estimates of the investment required under each option.
- **The gas market analysis was informed by the best and most up to date information available at the time the modelling was undertaken.** This included a range of the best and currently available public reports, primarily from AEMO Draft 2024 ISP, 2023 GSOO[321] and regulatory determinations, supported by public third-party expert reports where necessary (see Appendix D for details on key sources used).
- **The AEMO ISP and GSOO provided underpinning assumptions for the gas analysis**. AEMO does not undertake appliance-level analysis, so a direct methodological comparison was not conducted.
- **Where applicable, a conservative approach was adopted to avoid overstating the potential benefits of regulatory options**, particularly where there is significant uncertainty. This is in line with Better Regulation Victoria's preferred approach and corresponding requirements of a RIS, noting that options should be 'stress tested' where there is significant uncertainty.[322]

[321] Note GSOO 2024 was released after modelling for analysis in this RIS had commenced. Hence GSOO 2023 underpinned the initial gas modelling definitions as determined in consultation with DEECA.
[322] Commissioner for Better Regulation (2024), Victorian Guide to Regulation: A handbook for policy-makers in Victoria. <https://www.vic.gov.au/victorian-guide-regulation>

Costs recovered by gas transmission network providers and distribution network providers are regulated by the AER, who approve tariffs and revenue in published Access Arrangements in five-year cycles. The network providers may recover annual costs that fall into five categories in the building block model: return on capital, annual depreciation, tax, operating expenditure, and revenue adjustments. For the purposes of assessing the potential impact of options with all else held constant, it was assumed that the current regulatory and policy framework continue to remain in the future. However, given that a decline in customer numbers is expected under Option 2, 3 and 4, there is some uncertainty as to how the regulatory framework may adjust in the future. Noting significant uncertainty regarding the approach to gas network cost recovery under the options, key assumptions and limitations for gas modelling include:

- There are no new residential or commercial customer connections in Option 1, 2 or 3 and no new residential customer connections in Option 4.
- Pipeline kilometres in the distribution network are assumed to remain constant over time. i.e., additional augmentation stops in 2028, after the end of the current Access Arrangement period.
- Some capital expenditure in assets linked to pipeline maintenance or replacement is incurred in every year of the model and is depreciated over the total life of the asset. This represents an implicit assumption that the distribution network (and its regulatory cost recovery mechanism) continues to be commercially viable indefinitely, which is likely not true once customer connections drop to a certain point (a so-called 'tipping point').
- Abolishment of gas connections is included as a cost item linked to number of disconnections each year.[323] Costs associated with theoretical decommissioning of parts of the network are excluded due to lack of publicly available planning guidance, resources and costings, and ongoing uncertainty around how network costs may be allocated in future. Noting this uncertainty, the assumption that no costs are incurred for the decommissioning of network assets is based on current policy and regulatory settings, however this may not be economically feasible in the long-term. Further consultation and policy analysis of a different regulatory framework would be required to understand how costs of decommissioning could impact the outcome of the policy options under consideration, and viable pathways for gas network service providers.
- Depreciation of the existing regulatory asset base of gas network service providers was assumed to occur as calculated in the latest Access Arrangements.[324] Depreciation of new capital expenditure occurs via straight-line depreciation and does not account for any potential changes in allowed cost recovery of the regulated asset base such as any additional accelerated depreciation.
- The approach to projecting disconnection assumes buildings only replace appliances once required at end of life. It is possible that some buildings may choose to electrify some appliances earlier, at the same time as other appliances that have reached end of life, and therefore disconnect from the gas network earlier. This would accelerate the disconnection of gas customers and accelerate the gas tariff impacts associated with disconnection.
- The projected change in total retail gas price is estimated across all customer types and does not distinguish between residential, commercial, or industrial customers. This assumes that fixed costs (such as network infrastructure) would be spread across all gas customers in line with their respective volume of energy consumption.

The following sections focus mostly on impact of Options 2 and 3, given that Option 3 is the preferred option and Option 2 presents the largest energy market impacts.

For detailed method and assumptions underlying the gas analysis, see Appendix D.

7.2.1 Gas demand and supply impacts

7.2.1.1 Reticulated gas demand

The proposed reforms are projected to reduce demand for fossil gas in Victoria. Figure 7.6 below shows that compared to the Base Case, fossil gas demand decreases by 12 PJ in Option 1, 79 PJ in Option 2, 60 PJ in Option 3 and 58 PJ in Option 4 by 2045. The differences in each option are driven by the number of residential and commercial customers incorporated in each option and types of appliances replaced.

Option 3 and Option 4 are relatively close in the volume of fossil gas reduction achieved as the volume of avoided fossil gas consumption captured by existing residential cooking under Option 4 (approximately 4 PJ per annum) is roughly equivalent to what is captured by new commercial buildings under Option 3. Fossil gas reduction under Option 4 plateaus from 2039 as existing residential properties are anticipated to be fully electrified by this point and new residential properties are almost

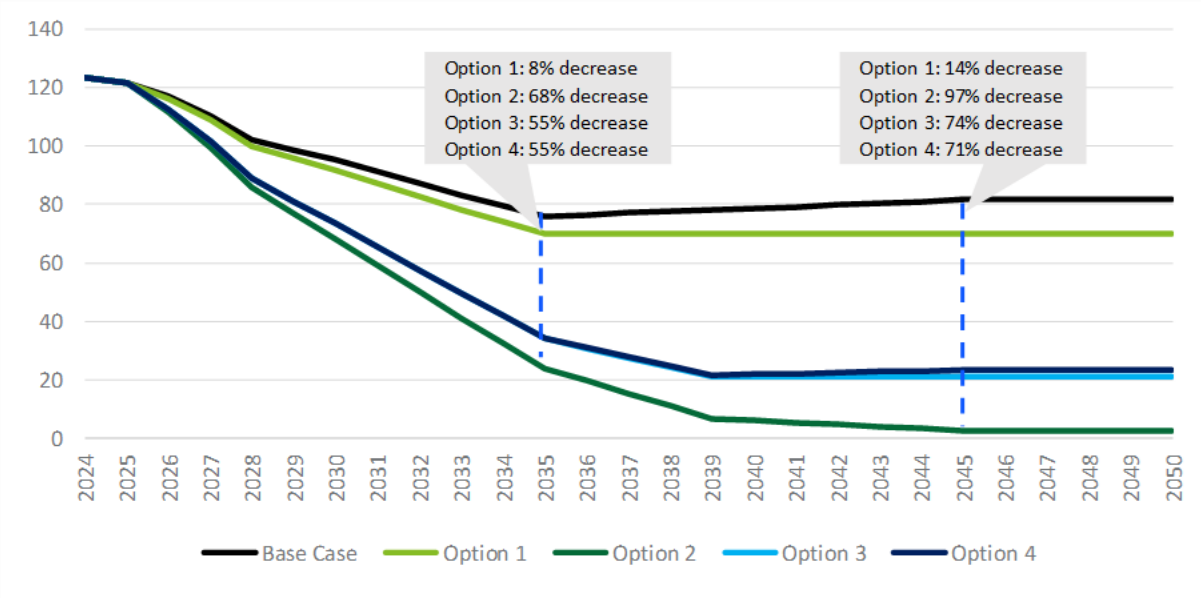
[323] This accounts for the remaining cost borne by gas distribution network providers that are not covered directly by the disconnecting customer and therefore recovered through the broader network supply charge.
[324] Australian Energy Regulator (AER), Victorian gas access arrangements. <https://www.aer.gov.au/industry/registers/access-arrangements>

entirely electric under the Base Case from this point in time. Whereas under Option 3 fossil gas usage from new commercial buildings is projected to continue to grow by approximately 1.2 per cent over the long-term under the Base Case.

Figure 7.6 also demonstrates that fossil gas consumption also decreases substantially under the Base Case, in line with electrification of rental heating and hot water, as well as existing government buildings and voluntary uptake across all residential and commercial buildings. See section 4.2 for further detail on assumptions under the Base Case.

Decreased reticulated gas consumption has implications for Victoria's fossil gas shortfalls, wholesale prices, network infrastructure and tariffs.

Figure 7.6: Projected Victorian residential and commercial gas consumption under Base Case and options (PJ)



Source: Deloitte analysis

7.2.1.2 Wholesale market impacts

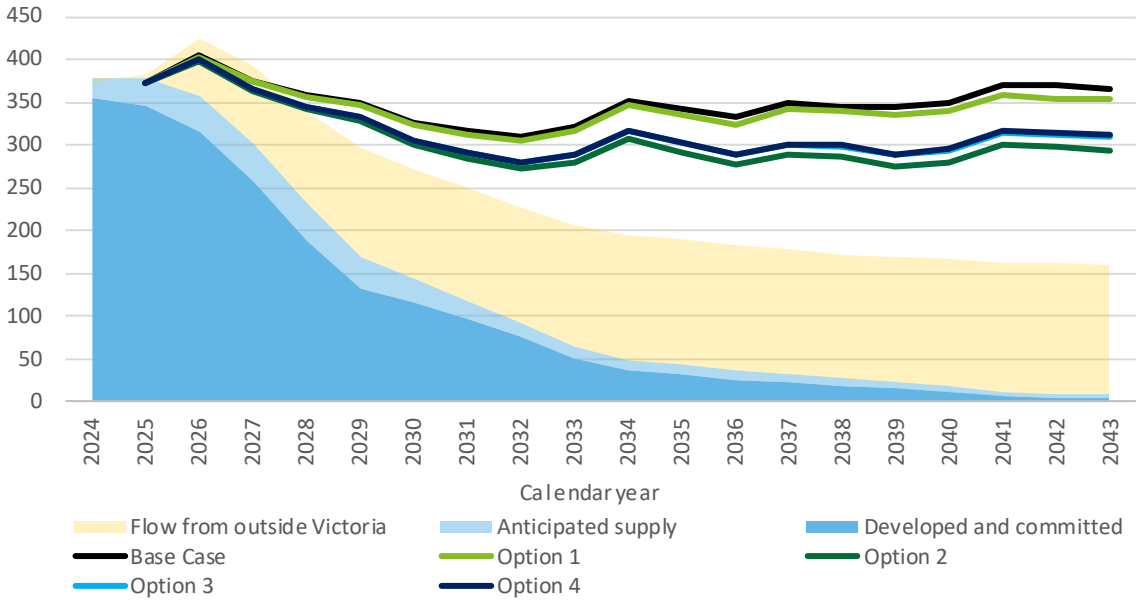
As outlined in Chapter 2, AEMO's GSOO notes that there is a continued risk of short-term fossil gas supply shortfalls and long-term fossil gas supply gaps arising from declining production in southern Australian states. These risks are most pronounced during winter months, when there is high demand for fossil gas for space heating in Victoria and expected need for GPG gas consumption (i.e., emerging winter GPG peaks). The report also notes that LNG volumes produced in Queensland and contracted for export may need to be diverted to east coast domestic gas customers from 2026 – especially during winter – to maintain adequate domestic supply. The options assessed in this RIS would result in a material reduction in domestic fossil gas demand in Victoria, reducing the magnitude of projected demand shortfalls in winter.

In the near-term, total Victorian fossil gas demand in the Base Case is expected to exceed existing supply by 2027, and mostly exceed existing and committed supply by 2028. The reduction in fossil gas demand, in addition to new interim fossil gas supply, transport or import options, is key to avoiding increasing shortfall risks. While the options assessed in this RIS will reduce fossil gas demand, because existing gas appliances account for the largest reduction in fossil gas usage and options only require replacement of existing appliances at end of life, it is unlikely the options will have sufficiently large impact on fossil gas demand before it begins to exceed supply.

This supply gap can be seen across all southern states, even with committed and anticipated projects accounted for, as shown in Figure 7.7. Across all southern states the supply gap continues to widen until 2043, reaching a maximum of 205 PJ for the Base Case. Option 2 halves this supply gap in the early 2030s. Similarly, Option 3 and 4 reduce the supply gap by approximately a third. AEMO notes there is further additional 'uncertain' supply from southern gas fields, totalling 274 PJ in

2043. These projects represent contingent or prospective resources,[325] and are therefore highly uncertain as to whether it would be a viable source of fossil gas supply.[326]

Figure 7.7 Existing, committed, and anticipated supply in southern states, including projected supply from north, and the southern states forecast demand (PJ)



Source: Deloitte analysis and AEMO GSOO 2024. Note: Gas consumption represents total across all southern states (Victoria, New South Wales, Tasmania, South Australia). Option 3 and Option 4 have a similar gas projection profile.

Modelling indicates that annual wholesale fossil gas prices are projected to decrease only slightly when compared to the Base Case. The sensitivity of fossil gas prices to changes in demand is based on AEMO's ISP 2022 IASR, which indicates relatively low change in price in response to changes in demand in southern states (VIC, TAS, NSW, SA).[327] The underlying trend from AEMO's forecast predicts a decrease in prices in the near term as international LNG prices fall, followed by a steady increase out to 2050. However, as detailed in Chapter 2, there are several uncertainties regarding the future supply of fossil gas in Victoria and therefore projected prices under the Base Case. While AEMO projects relatively low and stable wholesale fossil gas prices under the Base Case, as shown in Figure 2.5, these may be impacted by future pipeline capacity, the extent to which demand can be met by sources of supply from other jurisdictions, the regulatory environment, new supply sources and the impact of GPG demand. Ability to reduce fossil gas demand may help to alleviate some of these risks and therefore reduce potential price rises in the future. Option 2 results in the highest magnitude of volumetric fossil gas demand reduction and therefore reduces the risk of fossil gas shortfalls by the greatest extent; this is followed by Option 3.

7.2.2 Gas network impacts

Gas network infrastructure is made up of transmission and distribution pipelines.

The annual cost of operating the transmission pipeline is assumed not to change under each option on the basis that the network is needed to be maintained to supply industrial users, GPG, or provide carriage for gas production/storage sites, and because under each option there are at least some residential or commercial buildings with at least one appliances type that can still be gas-powered.

[325] As defined by the Society of Petroleum Engineers – Petroleum Resource Management System project maturity sub-classes.
[326] The federal government has finalised new offshore gas exploration permits in the east and west coast markets, however these projects are still uncertain and, if approved, would not be operational for many years. Department of Industry, Science and Resources (2024), Media release: Finalisation of offshore exploration rounds. <https://www.minister.industry.gov.au/ministers/king/media-releases/finalisation-offshore-exploration-rounds>
[327] Lewis Grey Advisory (2021), Gas Price Projections for Eastern Australia Gas Market 2022. <https://aemo.com.au/-/media/files/major-publications/isp/2022/iasr/lewis-grey-advisory-gas-price-projections-report.pdf>

Analysis indicates that gas distribution network costs would decrease over the long term as a result of declining customer numbers and avoided expansion of the network under the regulatory options. However, based on the current regulatory framework and policies in place, it was assumed fixed costs associated with existing network length would not change. This assumes the current distribution network length is maintained over time, noting that in practice as large volumes of customers disconnect this may not be required. In addition, there is an increased operational cost associated with abolishment of gas customer connections[328] which progressively increases with rising disconnections modelled up to 2039.[329] While some of this is recovered directly from the disconnecting customer, under the existing regulatory framework the majority of the cost (approximately $602 to $730 per small customer) is passed on to remaining gas customers.[330]

As a result of falling customer numbers and gas volumes under Option 2, the estimated network infrastructure tariff is predicted to increase substantially over the projected horizon, peaking around 2039 as the largest number of disconnections are assumed to occur in that year. A similar impact is anticipated for Option 3 and 4, although to a lesser extent, noting that under Option 3 existing residential properties retaining gas cooking would not disconnect from the network.[331] Network regulatory settings could mitigate cost increases by ensuring only appropriate and efficient investment in network infrastructure in a declining gas use environment. The impact of this on customer retail gas tariffs is considered in section 7.2.3.

It was assumed that the costs are spread volumetrically across the customer base, such that price increases are shared with gas powered generators and large industrial users who are expected to maintain a level of demand on the network, noting how future costs are allocated in practice is highly uncertain. Consultation with gas sector stakeholders and government agencies would be a valuable source of input into further detailed analysis of how costs may be allocated across various customer segments in the future as residential and commercial demand nears zero under some options.

There are some further considerations to make when interpreting the anticipated rise in gas network prices. First, the context of the current regulatory framework: gas distribution networks are regulated by the AER, which determines the setting of tariffs in line with agreed forecast costs and expenditure for each distribution network provider.

Second, the physical distribution networks constitute a large, regulated asset base yet to be fully recovered. The current regulatory model is predicated on a stable and long-lasting customer base, such that the depreciation (and therefore cost recovery) of these assets is spread over their useful economic lifetimes. This spreads the cost of capital investments over several decades and reduces year-on-year tariff volatility. As a result of declining customer base under Option 2, 3 and 4, there is increased risk of asset stranding of the gas network infrastructure.

Some accelerated depreciation has been approved in the most recent Access Arrangements in order to allow gas distribution network providers to recover more of their RAB while customer numbers remain high. However, this increases network prices in the short to medium term and the future scale of recovery of the distribution networks provider's regulated asset base remains uncertain. The AER note that the stranded asset risk poses wider risks to future tariff prices, but how the fiscal responsibility of this risk is shared between governments, consumers or asset owners is yet unclear.[332,333]

Generally, the AER seeks to stabilise customer gas bills as much as possible, but the acceptable rate and spread of price increases in the context of a rapidly declining customer base remains uncertain. In practice, it is likely that a declining customer base would prompt changes to the network and examination of the cost recovery regulatory framework to address these issues. The Victorian Government is aware that careful consideration is required to limit price impacts to remaining gas users and ensure Victoria's gas network is fit for the future.

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[328] Gas abolishment in this context refers to removal of customer meter and disconnection of the building from the distribution network. It does not refer to the broader abolishment or decommissioning of the distribution gas network itself.
[329] By 2039, all residential appliances are assumed to reach end of life and therefore no residential disconnections occur beyond 2039.
[330] AER (2023), Final decision – Attachment 6 – Operating Expenditure (for AGN/AusNet/Multinet).
[331] As noted in Chapter 5, this approach assumes properties only electrify appliances that are required by the regulatory change, such that voluntary uptake is the same as under the Base Case. There may be an increase in properties that, having been required to electrify two appliances, also choose at that point to electrify all remaining appliances and then disconnect from the gas network. Increased voluntary electrification and disconnection from the gas network under sub-options would increase the impact of network supply charges for remaining gas customers.
[332] AER (2023), Final decision – Attachment 4 – Regulatory Depreciation (for AGN/Ausnet/Multinet).
[333] AER (2021), Regulating gas pipelines under uncertainty - Information paper. <https://www.aer.gov.au/system/files/AER%20Information%20Paper%20-%20Regulating%20gas%20pipelines%20under%20uncertainty%20-%2015%20November%202021.pdf>

Stakeholder questions:

- The Victorian Government seeks advice from relevant stakeholders on the anticipated impact on cost of owning and operating the gas network as a result of the regulatory options, and how costs may be recovered through a changing customer base.

7.2.3 Gas tariff impacts

As a result of modelled rising network charges per connection under Option 2, 3 and 4, retail gas tariffs are estimated to increase proportionately.

Figure 7.8 presents the percentage increase in annual gas tariffs relative to the Base Case, averaged over 5-year interval periods. As there are a number of anticipated future changes underpinning the gas market under the Base Case these figures are not intended to be (and should not be) compared to current day retail tariffs. Estimated tariff impacts represent averages over the whole industry (including industrial) and do not apply to any one individual tariff or customer type.

Analysis indicates tariff increases are relatively modest under Option 1 compared to Base Case, while Option 2, 3 and 4 are all anticipated to have a higher impact on gas tariffs relative to Base Case as fewer consumers would pay for remaining fixed system costs. Of these three options, Option 2 is modelled to have the highest impact on retail gas tariffs due to limited residential properties remaining connected after 2039 and only some commercial buildings (those with commercial kitchens) remaining connected after 2045. Retail tariffs are anticipated to peak in 2039 as the greatest number of small customer disconnections are projected to occur in this year (see section 5.2.1.1 for more details on the approach to projecting disconnections) and therefore incur a higher operational cost for the gas distribution network providers. As a result, annual gas tariffs increase by over 80 per cent on average over the period 2036 to 2040 relative to Base Case. The increase in gas tariffs relative to Base Case under Option 2 tapers down from 2040 onwards as gas distribution network providers see costs to service customers decline in the longer term, in line with reduced number of customer connections.

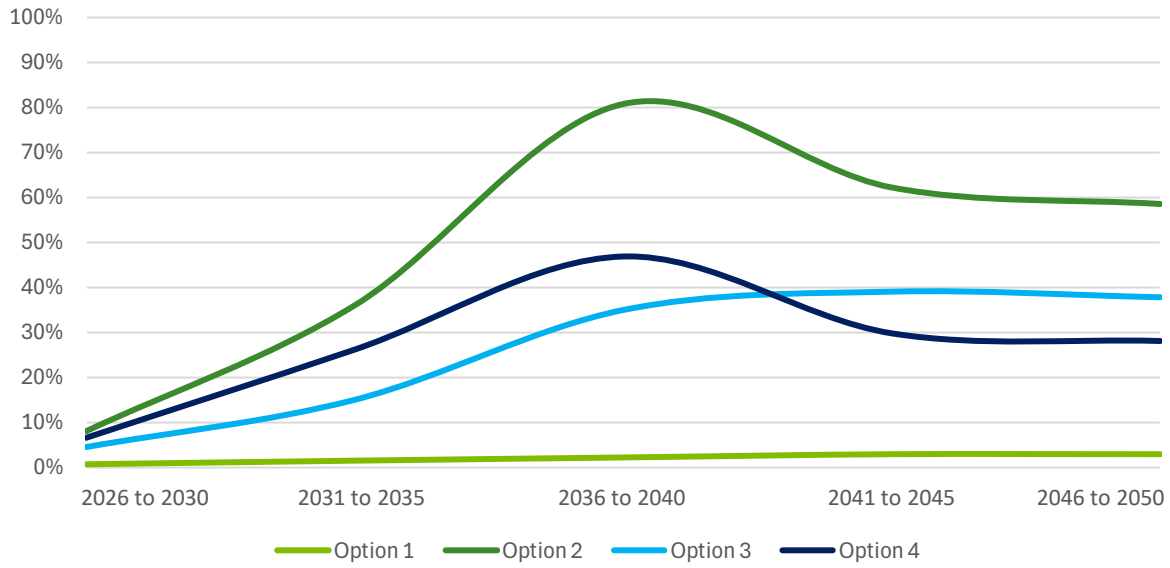
The remaining connection of existing commercial buildings under Option 4 as well as existing properties' residential cooking under Option 3 substantially reduces the projected gas tariff impact modelled under Option 2. Under Option 3, retail tariffs rise slowly to reach a 40 per cent annual increase relative to Base Case by the 2040s. This further supports Option 3 as the preferred option. Option 4 sees retail tariffs rise more rapidly in the short term as an increased number of residential disconnections result in high operational costs for gas network service providers. However, retail tariffs taper from 2039 onwards as fewer customers connected results in some operational cost savings to the gas network.

The modelled increase in gas retail tariffs would be felt by customers remaining connected to the gas network, including industrial and commercial users. This differs to the electricity tariff impacts in which although the annual price increase relative to Base Case is projected to be relatively minor, would impact a larger number of Victorian consumers, if not almost all (see section 7.1.5).

These projections are based on a methodology and assumptions developed to assess the potential impact of the options on energy tariffs (see Appendix D for detailed methodology). Because there are a range of other plausible futures, the results should not be interpreted as predictions of Victoria's gas market or exact estimates of future gas tariffs. Further, given regulatory reform that would be required to manage the transition towards electrification, the gas retail tariffs presented should be viewed as a mathematical calculation, rather than a true prediction of what consumers are likely to experience in the future.

In relation to how higher gas tariffs may impact the results of the CBA, it is noted that increased gas prices improve the NPV and BCR of all options (see section 6.3 for sensitivity analysis conducted) as it increases the avoided costs to customers of electricity. However, the CBA only considers direct impacts of the regulations and does not account for indirect (flow-on) effects to gas users who remain connected to the reticulated gas network. See section 8.5 for further consideration of the impact of the preferred option on remaining gas users.

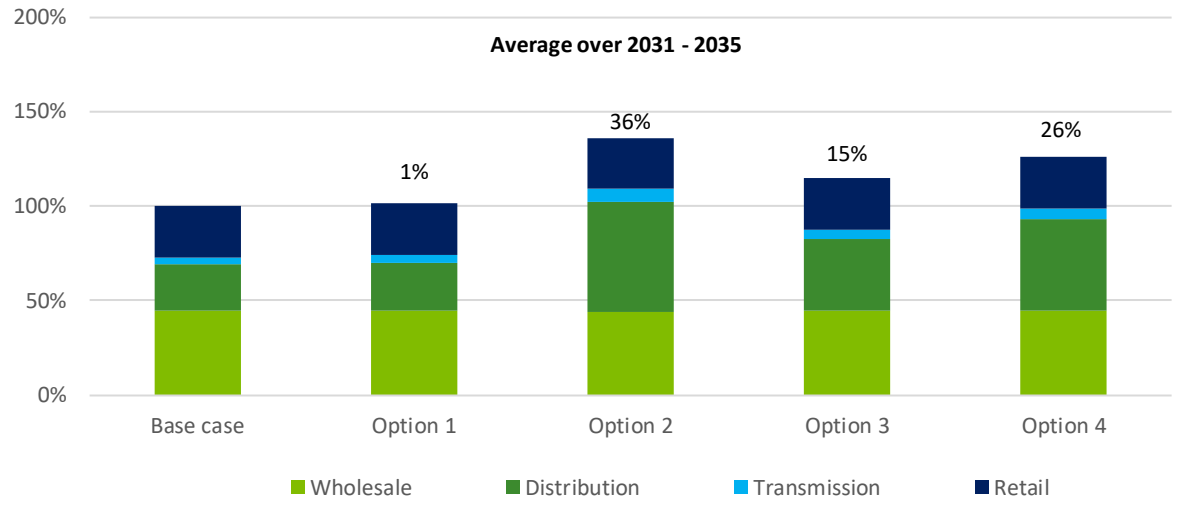
Figure 7.8: Percentage increase in gas retail tariffs relative to Base Case, averaged over 5year periods



Source: Deloitte analysis.

Retail gas tariffs primarily comprise wholesale costs, network costs (distribution and transmission) and retailer margin. For the purposes of the analysis it was assumed the retail component is in line with current margins, on the basis the proportionate cost will not change as a result of the regulatory options proposed. It is difficult to determine how energy retailers may react to the proposed changes and therefore uncertain how retail margins may change as a result of the options. Further stakeholder consultation and analysis would be required to assess whether the proportion of retailer margin would change as a result of the options. Therefore, changes in gas tariffs are assumed to be primarily driven by changes in wholesale prices and network charges. Figure 7.9 demonstrates the estimated breakdown for each component, averaged over 2031 to 2035 period (selected to demonstrate the short to medium term impacts anticipated under a 10-year analysis period, see section 5.1.2). It shows that distribution charges contribute the most to rising retail tariffs relative to the Base Case. Although transmission tariffs are also anticipated to rise with falling customer numbers, this only makes up a small proportion of the total retail tariff and therefore is estimated to only have a minor impact on retail gas tariffs. Rising gas network charges is offset by a small decrease in wholesale gas prices relative to Base Case, due to falling demand. See section 7.2.1 and 7.2.2 for further analysis of anticipated impact of options to wholesale market and gas networks.

Figure 7.9: Change in gas retail tariffs relative to Base Case, averaged over 2031 to 2035 (% change, 100% = Base Case)



Source: Deloitte analysis. Note: For the purposes of the analysis it was assumed the retail margins are based on existing reported margins, on the assumption their proportionate costs will not change as a result of the regulatory options proposed or would otherwise be shared across retailer's electricity users.

As noted in section 4.2.2, while impacts of reducing fossil gas consumption under the Base Case is not directly assessed in the analysis there may be cumulative effects of broader industry electrification on rising gas retail tariffs. Reduced fossil gas consumption from residential rental properties and government buildings (as well as voluntary electrification across the state) will likely further increase retail tariffs under the Base Case as a result of network costs being spread across fewer customers. The ability of Option 3 to reduce retail gas tariff impacts relative to Options 2 and 4 further supports its ranking as preferred option.

It is noted that regulatory revenue frameworks currently in force were developed to ensure cost recovery for a then growing network and gas demand, and were not developed in a network with gradually declining consumption patterns. In this novel environment, careful consideration is required to ensure that regulation and policy are complementary to provide a secure and predictable environment for business investment. The Victorian Government, through DEECA, is monitoring the network to ensure it remains fit for purpose, delivering value for producers, operators, and users. The potential impacts of the preferred option on households and businesses under the current regulatory framework are explored further in Chapter 8.

7.3 Broader economic implications

As discussed in Chapter 5, CGE modelling was undertaken to estimate the impact of electrification of buildings on GSP and sectoral GVA. The CGE modelling considered the implications of regulatory options relative to the Base Case under a 20-year period with sustained electrification (i.e., continued reinstallation of electric appliances).

Note the following limitations apply to the CGE modelling and results discussed below:

- CGE modelling is conducted at the sectoral level and therefore may not reflect market dynamics for certain products or occupations. For instance, the construction sector (which experiences higher activity under the options) incorporates workers and materials across a wide range of areas, including electrical and plumbing work. Therefore all plumbers and electricians are assumed to be the same pool of workforce under 'construction' and impacts on these occupations are unable to be discerned separately.
- This modelling approach is a dynamic representation of the Victorian economy and has a limited amount of labour which can be allocated to different sectors or activities. No additional labour market constraints (i.e., specific skills shortages in Victoria) have been incorporated into this model beyond what exists in the current underlying database.
- In response to an increase in capital expenditure for a particular sector and region, labour will typically flow into this sector and region (from either the pool of unemployed people, workers from other sectors within the region, or from workers outside of the region). Typically, the demand for labour generated by a policy option is often unable to be met

by workers within the local region. Therefore, some amount of crowding out (the movement of labour from other regions or sectors) will occur. Section 7.3.3 contains further discussion on impacts on labour and materials.

- The model assumes that skills are transferable within the construction sector (i.e., it was assumed that plumbers do not require any extra training or qualifications for appliance installation and retrofitting). If a policy option requires expansion of a niche sub-sector within the model (with specific skills and experience requirements), the modelling will assume that the labour make-up of that sub- sector is equivalent to that of the broader sector. Section 7.3.3 contains further discussion on impacts on labour and materials.
- The behavioural parameters in the model (such as those influencing the fossil gas use from other sectors that are not directly targeted by the proposed regulation) are sourced from Global Trade Analysis Project,[334] and no further behavioural constraints of Victorian fossil gas users have been incorporated into the modelling.
- Fossil gas use under the Base Case in the model is assumed to remain constant. Furthermore, the model assumes a smoothed phasing out of coal power plants in Victoria. The increase in electricity from households and businesses impacted by the regulatory options is solved endogenously (within) in the model.
- As agents substitute away from fossil gas towards electricity, there is an increase in fossil fuel electricity as well as renewable electricity, as there are no additional constraints or shocks introduced into the model which would target renewable electricity specifically. The model does have a declining share of fossil fuel electricity over time, but as there are no additional targets for renewables introduced, these may differ from the energy mix in reality.

Detailed methodology and assumptions underlying CGE modelling is provided in Appendix E.

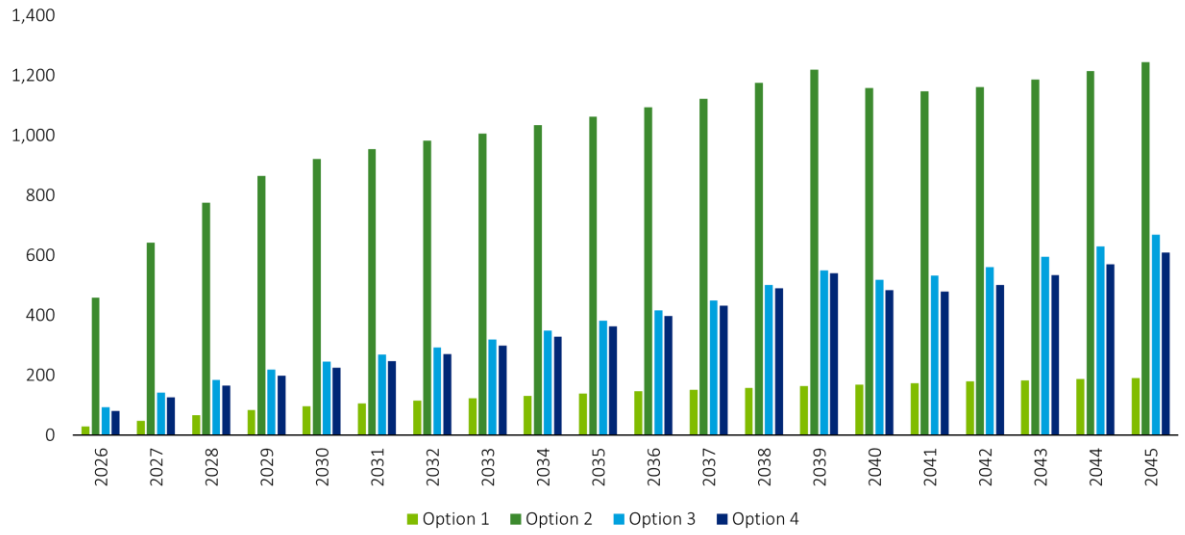
The options may also impact access to labour and materials as a result of increasing demand for key services (such as electricians). Noting the above limitations of CGE modelling with regard to the granularity of impacts (i.e. sectoral rather than occupational) and assumptions with regard to the transfer of skills between occupations within the same sector, the impact of the options on labour markets and key occupations has been assessed qualitatively, drawing on previous analysis for Jobs Skills Australia.[335] Note the Victorian Government is currently undertaking the Victorian Energy Jobs Plan to support the workforce transition to deliver Victoria's renewable energy goals.[336]

7.3.1 Impact on economic output

Construction activity, predominantly in the form of electrical work associated with the electrification requirement, is expected to positively impact economic activity in Victoria. Increased construction activity has positive 'spill over' effects for the broader economy as tradespeople require resources from, and spend additional income on, other parts of the economy (therefore increasing demand for other sectors such as services and trade). This results in an overall positive impact on GSP across Victoria under all options. As shown in Figure 7.10, increases in GSP are expected to be observed from 2026 onward (the year in which the first end of life replacements occur). Under Option 1, the uplift in GSP is relatively constant at an average of $133 million per annum. Option 2 has the highest incremental GSP impact relative to the Base Case at around $1 billion per annum. This is due to the higher scale of electrification required under Option 2 relative to the other options. The GSP impact under Options 3 are just under $396 million per annum on average over the modelled period. This is marginally higher than Option 4, which has an annual average GSP impact of $368 million per annum.

[334] Global Trade Analysis Project, GTAP Data Base. <https://www.gtap.agecon.purdue.edu/databases/>
[335] Jobs and Skills Australia (2023), The Clean Energy Generation. <https://www.jobsandskills.gov.au/sites/default/files/2023-10/The%20Clean%20Energy%20Generation_0.pdf>
[336] Department of Energy, Environment and Climate Action (2024), Victorian Energy Jobs Plan. <https://www.energy.vic.gov.au/renewable-energy/victorian-energy-jobs-plan>

Figure 7.10: Difference in Victoria's GSP across each regulatory option, 2026-2045 ($ million)



Source: Deloitte analysis.

7.3.2 Impact on sector value added

Due to a larger decrease in demand for fossil gas in the state, the electricity sector experiences an increase in GVA across all options (see Table 7.1). Conversely, GVA in oil and gas, and gas distribution and transmission decreases marginally across all options, proportionate to the scale of fossil gas reduction under each option. This is due to reduced demand for fossil gas and gas network services. See section 8.7.4 for further discussion of the impact of the preferred option on the gas industry.

The construction industry experiences significant growth in GVA throughout the modelling period. This is due to increased demand for construction (including electrical and plumbing work) to accommodate the required electric appliance installations. Increase in construction activity has 'spill over' effects to ancillary sectors such as services,[337] government services and trade due to increased purchase of intermediate inputs and resources from the construction sector.[338] In addition, as fossil gas use reduces this may lower the price of fossil gas, improving productivity across other sectors of the economy.

The increase in GVA in the services, electricity, construction, trade and government services sectors is proportionate to the scale of electrification under each option. With Option 2 seeing the highest impact on these sectors, followed by Option 3, Option 4 and Option 1.

[337] Services includes industries such as communication, financial services, insurance, real estate activities, business services, recreational and other services, human health and social worth activities and dwellings.
[338] See Appendix E for further details how each sector is defined.

Table 7.1: Change in annual average GVA by sector relative to Base Case under each option ($ million)

Sector	Option 1	Option 2	Option 3	Option 4
Oil and Gas	-8	-86	-83	-84
Electricity	32	330	298	307
Gas distribution and transmission	-4	-43	-42	-41
Construction	23	173	73	65
Trade	14	101	26	20
Government services	12	74	20	14
Services	55	407	105	88

Source: Deloitte analysis.

7.3.3 Access to labour and materials

Supply side factors will be a key determinant of the extent to which the impacts on GSP and GVA outlined above (as well as the net benefits estimated in the core CBA) are able to be realised. To the extent that supply side shortages result in delays in work to replace gas appliances with electric appliances, the costs and benefits will be deferred. If shortages result in higher costs of replacement, the net benefits will be reduced, as noted below.

Given the scale of electrification required in the regulatory options, additional workers in occupations such as electricians and plumbers will be required to implement the policy. Key skills and occupations of interest will be in demand across many other sectors of the economy. It is therefore important to consider the state of the labour market. While the modelling undertaken for the RIS did not address potential shortages or gaps within individual occupations, other modelling previously undertaken focuses on assessing the overall capacity of the workforce at a sectoral level to meet demand.

Deloitte conducted a national analysis for Jobs and Skills Australia (JSA) on Australia's current and future clean energy workforce capacity.[339] The clean energy workforce encompasses workers engaged in designing, developing, constructing and operating the infrastructure necessary for generating, storing, transmitting and distributing renewable, zero or low emissions energy. It also includes workers focused on reducing or managing the energy required to deliver energy services, as well as those responsible for installing and maintaining the technology that uses clean energy rather than fossil fuels. The analysis in the JSA report was undertaken independently of the modelling undertaken in this report, so these scenarios are not directly reflective of the policy scenarios in this RIS. The study undertook preliminary economic modelling to identify workforce needs for the clean economy Australia-wide, across three possible scenarios. These scenarios are:

- **Central scenario**: This scenario is broadly aligned with the Commonwealth Government's climate and energy policies. Under this scenario, the National Energy Market (NEM) has 82 per cent renewable energy by 2030.[340]
- **Low scenario**: Under this scenario, there is slow implementation. The NEM only achieves 69 per cent renewable energy by 2030, falling short of the current government target of 82 per cent by 2030.
- **High scenario:** Under this scenario, ambitious and coordinated policies drive Australia to over 90 per cent renewable energy by 2030.

The workforce modelling demonstrates that the demand for electricians, plumbers and air conditioning refrigeration mechanics is expected to grow strongly until 2030, with the average annual growth then slowing down out to 2050. The average annual employment for both plumbers and air-conditioning and refrigeration mechanics is expected to increase by 2.6 per cent per year between 2023 and 2030 under the central scenario. The average annual change in employment for

[339] Jobs and Skills Australia (2023), The Clean Energy Generation. <https://www.jobsandskills.gov.au/sites/default/files/2023-10/The%20Clean%20Energy%20Generation_0.pdf>

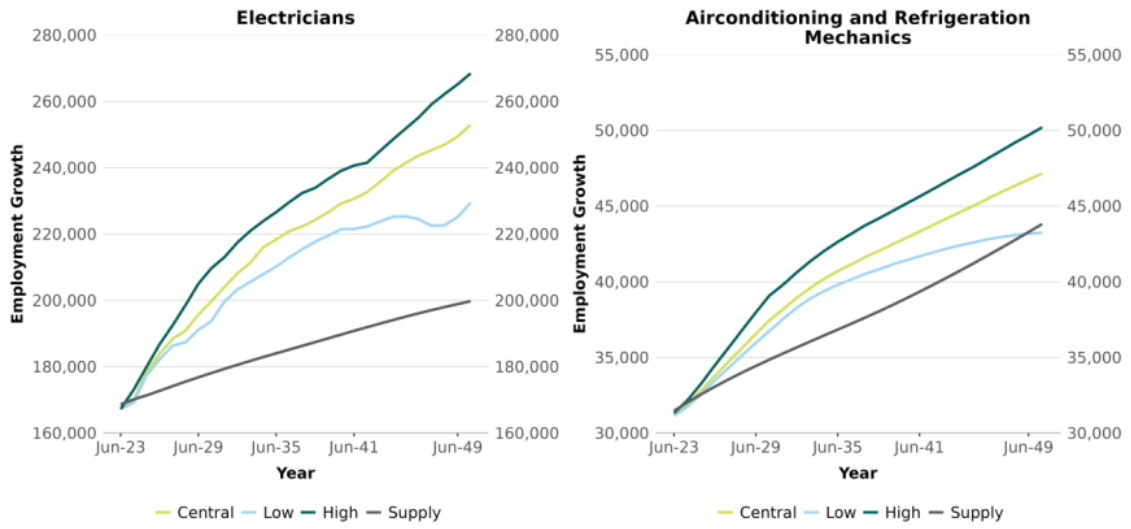
[340] This scenario is based off the Australian Energy Market Operator's Draft 2023 Integrated System Plan. It reflects the policies that were incorporated into this document, and as such may not reflect policies announced since (such as Victoria's Gas Substitution Roadmap).

electricians is projected to be 2.5 per cent over this time period. The average annual change in employment for the three occupations is then projected to reduce to 1.4 per cent between 2030 to 2040, and to 1 per cent between 2040 and 2050. Electricity workforce analysis also suggests that the supply of electricians is expected to grow slowly relative to demand due to relatively flat course completions and a relatively older current workforce. Demand for electricians is expected to outstrip supply under all three scenarios, as demonstrated in Figure 7.11. The analysis undertaken for JSA show that of the occupations assessed as part of the clean energy transition, electricians were among those to face the largest supply gap and that the excess demand for electricians is at risk of growing over time in the absence of substantial change. Preliminary modelling conducted for the JSA indicates that an additional 85,000 electricians will be required Australia-wide by 2050 under a clean energy modelling context, representing a supply gap of 27 per cent. In the short-term, approximately 32,000 more electricians are likely to be needed Australia-wide by 2030 under a clean energy modelling context. This suggests that any policies to expand supply, such as the implementation of additional training programs, will be required to meet the demand for electricians.

The demand for air-conditioning and refrigeration mechanics Australia-wide is also projected to be higher than the supply under the central and high clean energy scenarios. As shown in Figure 7.11 demand for this occupation Australia-wide outpaces the supply under the low clean energy scenario until 2048 when supply is slightly higher than the demand.

It is possible that increasing demand for these services under the options, with limited supply available, may put upwards pressure on labour costs and further increase the cost of the proposed regulation. Moreover some electrification under the Base Case (including electrification of government buildings, see section 4.2) is not exempt from the proposed regulations and may have a compounding effect on labour costs. Similarly, growing demand for services under the Base Case and options may put upwards pressure on materials and appliances required. Sensitivity testing of the cost to electrify was conducted on the CBA, demonstrating that the preferred Option 3 remains robust even under a 25 per cent increase in purchase and installation costs (see section 6.3).

Figure 7.11: Australia-wide demand (all scenarios) and supply for electricians and air-conditioning and refrigeration mechanics



Source: Deloitte Access Economics (2023)

The analysis above only considers the Base Case demand for the three occupations and was designed for the preliminary economic modelling of workforce needs for Australia's current and future clean energy workforce capacity undertaken for JSA. Note that the trades required for Victoria's clean energy workforce would be a subset of this, while the trades required to meet Victorian building electrification demand (rather than those required to develop wind or solar farms for example) would constitute an even smaller subset. The proportion of this analysis which would apply to Victorian building electrification activities is uncertain.

DEECA have made further efforts to estimate the likely supply of appropriately skilled trades to meet demand, however electrification activities only constitute a small proportion of the work undertaken by electricians, plumbers and refrigeration mechanics. For example, an electrician may install reverse cycle air conditioners, but they also install wiring in new buildings, rectify electrical faults, install ceiling fans and more. Quantification of the amount of time currently spent on electrification

activities, the likely increase of time from policies and the calculation of additional numbers of trades has been challenging. Conceptually, it is likely that:

- There will continue to be some employment for plumbers and gas fitters. Gasfitters will be required to safely decommission gas heaters and hot water units, and to install and replace cooktops in existing homes. Plumbers are also required for the installation of hot water heat pumps, and for all other residential plumbing. Plumbers are also required to maintain and service existing gas appliances and install or replace gas appliances where permitted.
- Residential electrification will require more electricians and refrigeration and air-conditioning technicians, with electricians required across a wide range of retrofits.
- Smaller volumes of additional labour for professionals, sales and administrative staff will be required, with small and medium-size businesses and contractors also required within relevant sectors.

Further detailed analysis would need to be undertaken to understand the incremental workforce demands from electrification projects and the likely trends in changes in workforce demand. For example, the need to disconnect more gas appliances as a result of increased electrification will increase demand for gasfitters and plumbers. After these appliances are installed, the demand for these occupations will change due to two offsetting factors:

1. reduced demand from the need to install and maintain fewer gas appliances
2. increased demand for the maintenance and installation of electric hot wat
3. er and heat pumps.

Given the projected supply gaps in occupations critical to electrification, it is important that measures be implemented to increase the pipeline of workers. The JSA report identifies the Vocational Education and Training sector (VET) as key in increasing the number of tradespeople in Australia. The report states that increasing the number of electricians will require a rapid increase in the number of VET trainers and an increase in the capacity of the VET system. Other measures proposed by the report to increase the trades workforce include investing in training facilities particularly in regional areas, increasing the number of apprentices engaged by businesses and opening up trades career pathways for women and First Nations people.

The *Victorian Energy Jobs Plan*, which is being completed by DEECA and anticipated for release in 2025, will provide additional context and analysis on the workforce required to support Victoria's whole energy sector transition, including residential electrification.

See section 8.7.4 for further discussion on the impact of the preferred option on Victoria's workforce.

7.4 Swimming pool and spa analysis

Residential swimming pools and spas would also be captured under the proposed regulations.[341] There are an estimated 235,000 residential swimming pools and spas in Victoria in 2024.[342]

There are three types of common heaters available to heat residential pools and spas:

- **Gas heaters**. These heaters use gas or propane to heat the water. The gas is burnt in the heater's combustion chamber which generates heat that is transferred to water flowing through it.[343] The heated water is then returned to the pool. Gas heaters are fast acting and can heat pools within 8 to 12 hours from a starting 'cold' point.[344] They are often cheaper to purchase than electric heaters and can operate all year round, regardless of weather conditions and air temperature. However, the speed and upfront cost savings come at the expense of higher running costs. As discussed in section 2.2.2, gas appliances tend to be less efficient than electric appliances. This also applies to pool heaters, with gas heaters requiring more energy to operate than an electric heat pump.

[341] Due to the top-down approach to hot water analysis in the commercial sector, commercial swimming pools are implicitly captured within the CBA.
[342] The Building Amendment (Swimming Pool and Spa) Regulations 2019 Regulatory Impact Statement estimated that there were approximately 220,000 pools and spas in 2019. The RIS estimated that an additional 3,025 pools would be built each year for the following 10 years. Based on this growth rate, it is estimated that there are approximately 235,000 swimming pools in Victoria in 2024. <https://content.vic.gov.au/sites/default/files/2019-10/Building-Amendment-Swimming-Pool-and-Spa-Regulations-2019-RIS.pdf>
[343] Department of Energy (United States), Gas Pool Heaters. <https://www.energy.gov/energysaver/gas-pool-heaters>
[344] Desktop analysis shows heating times for gas water heaters can range from 4 to 24 hours, with 8 to 12 hours being the most common estimate. Sources viewed include The Pool Heating Company <https://thepoolheatingcompany.com.au/uncategorized/how-long-does-it-take-to-heat-a-pool>, Sun Lover Heating <https://sunloverheating.com.au/how-long-does-it-take-to-heat-a-pool-in-victoria/>, Hilltop Pools <https://www.hilltoppools.com/how-long-does-it-take-to-heat-a-pool>, and Astral Pool <https://www.astralpool.com.au/pool-and-spa-guides/pool-heating>

- **Heat pumps**. Heat pumps extract heat from the surrounding atmosphere and transfer this to a compressor which increases the temperature. The heat is then transferred to the pool water. Electric heat pumps are very energy efficient as they require little electrical energy to operate, and they produce 3 to 5 units of heat energy for every unit of electricity consumed.[345] Heat pumps operate best in warm weather and may be less efficient when used during cold weather (<10 degrees Celsius), however this is unlikely to be an issue as most people use their pools in warmer weather.[346] They also take a longer time to heat the water from a starting 'cold' point, up to 3 times the time required by gas heaters, however once the pool reaches the desired temperature the heat pump is able to maintain the required temperature using significantly less energy. They are more expensive to purchase but provide lower operating costs.
- **Solar pool and spa heaters.** Solar pool and spa heaters are also available which use energy from the sun to heat up water in the swimming pool and spa. Solar heating offers low-cost heating for pools but has the drawbacks of being highly dependent on prevailing weather conditions and having a higher upfront cost.

It is estimated that 3 per cent of pools use fossil gas for heating, equating to 7,050 pools and spas in Victoria in 2024.[347] Pool heaters have an estimated asset life of 9 years, therefore on average approximately 783 residential gas swimming pools would be required to upgrade each year.[348]

7.4.1 Methodology for swimming pool analysis

As discussed above, there are trade-offs between gas and electric heaters in terms of upfront costs and running costs. The costs and benefits of operating each heater type were estimated for the same cost and benefit metrics as in the CBA. The following steps were undertaken to estimate the costs and benefits of electric and gas pool heaters:

- identify the average capital cost of electric and gas pool heaters plus an additional hour of administrative time incurred by homeowners[349]
- estimate the reduction in average energy usage from switching from gas to electric pool heaters
- quantify the benefits associated with avoided energy costs, including cost of energy supply and GHG emissions savings.

Costs and benefits are presented as a range as there are a wide range of pool heaters available with varying energy consumption and cost characteristics depending on size of pool and heating specifications.

7.4.2 Analysis

Table 7.2 presents the lower bound, average and upper bound energy consumption and appliance costs for both gas and electric swimming pool heaters. It is estimated that the average incremental cost of replacing a gas pool heater with an electric pool heater is approximately $2,259. Replacing the heaters for 783 pools each year results in an annual incremental cost of $1.8 million (less than 1 per cent of the average annual cost of Option 3).

[345] Master Pool Builders Association Australia, Electrical Pool Heating – fact Sheet 12. <https://www.mpbaa.com.au/fact-sheets/13-electrical-pool-heating>
[346] Department of Energy (United States), Why use a heat pump for water heating? <https://www.energy.gov/energysaver/heat-pump-swimming-pool-heaters>
[347] Woolcott (2016), Pool Pumps: An investigation of swimming pool pumps in Australia and New Zealand. <https://www.energyrating.gov.au/sites/default/files/2023-04/2016-Pool-Pump-Market-Research-Report_0.pdf>
[348] Woolcott (2016), Pool Pumps: An investigation of swimming pool pumps in Australia and New Zealand. <https://www.energyrating.gov.au/sites/default/files/2023-04/2016-Pool-Pump-Market-Research-Report_0.pdf> It has been assumed that a constant share of gas pool heaters will reach end of their life each year (7,050 gas pool heaters/9 years of average life).
[349] An administrative time of one hour has been assumed for consistency with the assumptions used in the CBA.

Table 7.2: Range of energy consumption and costs for gas and electric pool heaters

	Lower bound	Average	Upper bound	Source
Gas pool heaters				
Energy usage (MJ per hour)	100	262.5	425	South Australian Government[350]
Appliance costs ($)	$3,007	$4,865	$6,723	Desktop research[351]
Electric pool heaters				
Energy usage (MJ per hour)	30	79	128	Electric heaters are estimated to be 3.3 times more efficient than gas.[352]
Appliance costs ($)	$3,442	$7,088	$10,733	Desktop research[353]
Administrative time to upgrade	$36	$36	$36	Based on average value of leisure time in Australia.[354]
Increment cost of purchasing an electric pool heater	**$471**	**$2,259**	**$4,046**	**Calculation**

Source: Deloitte analysis.

Table 7.3 below presents the hourly costs of running a gas and electric pool heater in 2024. These costs include the energy cost, cost of GHG emissions and cost of air pollution based on today's prices and emissions intensity of each fuel. The potential hourly saving from electrification ranges from $0.73 per hour of heating to $3.10 per hour of heating. As GHG emissions of the electricity sector fall, the hourly cost saving is anticipated to increase. In order to make up for the incremental cost of replacing gas heaters with electric ones, an average pool heater must operate for approximately 13.5 per cent of the first year of purchase, or approximately 1.5 per cent over the life of the asset. On the lower bound this is as low as 0.8 per cent over the life of the asset, and up to 1.7 per cent of the life of the asset on the upper bound.

To estimate the annual payback period on switching to electric pool heating, an assumption must be made regarding the average amount of time a household heats their pool or spa each year. Due to the hourly savings from an electric pool heater, the longer the pool heater is used the shorter the payback period. There is limited information regarding how long pools or spas are heated for over the year in Victoria, noting there is likely significant variability between households based on behaviour, preferences and size of pool or spa. Research indicates that across Australian and New Zealand on average, pool owners tend to use their pool pumps around 1.5 hours per day in winter and 3.5 hours per day in autumn[355] Due to the colder temperature in Victoria, utilisation is likely to be lower than this. However, we note that pool heaters tend to operate longer than pool pumps as it can take several hours to heat the pool, as such this may understate the amount of time pools are heated. Overall, if it was assumed that an average swimming pool heater is utilised for 5 per cent of the time each year, this would result in an average payback period of 3 years.[356]

[350] South Australian Government (2023), Swimming pools and spas. <https://www.sa.gov.au/topics/energy-and-environment/using-saving-energy/swimming-pools-and-spas>
[351] Appliance costs for gas and electric heaters were obtained from a range of supplier websites. The figures in the table represent the average lower cost, average and upper bound costs of appliances from multiple suppliers.
[352] This is based on an average energy efficiency of 300% for electric pool heaters, compared to an average energy efficiency of 90% for gas pool heaters.
[353] Appliance costs for gas and electric heaters were obtained from a range of supplier websites. The figures in the table represent the average lower cost, average and upper bound costs of appliances from multiple suppliers.
[354] The Office of Impact Analysis (2023), Regulatory Burden Measurement Framework. <https://oia.pmc.gov.au/sites/default/files/2023-09/regulatory-burden-measurement-framework.pdf>
[355] Woolcott Research and Engagement (2016): Pool pumps: An investigation of swimming pool pumps in Australia and New Zealand. <https://www.energyrating.gov.au/sites/default/files/2023-04/2016-Pool-Pump-Market-Research-Report_0.pdf>
[356] To be conservative it has been assumed that pool heaters are not used during the spring and summer season.

Note that this analysis is based on current day emissions intensity of the electricity sector, which is higher than the emissions intensity of gas on a per MJ basis.[357] If only direct financial impacts are considered (i.e. externalities from GHG emissions of gas and electricity usage are excluded), the hourly saving of switching to an electric swimming pool or spa improves, therefore reducing the payback period on the upfront cost.

Table 7.3: Hourly cost impact of gas and electric pool heater in 2024

Heater type	Unit	Lower bound	Average	Upper bound
Cost of running gas pool heater*	$ per hour	$3.74	$9.83	$15.91
Cost of running electric pool heater*	$ per hour	$3.02	$7.92	$12.81
Hourly cost savings from an electric heater	**$ per hour**	**$0.73**	**$1.91**	**$3.10**
Total incremental cost (capital cost and administrative time required)	$ upfront cost	$471	$2,259	$4,046
Hours required to operate to break-even	Hours	646	1,181	1,307
Proportion of total hours in first year heater must operate to break even	% of year	7.38%	13.48%	14.92%
Proportion of total asset life heater must operate to break even	% of total asset life	0.82%	1.50%	1.66%

*Costs represent socio-economic costs including externalities such as greenhouse gas emissions savings and air pollution costs.

Source: Deloitte analysis

It is recognised that electric heat pumps may take 2 to 4 times as long to heat water relative to a gas pool heater.[358] Therefore, some benefits of reduced energy consumption by an electric heat pump would be offset by the need to heat for a longer time. However, once heated an electric heater is assumed to operate just as long as a gas heater and given the time required to heat, would stay on for a period of time before being switched off.

In summary, electrifying pool heaters can help households save on energy costs and can provide net savings to pool owners over the life of the asset.

7.5 Refrigerant gases from heat pumps

As a result of the proposed regulatory reforms, most residential and new commercial buildings are expected to replace gas appliances with heat pumps, including heat pump hot water systems. Although heat pumps are more energy efficient than gas appliances and produce significantly lower operating GHG emissions over their lifetime, they also require a small volume of refrigerants to operate effectively. If the refrigerants leak or are not properly managed at end of life, they could contribute to climate change.

Refrigerants have historically been found to have a detrimental effect on the ozone layer, with chlorofluorocarbons (CFCs) used until the Montreal Protocol in 1987. Since then, regulations and technological advances have led to a shift towards less harmful alternatives. In Victoria, hydrochlorofluorocarbons (HCFC) are being phased out by 2030 and to date have already been largely replaced by hydrofluorocarbons (HFC).[359] HFCs are currently the predominant refrigerant in heat pumps. While they are a potent GHG relative to carbon dioxide,[360] they are gradually being replaced by better alternatives such as hydrocarbons and carbon dioxide. Hydrocarbons and carbon dioxide are already being widely used in heat pump hot water systems.

[357] Although the emissions intensity of the electricity sector is higher than gas usage, this is anticipated to decrease as the electricity sector reaches Victoria's renewable energy targets (see section 2.4). Therefore, the socio-economic return on an electric swimming pool or spa improves over time.
[358] The Pool Heating Company, How long does it take to heat a pool? <https://thepoolheatingcompany.com.au/uncategorized/how-long-does-it-take-to-heat-a-pool>
[359] Expert Group (2022), Climate risk of heat pumps. <https://www.parliament.vic.gov.au/4a500f/globalassets/tabled-paper-documents/tabled-paper-8434/2---climate-risk-of-heat-pumps.pdf>
[360] Common HFCs currently have a Global Warming Potential (GWP) of between 675 and 2,088. For context, carbon dioxide has a GWP of 1.

The Expert Group analysed, on behalf of DEECA, the climate risk posed by the increased uptake of heat pumps out to 2050.[361] The analysis included a scenario with no further policy prevention (worst case scenario), along with the scenarios that assessed the implementation of higher Global Warming Potential (GWP) thresholds and improved end of life stewardship (best case scenario). The analysis indicated that total emissions for the entire residential and commercial sector would range between 5.8 $MtCo_2$-e (best case scenario) and 11.4 $MtCo_2$-e (worse-case scenario), representing cumulative emissions over 2021 to 2050.

Refrigerant emissions are not anticipated to change the outcomes of the CBA. For example, under Option 3, the emissions from refrigerants are expected to range between 3.9 $MtCo_2$-e and 7.6 $MtCo_2$-e.[362] While this is not an insignificant volume of GHG emissions, this would only reduce the energy emissions saving estimated in the CBA by between 7 to 14 per cent.

The Victorian Government's 2022 Industrial Process and Product Use sector emissions reduction pledge sets out plans for Victoria to improve the management of refrigeration and air conditioning (RAC) equipment and refrigerant gases at a state level, while advocating for further national action to reduce emissions from RAC equipment and accelerate the transition to lower-emissions alternatives.[363] Furthermore, the VEU[364] and Solar Homes[365] programs have introduced a GWP threshold (less than 700) for refrigerants used in heat pump hot water systems installed through their programs. At the international level, Australia is signatory to the Kigali Amendment to the Montreal Protocol which includes a commitment to reduce the use of HFCs by 85 per cent relative to the HFC consumption between 2011 and 2013 by 2036.

7.6 Lost productivity under Option 2

Option 2 is the only option that includes electrification requirements for existing commercial buildings. Undertaking substantial building modification required for electrification in existing commercial buildings can potentially disrupt the productivity of businesses, particularly those that operate around the clock and do not have capability for employees to work from home. This includes industries such as healthcare, aged care, accommodation and hotels, and warehouses. These buildings might need to be closed either fully or partially while appliances and ancillary infrastructure is upgraded from gas to electricity, leading to lost productivity and reduced economic output for existing businesses under Option 2. A well-planned feasibility study conducted in advance that optimises opportunities for undertaking electrification as part of normal asset management and maintenance activities can help minimise disruption to businesses.

Analysis conducted by Energeia indicates that installation time is relatively similar between gas and electric appliances.[366] Based on this it is likely there would be minimal impact at end-of-life replacement, where a business would require the same amount of time to reinstall a gas appliance in the Base Case. However, it is unclear whether the analysis from Energeia considers additional infrastructure, electrical and gas decommissioning work that may be required, particularly in moderate to larger buildings where electric appliances may require larger plant room space to be constructed. Therefore, there may be some lost productivity under Option 2, particularly for moderate to larger buildings.

While building works and upgrades are likely to be undertaken even in the Base Case, the scale of changes required in buildings that currently use fossil gas may be greater, particularly for installing electric heating appliances. The actual economic and lost productivity impact will depend on how the transition is managed by the building owners. Some strategies to minimise disruptions include undertaking the building works in sections, allowing staff to work from home where possible and scheduling upgrades for times when the gas appliances are least in use.

There may also be productivity impacts from not electrifying. As discussed in section 2.3, the possibility of fossil gas shortfalls has been projected for Victoria. Some business and industrial uses require fossil gas to generate high temperatures such as chemical plants and smelters. There is a risk that a potential fossil gas shortfall would adversely affect the operations and productivity of such industries that have no feasible electrification alternatives. Therefore, electrifying uses where possible can help ensure that sufficient fossil gas is available for uses that cannot electrify easily. Reduced productivity and disruption

[361] Expert Group (2022), Climate risk of heat pumps. <https://www.parliament.vic.gov.au/4a500f/globalassets/tabled-paper-documents/tabled-paper-8434/2---climate-risk-of-heat-pumps.pdf>
[362] Calculated by DEECA by proportionally excluding existing commercial buildings and rental houses from Expert Group's refrigerant forecast.
[363] Victorian Government, Industrial processes and product use sector emissions reduction pledge. <https://www.climatechange.vic.gov.au/victorian-government-action-on-climate-change/IPPU-sector-pledge-accessible.pdf>
[364] Department of Environment, Land, Water and Planning (2022), Victorian Energy Upgrades: Space heating and cooling. <https://www.energy.vic.gov.au/__data/assets/pdf_file/0026/614744/VEU-Space-Heating-and-Cooling-Response-to-Consultation.pdf>
[365] Solar Victoria, Requirements for hot water rebates. <https://www.solar.vic.gov.au/notice-market-2024-25/section-5-requirements-hot-water-rebates#521-hot-water-systems-%E2%80%93-mandatory-requirements>
[366] Energeia, Removing Building Electrification Barriers. <https://energeia.au/removing-building-electrification-barriers/>

in the fossil gas market is a risk facing all gas users across the market (GPG, industrial, commercial and residential) due to potential fossil gas supply shortages (see section 2.3.1).

7.7 Future option value

All options would result in no new gas network infrastructure built for new residential buildings. Moreover, Options 1, 2 and 3 all result in no new gas network infrastructure built for new commercial buildings. While this would result in a capital cost saving, it also reduces future option value for new buildings and existing buildings that electrify if the proposed regulations were not applied in the future.[367] It would be difficult and costly for new buildings and existing buildings that electrify during the analysis period to install gas appliances after the analysis period has passed. Therefore, these buildings would have limited choices to install gas appliances if the proposed regulations were not renewed. However, it is difficult to estimate the extent of future option value lost as a result of the proposed regulations. Moreover, many new residential properties built are already covered by the VPP amendment VC250 which specifies all new dwellings, apartment buildings, and residential subdivisions requiring planning permits are required to be all-electric (see section 3.1) and therefore the impact of the proposed regulation is limited primarily to new commercial buildings.

[367] Option value refers to the value that is placed on private willingness to pay for maintaining or preserving a public asset even if there is a low likelihood of the individual using it.

8 Impact of preferred option

This chapter presents the potential impacts of the preferred option, Option 3, on various stakeholder groups.

8.1 The preferred option

Option 3 is the preferred option due to its high economic benefits relative to costs. The option significantly reduces fossil gas usage and GHG emissions while allowing residential property owners to choose whether and how to replace gas cooktops with electric cooktops. Option 3 aims to support an orderly transition to a low-carbon economy by progressively phasing out energy intensive gas appliances (heating and hot water systems) in residential properties over time.

Under Option 3, all existing residential building classes will be required to electrify their space heating and water heating appliances at end of life. New residential and new commercial buildings are required to have only electric appliances, including space heating, water heating and cooking appliances. This option excludes all existing residential cooking from electrification requirements. Therefore, existing households will be permitted to retain their connection to the gas network for cooking purposes. Existing commercial buildings will also be excluded from all mandatory electrification requirements. Section 9.1 contains more details on this option and the proposed exemptions.

Option 3 results in a total cost of $5.9 billion (PV) and a total benefit of $10.9 billion (PV) over a 10-year period, resulting in a NPV of $5.0 billion and a BCR of 1.85. Over the 20-year period, Option 3 results in costs of $8.2 billion (PV) while providing $15.7 billion in total benefits (PV) over a 20-year period, resulting in a NPV of $7.5 billion and BCR of 1.91.

Electricity market modelling indicates that Option 3 has a low impact on electricity tariffs relative to the Base Case (less than 4 per cent per annum, see section 7.1.5). Gas market analysis shows that Option 3 is likely to increase gas tariffs for consumers who remain on the gas network if there is no change to the size of the gas network and the regulatory framework under which it operates, as the fixed infrastructure cost is spread over a smaller customer base. However, the impact on gas tariffs under Option 3 is lower than under Option 2 (see section 7.2.3). It is anticipated that Option 3 will have an overall positive impact on GSP in Victoria. While some sectors (such as gas distribution and transmission) will likely see reduced GVA, these will be offset by increases in other in-demand and emerging sectors such as construction, and clean energy.

The Building Legislation Amendment and Other Matters Bill 2024 (Bill) amended the *Building Act 1993* to enable the making of regulations that, among other things, can:

- prescribe circumstances under which a relevant building surveyor must refuse a building permit for building work that includes a reticulated gas connection
- prohibit the connection of reticulated gas, or extending the capacity of an existing reticulated gas connection, to a new or existing building
- prohibit the installation or replacement of reticulated gas appliances by plumbers.

8.2 Distributional impacts of Option 3

The breakdown of NPV and BCR results for each building class under Option 3 is shown in Figure 8.1.

The NPV for the residential sector is $4.9 billion over a 10-year period, representing a BCR of 2.1. According to ABS 2021 census data, Class 1 buildings make up 86 per cent of residential properties in Victoria. Therefore, the overall impact of Option 3 on residential properties is driven primarily by Class 1 buildings.

For the commercial sector, all building classes except Class 5 (Offices) present a positive NPV of electrification. Due to limited data, upgrade costs to building classes are based on the same case studies (see section 5.4.2). Therefore, variation in CBA results is driven primarily by:

- the volume of gas used by the sector
- the proportion of gas use attributed to heating, hot water or cooking across the sectors
- the assumed large building archetype (office, hospital or aged care)
- the proportion of small to large businesses in each sector.

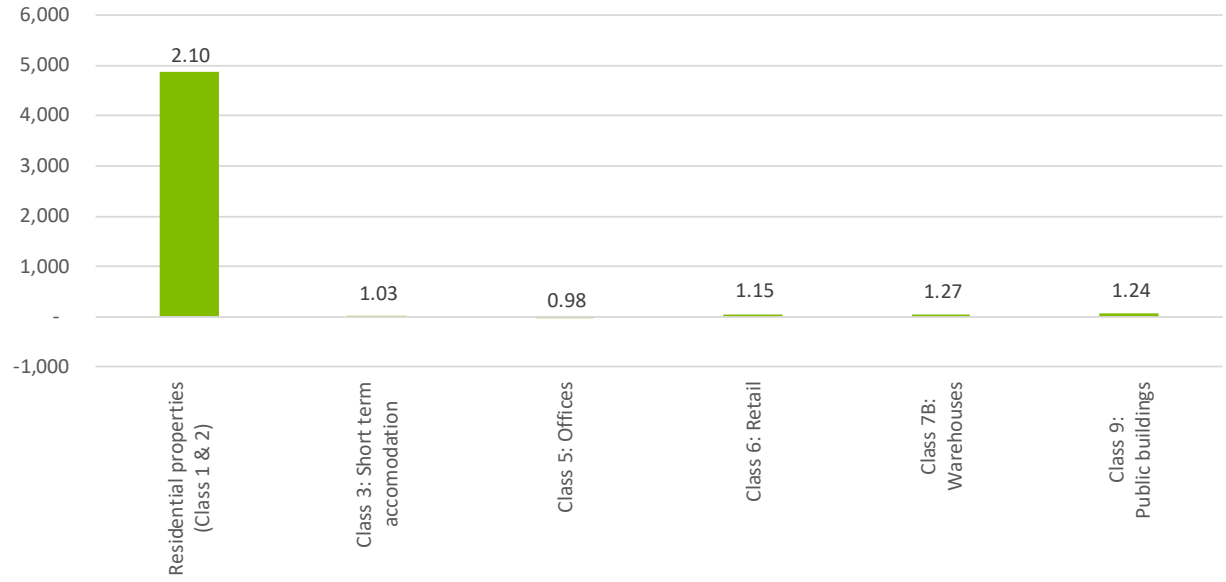
Modelled electrification of new Class 5 buildings results in a NPV of negative $14 million, resulting in a BCR of 0.98 over a 10-year period. However, when considered over a 20-year period, Class 5 buildings are projected to receive a positive NPV of $48 million, resulting in a positive BCR of 1.31. As a result, and noting there is limited data and uncertainty regarding the average costs and benefits of electrification, the results of electrifying new Class 5 buildings is close to breakeven.

Including all new commercial buildings under Option 3 prevents the continued growth of the gas network. Continued growth in the network results in additional augmentation and operating costs which gas distribution networks will ultimately seek to recover from consumers.

There are many areas in Australia and the South Island of New Zealand that are not connected to the reticulated gas network.[368,369] These include areas such as Cairns and Queenstown which are popular tourist destinations and have a number of hospitality businesses. Many small to large commercial businesses successfully operate in these regions without a connection to a reticulated gas network.[370]

This highlights that a reticulated gas connection is not necessary for a commercial operation in a modern economy to enjoy reliable and secure energy supply. Reticulated and bottled LPG is also out of scope for the proposed regulations and will remain an available alternative for businesses wanting to continue to use gas.

Figure 8.1: NPV and BCR results under Option 3 by building class over a 10-year period ($ million)



Source: Deloitte analysis.

8.3 Costs to residential properties

An average cost per property has been used to estimate the cost to residential properties in the CBA. However, it is possible that some homeowners will be required to pay more to upgrade and some less based on their existing appliance and preferred electrical upgrade, as well as a range of other factors such as age and type of building.

The proposed regulations apply only at the end of the life of the current gas appliance, meaning a replacement cost will be incurred whether the appliance is replaced by a gas or electric appliance. On average, existing properties are estimated to incur an incremental cost of approximately $2,200 to replace, however this may range from approximately $15,500 in

[368] The Australian Pipeliner (2016), New Zealand gas pipelines: past, present and future. <https://www.pipeliner.com.au/new-zealand-gas-pipelines-past-present-and-future/>
[369] Queensland Government (2023), Compare and choose gas retailers. <https://www.qld.gov.au/housing/buying-owning-home/energy-water-home/gas/choose-gas-retailer>
[370] The Australian Pipeliner (2016), New Zealand gas pipelines: past, present and future. <https://www.pipeliner.com.au/new-zealand-gas-pipelines-past-present-and-future/>

additional costs,[371] to a net saving of $4,800, depending on the building class and what upgrades or equipment may be required or avoided. In some situations, replacing a gas appliance with an electric appliance can be cheaper than replacing like-for-like. For example, based on CBA cost estimates a single split system could be up to $572 cheaper than a room gas heater, while a heat pump hot water system could be up to $2,764 cheaper than a gas boosted solar hot water system (depending on dwelling type and size).

These costs would not be incurred all at once but would be spread out as each appliance is replaced at end of life (assuming property owners replace each appliance individually as they reach end of life). Victorian Government programs such as Solar Victoria's Solar Homes Program, the VEU program and Small-scale Technology Certificates (STCs) can help homeowners offset a range of costs associated with electrification upgrades. Under the Solar Homes Program, eligible Victorian households can access a hot water rebate of up to $1,000 on eligible heat pump and solar hot water systems.

The VEU program provides existing households and businesses with incentives to improve their energy efficiency. Activities currently eligible under the program include upgrades to efficient electric heating and cooling appliances and hot water systems. Incentives for induction cooktops are due to be introduced in the second half of 2024.[372] Table 8.1 below outlines the range of potential incentives that could be available for the replacement of gas heating and hot water systems. The exact amount of the incentive would depend on factors such as eligibility, size of existing and new system, and property types.

The *Victorian Energy Efficiency Target Act 2007*, under which the VEU program operates, specifies that to be eligible for an incentive, an activity must "result in a reduction in GHG emissions that would otherwise not have occurred if the activity was not undertaken." This means in its current form, the VEU program may be unable to provide incentives for upgrades to meet regulatory requirements, including any potential mandated electrification upgrades under the Roadmap. The Victorian Government intends to amend the VEET Act to clarify the existing head of power for prescribing activities in relation to the 'additionality' requirement, to confirm the VEU program can provide incentives in instances where an upgrade is mandated.

Table 8.1: Range of incentives available for households to replace gas appliances under the VEU program

Appliance upgrade	Potential VEU incentive
Non-ducted gas room heating to efficient room RCAC	$560 to $1,400
Gas ducted heating to efficient ducted RCAC	Up to $5,180
Inefficient gas hot water system to efficient heat pump	$490
Inefficient gas hot water system to efficient electric-boosted solar	$700

Source: Victorian Energy Upgrades Program website. Note: The potential VEU incentive amount assumes a Victorian Energy Efficiency Certificate price of $70.

The total potential cost to replace gas with electric heating and hot water appliances is lower for new properties. This is driven by substantial savings in avoided gas infrastructure, both gas piping within the residential property and connection to the gas network. However, heating appliances in new buildings are often more expensive than existing buildings, due to new buildings having a larger floor area than existing buildings (on average).[373] On average new properties will incur an upfront incremental cost of $100, ranging from a maximum incremental cost of $11,100 to a minimum incremental saving of $8,200.[374]

As mentioned in section 7.3.3, a national analysis for Jobs and Skills Australia (JSA) on Australia's current and future clean energy workforce capacity found that that the demand for electricians and air conditioning refrigeration mechanics is

[371] This includes incremental cost to purchase and install an electric appliance (variable), and administrative and other costs including: administrative time to enable the replacement ($36), capping of gas pipes ($300), removal and decommissioning of appliance (up to $799), gas abolishment fees ($242), switchboard upgrade costs ($1,200) and supply connection upgrade costs ($3,500).. See section 5.4.1 for further details.

[372] Department of Energy, Environment and Climate Action (2024), Induction Cooktops. <https://www.energy.vic.gov.au/households/victorian-energy-upgrades-for-households/induction-cooktops>

[373] As a result, the incremental upfront cost of replacing gas heating with electric heating is marginally higher in new buildings than existing buildings.

[374] This includes cost to purchase and install the electric appliance and to provide additional internal electrical wiring for new builds, as well as avoided gas piping and gas connection costs. See section 5.4.1 for further details.

expected to grow strongly until 2030 and that demand for electricians is expected to outstrip supply under all three scenarios. Electrification activities under Option 3 may contribute to the environment where demand for key labour and materials exceeds available supply which exists under the Base Case. This may further put upwards pressure on the cost to electrify as well as create delays in replacement timelines.[375] While it is unknown to what extent this may occur, the impact of the proposed regulations on rising electrification costs to households will be monitored as discussed in Chapter 9.

Residential properties that electrify are expected to reduce their ongoing energy bill, enabling upfront capital costs to be recovered over time. As a result, the estimated payback period based on the average upfront costs of replacing gas appliances with electric appliances may be as soon as 3 years and as long as 13 years, depending on the class of building and whether the property avoids paying gas network charges by disconnecting from the gas network. It can therefore be expected that most residential properties that upgrade to electric appliances will recoup the up-front costs within the new appliance's lifetime.

Barriers to key stakeholder groups

Despite the medium to long term benefits, the upfront capital outlay could be a barrier for some Victorians. There are several demographic groups in Victoria that may be less likely to be able to afford the costs of replacing gas appliances to electric ones, or otherwise may face a higher cost of doing so than an average household. These demographic groups also often overlap with vulnerable communities, including low-income households, retirees and the elderly, and regional communities. Due to limited data it is difficult to estimate the extent to which these cohorts may be impacted, however potential considerations and implications have been described qualitatively.

Low-income households

A survey of 236 low-income households in Victoria found that 88 per cent of respondents used fossil gas in their homes.[376] Low-income households are less likely to have disposable income or available savings to pay for the upfront costs of replacing gas appliances with electric. In addition:

- low-income households may be more likely to live in older properties and therefore may be more likely to require additional infrastructure upgrades such as switchboard or supply connection upgrades
- low-income households may be more likely to live in apartments or smaller townhouses. Some existing apartments may have shared heating and hot water services via an owners corporation that makes electrification more complex, and potentially more costly. Moreover, energy usage in apartments is typically lower than average households and therefore the ongoing financial savings from improved energy efficiency may not be sufficient to recover the upfront cost of electrification.[377]

Despite this, two-thirds of low-income households surveyed indicated strong or very strong support for transitioning from gas to electricity usage.[378]

When replacing a room gas space heater, installing a room RCAC instead is typically cheaper and can also provide the added benefits of cooling. For hot water, electric storage hot water systems are available, which generally cost less than hot water heat pumps and are comparable to low-cost gas storage hot water systems. Ducted or multi-split RCAC systems are often incrementally more expensive than a ducted gas like-for-like replacement, however they are less likely to be installed in low-income households.[379] Meeting the cost of replacing an appliance is likely to be challenging for low income households under any circumstances. There is a risk that the additional incremental or ancillary costs of installing an electric appliance results in low-income households choosing not to install a heater at the end of the life of their current appliance. Victorian Government programs such as the Solar Victoria's Solar Homes Program, the VEU program and Small-scale Technology Certificates (STCs) can help homeowners offset a range of costs associated with electrification upgrades.

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[375] Note sensitivity analysis has been undertaken to assess the impact of a potential increase in material and labour cost on the CBA results (see section 6.3.1.3).

[376] Social Policy and Research Centre (2023), Enabling electrification: Addressing the barriers to moving off gas faced by lower-income households.

[377] Due to limited data on the prevalence of shared gas services in Class 2 buildings and the cost of electrification there is some uncertainty regarding the magnitude of these costs, noting that an additional cost of $1,000 per Class 2 water heating heat pump upgrade (from gas instant) was incorporated in the CBA to reflect the potential additional costs for upgrading shared hot water systems or instances where limited space may be a barrier in Class 2 buildings. Figure provided by DEECA.

[378] Social Policy and Research Centre (2023), Enabling electrification: Addressing the barriers to moving off gas faced by lower-income households.

[379] Oxford Economics Australia (2022), The Climate Control Market in Australia, 2022 – The Climate Control Profile.

Retirees and the elderly

Data from Energy Consumers Australia Behaviour Survey indicates that retired and elderly households are more likely to have gas heating or hot water than the average Victorian household.[380] Retirees may also live in older properties that may be more likely to require additional infrastructure upgrades such as switchboard or supply connection upgrades. Limited savings and lack of income may be a barrier to switching to electric heating and hot water.

Regional communities

Those living in regional areas of Victoria are more likely to be living in colder climates (i.e. climate zone 7) and therefore may have higher heating and hot water energy requirements than the average Victorian living in climate zone 6. As a result, regional households may require larger heating and hot water appliances that may be more costly than the average household. In addition, regional households are more likely to earn a lower income than those in metropolitan areas.[381] These households may also face higher barriers to access labour to enable timely switching to electric appliances.

Potential consequences to households

The proposed regulations apply only at the end of the life of the current gas appliance, meaning a replacement cost will be incurred whether the appliance is replaced by a gas or electric appliance.

Any increase to the incremental cost of appliance replace would be a challenge for some households. Households may have to adjust or forgo spending on other items to save sufficient funds to afford the upgrade.

To address these concerns, potential exemptions for existing residential properties will be explored through the consultation process of this RIS. Noting limited data regarding individual households' ability to pay the anticipated up-front costs of electrifying, the extent or scale to which these impacts may occur as a result of the proposed regulations is unknown. In recognition of these barriers, potential exemptions are being considered for existing Class 1, Class 2 and Class 10b buildings (see Chapter 9). Additionally, it is proposed that heating or hot water is supplied by a centralised system in a Class 2 building be exempt from the regulations.

However, these communities could also benefit the most from electrification. As discussed in section 7.2.3, gas tariffs are expected to increase for users that remain on the gas network as the fixed costs of the gas network are spread across a smaller customer base. Low-income households tend to spend a larger proportion of their income on energy bills compared to higher income households. One survey showed that lowest income households spent 14 per cent of their total income on energy costs, which is more than five times higher than the proportion spent by the highest earning households.[382] Due to the energy efficiency savings, switching existing residential properties from gas to electric appliances will have a significant impact on low-income households. Likewise regional communities in cooler climates are also likely to see a greater saving on energy bills. Residents living in older properties are also likely to receive greater energy savings from upgrading to more efficient heating, as these properties typically have a poorer thermal performance and require more energy for heating.[383]

To help households understand the potential costs and benefits of electrification, the SEC has launched a free digital platform for consumers to switch to all-electric. This will allow customers to identify suitable appliances, connect with local installers and identify potential home improvements that can help to reduce costs.[384]

In addition to available government support, a growing number of Australian financial institutions offer a range of `green' products which can assist further with upfront costs of electrification. For example:

- Bank Australia with the support of the Clean Energy Finance Corporation offers a Clean Energy Home Loan. The homeowner receives a 0.44 to 0.5 percentage point discount on their home loan rate if their property is either NatHERS

[380] Deloitte analysis of Energy Consumers Australia Behaviour Survey (2023).
[381] Australian Bureau of Statistics (2023), Employee earnings. <https://www.abs.gov.au/statistics/labour/earnings-and-working-conditions/employee-earnings/latest-release#state-and-territory>
[382] Energy Consumers Australia (2023), How to close the energy divide. <https://energyconsumersaustralia.com.au/news/how-to-close-the-energy-divide#:~:text=Results%20from%20December%202023%20indicate,by%20the%20highest%20earning%20group>.
[383] CSIRO (2022), Keeping your older house warm without breaking the bank. <https://www.csiro.au/en/news/all/articles/2022/june/energy-efficiency-older-houses>
[384] State Electricity Commission (2024), SEC Helps Households Switch to Electric and Save. <https://www.premier.vic.gov.au/sec-helps-households-switch-electric-and-save>

7 star+ (new homes) or can demonstrate ambitious green upgrades in the previous 12 months based on a Residential Scorecard Assessment (for existing homes).[385]

- The Commonwealth Bank offers a Green Loan where customers with an eligible CommBank home loan or investment home loan can borrow from $5,000 to $30,000 to fund the purchase and installation of a range of clean energy products such as solar, batteries, heat pump hot water and switching from gas to electric cooktops.[386]

The Victorian Government is also considering the potential for exemptions in recognition of circumstances where electrification may not be viable, for example where the costs to augment electrical supply are disproportionately high or space constraints make installation of an electric appliance impractical (see Chapter 9). These exemptions may assist vulnerable cohorts, particularly where they may face a disproportionately high upfront cost to electrify due to living in an older home or more regional location, by providing these properties with greater choice as to how and when they may wish to switch to electric. As part of this RIS, the Victorian Government is seeking advice from stakeholders regarding relevant circumstances in which exemptions may be required. Further, to support implementation of the proposed regulations, DTP will undertake regular engagement and monitoring of vulnerable consumers to identify and address potential adverse impacts of the preferred option (see Chapter 9 for more details). This could include, for example, the risk that vulnerable cohorts may be more likely to be exposed to higher fixed network charges for gas if they are not able to electrify (see section 8.5).

Stakeholder questions:

The Victorian Government seeks advice from stakeholders on:

- any data available related to potential disproportionate impacts on key stakeholder groups or demographics as a result of the proposed regulation.
- the need for hardship exemptions for existing residential buildings in recognition of issues that may be faced by particular stakeholder groups.

Consideration of power interruptions and noise from heat pumps

Under the preferred option, residential properties would switch their gas heating and hot water appliance to electric. Given the fact that gas heating and hot water appliances require electricity to start and/or operate, the switch to electric is not anticipated to change the level of dependency on electricity to operate appliances. However, Option 3 is modelled to increase both annual electricity consumption and peak demand (see section 7.1.1) which may increase the risk of unserved energy if sufficient electricity generation and/or network capacity are not available to meet demand.[387] The risk of increased unserved energy as a result of Option 3 has not been quantified. However, it is noted that AEMO projects unserved energy in Victoria to remain substantially below the reliability standard over the coming decade to 2034 if actionable and anticipated developments (under the Step Change scenario) are deployed.[388]

Heat pump hot water systems and RCACs are refrigerative systems with compressors and fans, which will make some noise during operation. Although some heat pumps can be louder than others, reported noise levels are compared to modern refrigerators.[389] One study in the United Kingdom found that noise complaints from heat pumps are very low, with around 100 noise complaints for every 300,000 installations (0.03 per cent).[390]

For those residential properties that switch from a gas ducted system to an RCAC, the noise from the RCAC will likely be similar to the fans that the gas ducted system uses to distribute heat around the house. For those residential properties that switch from a gas hot water system to a heat pump hot water system, the noise of the heat pump may be more of a consideration since heat pump hot water systems can generate more noise than other hot water systems, are used all-year

[385] Bank Australia, Clean Energy Home Loan. <https://www.bankaust.com.au/banking/home-loans/clean-energy-home-loan>
[386] Commonwealth Bank of Australia, Commbank Green Loan. <https://www.commbank.com.au/home-loans/commbank-green-loan.html>
[387] Unserved energy refers to the volume of electricity demand that cannot be supplied due to shortage of generation, demand-side participation of network capacity.
[388] This includes only those announced and identifiable components of announced federal and state schemes, including various tender stages that have been concluded. AEMO (2024), Electricity Statement of Opportunities. <https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/nem_esoo/2024/2024-electricity-statement-of-opportunities.pdf?la=en>
[389] Solar Victoria, Planning a heat pump hot water system. <https://www.solar.vic.gov.au/solar-hot-water-buyers-guide/section-6-planning-heat-pump-hot-water-system#noise>
[390] Carbon Brief (2024), Factcheck: 18 misleading myths about heat pumps. <https://www.carbonbrief.org/factcheck-18-misleading-myths-about-heat-pumps/>

round and can operate any time during the day. Heat pump hot water heaters are no noisier than an RCAC, which more than half of Victorian households already have installed.[391]

Noise from the heat pump hot water systems can be managed in a number of ways if there are any concerns. Installing the heat pump water heater in an appropriate location such as outside a kitchen or bathroom rather than outside a bedroom or living area will help limit disturbance. Installation near a bathroom or kitchen can also help minimise heat loss from hot water pipes. Installing a system that has a controller or timer that can be programmed to heat at certain times of the day will limit the amount of noise at night. This feature can also provide additional benefits including maximising self-consumption of solar generation and improving unit efficiency by operating in warmer ambient temperatures during the day.[392]

8.4 Cost to commercial buildings

Similar to the residential sector, the primary cost drivers for electrifying new commercial buildings in Victoria are the upfront capital costs of alternative electric appliances and equipment, as well as replacements required to the building's electrical infrastructure. As outlined in section 5.6.1, the cost of replacing gas appliances with electric in new commercial buildings varies significantly across business types and use cases. Some businesses may make a capital saving from going electric by avoiding gas piping and network infrastructure costs, while many others may bear an additional cost.

As an example, Table 8.2 below presents a range of potential estimated costs incurred by the electrification of a new large office building and hospital, based on a typical building archetype for that sector. It shows that the cost to electrify both heating and hot water over a 50-year period could cost between $660,000 to $2.7 million for a large office building and $1.6 to $3.1 million for a hospital.[393] This includes future replacement costs over a 50-year period and does not consider avoided cost of gas plant or gas infrastructure. The analysis indicates that upfront savings on a gas plant could range from nearly $315,000 to $527,000 for a large office building, and $392,000 to $497,000 for a hospital.[394] These archetypes represent more 'difficult to electrify' commercial buildings (relative to small or medium sized buildings) and therefore likely present an upper range of costs.

Table 8.2: Estimated range of costs to electrify new commercial large office building and hospital

Cost item		Large office building (11,040 m²)	Hospital (5,710 m²)
Mechanical plant cost for electrification	Heating	$186,000 to $1,080,000	$726,000 to $1,430,000
	Hot water	$121,000 to $169,000	$150,000 to $338,000
Additional building infrastructure (plant room and electrical cost)	Heating	$142,000 to $207,000	$0 to $139,000
	Hot water	$32,000 to $84,000	$104,000 to $130,000
Future lifecycle replacement costs (chiller and heat pump replacement over 50-year period)[1]	Heating	$94,000 to $1,062,000	$435,000 to $885,000
	Hot water	$85,000 to $101,000	$151,000 to $201,000

Source: DeltaQ, rounded to the nearest $1,000. 1.Note future lifecycle replacement costs were excluded from the CBA as the analysis only accounts for benefits and costs over the life of the asset and assumes reinstallation does not occur after the life of the regulations.

For many (if not most commercial sectors) the upfront costs of electrification would likely be paid by building developers and property owners. These costs would likely be passed on through to businesses through increased rental costs to tenant businesses. Although it is unknown to what extent upfront costs would likely be passed on to tenants. Some (if not all) of these upfront costs may be recovered through tenant's financial savings on energy costs from improved energy efficiency.

[391] JWS Research (2021), Household energy preferences: Research Report, prepared for the Department of Environment, Land, Water and Planning. <https://engage.vic.gov.au/download/document/27749>
[392] Solar Victoria, Requirements for hot water rebates. <https://www.solar.vic.gov.au/notice-market-2024-25/section-5-requirements-hot-water-rebates#521-hot-water-systems-%E2%80%93-mandatory-requirements>
[393] DeltaQ (2024), NCC 2025 Energy Efficiency – Advice on the technical basis – Electrification Report. <https://www.abcb.gov.au/sites/default/files/resources/2024/REP01080-B-006-Electrification-Report.pdf>
[394] This does not include ancillary gas infrastructure such as piping or connection to distribution network.

Stakeholder questions:

- The Victorian Government seeks advice from stakeholders on the key costs and considerations that may be a barrier to electrifying new commercial buildings.

8.5 Impact of preferred option on gas users

The preferred option would see no new residential or commercial gas connections and the disconnection of existing residential properties who do not use gas for cooking from the gas network.

As described in section 7.2, remaining gas users are likely to face increasing gas tariffs as the fixed cost of owning and operating network infrastructure is spread over fewer customers. This may have different impacts on different user groups, for example:

- **Existing residential properties with gas cooking:** Gas cooking appliances have relatively low gas use, therefore continuing to pay fixed annual supply charges for a low usage appliance may be uneconomical for households. For households with access to switch to electric cooking appliance, this may result in more households voluntarily disconnecting from the gas network and further drive-up gas tariffs for remaining users. However, not all households may be able to readily switch their cooking appliance, either because they are tenants and do not own the property themselves, or do not have the funds to do so. Therefore, rising gas tariffs may fall to more vulnerable community groups, such as low-income households.
- **Existing commercial businesses:** Under the preferred option, no existing commercial buildings are required to electrify. However, similar to remaining residential properties, it is possible that rising gas network charges may make it uncommercial to continue using gas appliances. As a result, businesses that have accessible and affordable alternatives may be driven to voluntarily switch to electric, and similarly drive-up gas tariffs for remaining commercial users. However, with sustained gas supply shortages projected for Victoria as soon as 2028, which may result in higher gas prices, businesses may face commercial risks regardless of whether the proposed regulations are in place.
- **Existing industrial users:** The regulatory options considered will not apply to Class 8 facilities which includes industrial facilities such as factories, manufacturing, and agriculture. However, anticipated increasing gas tariffs would apply to all gas users, including industrial users. However, AEMO is projecting structural gas shortfalls from 2028, which could result in significant upward pressure on wholesale gas prices. The projected reduction in gas demand proposed in the regulatory options would assist in alleviating upward wholesale price pressure and assist in reducing price impacts to industrial users. As there are a range of other plausible futures, the results in section 7.2 are subject to significant uncertainties and should not be interpreted as predictions of the impact to Victoria's existing industrial users.

The Victorian Government is aware that the proposed regulations will have an impact on gas users remaining on the network. This significant transition of Victoria's fossil gas use will require an evolution of the reticulated transmission and distribution network over time to ensure it continues to meet the needs of future gas users and the Victorian economy. Careful consideration will need to be given to how this transition is managed to ensure Victoria's stringent energy safety and reliability standards are maintained, and the ongoing costs of network operation are shared fairly and affordably between gas users and gas networks.

8.6 Small businesses

Small businesses can experience disproportionate impacts from regulation due to limited resources for interpretation of updates in compliance requirements, and the number of different requirements to comply with. The lack of economies of scale may affect these businesses' ability to comply with different options.

As noted, there is high variability and uncertainty of capital costs associated with electrification of heating, hot water and cooking for businesses. While some costs may scale with the size of the business' operations, there are likely a number of costs that are driven by a range of factors, such as building layout, age of building, existing infrastructure and location.

Most new commercial buildings are typically funded and built by developers and/or commercial property owners. It is unknown to what extent small businesses currently play a role in Victoria's new commercial developments. Given most new commercial developments are large capital cost projects, it is likely the incremental cost of electrification will not materially impact the overall cost of new commercial developments such that it would become a barrier for small businesses in the new commercial development industry. As noted in section 8.4, it is possible developers and commercial property owners may be able to pass on the cost of electrification to the occupying business, who in turn may recover some or all of the costs through reduced energy bills.

Stakeholder questions:

- The Victorian Government seeks advice from stakeholders on how the proposed regulations may impact small businesses due to limited resources to interpret compliance requirements, or to keep pace with regulatory changes.

8.7 Competition impacts

As Victoria is party to the Competition Principles Agreement, regulation in Victoria is required to include a competition assessment. The intention of the competition assessment is to identify if there may be adverse effects for consumers (through reduced choice of products and/or higher prices) and the broader economy (through reduced opportunities or incentives for businesses to invest and innovate, leading to lower productivity and employment growth). The Competition Principles Agreement states that any new primary or subordinate legislation should not restrict competition except where:

- restriction of competition is required to meet the government's objective; and
- the benefits of restriction outweigh the costs.

Restriction on competition can be identified where there will be changes to the way a market functions due to the implementation of the proposed regulation. Specifically, restriction can occur where:

- the number of suppliers is limited
- the ability of suppliers to compete is limited
- the incentives of suppliers to compete vigorously is reduced.

Given the large-scale impacts of the proposed regulations, this RIS includes qualitative consideration of a wide range of potential competition impacts.

Table 8.3 summarises the key test questions assessed against key industries and sub-markets to identify potential competition impacts. The following sections consider the key potential competition impacts identified through the assessment.

Several potential competition impacts were identified through the assessment and discussed in sections 8.7.2 to 8.7.4 However, based on information available, there were no competition impacts which would likely have adverse impacts on consumers that could not be managed through implementation. This includes through consultation with relevant stakeholders to identify potential mechanisms to support industry, regular monitoring of industry trends for early signs of competition impacts and proactive management of any competition issues identified with relevant agencies. See Chapter 9 for more details on implementation.

Table 8.3: Test questions and selected industries to assess competition impacts

Test question	Selected industry and sub-markets assessed
What is the good being supplied? Are the proposed measures likely to limit the number of producers or suppliers to: • only one producer? • only one buyer? • less than four producers? Would the proposed measures restrict the ability of businesses to choose their output, price or service quality? Would the proposed measures discourage entry into the industry by new firms/ individuals or encourage exit from existing providers? Would the proposed measures impose higher costs on a particular class or business or type of service (e.g. small business)? Are the proposed measures likely to make it more difficult for consumers to move between or leave service providers? Would the proposed measures affect the ability of businesses to innovate, adopt new technology or respond to the changing demands of consumers?	Residential sector: • New residential properties • Existing residential properties Key commercial sectors in which food and beverage services are a key product: • Hospitality • Accommodation Key commercial sectors in which food and beverage services are not a key product: • Offices • Retail excluding hospitality • Warehouses • Public services (aged care, religious, health, education) Gas industry: • Gas producers • Gas network providers • Gas retailers • Appliance manufacturers • Gas fitters and plumbers •

8.7.2 Residential sector

The following section considers the impact of the preferred option on the market for owner-occupied properties as residential rental properties are considered under the proposed minimum energy efficiency and safety standards for rental properties.

8.7.2.1 New residential properties

Historically new residential properties tend to be supplied by builders in emerging areas (such as outer urban areas of Melbourne or regional parts of Victoria). However, under the Housing Statement the Victorian Government is looking to support new residential building in established suburbs.[395]

In addition, polices that mandate new housing developments and small second dwellings cannot be connected to the gas network already covers the majority of new residential properties. The intention of the proposed regulations expands upon these policies to capture developments that do not require a planning permit.[396]

The proposed regulations are not anticipated to limit the number of builders or buyers in the market. While builders would no longer be able to provide gas connection or gas appliances in new buildings, this is not likely to reduce consumer choice between new properties. While builders may incur some additional cost to electrify, savings are also likely to occur from avoided gas infrastructure, therefore the impact on overall house price is not anticipated to be material.

8.7.2.2 Existing residential properties

Existing residential properties are supplied by existing property owners, often individual sellers, in established and well-developed regions of Victoria.

[395] Department of Premier and Cabinet (2023), Housing Statement. <https://www.vic.gov.au/sites/default/files/2023-09/DTP0424_Housing_Statement_v6_FA_WEB.pdf>

[396] By 2026 74 per cent of new residential buildings are anticipated to be built all-electric under the Base Case. This increases to 99.6 per cent by 2035. See Table 4.2.

It is possible that some existing properties that have not yet upgraded their gas appliances may have more difficulty in selling or that the sale price may be marginally lower due to buyers' anticipated future expenses associated with replacing the appliance. However, it is unlikely that this will affect supplier entry into the market. .

Apartments with shared gas services may be more costly or complex to electrify than detached houses, and therefore the proposed regulations may have a disproportionate impact on the potential market for existing apartments as a result of reduced demand. An exemption has been proposed for buildings where there are shared services and also where there are space constraints to install electric appliances. These exemptions, coupled with the fact that the decision to sell an owner-occupied property is driven by a range of other factors (such as finance, choice of location to live, number of occupants), means it is unlikely that the proposed regulations will limit the supply of existing apartments on the market.

Stakeholder questions:

- The Victorian Government seeks advice on any data that is available on stakeholders who may be particularly affected by the preferred option and where identified:
    a. proposed exemptions to address this acute impact.
    b. proposed delays to the commencement of the regulations to enable more time for adjustment

8.7.3 Commercial sectors directly impacted by the regulations

This section discusses the supply of commercial buildings and the impacts on the food and beverage sector.

For most new commercial buildings, the proposed regulations are not anticipated to have a substantial impact on competition as gas or electric supplied energy is unlikely to be a distinguishing factor between businesses. As described in section 8.4, the proposed regulations will likely impose a capital cost on new building developments, which is projected to be partially recovered through energy savings over time. However, given the significant investment required to establish a new building, the incremental cost of going all-electric is not considered material enough to discourage new entrants in the commercial building development market from entering.

In some instances, buildings with access to reticulated gas may be perceived to be more favourable than all-electric. Namely, business owners or operators in the food and beverage industry, such as hospitality or accommodation services, may prefer to operate in existing commercial properties where kitchens are able to operate on gas, while all new commercial kitchens must be electric or use LPG. There are some risks of using portable LPG cylinders in commercial kitchens such as the risk of fire, explosion and leaks in areas with insufficient ventilation.[397] The potential impact of the proposed regulations on competition in the food and beverage sector will be managed through the implementation plan (for more information on implementation see Chapter 9). As discussed in section 8.2, businesses have been shown to operate effectively in areas that do not have access to a reticulated gas network. In addition, new buildings make up a small proportion of the total commercial building stock in Victoria therefore the extent to which this occurs is likely to be limited.

[397] New South Wales Government (2017), LPG cylinders should not be stored or used inside commercial kitchens. <https://www.safework.nsw.gov.au/safety-alerts/safety-alerts/safety-alert-lpg-cylinders-should-not-be-stored-or-used-inside-commercial-kitchens>

8.7.4 Gas industry

The preferred option is anticipated to have an impact on gas industry dynamics. The potential competition impacts have been considered across gas producers, gas network service providers, gas retailers, appliance manufacturers and gasfitters and plumbers.

Across these sub-industry groups, the proposed regulations may limit the gas industry's ability to innovate by transitioning into low-carbon alternative gas technologies such as biomethane or hydrogen. This is because falling customer demand may limit use of revenues for research and development spending, as well as potentially impact ability to secure financing due to perceived risk from lenders. However, as detailed in Appendix B, the cost of these alternative technologies is high and they are not available at a sufficient scale to fulfil the demands from the residential, commercial and industrial sectors. They are therefore unlikely to present an affordable or accessible choice for building space heating, water heating and cooking in the short to medium term. Therefore, this is not anticipated to disadvantage consumers.

The following sections considers each sub-industry group in turn.

8.7.4.1 Gas appliance manufacturers

Gas appliances in Victoria are supplied both by local (Victorian) and international or interstate manufacturers.

It is likely that Victorian-based manufacturers mostly supply to Victoria therefore reduced Victorian demand for gas appliances may result in a reduction in sales of gas appliances locally. Many gas appliance manufacturers already also offer electric appliances and may be able to expand existing and new electric product lines to meet the growing demand the proposed policy reform will create, but for some, the proposed policy may encourage exit from the market. In theory, gas appliance manufacturing would scale down in line with lower demand.

With sustained gas supply shortages projected for Victoria as soon as 2028, additional supply from interstate or import terminals will likely lead to increased gas retail prices due to higher transport costs. This, in turn, may result in additional voluntary uptake of electrical appliances. As a result, gas appliance manufacturers may face commercial risks regardless of the proposed regulations. The impact of the proposed regulations on plumbers will be monitored as discussed in Chapter 9.

Stakeholder questions:

- The Victorian Government seeks advice from stakeholders on how the proposed regulations may impact competition in the gas appliance manufacturing market and potential adverse impacts on consumers, including any data or analysis indicating the scale of potential consumer impact.

8.7.4.2 Plumbers

Victoria has 33,600 licensed plumbers, of which 20,000 are gasfitters.[398] Plumbers install and maintain water, drainage, gas and sewer systems. They may also install fire protection and sanitary systems.[399] They also provide services for installation, maintenance and decommissioning of gas infrastructure and appliances as well as installation and maintenance of hot water heat pumps.

There is likely to be a reduced demand for gas heaters in the long term, however, in the short to medium term plumbers will continue to be in demand to support decommissioning of existing gas heaters and infrastructure, therefore there may be more opportunities for businesses over this period. The number of gasfitting businesses would, in theory, scale down in line with lower demand, therefore limiting any change in market concentration.

However, plumbers will continue to be required to support the installation, and maintenance of hot water heat pumps, and gas cooktops in existing residential properties. Plumbers will also continue to be in demand for other plumbing work unrelated to the consumption of fossil gas such as LPG line fitting and installation, and servicing and maintenance.

The impact of the proposed regulations on plumbers will be monitored as discussed in Chapter 9.

[398] Victorian Skills Authority (2022), Plumbing Industry Climate Action Centre Submission in Renewable Hydrogen Discussion Paper 2020 (cited in Victorian Renewable Hydrogen Industry Development Plan 2021)
[399] Victorian Government (2024) Plumber <https://www.vic.gov.au/plumber>

Stakeholder questions:

- The Victorian Government seeks advice from stakeholders on how the proposed regulations may impact competition in Victoria's gas plumbing industry and potential adverse impacts on consumers, including any data or analysis indicating the scale of potential consumer impact.

8.7.4.3 Fossil gas producers

Fossil gas producers are those that undertake extraction and processing of gas for wholesale markets. Entry and exit for fossil gas producers largely depends upon the availability of gas which, as discussed in section 2.3.1, is already declining in Victoria, with sustained gas supply shortages projected for Victoria as soon as 2028. The proposed regulations are therefore expected to have a limited impact on competition among fossil gas producers.

Victoria's wholesale gas market will continue to be monitored and managed by the Victorian Government, and relevant agencies such as the AER and AEMO.

Stakeholder questions:

- The Victorian Government seeks advice from stakeholders on how the proposed regulations may impact competition in wholesale gas production and potential adverse impacts on consumers, including any data or analysis indicating the scale of potential consumer impact.

8.7.4.4 Gas network service providers

There is currently one gas transmission and three distribution network service providers in Victoria.[400] They are each regulated by the AER as a monopoly service in their defined regions. As detailed in Chapter 7, the prices of gas network services are likely to be impacted as fewer users remain on the network. Risks to future commercial viability of the gas network may encourage businesses to exit the market which would require the sale of their assets to another private or state-owned corporation. Such a sale would be overseen by relevant regulatory agencies (e.g. AER, ACCC or ESC) and any potential competition impacts of the sale would be managed through this process.

It is possible that risks to future commercial viability of the gas network may increase the financial cost of owning and operating network infrastructure by resulting in higher risk of lending to network service providers (i.e. higher cost of capital). This in turn may be passed on to consumers through their regulated tariffs (i.e. higher consumer energy prices).

With sustained gas supply shortages projected for Victoria as soon as 2028, gas network service providers are likely to face commercial risks regardless of whether the proposed regulations are in place. Further work with the AER and industry stakeholders is required to ensure implementation of the proposed regulations allows an orderly transition for gas network infrastructure, with impact to consumers limited as far as reasonable (see Chapter 9).

Stakeholder questions:

- The Victorian Government seeks advice from stakeholders on how the proposed regulations may impact the provision of gas network services and potential adverse impacts on consumers, including any data or analysis indicating the scale of potential consumer impact.

8.7.4.5 Gas retailers

Gas retailers provide retail services for the end sale of gas to consumers. Most gas retailers in Victoria are also electricity retail providers, and therefore impacts to the gas industry can likely be buffered by growth in the electricity sector. Despite this, gas only retailers may be encouraged to exit the market in light of reducing gas customers or look to expand into electricity retail, therefore reducing the amount of choice for remaining gas consumers. This may result in increased market concentration in the gas retail sector and lead to higher retail prices or lower customer service quality for consumers.

With sustained gas supply shortages projected for Victoria as soon as 2028, gas retailers may face commercial risks regardless of whether the proposed regulations are in place. Further work with ESC (who oversees Victoria's energy retail

[400] As well as one micro network provider (see section 2.1).

market) and industry stakeholders is required to ensure implementation of the proposed regulations limits impact to gas retailer competition (see Chapter 9).

Stakeholder questions:

The Victorian Government is seeking advice from stakeholders on:

- any data related to potential impacts on their business industry or sector, including disproportional impacts on small businesses or market competition.
- timing and potential need for any transitional arrangements to ensure the implementation of the regulations occurs smoothly.

9 Implementation plan and evaluation strategy

This chapter outlines the actions that DTP and DEECA will undertake to implement and assess the efficiency and effectiveness of the proposed electrification requirements.

9.1 Proposed regulations

To implement the preferred option, the Victorian Government proposes to:

- prohibit new residential and most new commercial buildings from connecting to the reticulated gas network, as described in Table 9.1
- prohibit the installation of reticulated gas appliances and replacement of reticulated gas appliances at end of life with reticulated gas appliances in existing residential buildings, excluding reticulated gas appliances used for cooking, as described in Table 9.2.

Residential renovations and extensions that require a building permit will not trigger the electrification requirements unless the building work proposes to replace or install new gas appliances. Only new buildings that require building permits will be required to be all-electric.[401]

Table 9.1: New connections to the reticulated gas network

Building class	Scenario	Example	Current state	Proposed future state
Residential (NCC Building Class 1, 2)	New residential (greenfield)	New property constructed on a greenfield site.	From 1 January 2024, amendment VC250 to the VPP prohibited new gas connections for new dwellings, apartments and residential subdivisions where a planning permit is required. Where a planning permit is not required, new dwellings, apartments and residential subdivisions requiring a building permit can connect to reticulated fossil gas.	Under proposed amendments to the Building Regulations 2018 that insert new regulation 37A, a relevant building surveyor must not issue a building permit in relation to the construction of the building if it includes a connection to reticulated gas. Under proposed amendments to the Plumbing Regulations 2018 that insert Part 6A, a plumber must not connect reticulated gas downstream of the gas supply point to a building if that building is an existing building that does not have a reticulated gas connection or during the construction of that building.
	New residential (infill)	A household with an existing connection is demolished and a new property is constructed. The presence of a gas meter does not mean that a connection to the reticulated gas network is permitted.		

[401] In the CBA modelling, major renovations that require a building permit were treated as new buildings and assumed to electrify at point of renovation (see section 5.2). In practice, the proposed regulations would not trigger electrification at the point of a major renovation. Given the small proportion of renovations accounted for and noting that for residential properties this would shift the point of time at which appliances are electrified to end of life (for heating and hot water systems), this is not anticipated to change the findings of the RIS.

Building class	Scenario	Example	Current state	Proposed future state
	Small second dwelling (SSD)	An SSD cannot connect to reticulated fossil gas.	On 14 December 2023, Amendment VC253 to the VPP and all planning schemes in Victoria introduced a new land use term prohibiting reticulated fossil gas connections to SSDs.	Reticulated fossil gas connections to SSDs continue to be prohibited. Under proposed amendments to the Building Regulations 2018 that insert new regulation 37A, a relevant building surveyor must not issue a building permit in relation to the construction of the building if it includes a connection to reticulated gas. Under proposed amendments to the Plumbing Regulations 2018 that insert Part 6A, a plumber must not connect reticulated gas downstream of the gas supply point to a building if that building is an existing building that does not have a reticulated gas connection or during the construction of that building.
Commercial (NCC Building Class 3, 4, 5, 6, 7b, 9, 10a, 10b)	New commercial (greenfield)	New building constructed on a greenfield site.	New commercial buildings can connect to reticulated fossil gas.	Under proposed amendments to the Building Regulations 2018 that insert new regulation 37A, a relevant building surveyor must not issue a building permit in relation to the construction of the building if it includes a connection to reticulated gas. Under proposed amendments to the Plumbing Regulations 2018 that insert Part 6A, a plumber must not connect reticulated gas downstream of the gas supply point to a building if that building is an existing building that does not have a reticulated gas connection or during the construction of that building.
	New commercial (infill)	Building with an existing connection is demolished and a new building is constructed. The presence of a gas meter does not mean that a connection to the reticulated gas network is permitted.	New commercial buildings can connect to reticulated fossil gas.	

Source: DTP

Table 9.2: Reticulated gas appliances in existing residential buildings

Type of plumbing work	Current state	Proposed future state
Installation	Plumbers can install reticulated gas appliances in buildings.	Proposed amendments to the Plumbing Regulations 2018 inserting Part 6A will introduce an offence for the installation of space heating or water heating reticulated gas appliances in an existing Class 1, Class 2 or Class 10b building, unless an exemption applies.
Replacement with a reticulated gas appliance	Plumbers can replace a reticulated gas appliance with a reticulated gas appliance when the current appliance reaches end of life.	Proposed amendments to the Plumbing Regulations 2018 inserting Part 6A will introduce an offence for the replacement of space heating or water heating reticulated gas appliances with another reticulated gas appliance in an existing Class 1, Class 2 or Class 10b building, unless an exemption applies.

Source: DTP

9.1.2 Proposed exemptions

The Victorian Government is aware that there are a number of circumstances where electrification of buildings may be unviable. Therefore several exemptions for Class 1, Class 2 and Class 10b buildings have been proposed and are presented in Table 9.3.

Note there will not be an administered application process to obtain an exemption. A plumber will determine if the circumstance meets the exemption as described in the proposed regulations or not. A plumber will need to note the reasoning the exemption was applied when issuing the certificate of compliance.

Table 9.3: Proposed exemptions for Class 1, Class 2 and Class 10b buildings

Exemptions	
In an existing Class 1,2 or 10b building, a person must not install a reticulated gas appliance or replace a reticulated gas appliance with a reticulated gas appliance if that appliance is intended to be used for space heating or water heating, unless:	There is insufficient space to install a non-reticulated gas appliance, or replace a reticulated gas appliance with a non-reticulated gas appliance
	In the case of a Class 2 building, heating or hot water is supplied by a centralised system
	Installing a non-reticulated gas appliance, or replacing a reticulated gas appliance with a non-reticulated gas appliance is unlawful because of any other Act, regulation or law (for example, the Heritage Act 2017 and associated Heritage Regulations 2017)
	Installing a non-reticulated gas appliance, or replacing a reticulated gas appliance with a non-reticulated gas appliance requires augmentation of a transmission system or a distribution system to provide more than a basic connection service or a standard connection service
	A reticulated gas appliance is being temporarily disconnected and reconnected in the same building
	A contract was entered into before the commencement of the regulations to install a reticulated gas appliance or replace a reticulated gas appliance with a reticulated gas appliance. A 3-month transition period is provided after the commencement of the regulations to carry out the installation or replacement
	Section 10(1) or (2) of the *Building Act 1993* applies

Source: DTP.

9.1.3 Complementary Policies

The proposed 2025 revision to the National Construction Code will assist with building electrification via the introduction of electrification readiness requirements for both new residential and commercial buildings nation-wide. This follows on from changes as part of NCC 2022 which introduced as part of the 7-star update for thermal efficiency, a new energy budget approach. This limits the use of appliances that would impact this budget, and is already encouraging more efficient all-electric appliances for residential construction.

The proposed 2025 NCC requirements will include:

Residential (Class 1 buildings)

Increased switchboard capacity for new residential houses to facilitate future electrification. A larger number of spare circuits will be required where gas appliances are intended to be installed.

Provision of electrical infrastructure to support faster EV charging (dedicated circuit and electrical capacity), which would also be sufficient for domestic electrical heating, hot water and cooking appliances.

Commercial (includes Class 2 buildings)

Provision of electrical infrastructure and physical space to support the future electrification of gas-powered heating systems, hot water systems and heating for pools and spas.

Provision of electrical infrastructure to support further EV charging in carparks

Collectively, these new requirements will ensure that new residential and commercial buildings across Australia have the necessary electrical infrastructure to run electrical heating, hot water and cooking appliances without further upgrades.

Additionally, any new Class 2 or commercial buildings will be subject to a requirement for solar PV panels to be installed, which will provide further energy bill savings from electrification. Where a new Class 2 or commercial building installs gas appliances, additional solar PV panels will be required to offset the GHG emissions

Stakeholder questions:

The Victorian Government seeks feedback from stakeholders on:

- the proposed exemptions in the exposure draft of the Regulations and whether there is need for additional exemptions.
- the proposed commencement date of the regulations and whether there is a need for transitional arrangements to support supply chain or workforce transition.

9.2 Implementation plan

The key questions considered for implementation are:

- What needs to be done?
- When will it be done?
- Who will do it?
- Who will monitor implementation?

DTP will oversee the introduction of the proposed regulations and will work with the VBA and DEECA will work with ESV to prepare industry, businesses, and consumers during the transition period in preparation for the commencement of the new requirements. The actions outlined in Table 9.4 will take place in the lead up to the amendment of the Building Regulations and Plumbing Regulations to implement the preferred electrification reform option. Following the completion of the consultation period for the RIS, DTP will evaluate the feedback received to inform a final decision on the regulations.

As part of the consultation process, individual households may provide a submission to this RIS. Moreover, a survey will be made available for individuals to provide input on the RIS.

Table 9.4: Implementation timeline

Action	Responsible party	Anticipated timeframe
RIS and exposure draft of the proposed regulations release	Department of Transport and Planning	December 2024
Consultation period	Department of Transport and Planning Department of Energy, Environment and Climate Action	Greater than 60 days
Review of submissions	Department of Transport and Planning	Early 2025
Recommend and implement Regulations	Governor in Council	Early-mid 2025
Electrification requirements come into effect	Department of Transport and Planning Victorian Building Authority Energy Safe Victoria	2026[402]

Source: DTP.

9.2.2 Regulatory readiness

Regulatory systems and processes will likely need to be enhanced to support households and industry to deliver the new requirements and meet compliance and reporting obligations. DTP will work with the VBA and ESV to establish the necessary frameworks to implement building electrification reforms and support the ongoing monitoring and evaluations that follow, including identifying any exemptions required to ensure adverse impacts are appropriately minimised. DTP will also work with relevant government agencies and industry groups to identify and mitigate potential industry and competition impacts identified in Chapter 8 and ensure an ease of transition for stakeholder groups. This includes supporting adequate workforce transition to deliver the proposed regulation through the Victorian Energy Jobs Plan and liaising with ESV who manage complex gas installations in Victoria.[403]

9.2.3 Communicating the changes

Communications and education activities will be priority during early implementation period (first 12 months). The Victorian Government will engage with stakeholders in the residential and commercial sectors to raise awareness of the new building and plumbing requirements. DTP, DEECA, ESV and the VBA will collaboratively develop and implement education and

402 For analytical purposes, the proposed regulations were assumed to start in 2026 however this is not government policy and a commencement date has not been finalised.

403 Department of Energy, Environment and Climate Action (2024), Victorian Energy Jobs Plan. <https://www.energy.vic.gov.au/renewable-energy/victorian-energy-jobs-plan>

communication content to raise awareness and support adoption of the new requirements. Additionally, VBA and ESV guidance for industry practitioners will be published.

The electrification requirements will be communicated to stakeholders via various communication channels once the proposed regulations are made. These communication channels will include information sheets (developed in consultation with DEECA) for households, businesses and relevant practitioners on the DTP, DEECA, ESV and VBA websites.

Broadly, communications and resources for consumers will focus on how to plan for electrification and existing programs available to support consumers and businesses to electrify, such as the VEU Program, Solar Victoria incentives and SEC Victoria, as well as communication with industry.

9.2.4 Monitoring

DTP and DEECA will monitor the transition and implementation periods following the introduction of the proposed regulations. Close attention will be paid to the function of the regulations to ensure they operate as intended, and any associated risks will be monitored. The VBA has oversight of building and plumbing practitioners and will continue to monitor and enforce standards using existing functions and programs. The VBA will monitor the introduction of the new requirements through engagement with communications and educational material and through existing regulatory monitoring activity such as proactive building and plumbing audits and inspections.

The trigger points for compliance vary depending on the type of work being carried out and are summarised in Table 9.5.

Table 9.5: Trigger points for compliance by building class

Type of work	Trigger for compliance	Responsible practitioners
Residential (NCC Class 1, 2, 10b buildings)		
Construction of a new residential building (greenfield and infill)	Building permit application stage AND Connection to reticulated gas	Building Surveyors Plumbers
Existing residential building	Installation and replacement of a reticulated gas appliance used for space heating or water heating	Plumbers
Commercial (NCC Class 3, 4, 5, 6, 7b, 9, 10a, 10b buildings)		
Construction of a new commercial building (greenfield and infill)	Building permit application stage AND Connection to reticulated gas	Building Surveyors Plumbers

Source: DTP.

In addition to monitoring compliance with the regulations, DTP and DEECA will work closely with key agencies and industry bodies to prepare key stakeholders and ensure potential adverse impacts on consumers are closely monitored and managed over the life of the regulations. This includes:

- working closely with government agencies to monitor and manage potential consumer impacts of changes in the gas industry, including:
  - ESC, Energy Consumers Australia or Victorian Department of Families, Fairness and Housing to understand changes in customer hardship and ability to pay for essential services (such as through energy bill hardship rates via the Utility Relief Grants Scheme (URGS))

  - the AER to monitor and manage potential consumer impacts of changes in wholesale gas market and gas network services
  - AEMO to monitor and manage potential consumer impacts of changes in wholesale gas market and ensuring adequate investment in electricity networks
  - ESC to monitor and manage potential consumer impacts of changes in the retail gas market
  - DJSIR and relevant associations to monitor business trends in industries anticipated to be impacted, particularly potential adverse impact to competition in the food and beverage sector (see Chapter 8)
- engaging with relevant industry associations and bodies, such as:
  - Justice and Equity Centre, St Vincent de Paul Society and Brotherhood of St Laurence to understand household and consumer issues
  - Gas Appliance Manufacturers Association of Australia to understand concerns for manufacturing businesses
  - Master Builders Association of Victoria and Housing Industry Association Victoria to understand the concerns and needs of the construction industry
  - Master Plumbers Australia and Plumbing and Pipe Trades Employees Union to understand workforce needs and support transition
  - Gas Energy Australia and Australian Energy Producers to understand wholesale gas industry trends
  - Energy Network Australia and Australia Pipeline Gas Association to understand impacts on gas network services
  - Energy Retailers Association of Australia to understand impact on the retail gas market.

9.3 Evaluation strategy

The proposed regulations assessed in this RIS are considered high impact according to the Victorian Guide to Regulation, and so trigger the requirement for a mid-term evaluation. Given the proposed regulations will require amendments to the Building Regulations and the Plumbing Regulations, both of which are due to sunset in 2028, mid-term evaluation of the proposed regulations will be incorporated into the broader sunsetting review and remaking of the regulations by DTP over 2027-2028. As the proposed regulations form part of the Victorian Government's broader gas substitution agenda, DEECA will support DTP in evaluating the effectiveness of the electrification requirements over the forward period. This will be a holistic evaluation, taking into consideration the economic, environmental and social impacts, as well as any unintended consequences, arising from the introduction of the electrification requirements.

In undertaking the evaluation, DTP and DEECA actions will include:

- developing key evaluation questions
- establishing an outcomes logic framework, identifying the key outcomes to be achieved over the short, medium and long term
- establishing baseline data, prior to the introduction of the electrification requirements
- identifying key performance indicators and measures to track progress towards outcomes
- developing a data collection strategy
- reporting on evaluation findings.

9.3.1 Available data to inform evaluation

The VBA is able to track certificates of compliance issued when a gas appliance is replaced by an electric appliance to assess replacement rates.[404] It is anticipated that many of the mechanisms to monitor compliance will be folded into existing activities conducted by the VBA or other parties (for example, Registered Building Surveyors' sign-off on Certificates of Occupancy, compliance certificates for plumbing work, or the VBA's Proactive Inspections Program compliance monitoring program). Additionally, available data on the following will be key performance indicators to gauge whether the reforms are delivering reduced or slow growth in new connections and an increase in electric appliance installation:

- the number of properties connected to the reticulated gas network, reported by the AER
- Victorian gas demand, reported by AEMO
- plumbing and electrical installation activity.

[404] However, if a practitioner replaces a gas appliance with a new gas appliance it is unlikely they would lodge a certificate of compliance, therefore the VBA will be limited in its ability to track non-compliance with the regulations.

VBA data from compliance certificates for plumbing work, and ESV data from Certificates of Electrical Safety will likely be useful to inform connections/ disconnections and appliance installations.

Stakeholder consultation will also form a valuable aspect of data collection to inform evaluation of the electrification requirements. Interviews and surveys will be conducted by DTP and DEECA with key government and external stakeholders who are impacted by the proposed requirements, such as the VBA (as the regulator with the responsibility for administering the proposed regulations), other DTP and DEECA teams (to understand implementation challenges, as well as engagement with communications materials), and peak construction bodies such as the Masters Plumbers Association, Master Builders Association of Victoria and Housing Industry Association Victoria (to understand the impacts on the industry). This will enable collection of information regarding, for example:

- stakeholders' understanding of, and interaction with, the electrification requirements
- understanding of any issues encountered in implementation, or unintended consequences
- monitoring reasons for rates of non-compliance, such as financial costs, labour shortages, availability of appliances
- understanding of administration, compliance and enforcement costs.

Monitoring participation rates in the Utility Relief Grants Scheme can also provide an indication of the impacts of the electrification requirements on consumers. DJSIR also has stakeholder relationship managers and can identify potential issues for commercial users through their regular engagement.

DTP will monitor the use of exemptions to understand the impact such exemptions have on meeting the policy goals of the regulations, particularly whether the number of gas appliances that have been replaced by electrical appliances has been below that expected in modelling contained in this RIS.

Stakeholder questions:

- The Victorian Government seeks advice from stakeholders on relevant data sources that may be used in the evaluation of the proposed regulation.

10 Summary of questions for stakeholders

As discussed throughout this RIS, there are a range of sources of uncertainty regarding the potential impacts of the proposed regulations due to data gaps and the likelihood that the impacts for any given household or business may deviate substantially from the average expected impact. The Victorian Government therefore invites all stakeholders with input on how the proposed regulations may impact them or their industry to make a submission during the public submission process for subsequent consideration by the government.

The Victorian Government seeks advice and input from all stakeholders regarding:

1. any data available related to prevalence and energy usage of gas and electric appliances in commercial sectors, including both take up in new buildings and usage in existing buildings
2. any data related the asset lives of both gas and electric appliances in both the residential and commercial settings
3. any data available related to prevalence of gas commercial kitchen appliances in commercial sectors, or any related data regarding the proportion of buildings in Victoria that use a reticulated gas network connection solely for heating or hot water purposes
4. any data available related to prevalence of shared gas services in Class 2 buildings and views on relevant costs associated with electrification of shared gas services including the potential need for exemptions
5. any data available related to the administrative time required by residential homeowners to assess alternative options for the purchase and installation of an electric appliance and any additional infrastructure such as switchboard or connection supply upgrade
6. any data available related to the purchase and installation costs of electrifying residential buildings, including ancillary costs for labour, switchboard and supply connection upgrades, etc.
7. any data related to the proportion of homes which require switchboard, supply connection or broader wiring upgrades
8. any data available related to the purchase and installation costs of electrifying new and/or existing buildings in relevant commercial sectors, including estimated cost differentials between small, medium and large commercial buildings
9. any data available related to the prevalence of small and large buildings in Victoria for relevant commercial sectors
10. any data available related to the prevalence of commercial kitchens in Victoria and costs associated with electrifying or utilising LPG in commercial and non-commercial kitchens across various commercial sectors
11. key cost factors and considerations that may impact the cost of electrifying new or existing buildings in commercial settings that have not been identified
12. any data available related to the administrative time and associated cost of planning for and implementing electrification in buildings
13. any data available related to barriers to adoption of RCACs and considerations required around potential exemptions
14. any data available regarding historical or future forecasted improvements in the energy efficiency and/or cost of electric and gas appliances
15. the potential scale of and costs involved in undertaking building modifications when installing an electric appliance
16. any potential exemptions that may be required in recognition of barriers to electrify as a result of physical or regulatory constraints

17. differences in timing and cost of maintenance of electric and gas appliances in both residential and commercial sectors

18. anticipated impact on cost of owning and operating the gas network as a result of the regulatory options, and how costs may be recovered through a changing customer base

19. any data available related to potential disproportionate impacts on key stakeholder groups or demographics as a result of the proposed regulation

20. the need for hardship exemptions for existing residential buildings in recognition of issues that may be faced by particular stakeholder groups

21. any data related to key costs and considerations that may be a barrier to electrifying new commercial buildings

22. how the proposed regulations may impact small businesses due to limited resources to interpret compliance requirements, or to keep pace with regulatory changes.

23. any data that is available on stakeholders who may be particularly affected by the preferred option and where identified:
    a. proposed exemptions to address this acute impact.
    b. proposed delays to the commencement of the regulations to enable more time for adjustment

24. how the proposed regulations may impact competition in the gas appliance manufacturing market and potential adverse impacts on consumers, including any data or analysis indicating the scale of potential consumer impact

25. how the proposed regulations may impact competition in Victoria's gas plumbing industry and potential adverse impacts on consumers, including any data or analysis indicating the scale of potential consumer impact

26. how the proposed regulations may impact competition in wholesale gas production and potential adverse impacts on consumers, including any data or analysis indicating the scale of potential consumer impact

27. how the proposed regulations may impact the provision of gas network services and potential adverse impacts on consumers, including any data or analysis indicating the scale of potential consumer impact

28. any data available related to potential impacts on their business industry or sector, including disproportionate impacts on small businesses or market competition

29. the timing and potential need for any transitional arrangements to ensure the implementation of any regulations occurs smoothly.

Appendix A Legislative and regulatory framework

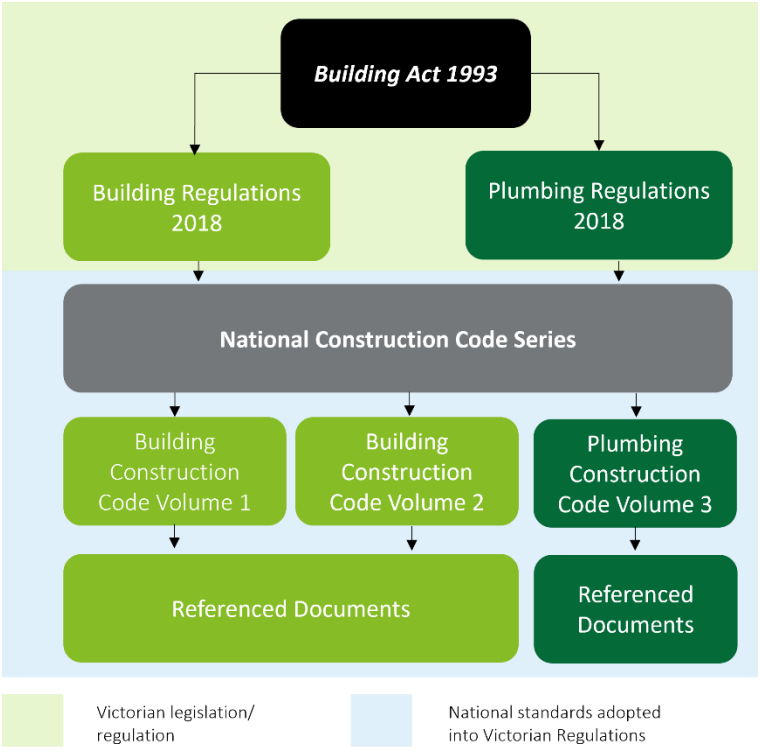
Legislative and regulatory frameworks governing building work

The Minister for Planning is supported by the DTP, who are responsible for the Regulations, and consequently for this RIS. The VBA regulates the building sector and ensures building and plumbing practitioners' compliance with the Regulations.

There is a separate legislative and regulatory framework governing the gas sector in Victoria, which is overseen by the Minister for Energy and Resources. This is discussed in section 0.

The legislative framework for the building sector is underpinned by a combination of legislation, regulations, the NCC, and reference documents such as standards prescribed by Standards Australia (see Figure A.1).

Figure A.1: Governance framework for the Victorian building sector



Building Act 1993

The Building Act is the primary legislation responsible for governing building and plumbing works, and the conduct of building and plumbing practitioners in Victoria. It also sets the legislative framework for building standards and maintenance of specific building safety features. Specifically, the Building Act sets out the requirement for plumbers when undertaking certain plumbing work related to gas appliances and gas piping.

The main objectives of the Building Act are to:

- regulate building work and building standards
- provide for the accreditation of building products, construction methods, building components and building systems
- provide an efficient and effective system for:

– issuing building and occupancy permits
– administering and enforcing related building and safety matters

- resolving building and plumbing disputes
- regulate building practitioners, building employees and plumbers
- regulate and enforce offences under the *Domestic Building Contracts Act 1995* in relation to demanding or receiving money under a major domestic building contract if the builder has not ensured that the domestic building work to be carried out under the contract is covered by domestic building insurance within the meaning of that Act
- regulate plumbing work and plumbing standards (including gas)[405]
- provide for accreditation, certification and authorisation of plumbing work, products and materials
- regulate cooling tower systems
- limit the periods within which building actions and plumbing actions may be brought.

Regulatory framework governing the building sector

The Building Act is supported by regulations which provide specific requirements for the various types of works conducted in the building industry. As such, there are two sets of regulations made under the Building Act – the Building Regulations 2018 and the Plumbing Regulations 2018.

Building Regulations 2018

The Building Regulations prescribe the standards for design, construction and use of buildings and places of public entertainment.

The objectives of the Building Regulations are to:

- remake with amendments the regulations which control the design, construction and use of buildings and places of public entertainment
- prescribe standards for the construction and demolition of buildings
- prescribe standards of safety for places of public entertainment
- regulate matters relating to the use and maintenance of buildings and places of public entertainment
- prescribe requirements for the design, siting and access requirements for single properties and associated buildings and for small second dwellings
- prescribe standards and matters relating to the maintenance of fire safety and safety measures
- prescribe requirements for swimming pools and spas including:

- swimming pool and spa safety
- registration of swimming pools and spas
- inspection of swimming pools and spas
- prescribing maximum fees relating to the registration of, lodgement of documents and information searches relating to swimming pools and spas

- provide for matters relating to the accreditation of building produces, construction methods, designs, components and systems connected with building work
- prescribe qualifications and provide for other matters relating to registration of building practitioners
- prescribe fees in relation to matters before the Building Appeals Board, the Authority and the Building Regulations Advisory Committee
- to provide for other matters for the purposes of the Building Act.

Plumbing Regulations 2018

The Plumbing Regulations came into effect on 18 November 2018 and prescribe the:

- scope of work for all classes of plumbing work and specialised plumbing work
- qualification and experience eligibility requirements for registration and licensing in each class of plumbing work and specialised plumbing work
- fees payable for registration and licensing applications and the price of a compliance certificate
- additional technical requirements with which work performed in specified classes of plumbing must comply, including some variations from the requirements in the Plumbing Code of Australia.

[405] Complex gas work is regulated by Energy Safe Victoria.

Only licensed gasfitters should undertake any installation, repair or renovations involving gas work in Victoria.[406] The Plumbing Regulations (co-regulated with ESV) define what constitutes gas-fitting work in Victoria and qualifications and experience requiring for licensing in gas-fitting work.

A.1.1.2 National Construction Code

The NCC combines both the building and plumbing construction requirements into a single code. The NCC is maintained by the Australian Building Codes Board (ABCB) which is a joint initiative of federal, state and local governments. It is a performance-based code and sets the minimum technical requirements for new construction work.

The NCC is updated every three years. NCC 2022 was adopted by all states and territories on 1 May 2023. It introduced minimum requirements for energy efficiency in new residential properties. Under the requirements, the minimum energy efficiency of new homes increases from 6 Stars to 7 Stars NatHERS equivalent. The standards also require new residential properties to meet a Whole of Home annual energy use budget. This budget can be met through "a flexible combination of type and efficiency rating of specific fixed appliances such as hot water, heating and cooling, lighting and pool and spa pumps, and through installing rooftop solar to offset energy usage".[407] Transitional arrangements in the Building Regulations have been introduced with changes coming into effect in Victoria from 1 May 2024.

The NCC consists of the Building Code of Australia (BCA) (Volumes One and Two), and the Plumbing Code of Australia (PCA) (Volume Three).

The BCA contains technical provisions for the design and construction of buildings and other structures throughout Australia. Volume 1 relates to Class 2 to 9 buildings while Volume 2 mainly relates to Class 1 and 10 buildings. The BCA is adopted by, and forms part of the Building Regulations (with modifications).[408]

The PCA sets out the technical provisions for design, construction, installation, replacement, repair, alteration, and maintenance of plumbing related work associated with all building classes. The PCA is adopted by, and forms part of the Plumbing Regulations.

Legislative and regulatory framework governing gas supply in Victoria

Gas Safety Act 1997

The *Gas Safety Act 1997* (Gas Safety Act) regulates the safety of gas supply and its usage in Victoria. It provides for the safe conveyance, sale, supply, measurement, control, and use of gas in Victoria, and regulates gas safety in Victoria. The Minister for Energy and Resources is responsible for the Gas Safety Act. The Act mandates standards for the design, installation, and maintenance of gas systems, ensuring that only qualified and licensed professionals undertake all gas-related work. The Gas Safety Act also encompasses consumer protection, with the requirement for all gas appliances sold and installed in Victoria to meet safety standards and be approved by relevant authorities.

The following regulations are made under the Gas Safety Act:

- **The Gas Safety (Gas Installation) Regulations 2018.** These Regulations provide for the standards for gas fitting work, procedures relating to the acceptance of appliances and gas installations, and provide for safety of gas appliances, gas installations and work on gas appliances and installations.
- **Gas Safety (Safety Case) Regulations 2018**. The Regulations provide for safety cases in relation to facilities, gas installations and appliances, the reporting of gas incidents, and prescribe safety standards for the quality of gas and testing of fossil gas conveyed through a transmission pipeline.

Agencies responsible for building and gas works in Victoria

The VBA, Energy Safe Victoria and the Essential Services Commission are three key agencies responsible for overseeing building and delivery of gas works in Victoria.

[406] Energy Safe Victoria (2024), Gasfitters. <https://www.esv.vic.gov.au/community-safety/working-tradespeople/gasfitters>
[407] Department of Energy, Environment and Climate Action (2023), Fact sheet for homebuyers: New home energy efficiency standards explained. <https://www.energy.vic.gov.au/__data/assets/pdf_file/0033/670299/7-star-new-home-standards-factsheets-home-buyers.pdf>
[408] These are Victorian specific modifications to the BCA. The modifications allow states and territories to vary or apply additional requirements specific to the jurisdiction. Any NCC provision can be overridden or modified by states/territories.

Victorian Building Authority

The VBA is the state's primary regulator for building and plumbing works. It enforces compliance with legislative requirements and building codes. The VBA undertakes the following functions:[409]

- overseeing practitioner capability through registration and licensing processes
- monitoring industry compliance with building and plumbing standards through proactive inspections and audits
- enforcing compliance with the regulatory system
- utilising intelligence and data gathered to improve the regulatory system
- using and sharing technical knowledge and expertise to improve the regulatory system and to support practitioners in delivering positive outcomes for consumers.

Energy Safe Victoria

ESV is the regulator responsible for the safe generation, supply and use of electricity, complex gas installations (type B), and pipelines in the state. They also regulate complex gas and electrical work and provide input into legislations and regulations relating to gas and electricity. The Gas Safety Act outlines ESV's objectives and functions. ESV undertakes the following functions:[410]

- license electrical workers in Victoria
- issue and audit Certificates of Electrical Safety
- ensure gas and electric appliances are approved and safe for use
- investigate gas and electrical incidents
- organise community education and safety awareness campaigns
- oversee major industry safety cases and safety management schemes for the design, construction and maintenance of electricity, gas and pipelines
- oversee bushfire mitigation programs and tree clearance around powerlines.

Essential Services Commission

ESC is the regulator for Victoria's energy, water, and transport sectors, and administers the rate-capping system for the local government sector. ESC regulates electricity generators, and gas and electricity distributors, retailers, and transmission services. ESC is also responsible for regulating the VEU program, which provides incentives for adopting energy efficiency upgrades (see section 3.1.4).

[409] Victorian Building Authority, Our Role. <https://www.vba.vic.gov.au/about/our-role>
[410] Energy Safe Victoria (2023), About Us. <https://www.esv.vic.gov.au/about-us>

Appendix B Non-regulatory options considered but not progressed

As part of the RIS process, it is necessary to consider different options that could achieve the Victorian Government's objectives. The *Subordinate Legislation Act 1994* requires a RIS to consider "other practicable means of achieving [the] objectives, including other regulatory as well as non-regulatory options". This includes consideration of a range of approaches, including co-regulation and non-regulatory approaches, and those that reduce the burden imposed on businesses and/or the community.

There were several types of options considered to achieve the objectives of the proposed regulations. These include:

- injecting renewable gases in the reticulated gas network
- encouraging voluntary electrification via
- information and educational campaigns
- mandatory disclosures.
- financial incentives.

While the options noted above are feasible, they are unlikely to completely address the problems and barriers discussed in Chapters 2 and 3. These are further discussed below.

Inject renewable gases into the reticulated gas network

Renewable gas has been promoted as an alternative to fossil gas. Renewable gas refers to biomethane or renewable hydrogen. Biomethane is produced when biogas, which is derived from anaerobic digestion of organic material such as plant and animal by-products, is upgraded to meet gas quality standards.[411] Renewable hydrogen can be produced by splitting water into hydrogen and oxygen using renewable electricity. Injecting renewable gases into the reticulated gas network for use by existing fossil gas users can be one alternative to the use of fossil gas. However, there are currently a number of barriers that make renewable gases non-viable as a large-scale alternative to fossil gas usage in residential properties and businesses.

Renewable gases are significantly more expensive than fossil gas. Previous analysis undertaken for the Roadmap has demonstrated that renewable hydrogen is the highest cost of the four main gas substitution options (electrification, energy efficiency, biomethane and hydrogen). Biomethane is lower cost than hydrogen but is considerably more expensive than electrification. According to one estimate, running electric appliances is four times cheaper than using biomethane and more than 10 times cheaper than using renewable hydrogen.[412]

Moreover, there is currently insufficient volumes of renewable gas available to fully substitute Victoria's gas need. Production is still primarily at the trial stages and commercial scalability is yet to be proven. Key challenges for production include:

- availability of feedstocks for biomethane production
- scalable technology for renewable hydrogen production, including dependence on available renewable electricity and water resources

Renewable gases will be required for many industrial gas users and for GPG, which provides support for the electricity grid. Given the challenges of producing renewable gases at scale, diverting available renewable gas to purposes where alternatives such as electrification are available can have implications for the energy security for other critical uses where electrification is not likely to be a feasible option (such as GPG and some industrial demand). The Victorian Government is working with industry to develop renewable gas alternatives for hard-to-abate industrial gas users.

[411] Department of Energy, Environment and Climate Action (2023), Victoria's renewable gas consultation paper. <https://engage.vic.gov.au/victorias-renewable-gas-consultation-paper>

[412] Department of Energy, Environment and Climate Action (2023), Gas Substitution Roadmap Update. <https://www.energy.vic.gov.au/__data/assets/pdf_file/0027/691119/Victorias-Gas-Substitution-Roadmap-Update.pdf>

Information and education campaigns

Information and education would allow building owners and developers to make more informed decisions about prospective properties, as well as help owners understand the potential benefits of replacing gas appliances with electric in their properties. Sustainability Victoria already run a range of informational campaigns to support greater knowledge around the benefits and costs of electrification to homeowners and businesses. This may address bounded rationality and information asymmetries that exist both in the residential and commercial sector. However, the program is not sufficient on its own to drive voluntary uptake at a rate that will meet Victoria's emission reduction requirements or prevent forecast gas shortfalls. The Victorian Government-owned State Electricity Commission (SEC) was introduced in 2023 to assist with accelerating Victoria's electrification through investment, electrification projects and public education on renewables. The SEC has also launched a free digital platform to support households in identifying suitable appliances and indicative costs and rebates available. The prevalence of externalities means that additional information is unlikely to completely increase electrification of residential and commercial buildings. Therefore, information and education campaigns are not likely to drive the pace of change required to meet Victoria's needs.

Mandatory disclosure for buildings

The mandatory disclosure of a property's energy rating or features would improve the quality of information in the property market. Disclosure of energy performance information could potentially address information asymmetry for some renters and buyers by providing information to assist them in choosing an appropriate property which meets their needs. It could also encourage rental providers and builders to improve their property to differentiate it from competitors and attract renters and buyers. As discussed in section 3.3.2, New South Wales has implemented the NSW Consumer Energy Strategy, which includes the mandatory disclosure of home energy performance ratings when properties are in the process of being sold and leased across the state. This is a voluntary program commencing in 2025.[413] . However, while mandatory disclosure can lead to energy efficiency improvements in buildings as a response to market demands, prescribing mandatory standards provides a clear approach which is more likely to achieve the minimum desired outcome. Furthermore, mandatory disclosure measures alone are unlikely to incentivise rapid fuel switching at a meaningful scale.

Energy Ministers across Australia agreed to a National Home Energy Ratings Disclosure Framework in 2023, with Version 1 of the framework released in July 2024.[414] When finalised, the framework will help inform future residential disclosure policy in Victoria.

For commercial properties, the CBD program sets the requirement for disclosure of energy efficiency information when commercial office space of 1,000 square metres or more is presented for sale or lease. This requirement only applies to office spaces, with other types of commercial buildings such as entertainment or retail buildings not currently covered. The Australian Government has recently announced a proposed expansion to the CBD program starting with a reduction to the floor area threshold for office buildings, as well as including hotels, shopping centres, data centres and public hospitals.[415] Consultation is currently underway to expand the CBD program to cover new building and ownership types.[416] As the CBD program is a national program, any further amendments to strengthen it would require a national response rather than a unilateral change in Victoria, adding time and complexity to the decision-making process. Therefore, Victorian-specific regulation would also be required to address the residual problem.

Financial incentives

Financial incentives may help address the gap between direct financial benefits and external benefits. Financial incentives, such as Solar Victoria rebates, Small-scale Technology Certificates, grants and loans and the VEU program can reduce the financial burden to building owners of replacing gas appliances with electric in their properties. However, there may be limitations where split incentives exist, primarily for tenanted buildings.

Where a financial incentive might be offered at less than or equal to cost, a building owner will still need to cover the remaining cost of upgrades at their own expense for the tenant (relevant to the electrification of cooking in residential rental properties and electrification of commercial rental properties). There is evidence in the literature that suggests that the

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[413] Department of Climate Change, Energy, the Environment and Water (2024), NSW Consumer Energy Strategy - Powering our people and communities. <https://www.energy.nsw.gov.au/sites/default/files/2024-09/NSW_Consumer_Energy_Strategy_2024.pdf>

[414] Department of Climate Change, Energy, the Environment and Water, Residential Buildings. <https://www.dcceew.gov.au/energy/energy-efficiency/buildings/residential-buildings#:~:text=Home%20energy%20efficiency%20disclosure,-Providing%20a%20home's&text=The%20final%20framework%20is%20expected,implement%20their%20own%20disclosure%20schemes.>

[415] Commercial Building Disclosure (2018), New Construction – Guidance Note. <https://www.cbd.gov.au/sites/default/files/2020-09/guidance_note_-_new_construction.pdf>

[416] Australian Government (2024), CBD Program expansion consultation. <https://www.cbd.gov.au/about-cbd-program/administration/cbd-program-expansion-consultation>

uptake of energy efficiency upgrades is lower in areas with a greater proportion of residential rental properties.[417] Rental providers will often only engage with the incentive program if it makes them better off – that is, if they can recover from renters any costs incurred.[418] Even if a financial incentive scheme covers the full cost of installation, building owners also have the logistical and administrative burden of organising the upgrades and may lose rental revenue if the property is uninhabitable while the upgrades are undertaken, and will likely be expected to maintain or replace installed appliances in the future, at their own cost. This would likely further decrease building owner's propensity to upgrade their properties in response to financial incentives. Furthermore, while financial incentives can help overcome the bounded rationality and financial barriers, they do not sufficiently help address the other barriers discussed in Chapter 32, such as information asymmetry and lack of accessible information.

Lastly, incentivising the scale of electrification required to address gas shortfalls and GHG emissions targets through financial incentives alone would impose a significant cost burden on the government. While financial incentives are useful support mechanism, particularly for low-income households, it is not a financially feasible option for the scale of change proposed. Despite increases in the uptake of existing electrification incentives, the uptake rate is not currently high enough to ensure Victoria meets its GHG emissions targets.

[417] Willand, N., Moore, T., Horne, R., & Robertson, S. (2020). Retrofit Poverty: Socioeconomic Spatial Disparities in Retrofit Subsidies Uptake. Buildings and Cities, 1(1), 14–35.
[418] Australian Housing and Urban Research Institute (2017), The Impact of Energy Efficiency Standards in the Victorian Private Rental Market.

Appendix C CBA parameters and sources

Table C.1: Key parameters for modelling

Parameters	Value	Source
Discount Rate	4%	*Economic Evaluation Guidelines, Victorian Department of Treasury and Finance, 2013*
Estimated retail electricity cost ($/kWh)	$0.27 in 2025 $0.29 in 2050	*Calculated by DEECA using wholesale prices from Endgame Economics (based on AEMO draft ISP Step Change model)*
Estimated retail gas cost ($/MJ)	$0.03 in 2025 $0.03 in 2050	*Calculated by DEECA using wholesale prices from* AEMO's 2023 Inputs Assumptions and Options Report Step change scenario
Greenhouse gas coefficient – electricity market	0.206 t/GJ in 2025 0.005 t/GJ in 2050	*Modelled by Endgame Economics using AEMO draft ISP Step Change model as basis*
Greenhouse gas coefficient – fossil gas	0.056 t/GJ (constant)	*National Greenhouse Accounts Factors, Department of Climate Change, Energy, the Environment and Water, 2023* *<https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-factors-2023>*
Carbon price per tonne	**2024** | **2025** | **2026** | **2027** | **2028** $106 | $112 | $118 | $124 | $130 **2029** | **2030** | **2031** | **2032** $135 | $141 | $154 | $167	*Intergovernmental Panel on Climate Change 6th Assessment Report, 2022 Carbon Price converted to AUD by DEECA*
Health cost of air pollution	Coal fired electricity: $15.88/MWh Gas fired electricity: $1.05/MWh	*Ward & Power, 2015* *Australian Technological Sciences and Engineering (ATSE), 2009*
Value of an hour of leisure time	$36	Regulatory Burden Measurement Framework, *Department of the Prime Minister and Cabinet, 2023*
Government cost to monitor and enforce	$656 per plumbing certificate audit	*Department of Transport and Planning*

Table C.2: Key modelling parameters for residential properties

Parameters	Value	Source
Total Class 1 owner-occupied properties in 2021	1,895,209	*ABS 2021 Census of Population and Housing in Australia*
Total Class 2 owner-occupied properties in 2021	205,556	*ABS 2021 Census of Population and Housing in Australia*
Average floor area - existing	**Class 1 – detached** Average floor area – 151 m^2 Conditioned area (room) – 45.3 m^2 Conditioned area (central) – 128.35 m^2 **Class 1 – semi-detached** Average floor area – 86m^2 Conditioned area (room) – 25.8 m^2 Conditioned area (central) – 73.1 m^2 **Class 2** Average floor area –75 m^2 Conditioned area (room) – 22.5 m^2 Conditioned area (central) – 63.75 m^2	*Housing Stock Model, developed by Energy Efficient Strategies for DEECA, 2019* *The Victorian Housing Stock Model provides a comprehensive representation of the energy efficiency-related aspects of the Victorian building stock.* *The model features a capacity to resolve housing stock down to:* - *the level of individual LGAs* - *each of the 13 NatHERS climate zones within Victoria.* - *three NCC classes* - *seven eras of significance (in terms of thermal performance)* - *a range of representative construction formats.*
Average floor area - new	**Class 1 – detached** Average floor area – 226.4 m^2 Conditioned area (room) – 67.92 m^2 Conditioned area (central) – 192.44 m^2 **Class 1 – semi-detached**	*ABS, Characteristics of new residential dwellings – a 15-year summary.* *<https://www.abs.gov.au/articles/characteristics-new-residential-dwellings-15-year-summary>*

	Average floor area – 144m^2 Conditioned area (room) – 43.2 m^2 Conditioned area (central) – 122.4 m^2 **Class 2** Average floor area –118.6 m^2 Conditioned area (room) – 35.58 m^2 Conditioned area (central) – 100.81 m^2	
Average NatHERS rating - New builds	Class 1 (detached) – 7 Stars Class 1 (semi-detached) – 7 Stars Class 2 – 7 Stars	*National Construction Code 2022*
Average NatHERS rating - Existing builds	Class 1 (detached) – 3 Stars Class 1 (semi-detached) – 4 Stars Class 2 – 4 Stars	*Housing Stock Model, developed by Energy Efficient Strategies for DEECA, 2019*
Projected housing growth rate	2023 – 2026: 1.90% p.a. 2027 – 2031: 1.74% p.a. 2032 – 2036: 1.67% p.a. 2037 – 2040: 1.60% p.a. 2041 – 2045: 1.50% p.a.	*Department of Transport and Planning, Victoria in Future*
Annual renovations	0.5 per cent p.a.	*DEECA analysis based on VBA data*
Annual demolitions	0.4 per cent p.a.	*DEECA analysis based on ABS data*
Asset lives – heating	Ducted gas: 14 years Room Gas: 14 years	*Victorian Energy Upgrades – gas appliances* *Energy Efficient Strategies Pty Ltd for electric appliances*

	Ducted RCACs: 12 years Multi-split RCACs: 12 years RCACs: 12 years	
Asset lives – hot water systems	Mains gas instantaneous: 14 years Mains gas storage: 14 years Solar gas: 12 years Solar electric boost: 12 years Electric instant: 12 years Heat pump: 12 years	*Provided by DEECA, based on:* • *Victorian Energy Upgrades Specifications 2018 – Version 15* • *Australian Building Codes Board, NCC 2022 Update Whole-of-Home Component V03* • *Oxford Economics Australia (2022)* • *Market research*
Asset lives – cooking	Gas ovens and cooktops: 14 years Electric ovens and cooktops: 12 years	*Multiple sources, including Oxford Economics Australia (2022) and market research*
Gas disconnection fee – Class 1 and Class 2 properties	$242	*AER, AER decision supports Victorian gas consumers in energy transition* *<https://www.aer.gov.au/news/articles/news-releases/aer-decision-supports-victorian-gas-consumers-energy-transition#:~:text=Ms%20Savage%20said%20the%20AER,haulage%20tariffs%20which%20are%20spread>*
Avoided gas network operational cost – Class 1 and Class 2 properties	$66 per disconnected property per annum	*Deloitte analysis of:* • *annual supply charges based on St Vincent de Paul Victoria Energy Price – Tariff Tracking report* • *proportion of costs of operating the gas network related to customer services based on AER 2023 Post-Tax Revenue Models (AGN, Multinet, AusNet)*
Cost of removing gas appliances	Gas ducted heating - $799 (Class 1), $491 (Class 2) Gas space heating - $132 (Class 1), $139 (Class 2)	*Based on Frontier Economics, Cost of switching from gas to electric appliances in the home, 2022* <https://gamaa.asn.au/wp-content/uploads/2022/07/Frontier-Economics-Report-GAMAA.pdf> *ABS 2023 – Monthly Consumer Price Index Indicator*

		Only costs of gas heater removal were included, as removal of gas hot water systems and gas cooktops would be required regardless of whether a gas or electric alternative is being installed.
Avoided gas network augmentation costs – Class 1 and Class 2 properties	$2,078	*Essential Services Commission*
Cost to cap gas appliances – Class 1 and Class 2 properties	$300	*ACT Government, Switching off your gas connection: what you need to know* *<https://energy.act.gov.au/wp-content/uploads/2023/06/Switching-off-your-gas-Fact-sheet.pdf>*
Cost of switchboard upgrade and supply connection upgrade	$4,700	*Frontier Economics, Cost of switching from gas to electric appliances in the home, 2022* *<https://gamaa.asn.au/wp-content/uploads/2022/07/Frontier-Economics-Report-GAMAA.pdf>* *The cost of the supply connection upgrade was calculated based on the average 'Power Supply Upgrade' cost (includes switchboard and street connection upgrades) for Archetype 1, minus the cost of the switchboard upgrade.Supported by Deloitte desktop analysis based on the following sources:* • Crowlz Electrical[419] • *Hipages*[420] • *All Ground Electrical*[421] • *Smillie Electrical Services*[422]
Proportion requiring capping – Class 1 and Class 2 properties	100%	*DEECA*
Proportion of properties requiring switchboard and supply upgrades	19% of owner-occupied properties 2.09% of residential rental properties[423]	*Solar Victoria – Home Heating and Cooling Program data*

[419] Crowlz Electrical, Residential Switchboard Repair and Upgrade Services.
[420] Hipages (2024), How much does it cost to replace a switchboard?
[421] All Ground Electrical (2023), How much does a switchboard upgrade cost? Understanding the investment.
[422] Smillie Electrical Services (2018), How much does it cost to upgrade your switchboard?
[423] This proportion was specifically applied to residential rental properties and was calculated as the percentage of total properties that require a switchboard and supply upgrade (19 per cent) multiplied by the proportion of residential rental properties that that were assumed to not be impacted by minimum energy efficiency rental standards (11 per cent).

Proportion of heating appliance replacements that would require removal of gas appliance (e.g. ductwork)	20%	*DEECA*
Voluntary uptake of electric appliances in existing properties	Heating: 0.825% p.a. Hot water: 2.25% p.a. Cooking: 1.25% p.a.	*Based on market and consumer research completed for DEECA by JWS Research (2021). To account for potential bias, the voluntary uptake assumptions were adjusted by a factor of 50 per cent to reflect that intention does not necessarily translate to action. Department of Environment, Land, Water and Planning Household energy preferences: Research report <https://engage.vic.gov.au/download/document/27749>*

Table C.3: Appliance propensity assumptions

	Class 1		Class 2		Source
	Existing properties	New properties[1]	Existing properties	New properties[1]	*Based on Oxford Economics Australia and 2021 Residential Energy Baseline Study data*
Heating					
Gas space heater 4.5 Stars	15.5%	10.0%	15.0%	10.0%	
Gas ducted	47.40%	53.6%	10.0%	0%	
Hot water					
Mains Gas Instantaneous (5.5 Stars)	40.6%	76.3%	30.0%	75.0%	
Mains Gas Storage (4.5 Stars)	28.7%	8.70%	20.0%	25.0%	
Solar gas boost	11.6%	15%	0%	0%	
Cooking					
Gas oven	20%	0%	20%	0%	
Gas cooktop	76%	100%	76%	100%	

Table C.4: Upgrade pathways from existing appliances to new appliances

These are reflective of expected upgrade pathways, based on current installation trends. Where applicable, multiple upgrade pathways were adopted to account for installation limitations (ie space constraints)

Existing Appliance	New Appliance Class 1	New Appliance Class 2
Heating		
Room gas	Room RCAC	Room RCAC
Ducted gas	Ducted RCAC (20%) Multi-split RCAC (50%) Non-ducted RCAC (30%) with additional RCAC in 3 rooms.	Non-ducted RCAC (100%) with additional RCAC in 2 rooms
Hot water		
Gas Storage	Heat Pump HWS	Heat Pump HWS
Gas Instant	Heat pump HWS (75%) Solar electric (25%)	Existing buildings: • Electric Instant (28%) • Heat pump (72%) New buildings: • Heat pump (100%)
Gas-Solar	Heat pump HWS (75%) Solar electric (25%)	Not applicable
Cooking		
Gas Cooktop	Induction cooktop	Induction cooktop
Gas Oven	Electric oven	Electric oven

Table C.5: Space heating appliance costs (capital expenditure and installation)

Appliance	Class 1 properties		Class 2 properties		Source
	Existing properties	New properties	Existing properties	New properties	
Ducted gas	$4,900	$5,658	$4,641	$4,876	*Provided by DEECA based on Energy Efficient Strategies (2022), Heater Model (developed by Energy Consult, 2019) and GHD (2022), All-electric new homes: Cost assessment*
Room gas	$2,504	$3,103	$2,257	$2,540	
Ducted RCAC	$10,667	$15,834	$6,004	$8,256	
Multi-split RCAC	$7,706	$11,094	$5,213	$6,788	
Room RCAC	$2,345	$3,666	$1,685	$2,167	

Table C.6: Water heating appliance costs (capital expenditure and installation)

Appliance	Class 1 properties	Class 2 properties	Source
Mains Gas Instantaneous	$2,658	$2,204	*Provided by DEECA based on Energy Efficiency Strategies, 2023*
Mains Gas Storage	$2,033	$1,809	
Solar Gas	$6,939	$6,050	
Electric Instant	NA	$2,210	
Solar Electric Boost	$6,204	$5,250	
Heat pump	$4,175	$3,870	

Table C.7: Cooking appliance costs (capital expenditure and installation)

Appliance	Class 1 properties	Class 2 properties	Source
Incremental cost to switch from gas to induction cooktop	$400	$400	*Grattan, Getting off gas, 2023*
Incremental cost to switch from gas to electric oven	$0	$0	*Note that gas ovens are typically more expensive than electric ovens. For the purposes of the CBA it was assumed that gas ovens are equivalent to an electric oven to be conservative. Alinta Energy < https://www.alintaenergy.com.au/help-and-support/energy-support-and-tips/the-difference-in-cost-between-gas-and-electric-ovens>*

Table C.8: Heating and cooling appliance gas usage (in MJ)

Appliance	Class 1 properties		Class 2 properties		Source
	Existing properties	New properties	Existing properties	New properties	
Ducted gas	31,103	14,692	13,427	8,277	*Provided by DEECA based on Heater Model (developed by Energy Consult, 2019)*
Room gas	11,953	4,978	5,109	2,670	

Table C.9: Heating and cooling appliance electricity usage (in kWh)

Appliance	Class 1 properties		Class 2 properties		Source
	Existing properties	New properties	Existing properties	New properties	*Provided by DEECA based on Heater Model (developed by Energy Consult, 2019)*
Ducted gas	379	379	326	326	
Room gas	54	54	54	54	
Ducted RCAC	1,836	867	793	489	
Multi-split RCAC	1,469	694	634	391	
RCAC	627	261	268	140	

Table C.10: Hot water system gas usage (in MJ)

Appliance	Class 1 properties	Class 2 properties	Source
Mains Gas Instantaneous	14,050	9,104	*Provided by DEECA based on Energy Efficiency Strategies, 2023*
Mains Gas Storage	17,723	13,585	
Solar Gas	4,523	2,623	

Table C.11: Hot water system electricity usage (in kWh)

Appliance	Class 1 properties	Class 2 properties	Source
Mains Gas Instantaneous	40	36	*Provided by DEECA based on Energy Efficiency Strategies, 2023*
Mains Gas Storage	-	-	
Solar Gas	52	48	
Electric Instant	-	2,224	
Solar Electric Boost	1,003	729	
Heat pump	1,190	993	

Table C.12: Cooking appliance gas usage (in MJ)

Appliance	Class 1 properties	Class 2 properties	Source
Gas cooktop	1,583	1,333	*Department of Climate Change, Energy, the Environment and Water, Nationwide House Energy Rating Scheme (NatHERS): NatHERS Whole of Home national calculations method, 2022* *<https://www.nathers.gov.au/sites/default/files/2023-06/WoH%20Calculation%20Method%20WIP%2020230609.pdf>*
Gas oven	1,682	1,417	

Table C.13: Cooking appliance electricity usage (in kWh)

Appliance	Class 1 properties	Class 2 properties	Source
Induction cooktop	196	165	*Department of Climate Change, Energy, the Environment and Water, Nationwide House Energy Rating Scheme (NatHERS): NatHERS Whole of Home national calculations method, 2022*
Electric oven	234	198	

Table C.14: Key modelling parameters for commercial buildings[424]

Parameters	Value	Source
Commercial properties by sqm in 2025	Short term accommodation buildings: 11,937,740 Offices: 45,000,057 Commercial buildings n.e.c.: 2,285,474.67 Entertainment and recreation buildings: 18,036,988.00 Hospitality: 1,291,692.50 Retail and wholesale trade buildings: 17,161,057.50 Warehouses: 35,869,952.00 Education buildings: 2,517,175.36 Religion buildings: 3,247,230.00 Aged care facilities (including nursing homes): 3,488,220.45 Health facilities: 1,573,089.39 Non-residential buildings n.e.c.: 6,221,717.00	*CBBS (2022)* *<https://www.dcceew.gov.au/energy/publications/commercial-building-baseline-study-2022>*
Number of commercial gas customers	50,923	*Gas Network Access Arrangements*
Average commercial building growth	1.03%	*CBBS (2022)*
Annual renovations and demolitions	0.68 per cent p.a.	*Centre for International Economics Decision Regulation Impact Statement (2018)*

[424] The costs for small buildings were estimated using the residential cost of an upgrade per MJ of gas taken out of the energy system in Victoria, under the assumption that smaller businesses are more likely to use residential gas appliances. The weighting of the commercial cost is based on the proportion of small and large businesses based on ABS Count of Australian Businesses.

		<https://www.thecie.com.au/s/Final_RIS_Energy_efficiency_of_commercial_buildings_PDF.pdf>
Asset lives – heating	Gas heating: 20 years Electric heating: 20 years	*D*eltaQ (2024), NCC 2025 Energy Efficiency – Advice on the technical basis – Electrification Report <https://www.abcb.gov.au/sites/default/files/resources/2024/REP01080-B-006-Electrification-Report.pdf>
Asset lives – hot water systems	Gas hot water systems: 20 years Electric hot water systems: 15 years	DeltaQ (2024), NCC 2025 Energy Efficiency – Advice on the technical basis – Electrification Report <https://www.abcb.gov.au/sites/default/files/resources/2024/REP01080-B-006-Electrification-Report.pdf>
Asset lives – cooking	Gas ovens and cooktops: 14 years Electric ovens and cooktops: 12 years	*Multiple sources including Oxford Economics Australia and market research*
Avoided gas augmentation costs	$19,052 per customer	*Essential Services Commission (2023)*

Table C.15: Voluntary uptake of electric appliances in existing commercial properties per annum

Building type	Heating	Hot water	Cooking	Source
Short-term accommodation buildings (Class 3)	1.05%	1.05%	1%	*Deloitte analysis of Energy Consumers Australia – Behaviour Survey Small Businesses*
Offices (Class 5)	0.55%	0.55%	1%	
Commercial buildings n.e.c. (Class 6)	0.23%	0.23%	0%	
Entertainment and recreation buildings (Class 9)	0.23%	0.23%	0%	
Hospitality (Class 6)	1.05%	1.05%	1%	
Retail and wholesale trade buildings (Class 6)	0.23%	0.23%	0%	
Warehouses (Class 7b)	0.15%	0.15%	0%	
Education buildings (Class 9)	0.35%	0.35%	0%	
Religion buildings (Class 9)	0.43%	0.43%	0%	
Aged care facilities (Class 9)	0.43%	0.43%	0%	
Health facilities (Class 9)	0.43%	0.43%	0%	
Non-residential buildings (Class 10)	0.00%	0.00%	0%	

Table C.16: Energy usage in commercial buildings (MJ/sqm)[425]

Energy use	Short-term accommodation buildings (Class 3)	Offices (Class 5)	Commercial buildings n.e.c. (Class 6)	Entertainment and recreation buildings (Class 9)	Hospitality (Class 6)	Retail and wholesale trade buildings (Class 6)	Warehouses (Class 7b)	Education buildings (class 9)	Religion buildings (Class 9)	Aged care facilities (Class 9)	Health facilities (Class 9)	Non-residential buildings n.e.c. (Class 10)
Heating												
Gas – new buildings	48.97	47.82	29.56	39.11	61.35	61.35	14.86	15.29	22.67	95.70	75.94	0.00
Gas– existing buildings	94.17	91.96	56.85	75.21	117.99	117.99	28.57	29.40	43.59	184.04	184.04	0.00
Electricity use post upgrade – new buildings	13.82	13.50	8.34	11.04	17.31	17.31	4.19	4.31	6.40	27.01	21.43	0.00
Electricity use post upgrade – existing buildings	26.57	25.95	16.04	21.22	33.30	33.30	8.06	8.30	12.30	51.93	41.21	0.00
Hot water systems												
Gas	101.80	27.45	22.74	30.08	45.38	45.38	11.11	8.98	13.32	60.47	96.38	-
Electricity use post upgrade	40.72	21.96	18.19	24.07	36.30	36.30	8.39	7.19	10.66	24.19	38.55	0.00
Cooking - commercial kitchen												
Gas	55.99	19.22	1.62	2.15	233.36	1.95	0.00	2.45	3.63	18.40	52.57	0.00
Electricity use post upgrade	30.80	10.57	0.89	1.18	128.35	1.07	0.00	1.35	2.00	10.12	28.92	0.00

Note: The data in this table was based on CBBS data that accounted for an average energy use across all commercial buildings in each sector, including those that did not use gas. As a result, the megajoule per square meter figures included in this table are likely to be lower than the than the energy use per square meter for buildings that use gas.

[425] The data in this table was based on CBBS data that accounted for an average energy use across all commercial buildings in each sector, including those that did not use gas. As a result, the megajoule per square meter figures included in this table are likely to be lower than the than the energy use per square meter for buildings that use gas.

Table C.17: Proportion of small to large buildings used in heating and hot water analysis

Building type	Small %	Large %	Source
Short term accommodation buildings	53%	47%	Due to limited data available, assumption derived from ABS Counts of Australian Businesses, including Entries and Exits, June 2019 to June 2023
Offices	45%	55%	
Commercial buildings n.e.c.	58%	42%	
Entertainment and recreation buildings	56%	44%	
Hospitality	53%	47%	
Retail and wholesale trade buildings	58%	42%	
Warehouses	63%	37%	
Education buildings	49%	51%	
Religion buildings	49%	51%	
Aged care facilities (including nursing homes)	50%	50%	
Health facilities	56%	44%	
Non-residential buildings n.e.c.	-	-	

Table C.18: Proportion of cooking related energy use that is attributable to commercial kitchen appliances and non-commercial kitchen appliances in each building class

Building type	Proportion of gas use attributable to commercial kitchen appliances	Proportion of gas use attributable to non-commercial kitchen appliances	Source
Short term accommodation buildings	97%	3%	Due to limited data available, assumption was derived based on data that indicates a standard residential kitchen uses less than 0.5 per cent of annual gas required by a commercial kitchen. Therefore, it was assumed that gas for cooking in the commercial sector is primarily driven by commercial kitchens rather than non-commercial kitchens. For residential cooking appliance gas usage see Table C.12. For commercial cooking appliance gas usage see Green Building Council Australia (2022), A practical guide to electrification for existing buildings. <https://gbca-web.s3.amazonaws.com/media/documents/electrification-guide---existing-buildings-final.pdf>
Offices	99%	1%	
Commercial buildings n.e.c.	97%	3%	
Entertainment and recreation buildings	97%	3%	
Hospitality	100%	0%	
Retail and wholesale trade buildings	97%	3%	
Warehouses	0%	0%	
Education buildings	100%	0%	
Religion buildings	95%	5%	
Aged care facilities (including nursing homes)	100%	0%	
Health facilities	100%	0%	
Non-residential buildings n.e.c.	-	-	

Table C.19: Estimated capital cost to upgrade heating in large commercial building archetypes ($ per building)

Heating	Climate zone	Avoided base cost for gas mechanical plant	Electrification cost of mechanical plant	Plant room and deck cost	Electrical cost	Source
Large office - new building	Zone 4	$329,476	$862,362	$97,847	$54,535	DeltaQ (2024), NCC 2025 Energy Efficiency – Advice on the technical basis – Electrification Report < https://www.abcb.gov.au/sites/default/files/resources/2024/REP01080-B-006-Electrification-Report.pdf> Note that lifecycle replacement costs reported by DeltaQ were excluded as these represent future replacement costs to continue the life of the electrical assets for 50 years, beyond the assumed life of appliance assets in this CBA (see Table C.14). The CBA modelling only accounts for benefits or costs over the standard asset life of the asset and does not account for future replacement beyond the analysis period as outlined in section 5.1.2.
	Zone 6	$313,598	$738,679	$92,619	$49,701	
	Zone 7	$342,149	$961,080	$102,021	$71,871	
Large office - existing building	Zone 4	$0	$1,116,922	$97,847	$390,132	
	Zone 6	$0	$1,153,078	$92,619	$377,531	
	Zone 7	$0	$1,310,361	$102,021	$406,352	
Hospital - new building	Zone 4	$377,706	$807,241	$54,667	$0	
	Zone 6	$353,367	$725,529	$51,901	$0	
	Zone 7	$396,637	$870,796	$0	$0	
Hospital - existing building	Zone 4	$0	$1,745,046	$109,333	$0	
	Zone 6	$0	$1,496,562	$103,801	$0	
	Zone 7	$0	$1,938,312	$113,749	$0	

Table C.20: Estimated capital cost to upgrade hot water in large commercial building archetypes ($ per building)

Hot water	Climate zone	Avoided base cost for gas mechanical plant	Electrification cost of mechanical plant	Plant room and deck cost	Electrical cost	Source
Large office - new building	Zone 4	$26,120	$131,118	$15,280	$22,578	DeltaQ (2024), NCC 2025 Energy Efficiency – Advice on the technical basis – Electrification Report < https://www.abcb.gov.au/sites/default/files/resources/2024/REP01080-B-006-Electrification-Report.pdf> Note that lifecycle replacement costs reported by DeltaQ were excluded as these represent future replacement costs to continue the life of the electrical assets for 50 years, beyond the assumed life of appliance assets in this CBA (see Table C.14). The CBA modelling only accounts for benefits or costs over the standard asset life of the asset and does not account for future replacement beyond the analysis period as outlined in section 5.1.2.
	Zone 6	$26,120	$131,118	$15,280	$22,578	
	Zone 7	$26,120	$131,118	$15,280	$22,578	
Large office - existing building	Zone 4	$0	$159,708	$15,280	$27,851	
	Zone 6	$0	$159,708	$15,280	$27,851	
	Zone 7	$0	$159,708	$15,280	$27,851	
Hospital - new building	Zone 4	$60,064	$330,948	$33,904	$94,044	
	Zone 6	$60,064	$330,948	$33,904	$94,044	
	Zone 7	$60,064	$330,948	$33,904	$94,044	
Hospital - existing building	Zone 4	$0	$404,837	$33,904	$381,257	
	Zone 6	$0	$404,837	$33,904	$381,257	
	Zone 7	$0	$404,837	$33,904	$381,257	
Aged care - new building	Zone 4	$31,394	$206,425	$22,334	$84,423	
	Zone 6	$31,394	$206,425	$22,334	$84,423	
	Zone 7	$31,394	$206,425	$22,334	$84,423	
Aged care - existing building	Zone 4	$0	$231,268	$22,334	$359,750	
	Zone 6	$0	$231,268	$22,334	$359,750	
	Zone 7	$0	$231,268	$22,334	$359,750	

Table C.21: Estimated capital cost to switch a new commercial kitchen from gas to electric

Appliance type	Avoided gas capital cost	Cost of electric alternative	Source
Cooktop	$3,199	$6,500	Building Council Australia (2022), A practical guide to electrification for existing buildings. <https://gbca-web.s3.amazonaws.com/media/documents/electrification-guide---existing-buildings-final.pdf>
Deep fryer	$3,220	$2,000	
Griddle/ chargrill	$4,789	$10,970	

Table C.22: Estimated factor for avoided capital cost of cooling appliances, $ avoided per large building

	Avoided cost per building	Source
Large office building	$377,235	DeltaQ (2024), NCC 2025 Energy Efficiency – Advice on the technical basis – Electrification Report < https://www.abcb.gov.au/sites/default/files/resources/2024/REP01080-B-006-Electrification-Report.pdf> Due to limited data available the avoided cooling appliance capital cost was based on the one-off future replacement cost of a cooling appliance in climate zone 5 for each building archetype.
Large hospital building	$268,380	

Table C.23: Building level cost assumptions for commercial businesses

Parameters	Value	Source
Average cost of avoided gas piping per large building	$21,000 per building	*Deloitte analysis based on Group14 Engineering (2020), Electrification of Commercial and Residential Buildings and New Buildings Institute (2022) Cost Study of the Building Decarbonisation Code*
Avoided gas network operational cost for commercial business	$157 per annum	*Deloitte analysis of:* • *annual supply charges based on St Vincent de Paul Victoria Energy Price – Tariff Tracking report* • *proportion of costs of operating the gas network related to customer services based on AER 2023 Post-Tax Revenue Models (AGN, Multinet, AusNet)*
Average gas network connection cost for new commercial business	$19,052 per connection	*Essential Services Commission (2023), Reviewing the Gas Distribution System Code of Practice*
Average hourly wage for building manager and caretaker	$37.50 per hour	*ABS Salary data*

C.2 Avoided capital expenditure on cooling appliances methodology

The average avoided capital expenditure on cooling appliances in the residential sector was provided by DEECA and is stepped out below for new and existing properties.

New residential properties

1. The proportion of cooling appliances used with different gas heaters in new Class 1 and Class 2 properties is based on the NCC 2022 Update Whole of Home Component. These proportions were multiplied by the cost of cooling appliances based on data from Energy Efficient Strategies[426] as shown in Table C.28.
2. The proportion of different cooling appliances with both gas central (ducted) and gas space (room) heaters were summed together, with these proportions then extrapolated to 100 per cent to account for the total portion of residential properties with gas ducted or gas space heaters. This is shown for Class 1 in Table C.24
3. For properties with room gas heating, it was assumed that they would just have a single RCAC unit (i.e., in the living room) if they used this system for cooling.
4. For properties with ducted gas, the number of room RCAC units installed was based on data from Oxford Economics Australia. For new properties, a higher proportion of 2 or more units (x1.5) than one (x0.5) was assumed. The opposite was assumed for existing properties.

Table C.24: Total proportion of cooling appliances combined with gas heaters in new Class 1 properties (NCC 2022)

	Room RCACs	Evaporative	No cooling	Total
Ducted Gas	64.38%	26.48%	9.14%	100%
Gas Space	87.43%	0%	12.57%	100%

Existing residential properties

The proportion of cooling appliances combined with different gas heaters in existing Class 1 and Class 2 properties is shown in Table C.25 below. These proportions were multiplied by the cost of cooling appliances to develop the avoided cost of cooler.

1. Proportions of existing residential properties with different cooling appliances were taken from multiple sources, including Oxford Economics Australia and the JWS Research report "Household energy preferences: Research report". A simple average was then taken for each cooling appliance based on the different sources, as shown in Table D.3 below. These final proportions were then multiplied by the total number of owner-occupied properties in Victoria (2,100,765) to obtain the total appliance pool, with this appliance pool then scaled down marginally to account for the presence of other heaters not in the analysis (i.e., plug in, hydronic).
2. The total number of cooling appliances were then matched against the total number of gas heating appliances (same proportions of gas heaters as per CBA) to develop the final percentages, as shown in Table C.26 below. In matching the number of cooling appliances to heaters, the following assumptions were made:

- the total pool of evaporative cooling appliances was applied to Class 1residential properties with gas ducted heating
- the total pool of room cooling systems and no cooling was split evenly across all heating and building types
- the remaining heating appliances for each building class were then attributed an RCAC system for cooling.

[426] Energy Efficient Strategies Pty Ltd (2022), Options analysis paper for minimum energy efficiency standards for rented premises.

Table C.25: Adopted cooling appliance proportions to calculate avoided capital expenditure on cooling appliances in existing residential properties.

Cooling appliance	Existing Class 1 - ducted gas	Existing Class 1 - room gas	Existing Class 2 - ducted gas	Existing Class 2 - room gas
Evaporative cooling	32.1%	0.0%	0.0%	0.0%
Room cooling	14.4%	14.4%	14.4%	14.4%
Room RCAC	41.5%	73.6%	73.6%	73.6%
None	12.0%	12.0%	12.0%	12.0%

Source: DEECA

Table C.26: Proportions of cooling appliances in Victorian residential properties.

Appliance	Combined proportion	Total appliances in Victorian owner-occupied homes	Adjusted No. of appliances
Evaporative cooling	**14.5%**	304,611	288,486
Room RCAC	**59%**	1,239,451	1,173,840
Cooling only	*31.5%*	*661,741*	*626,711*
Heating and cooling	*27.5%*	*577,710*	*547.129*
Room cooling	**9%**	189,069	179,061
None	***7.5%***	157,557	149,217

Source: DEECA

Table C.27: Total number of cooling appliances by number of gas heating appliances by appliance type and Class

	Heaters	Evaporative	RCAC	Cooling only	None
Class 1 gas ducted	898,329	288,486	372,684	129,359	107,799
Class 1 gas space	293,757	0	216,205	42,301	35,251
Class 2 gas ducted	20,556	0	15,129	2,960	2,467
Class 2 gas space	30,833	0	22,693	4,440	3,700
Total	1,243,475	288,486	626,712	179,061	149,217

Capital costs of cooling appliances

Table C.28: Cost of cooling appliances

	Class 1 (new)	Class 1 (existing)	Class 2 (new)	Class 2 (existing)	Source
Evaporative cooler cost	$5,542	$5,217	$4,546	$4,324	EES Options Analysis (2023)
Room cooling (assumed same as room RCAC)	$3,103	$2,345	$2,167	$1,685	EES Options Analysis (2023)
One RCAC	$3,103	$2,345	$2,167	$1,685	EES Options Analysis (2023)
Two RCACs	$4,548	$3,790	$3,612	$3,130	EES Options Analysis (2023)
Multiple RCACs(assumed same as multi-split heat pumps)	$11,094	$7,706	$6,788	$5,213	Calculated – assumed cost of multiple room RCACs plus additional install cost based on floor area

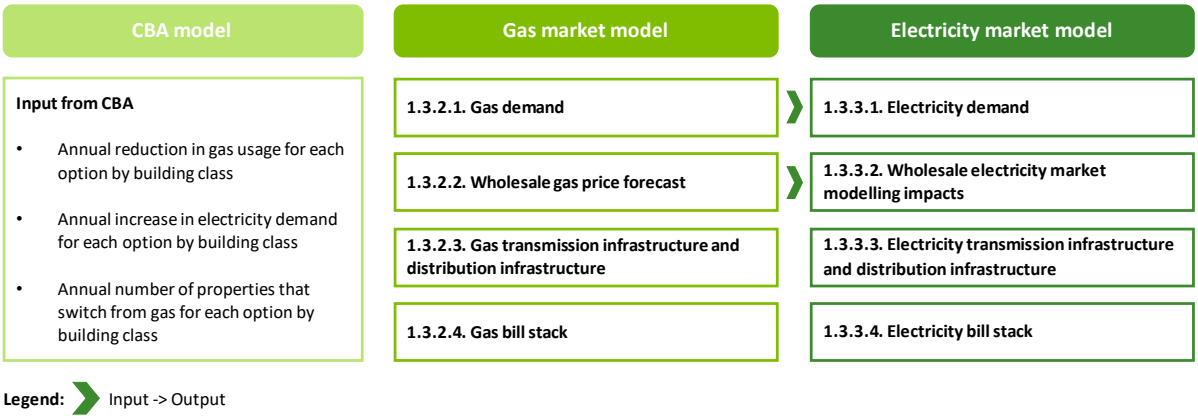
Appendix D Energy market modelling methodology

The following section summarises the methodology used to assess how key components of the gas and electricity markets have been impacted as a result of the options.

0 demonstrates the key components and process undertaken for gas and electricity market analysis and was developed in conjunction with the Department. Key outcomes of the energy market modelling relevant to the assessment of options are summarised in Chapter 7.

Energy market modelling was conducted for a 20-year analysis period from 2026 to 2045 over which the regulations apply (see section 5.1.2). This is to understand the implications of the regulations to achieving the Victorian Government's net-zero target by 2045.Note that impacts are modelled to 2050 as it was assumed that the switch to electric is sustained after the end of the regulations in 2045 to understand ongoing implications of electrification on the energy market.

Figure D.1: Modelling process



Gas methodology

Gas consumption

The incremental change in annual gas consumption for each of the regulatory options is based on method and assumptions undertaken in the CBA. This process involved estimating change in gas demand at the appliance level for each Building Class, resulting in demand segments more granular than AEMO modelling.

Current (2024) residential and commercial gas consumption was based on the 2023 AEMO Step Change scenario. Projected Base Case residential and commercial gas consumption was adjusted to account for the proposed electrification of hot water and heating in residential rental properties, the electrification of government buildings through other policy proposals being considered and voluntary uptake.

Wholesale gas price forecast

Wholesale gas price modelling was based on AEMO's latest gas price forecasts for input into the Draft 2024 Integrated System Plan (ISP).[427]

The Melbourne "Step Change" wholesale gas price was adjusted to reflect change in gas consumption under the Base Case and regulatory options. The sensitivity of gas prices to changes in demand was based on AEMO's ISP 2022 IASR.[428]

[427] ACIL Allen (2023), Natural gas price forecasts for the Final 2023 IASR and for the 2024 GSOO. <https://aemo.com.au/-/media/files/major-publications/isp/2023/iasr-supporting-material/acil-allen-natural-gas-price-forecasts.pdf>
[428] Lewis Grey Advisory (2021), Gas Price Projections for Eastern Australia Gas Market 2022. <https://aemo.com.au/-/media/files/major-publications/isp/2022/iasr/lewis-grey-advisory-gas-price-projections-report.pdf>

The total southern states demand was adopted from AEMO GSOO 2023 "Step Change" forecasts for TAS, NSW, VIC, and SA, with the Victorian residential and commercial gas consumption replaced by the forecast consumption associated with the CBA options. The price adjustments were calculated using the difference between the southern states demand for each option (including the Base Case) and "Step Change". These wholesale prices were converted to prices for each Victorian gas-powered electricity generator (GPG) using additional location-based charges.[429]

Wholesale gas prices, as modelled, represent annual wholesale contract prices, and consequently do not generally account for potential short periods of volatility in the spot gas market.

Gas transmission network

Costs recovered by gas transmission network providers and distribution network providers are regulated by the AER, who approve tariffs and revenue in published Access Arrangements in five-year cycles. The network providers may recover annual costs that fall into five categories in the building block model: return on capital, return of capital (regulatory depreciation), tax, operating expenditure, and revenue adjustments.

Victoria's Victorian Transmission System (VTS) is a transmission pipeline network wholly owned by APA Group and operated by AEMO.[430] The annual cost of operating the pipeline is assumed for the purposes of the modelling to not change as a result of the regulatory options on the basis that the network is needed to be maintained to supply industrial users, GPG, or provide carriage for gas production/storage sites.

The total transmission cost was divided by projected gas volume to estimate the transmission price component of the total retail gas tariff in cents per MJ of gas. The volume of gas supplied through the transmission network is made up of demand from residential, commercial, industrial, and GPG. Projected residential and commercial gas consumption under Base Case and regulatory options was based on volumes calculated in the distribution network model, detailed further in section E.1.4. Projected GPG gas consumption varies between Base Case and regulatory options as increasing electricity consumption requires more GPG. Projected GPG under Base Case and regulatory options is an output of the electricity market model. Electricity market model method and assumptions are detailed in section 0. Industrial gas consumption is based on AEMO's GSOO Step Change Scenario.

Gas distribution network

The annual cost of gas distribution was projected for Base Case and regulatory options using a simplified building block model, in line with the AER's regulatory framework for Victorian gas companies. A simplified building block model was developed to estimate the total revenue requirement across the three gas distribution companies (AusNet, Australian Gas Networks, Multinet), key cost components modelled are return on capital, operating and maintenance expenditure, and depreciation.

Key inputs of distribution cost were adopted from the post-tax revenue models for each distribution network service provider (DNSP), or otherwise from supporting information in Access Arrangement proposals or final decisions,[431] namely:

- existing RAB and depreciation schedule, used as a starting point to determine return on capital and depreciation
- annual capital expenditure, added to the RAB and used to calculate further return on capital and depreciation. Capital expenditure was scaled based on:
  - total number of customers
  - total pipeline kilometres (assumed constant in all options)
  - capital expenditure per new customers (only relevant for Base Case)
- annual operating expenditure assumed to be recovered in the year of spend, calculated by categorising and scaling operating expenditure based on either:
  - total number of customers; or
  - total pipeline kilometres (assumed constant in all options)

[429] ACIL Allen (2023), Natural gas price forecasts for the Final 2023 IASR and for the 2024 GSOO. <https://aemo.com.au/-/media/files/major-publications/isp/2023/iasr-supporting-material/acil-allen-natural-gas-price-forecasts.pdf>
[430] Note: The Eastern gas pipeline and the Seagas pipeline also operate within Victoria, providing interstate transmission. These are non-scheme pipelines exempt from Access Arrangements. These pipelines are also linked more closely to interstate markets and thus excluded from this analysis.
[431] Australian Energy Regulator (AER), Access arrangements. <https://www.aer.gov.au/industry/registers/access-arrangements>

- an additional operating expenditure calculation was included to account for the cost of small customer abolishment, which was calculated using a cost per disconnection as approved by the AER (note: this is exclusive of the $220 charged to the consumer, and is recovered across the entire customer base)
- Base Case customer numbers were based on existing number of gas connections and business as usual disconnection rates for each DNSP. These were then adjusted based on the proportion of additional disconnections as a result of regulatory options.

Costs from 2024 to 2028 were assumed committed as agreed in the latest access arrangements, with the model beginning to forecast costs from 2029 onwards. Similarly, to transmission, the total annual cost of distribution network was divided by the total gas volume supplied through distribution to estimate the price per MJ of gas as a component of the retail bill.

The average consumption for existing properties is split between the three appliance types as a percentage, in line with usage assumptions in the CBA. Each component is then reduced based on the expected replacement rate (product lifetime) of the appliances and the proportion of properties in which the appliances are installed.

Projected customer numbers (based on projected disconnections detailed in section 5.2.1.1 and 5.2.2.1) were applied to the average gas consumption per customer to develop a projection of total gas consumption for each gas network under the Base Case and proposed options. This was used to estimate the per MJ transmission and distribution network tariff impact based on a bottom-up build using publicly available AER information. The NEM has a different structure to the gas market, and the electricity impacts were modelled using the AEMO Step Change scenario via an optimised PLEXOS model. Where there were common inputs to gas and electricity market modelling, these were consistently adopted.

Assumptions and limitations

Noting significant uncertainty regarding the approach to gas network cost recovery under the options, several assumptions were made to estimate gas distribution cost and price impacts.

It was assumed there are no new residential or commercial customer connections in Option 1, 2 or 3 and no new residential customer connections in Option 4. Pipeline kilometres are assumed to remain constant over time (i.e., additional augmentation stops after the end of the current Access Arrangement period).

Some capital expenditure linked to pipeline maintenance or replacement is incurred every year of the model and is depreciated over its total asset life. This represents an implicit assumption that the distribution network (and regulatory cost recovery mechanism) continues to be commercially viable indefinitely, which is likely not true once customer connections drop to a certain point (a so-called 'tipping point').

Abolishment of gas connections is included as a cost item linked to number of disconnections in a given year. Costs associated with theoretical decommissioning of parts of the network are excluded due to lack of publicly available planning guidance and resources and costings, and ongoing uncertainty around how network costs may be allocated in future. Noting this uncertainty, the assumption that no costs are incurred for the decommissioning of network assets is based on current policy and regulatory settings, however this may not be economically feasible in the long-term. Further study, policy analysis and costing of a different regulatory framework would be required to understand how costs of decommissioning could impact the outcome of the policy options under consideration.

Depreciation of the existing RAB occurs as calculated in the latest Access Arrangements. Depreciation of new capital expenditure occurs via straight-line depreciation and does not account for any potential changes in allowed cost recovery of the regulated asset base such as any additional accelerated depreciation.

The approach to projecting disconnection assumes buildings only upgrade appliances once required at end of life. It is possible that some buildings may choose to electrify some appliances earlier, at the same time as other appliances that have reached end of life, and therefore disconnect from the gas network earlier. This would accelerate the disconnection of gas customers and accelerate the gas tariff impacts associated with disconnection.

Gas tariff impact

The underlying gas retail tariff was calculated from the modelled wholesale, transmission, and distribution components described in sections 0 to 0. The retail component of the gas tariff was estimated based on the Oakley Greenwood 2017 Gas Price Trends Review and assumed to stay unchanged over time or between options.

The projected change in total retail gas price was estimated across all customer types and did not distinguish between residential, commercial, or industrial customers. This assumed that fixed costs (such as network infrastructure) would be spread across all gas customers in line with their respective volume of energy consumption.

Electricity methodology

Electricity (operational) demand

Electricity (operational) demand was required in half-hour intervals (or 'traces') for input into Deloitte's Electricity Market Model (DEMM). The DEMM, in-line with AEMOs published Draft 2024 ISP model, utilised PLEXOS as a techno-economic modelling tool to simulate operation of the National Electricity Market (NEM). The model is a bottom-up representation of NEM considering existing, committed, anticipated and future assets as well as state and federal government policies. Section 0 below details the typical modelling approach and scope inclusions for the modelling conducted within this report.

The wholesale electricity demand (in 30-minute increments) for the Base Case and regulatory options were developed using AEMO's draft 2024 ISP Step Change 30-minute demand traces and adjusted based on CBA annual gas usage and DEECA-provided 60-minute gas usage data.[432]

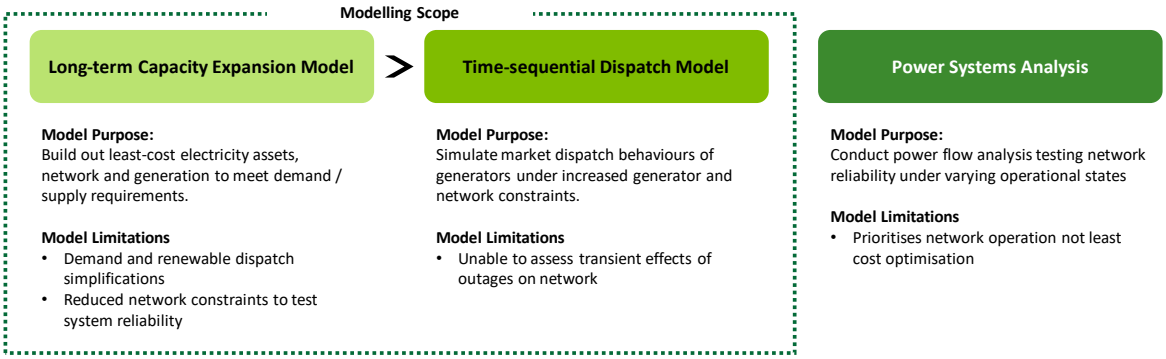
Wholesale electricity market modelling impacts

Wholesale electricity prices were modelled in PLEXOS using inputs from AEMO draft 2024 ISP[433], supplemented with project specific inputs (e.g., 30-minute electricity demand and wholesale gas prices specific to Base Case and regulatory options). The model considered:

- installed generation capacity
- fuel generation mix
- increased in gas powered generation (GPG)
- wholesale electricity price trends and volatility.

The wholesale electricity market modelling scope is explained in Figure D.2 below. The electricity infrastructure requirements (generation, storage, and transmission capacity) for the Base Case and regulatory options were modelled using long-term capacity expansion modelling using PLEXOS. This was then supplemented by conducting of time-sequential dispatch modelling to simulate the dispatch behaviours of generators and estimate impact on wholesale electricity prices.

Figure D.2: Wholesale electricity market modelling scope



Source: Deloitte. Note: This modelling approach does not include power systems analysis to determine network reliability requirements.

Long-term capacity expansion models were designed to develop a least-cost investment pathways on the network and generation assets that allows meeting current and future demand, while also adhering to technical limitations and

[432] The incremental annual electricity consumption was scaled to incremental 30-minute segments across the year based on the estimated 60-minute gas usage profile by appliance type, season and sector. The estimated 60-minute gas usage profile was provided by DEECA based on data from Victorian gas distribution network service providers. This incremental 30-minute electricity demand was then added to AEMO Step Change 30-minute demand traces.

[433] AEMO (2023), Draft 2024 ISP data files and demand trace data. < https://aemo.com.au/consultations/current-and-closed-consultations/draft-2024-isp-consultation>

constraints of assets and the network. That is, the NEM-wide model assesses operation and investment in generation, storage, and transmission over the modelled horizon, identifying key development areas.[434]

The time-sequential dispatch model factored in the bidding behaviour of market participants across the NEM. It was used to augment the generation and transmission outlook developed under the long-term capacity expansion model by imposing operational constraints on generators and transmission lines, while also optimising electricity dispatch for every half-hourly interval and produce wholesale prices.

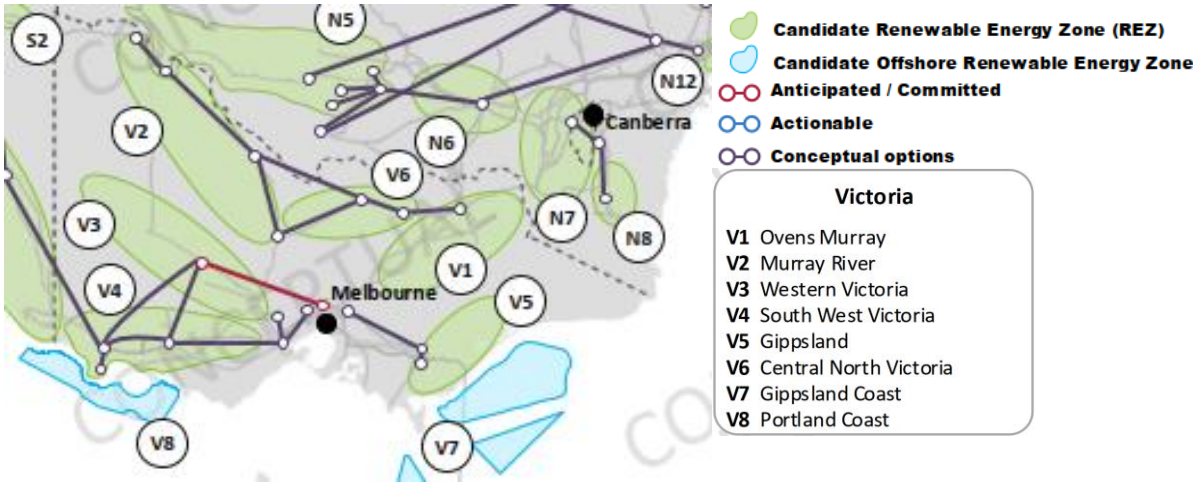
Key input data such as coal and base gas retirement forecasts, carbon budgets, weather forecasts for hydro inflows, existing and announced generators within the NEM and asset build costs were aligned with AEMO's Draft ISP2024[435] Step Change scenario as agreed with DEECA, except for operational demand and gas prices which were updated based on the requirements of this study described above.

Electricity transmission and distribution infrastructure

Electricity transmission was modelled using PLEXOS-produced network capacity requirements and AEMO's 2023 Transmission Expansion Options Report (note that this informs the development of the Draft 2024 ISP).

PLEXOS' long-term capacity expansion model also considers transmission network expansion requirements relating to the transfer capacity of REZs and the interconnections between regions. To inform the development of the Draft 2024 ISP, AEMO also published the 2023 Transmission Expansion Options Report which outlines transmission expansion 'options' (henceforth referred to as 'projects'). These projects consist of either flow path augmentation projects between regions (i.e., upgrades to transmission infrastructure linking Victoria to Southern New South Wales) or REZ expansion projects (i.e., upgrades to transmission infrastructure connecting REZs to load centres and the broader network). For each of these projects, AEMO has considered conceptual design, lead time, location, network capacity enabled and cost estimates. Figure D.3 Figure D.3 provides an overview of Victoria's transmission expansion projects included within the Draft 2024 ISP.

Figure D.3: AEMO's 2023 transmission expansion projects



Source: AEMO

A combination of these projects was used within the Draft 2024 ISP to define the ODP[436], which outlines actionable projects to meet future (forecast) load requirements. Aligned with AEMO's Draft 2024 ISP "Step Change" scenario, the ODP was utilised as a key input to the DEMM, which was then subsequently stress-tested to determine if it would sufficiently support

[434] The model operates with perfect foresight in relation to least-cost capacity expansion planning to meet forecasted demand. Feasibility of infrastructure build out such as build rates of electricity assets, labor availability, availability of connection points, supply chain constraints and other potential factors would require further consideration.

[435] AEMO (2024), Draft 2024 Integrated System Plan. <https://aemo.com.au/consultations/current-and-closed-consultations/draft-2024-isp-consultation>

[436] The specific ODP defined by AEMO can be found within the following document: AEMO (2023), Appendix 5. Network Investments (Appendix to the Draft 2024 Integrated System Plan for the National Electricity Market). <https://aemo.com.au/consultations/current-and-closed-consultations/draft-2024-isp-consultation>

future transfer capacity requirements across the Base Case and the regulatory options. For the Base Case and regulatory options:

- when the ODP was sufficient, it was assumed that transmission augmentation would align with the ODP.
- when the ODP was not sufficient in delivering the forecasted demand, alternative combinations of AEMO-defined transmission projects were selected to meet the augmentation requirements.
- when combinations of AEMO-defined transmission projects were not sufficient, then hypothetical 500 kV (3,000 MW) double circuit lines were implemented to meet the augmentation requirements. Assumptions for the hypothetical 500 kV lines have been sourced from the Draft 2024 ISP "Green Energy Export" scenario.

Electricity distribution was modelled using the Base Case and regulatory options' peak demand and the augmentation unit rates[437,438] published within the connection policies of each of the five Victorian electricity Distributed Network Service Providers (DNSPs).[439] These augmentation unit rates represent the estimated average cost of augmentation per unit of capacity (usually expressed in $/kVA or $/MVA), as a result of network augmentation (i.e., network costs incurred as a result of new or altered connections). A weighted average was then calculated across each of the DNSPs based on estimated customer numbers.[440]

These augmentation unit rates were then multiplied by the average power factor in Victoria,[441] which enables a conversion from KVA (or MVA) to KW (or MW). This resulted in a $/MW value for the augmentation unit rate applied to the incremental peak demand above existing network capacity. It was assumed that Victoria has at least 10.4 GW of network capacity and would require augmentation only when peak demand exceeds 10.4 GW.[442] The annual incremental increase in peak demand was then multiplied against the average augmentation unit rate to estimate the total required distribution investment, which was then compared to the Base Case to identify the magnitude of investment required for all regulatory options.

This approach was developed in conjunction with DEECA for this scope of work. This modelling approach does not include techno-economic modelling of the electricity distribution network or power systems analysis to determine network reliability requirements. Hence the incremental distribution investment required is high-level and directional. Detailed analysis of network and pricing impacts requires further dedicated modelling and studies, including engagement with transmission and distribution networks.

Electricity tariff impact

The electricity tariff impact contains the following components:

- wholesale electricity prices
- network costs (which includes both transmission and distribution costs)
- retail costs (which includes both retail operating costs and margin)
- environmental costs.

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[437] These augmentation unit rates are averaged across the networks managed by the DNSPs and typically reflect the cost of 'deep' network augmentation only. Many factors impact the cost of augmentation which may not be fully considered and/or reflected in this approach. Such factors include location of connection, the type of augmentation required (i.e., single vs. three phase power) and the level of connection required by customers. Further analysis that considers the results of current electrification trials run by DNSPs, as well as the other factors listed would help to ensure such analysis is more robust in future and hence the result of this analysis should be treated as high level and indicative only.

[438] Where multiple augmentation unit rates were listed by a DNSP for the same customer segment (i.e., discounted unit rate vs. discounted cumulative unit rate), the upper value was used to identify the upper bound of estimated distribution costs.

[439] CitiPower, Powercor and United Energy provided updated values upon request in the form of an undiscounted network augmentation charge (NAC) rate in FY 2024 dollars. These have been assumed to be an average across customer segments.

[440] AER (2023), Annual Benchmarking Report: Electricity distribution network service providers. <https://www.aer.gov.au/industry/registers/resources/reviews/annual-benchmarking-reports-2023>

[441] Essential Services Commission (2020), Electricity Distribution Code review – Technical standards. <https://www.esc.vic.gov.au/sites/default/files/documents/Electricity%20Distribution%20Code%20-%20Technical%20review%20-%20Final%20decision%20paper.pdf>

[442] AEMO (2024), Quarterly Energy Dynamics Q1 2024. <https://aemo.com.au/-/media/files/major-publications/qed/2024/qed-q1-2024.pdf?la=en>. Figure 11 noted that, between 1998 to 2024, Victoria experienced its maximum operational demand in 2009. AEMO's Aggregated Price and Demand Data – Historical for Vic – 2009 – Jan, Feb and Mar confirm Victoria has network capacity of at least 10,415 MW (the maximum 30-minute operational demand experienced on 29/01/2009 12:30:00 PM). <https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/data-nem/aggregated-data>

These components were informed by the Essential Services Commission's Victorian Default Offer 2023-24 report.[443]

The high-level impact of each of the regulatory options, relative to the Base Case relating to the electricity tariff impact was developed based on modelled increases in wholesale electricity prices and network costs in conjunction with increasing customer numbers across the time horizon.

Wholesale electricity prices have been forecasted using DEMM in line with the time-sequential dispatch model for each 30-minute interval across the modelling horizon. The price across each interval was then utilised to calculate a volume weighted average annual wholesale electricity price to inform the tariff impact.

Network costs are comprised of both transmission and distribution costs. To estimate the relative change of each regulatory option compared to the Base Case, the differing levels of investment in transmission and distribution cost were compared at selected sample years.

Retail and environmental costs were based on existing reported margins[444] on the assumption their proportionate costs will not change as a result of the regulatory options proposed. To the extent future margins change it will have a corresponding impact on the analysis presented.

For the purpose of analysis, GST and other minor components (i.e., market intervention costs, market operator fees, ancillary fees etc.) have all been excluded as these would stay relatively stable across all options. The analysis was focused on understanding the relative differences between options to inform decision making.

Interpretation and limitations

All analysis is based on average industry assumptions and scenario-specific inputs are developed in conjunction with DEECA. The intention of these scenario analysis is to assist DEECA to help identify the impacts of proposed requirements for electrification of residential and commercial buildings. The outcome of this must be interpreted in relation to this purpose, where the insights provided cannot be directly transferred to other studies without appropriate due diligence and further consideration.

While we believe all analysis to be a reasonable assessment of prospective trends based on agreed scenarios and current inputs, these projections will not aim to provide an exact picture of future due to:

- great uncertainty in the electricity and gas market and factors outside of Deloitte control such as policy and legislative changes, market forces and global decarbonisation trajectories
- simplifications required in order to reasonably model outcomes for the purpose of the analysis as outlined above.

Analyses are not representations as to future matters but rather indicate possible outcomes based on possible circumstances and currently available public information. The projections reflect various assumptions concerning anticipated matters and are subject to significant uncertainties and contingencies, all of which are difficult to predict. Therefore, the projections do not constitute, and should not be regarded as, a representation that the relevant results will actually be achieved or that the underlying assumptions are true.

[443] Essential Services Commission (2023), Victorian Default Offer 2023-24: final decision. <https://www.esc.vic.gov.au/media-centre/victorian-default-offer-2023-24-final-decision>
[444] Essential Services Commission (2023), Victorian Default Offer 2023-24

Appendix E CGE modelling

The following section summarises the methodology used to undertake CGE modelling for the purpose of assessing broader economic impacts of the options.

Computable General Equilibrium modelling

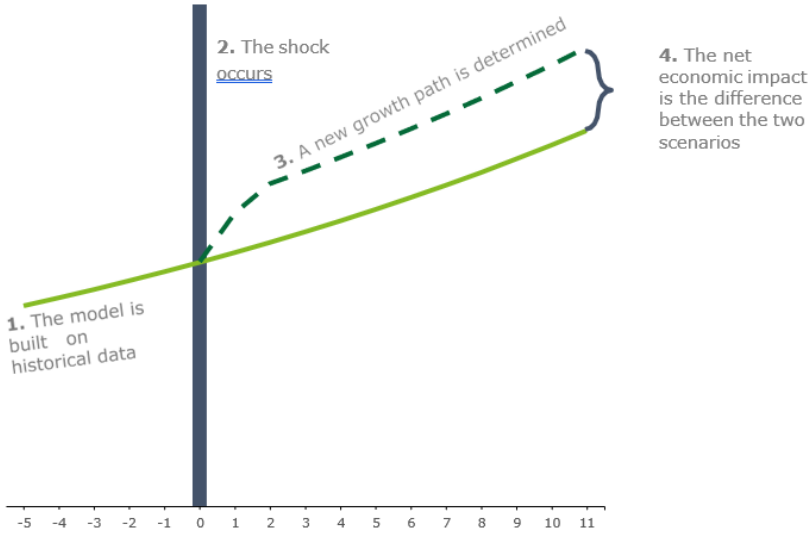
The modelling has used Deloitte Access Economics' in-house CGE modelling capability. CGE models incorporate the following assumptions:

- resource constraints (the use of labour or capital by one activity or industry comes at the expense of its use elsewhere)
- the possibility of changes in the mix of inputs used in production due to changes in relative prices or technology
- the responsiveness of prices and other variables to policy changes affecting such things as tariffs on imported goods, budgetary support to industry, industry productivity and workforce participation.

Because of these assumptions, CGE models enable estimation of impacts across the entire economy and allow for second-round impacts — where agents respond to changes in price signals. Other economic modelling techniques (such as input output modelling) are unable to address the above assumptions and therefore can produce inflated results of economic impacts.

CGE models estimate economic impacts by comparing a regulatory option against a baseline. The baseline scenario is built off historical data with the economy growing as per 'business as usual (Chart .526961Figure E.1). Here the baseline presents what would be expected to happen if the Victorian economy were to continue under 'business as usual'.

Figure E.1: Stylised representation of economic impact modelling using a CGE framework

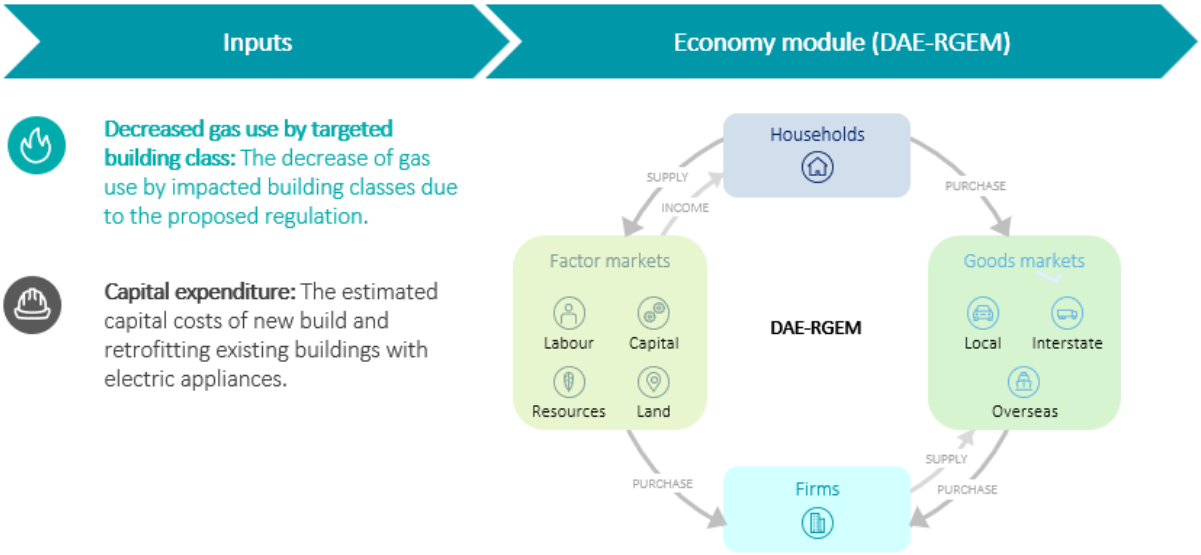


Source: Deloitte Access Economics.

Data on an issue, project or policy in focus is then introduced into the model (2). This enters the model as a shock to the economy and represents change to the baseline. CGE models then solve for the market-clearing (equilibrium) levels of demand and supply across all specified goods and factor markets in the economy. This effectively creates a new path for the economy over time (3). This new path is typically referred to as the regulatory option. Comparing this new policy path to that of the baseline (where the change does not occur), shows the economic impact of the shock (4).

The shocks in this modelling include the expected decrease in fossil gas use from impacted building classes across Victoria, and the anticipated capital expenditure required to install electric appliances in new builds and retrofitting existing buildings with these appliances. The righthand side of Figure D.2 is a stylised diagram showing the circular flow of income and spending that occurs in the CGE model. To meet demand for products, firms purchase inputs from other producers and hire factors of production (labour and capital). Producers pay wages and rent (factor income) which accrue to households. Households spend their income on goods and services, pay taxes and put some away for savings. The government uses tax revenue to purchase goods and services, while savings are used by investors to buy capital goods to facilitate future consumption. As the CGE model is an open economy model, it also includes trade flows with other regions, interstate and foreign countries.

Figure D.2: Components of DAE-RGEM and their relationships



Source: Deloitte Access Economics.

Modelling inputs

The core economic data underpinning the CGE model is sourced from the Global Trade and Analysis Project (GTAP) database.[445] Inputs from GTAP are used to set up the underlying economic relationships between sectors and regions in the model used for this analysis. GTAP is a global database representing the world economy for a given reference year. Several inputs including data from national input-output tables, trade flows, macroeconomic indicators, emissions and trade barriers are used to represent the world economy and to characterise economic linkages among regions and inter-sectoral linkages within regions. Data from GTAP provides the 'business-as-usual' baseline for the CGE modelling. In addition to GTAP data, baseline emissions data (i.e., Victoria's projected emissions trajectory in absence of the proposed policy) was provided by DEECA and no additional assumptions have been made to Victoria's anticipated reductions in the baseline.

For the CGE modelling of the policy scenarios, the following inputs were incorporated:

- estimates of fossil gas demand reducing in line with assumptions and modelling undertaken in the CBA
- estimates of capital expenditure for installing electric appliances in new and existing buildings in line with assumptions and modelling undertaken in the CBA.

These inputs were used to lower the demand for fossil gas and to reflect the required construction costs for households and businesses who will be impacted by the regulatory option. The model then solves for changes in demand for other goods, such as electricity, endogenously (demand for electricity is calculated within the CGE model as a function of several equations and external variables).

[445] Global Trade Analysis Project, *GTAP Data Bases: GTAP 9 Data Base Final Release 1 Release Candidate 1 Regions* <https://www.gtap.agecon.purdue.edu/databases/regions.aspx?version=9.211>

In this modelling exercise, the impacted building classes are spread across three sectors represented in the CGE model's database: Services, Government Services and Trade. Information mapping each building class to the relevant GTAP sector is provided in D.2.2.1.1.1.Table E.1. These sectors capture the following industries in the representative economy:

- services: includes industries such as communication, financial services, insurance, real estate activities, business services, communication, recreational and other services, human health and social worth activities and properties.
- government services: includes education, public administration and defence.
- trade: includes accommodation, food and service activities, and trade
    - construction: includes construction of buildings, civil engineering (which includes utility projects) and specialised construction activities such as electrical, plumbing, heat and air-conditioning and other construction installation activities.

Assumptions and limitations

CGE modelling is underpinned by several assumptions that limit the interpretation of the results.

While CGE models do have various constraints built into the model (a limit to the amount of goods, land, workers, capital etc., that can be drawn upon), these constraints may not necessarily reflect the market for certain products. For instance, the construction sector (which experiences higher activity under the regulatory options) incorporates workers and materials across a wide range of areas, including electrical and plumbing work. The exact appliances to be installed under the regulatory options form one part of the construction sector, and the capability for the sector to produce these specific appliances is dependent on availability of suitable components and labour. The model also assumes that the production function (how much time, materials and labour is needed to manufacture appliances) for each appliance in the construction sector is relatively similar.

This modelling approach is a dynamic representation of the Victorian economy and has a limited amount of labour which can be allocated to different sectors or activities. No additional labour market constraints (i.e., specific skills shortages in Victoria) have been incorporated into this model beyond what exists in the current underlying database.

In response to an increase in capital expenditure for a particular sector and region, labour will typically flow into this sector and region (from either the pool of unemployed people, workers from other sectors within the region, or from workers outside of the region). Typically, the demand for labour generated by a regulatory option is often unable to be met by workers within the local region. Therefore, some amount of crowding out (the movement of labour from other regions or sectors) will occur. The ways in which labour flows between region and sector is determined by a series of equations within the model and are representative of the substitutability of labour at a sectoral level. The model assumes that skills are transferable within the construction sector (i.e., it was assumed that plumbers do not require any extra training or qualifications for appliance installation and retrofitting). If a regulatory option requires expansion of a niche sub-sector within the model (with specific skills and experience requirements), the modelling will assume that the labour make-up of that sub-sector is equivalent to that of the broader sector. There are no additional assumptions around specific skills required for the proposed electrification.

The behavioural parameters in the model (such as those influencing the fossil gas use from other sectors that are not directly targeted by the proposed regulation) are sourced from GTAP, and no further behavioural constraints of Victorian fossil gas users have been incorporated into the modelling.

Fossil gas supply in the model is assumed to remain constant and does not follow AEMO projections. Furthermore, the model assumes a smoothed phasing out of coal power plants in Victoria. The increase in electricity from households and businesses impacted by the regulatory options is solved endogenously (within) in the model. The model contains a series of equations and parameters which represent the equilibrium level of demand and supply for all goods in the economy. When one or more variables are shocked (e.g. a reduction in gas demand or increase in construction activity is imposed), these equations will determine the new level of equilibrium demand and supply in the economy. These equations accommodate several factors such as price, supply and substitutability between goods.

As agents substitute away from fossil gas towards electricity, there is an increase in dirty electricity (electricity generated by fossil fuels) as well as clean electricity (renewable electricity), as there are no additional constraints or shocks introduced into the model which would target clean electricity specifically. The model does have a declining share of dirty electricity over time, but as there are no additional targets for renewables introduced, these may differ from the energy mix in reality.

Sector definitions

This section contains the definitions of the sectors modelled. D.2.2.1.1.1.Table E.1 provides a concordance between these sectors and the impacted building classes.

Table E.1: Concordance of building class and sectors modelled in the CGE

Building Class	Description	Modelled GTAP Sector	Required to electrify?
Class 1	Domestic or residential buildings that are either single standalone houses or horizontally attached houses such as terrace houses, row houses or townhouses. Class 1 has two sub-classes: • Class 1a: Single properties such as a detached house, or a part of attached properties such as rowhouses or townhouses • Class 1b: boarding house, guest house or hostel with a floor area of less than 300 m2.	Services (includes households)	Yes, however the costs and benefits of electrifying government owned and operated housing are being considered through other policy proposals but will not be exempt from regulations.
Class 2	Domestic apartment buildings where people live above, below or beside each other.	Services (includes households)	Yes, however the costs and benefits of electrifying government owned and operated housing are being considered through other policy proposals but will not be exempt from regulations.
Class 3	Residential buildings other than Class 1 and Class 2 buildings that provide long-term or transient accommodation for a number of unrelated people such as hotels and student accommodation.	Services (includes households)	Yes
Class 4	Sole properties or premises within a non-residential property such as a caretaker's residence in a storage facility.	Services (includes households)	Yes, excluding existing commercial kitchens for the purposes of the CBA.
Class 5	Office buildings for professional and/or commercial purposes.	Services (includes households)	Yes

Building Class	Description	Modelled GTAP Sector	Required to electrify?
Class 6	Buildings where retail goods and services are provided to the public such as a shopping centre, hairdressing salon.	Trade	Yes
Class 7	Class 7a: Carparks Class 7b: Warehouses, storage buildings or displaying wholesale goods.	Trade	Class 7a excluded. Class 7b only.
Class 9	Class 9a: Healthcare buildings (such as hospitals, day surgery clinics) Class 9b: Buildings where people assemble for social, political, theatrical, religious or civic purposes such as schools, universities and sports facilities. Class 9c: Aged care facilities	Class 9a: Services Class 9b: Government services Class 9c: Services	Yes, however only costs and benefits of privately owned facilities such as private hospitals and private schools were in scope for this CBA. Publicly owned Class 9 buildings are to be considered through other policy proposals but will not be exempt from regulations.
Class 10	Non-habitable structures. There are three sub-classifications: • Class 10a: sheds, carports and private garages • Class 10b: fences, masts, antennas, retaining wall, swimming pools Class 10c: private bushfire shelter.	Not modelled	Class 10a and 10b only. Class 10c excluded. Gas use in Class 10a buildings is anticipated to be immaterial and was not modelled in the CBA.