GRATTAN
Institute

Bills down, emissions down

A practical path to net-zero electricity

Alison Reeve, Tony Wood, Dominic Jones, and Ben Jefferson

October 2025

Overview

Without a constraint on electricity emissions, Australia will find it difficult to meet its emissions reduction targets. Left to its own devices, the electricity sector will continue to decarbonise, but not fast enough.

Expanding the Safeguard Mechanism – a federal government policy which already constrains greenhouse gas emissions from big industry – to the electricity sector could solve this problem.

This need not mean a big jump in household energy bills. Household bills are already on track to halve by 2050 as more people move away from using petrol and gas, and constraining electricity emissions in the way we recommend would shave that saving only slightly.

Our modelling finds that, with no policy change, the average annual household energy bill (including petrol, electricity, and gas) in 2050 would be about $2,900 – down from about $5,800 today.

With a binding policy to reduce electricity emissions in line with the national target of net-zero emissions, the average household energy bill in 2050 would be about $3,000. Emissions reduction targets would be met, and households would still be about $2,800 better off than they are today.

For too long, governments in Australia have avoided pricing carbon because the trade-off is higher electricity prices. But this assumption is becoming outdated, because the world has changed since Australia last debated carbon pricing.

Renewable power has grown from 11 per cent of total electricity generation in 2008 to 36 per cent in 2024. The cost of wind power has fallen by 25 per cent, and the cost of solar by 88 per cent. Batteries and storage have become realities. Coal plants have been closing without the lights going out, and most remaining coal-fired power stations are scheduled to close in the next decade or so. Carbon markets have matured. Many of Australia's most important trading partners are acting to reduce emissions, and using trade policies to ensure no unfair advantage accrues to countries that don't price carbon. And the benefits to households of the energy transition are now clear.

The Safeguard Mechanism is already constraining emissions in the industrial and transport sector, so it would be a natural choice to use it in the electricity sector. It may require some modifications, but no wholesale redesign. It also has a good chance of maintaining bipartisan support, because it was introduced by the former Coalition government and has been reformed to reduce emissions by the incumbent Labor government. And it would make upcoming essential reforms to the National Electricity Market more effective.

The Safeguard will be reviewed next year. The federal government should use that review to analyse the benefits and costs of activating the Safeguard in the electricity sector. In the meantime, all governments should increase efforts to ensure all households can get the benefits of electrification.

Introducing a carbon constraint into the electricity sector would increase Australia's chances of finding the least-cost road to net zero, and could be done without hurting households. This report shows how.

Recommendations

1. The federal government should begin designing and consulting on policies to constrain emissions in the electricity sector from 2030, to complement measures recommended by the National Electricity Market review, and to keep costs low for consumers.
2. The federal government should focus on extending the Safeguard Mechanism into the electricity sector, and it should test the effect on the wider economy via the planned review of the Safeguard Mechanism in 2026-27.
    - This should include considering the impact on other Safeguard facilities, the supply of Safeguard Mechanism Credits, appropriate thresholds for participation, and treatment of new entrants.
3. Federal and state governments should maintain and extend programs to ensure that the benefits of electrification are available to all households.
    - Ensure renters, low-income households, and multi-unit dwellings have access to rooftop solar, batteries, electric vehicles, and all-electric appliances.
4. Federal and state governments should continue reforms to make planning approvals for transmission faster and easier, and build social licence in host communities.

Table of contents

1 Australia needs a policy to constrain electricity sector emissions

Australia's future prosperity depends on action to reduce greenhouse gas emissions, to lessen the worst effects of climate change. No sector is immune from these effects, and all sectors have a role to play in cutting emissions and achieving net-zero[1] emissions by 2050.

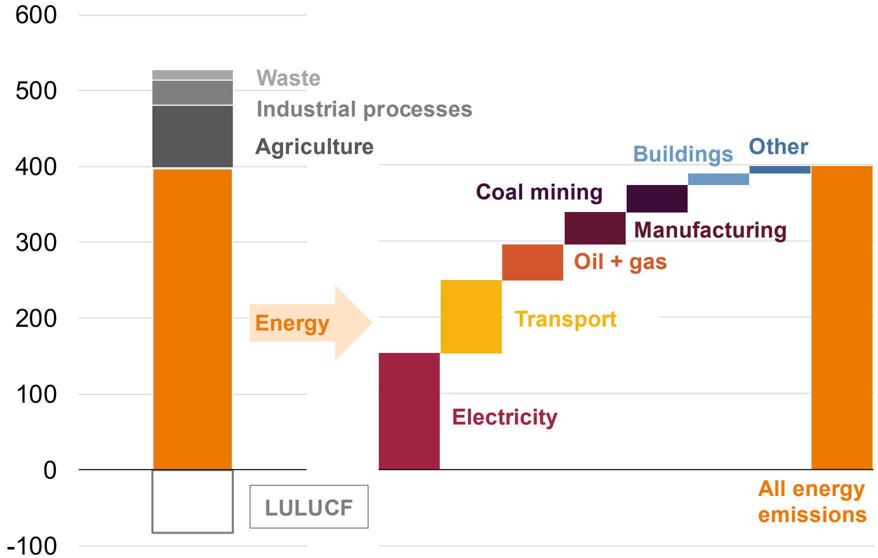
Most of Australia's emissions come from the production and use of energy, and most energy emissions come from electricity (fig. 1.1. Electricity use is expected to grow over coming decades because electrification is the pathway to decarbonisation for other fuel users, particularly transport, household gas use, and parts of the industrial sector. Compared to other sectors, electricity has more, lower cost, options to decarbonise, and it makes sense to ensure these are exploited to achieve emissions targets.

The task is to decarbonise the electricity sector while maintaining reliability of supply at affordable prices. The Renewable Energy Target and the Capacity Investment Scheme will contribute to lower emissions but both policies will be gone by 2030. The Safeguard Mechanism does not currently apply to electricity in a meaningful way and the proposals emerging from the review of the National Electricity Market will not deliver a direct constraint on emissions.

Without effective carbon policy in the electricity sector post-2030, emissions will stay too high for too long. It is time to reopen the conversation about constraining carbon in the electricity sector, ideally through a carbon price.

Figure 1.1: Most of Australia's emissions come from energy, and most energy emissions come from electricity

Emissions ($MtCO_2$-e in 2023)



Notes: $MtCO_2$-e = millions of tonnes of carbon dioxide-equivalent. 'LULUCF' = land use, land-use change, and forestry. 'Oil + gas' includes oil and gas extraction, processing, refining, and delivery. 'Buildings' includes all stationary fuel combustion emissions in the commercial and residential sectors. 'Other' includes stationary fuel combustion emissions from manufacture of solid fuels, agriculture, forestry, fishing, and military activities; and fugitive energy emissions not associated with oil, gas, and coal production.

Source: Grattan analysis of DCCEEW (2023).

---

[1] 'Net zero' refers to a state where all sources of emissions are balanced by 'sinks' that remove emissions from the atmosphere. Achieving this by the middle of the century is the defining goal of the Paris Agreement, and is essential to stabilise the global climate.

1.1 Energy production and use are Australia's largest sources of emissions

Producing and consuming energy generates 90 per cent of Australia's net greenhouse gas emissions, and 75 per cent of gross emissions (Figure 1.1 on the previous page).[2] Electricity production is the largest source of energy emissions, at 34 per cent of net emissions and 29 per cent of gross emissions (Figure 1.1 on the preceding page).

Australian governments have chosen to take a sector-by-sector approach to emissions reductions. Even so, 73 per cent of Australia's gross emissions do not have an effective constraint (Figure 1.2). And electricity is the most significant of these.

1.2 Reducing emissions from transport, industry, and households will drive growth in electricity consumption

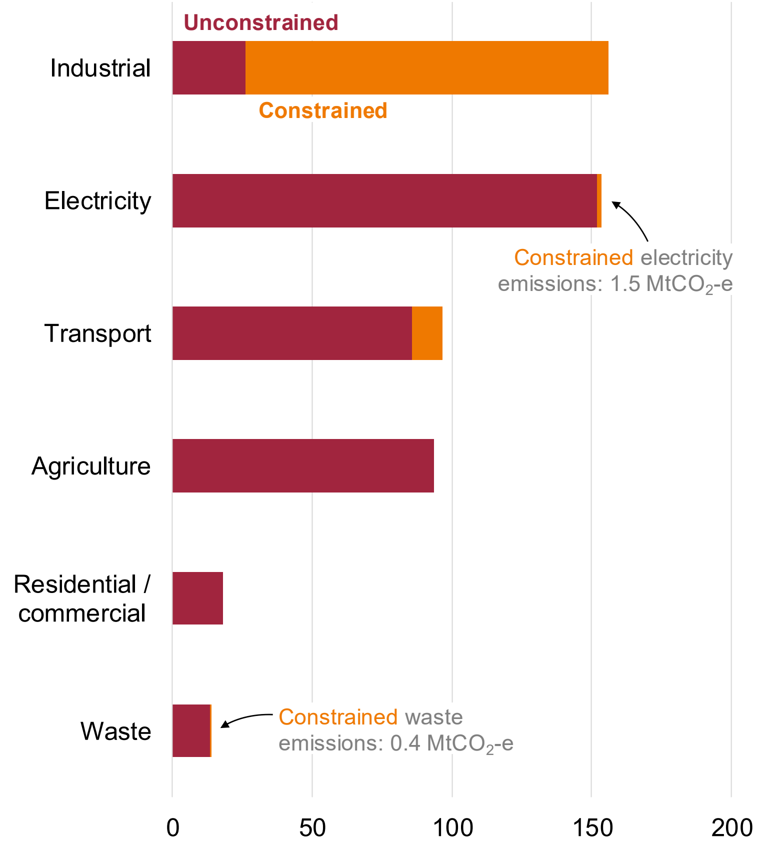
The primary solution to reaching net zero in many sectors of the economy is to switch from using coal, oil, and gas to using electricity. In the transport sector, this switch is already happening as more consumers choose electric cars over petrol and diesel cars. And more households are choosing to upgrade from gas appliances to efficient electric ones,[3] a decision that is also in their economic best interests.[4]

Demand for electricity will therefore increase in the coming decades as it substitutes for other fuels (Figure 1.3 on the following page).

For the electricity system to reach net zero while demand is growing, the emissions intensity of electricity production must fall faster each year than demand increases. If the expected demand growth shown

Figure 1.2: Most of Australia's emissions are not subject to an effective regulatory constraint

Emissions ($MtCO_2$-e)



Notes: $MtCO_2$-e = millions of tonnes of carbon dioxide-equivalent. Land sector and military emissions not shown.

Source: Grattan analysis of DCCEEW (2023), CER (2025), and BITRE (2023).

---

[2] Figures refer to 2023, the most recent year for which inventory data is available. Grattan analysis of DCCEEW (2023). Net emissions includes abatement from the land sector; gross emissions does not.

[3] AEMO (2024b).

[4] Wood et al (2023).

in Figure 1.3 occurred at the present emissions intensity, there would be an additional 55 $MtCO_2$-e of emissions from electricity across NSW, Victoria, Queensland, South Australia, and Tasmania in 2050.[5]

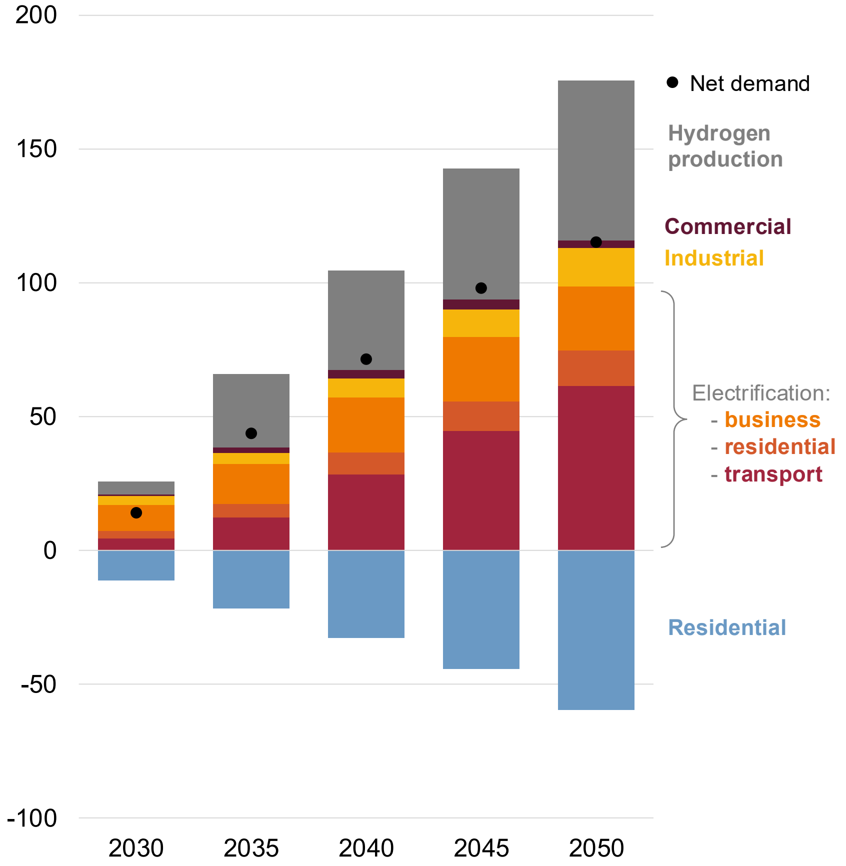
1.3 There are likely to be some residual emissions from electricity production in 2050

Credible models of the electricity system show that a 100 per cent renewables electricity system is overly expensive.[6] Up to about 90-to-95 per cent renewable electricity (depending on the model) achieves emissions reductions at zero or low costs. But beyond that, one or more of the following options is required to eliminate the last remaining emissions: overbuilding renewable energy capacity and not using most of the electricity from these generators most of the time; building yet more transmission; building ultra-deep storage;[7] or building zero-emissions dispatchable capacity, such as biomass, hydrogen fuel cells or turbines, geothermal energy, or dispatchable fossil fuels with near-perfect carbon capture and storage (CCS). All these add significantly to the cost of electricity, although it is possible that costs will reduce for some of them as they are deployed further.[8]

Modelling suggests that the most cost-effective solution is gas generation. Gas generators can ramp up and down quickly to respond to fluctuating renewable output. The fuel is able to be stored, and the capital cost of the units is relatively low. To create a net-zero electricity system in 2050, any emissions from gas generators must be offset by atmospheric removals of greenhouse gases.[9]

Figure 1.3: Electrification to support net zero will drive expansion of the electricity system

Additional electricity demand (TWh) above 2025 levels, National Electricity Market



Notes: 'Industrial' category includes large industrial loads and LNG. Residential demand falls because of increased uptake of rooftop solar (which shows up as reduced demand in the NEM due to own consumption and net exports to the grid). 'Hydrogen production' category includes production for domestic use and exports.

Source: Grattan analysis of AEMO (2024a).

---

[5] Grattan calculation using Jacobs (2025) and AEMO (2024a).

[6] Wood and Ha (2021).

[7] Devices or systems that can store electricity for months on end without significant deterioration.

[8] See, for example, AEMO (2024c), Wood and Ha (2021), and CCA (2024).

[9] See Wood et al (2021) for background on offsetting via atmospheric removals.

1.4 Paying for these emissions is essential for a clean and affordable electricity system

In a net-zero economy, no sector can be left without a constraint on emissions – whether via an explicit carbon pricing mechanism or through direct regulation of emissions.

The earlier emitters get used to paying this price, the more consistent their decisions will be with flourishing in a net-zero economy. Decisions about which assets to divest, which to invest in, and how to operate them, will all be consistent with a pathway to net zero.

Similarly for governments, decisions about market reform, regulation, and planning are easier to make if carbon is priced in. They don't have to rule different generators or fuels in or out. Making policy when carbon is not priced (particularly in the federalised Australian electricity market) becomes hostage to decisions that try to replicate the effect of a price, without ever naming it. The fraught process of attempting to design an enduring capacity mechanism is a case in point (see Box 1).

The upshot of introducing carbon pricing in the electricity market would be that all decisions would be consistent with reaching net zero, and could be made in the most economically efficient way. The outcome would be lower costs to the economy as a whole. When carbon isn't priced, someone still pays (whether for inefficient policy or the impact of climate change), but these costs are opaque and inconsistent, and are most likely to result in the overall cost being higher.

1.5 More work is needed to get Australia's emissions on track

To meet Australia's climate goals, the task ahead for the electricity sector is four-fold. It must build sufficient new renewable generation, storage, and transmission to replace coal generation as it retires. Once coal has been retired, the system must continue to expand to provide sufficient electricity to support electrification of transport, household

Box 1: Designing a capacity mechanism without clarity on carbon

In 2019, the federal government asked the Energy Security Board (ESB) to drive reform of the National Electricity Market (NEM), with a critical element being a capacity mechanism to ensure dispatchable electricity is available to maintain reliable supply. In June 2022, the ESB published a paper on how to achieve this. A controversial element of its design was the role of fossil-fuel generation in the capacity procurement and payment processes.

Australia's federal, state, and territory governments are all committed to net-zero emissions by 2050, and some had programs to support renewable generation.

Some ministers valued the right to exclude coal and/or gas generators in their jurisdictions from capacity payments on the grounds that such payments would prolong the operating life, and associated emissions, of such plants. One of the 14 principles the energy ministers set down for the ESB was to focus on continued reduction of electricity sector emissions. But ministers provided no clear policy framework to meet this principle.

To deliver a capacity mechanism to meet all the ministers' needs, the ESB sought 'further guidance on the principle of continued emissions reduction of electricity supply to allow the principle to be operationalised in the design'.[a] To translate from bureaucratese: please tell us what level of emissions are acceptable, so we can design the mechanism you asked for.

The ESB never got an answer from the ministers. It was wound up in 2022, and policy development on an enduring capacity mechanism stopped.

---

[a] ESB (2022).

gas, and industry. It must keep decarbonising to achieve net zero. And throughout, the system must remain affordable and reliable.

At present, the federal policies contributing to these goals are the Renewable Energy Target (RET) and the Capacity Investment Scheme (CIS). These policies will be gone by 2030.

Market reforms to underwrite new sources of electricity generation are being developed, but the government has specifically precluded this process from considering carbon.[10]

Then there is the Safeguard Mechanism, which limits emissions from facilities emitting more than 100,000 tonnes of carbon dioxide-equivalent (tCO_2-e) annually. In principle, the Safeguard applies to the electricity sector, but in practice, because of the way it was designed, it does nothing to encourage emissions reductions in the sector.

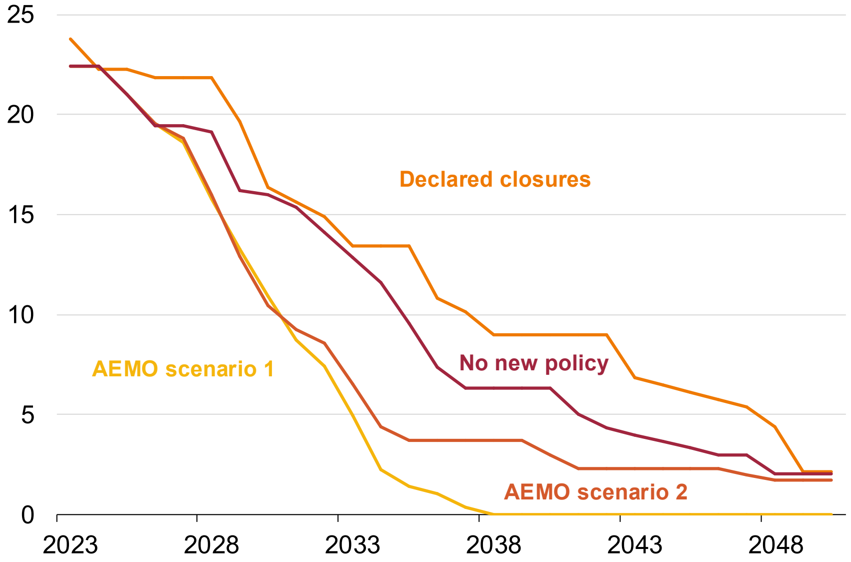
In the absence of new policy, emissions will be too high to achieve a smooth pathway to net zero by 2050. Modelling done for this report shows that without new policies, electricity emissions in 2050 will be about 30 million tonnes of carbon dioxide-equivalent ($MtCO_2$-e) – when they should be about 2 $MtCO_2$-e in that year to be consistent with climate goals[11].

1.5.1 Four tasks for the electricity sector

Task 1: Replace coal. There are different forecasts for when the last coal generator will leave the system (Figure 1.4) but the consensus is that coal is mostly leaving in the next decade. New capacity is required to meet energy demand, and the lowest-cost mix to deliver this

Figure 1.4: All scenarios show coal leaving the market quickly

Coal capacity (GW)



Notes: Includes National Electricity Market (NEM) and Western Electricity Market (WEM). Worsley Power Station not included because it is converting to gas rather than exiting the WEM. 'Declared closures' scenario assumes Callide C Units 3 and 4 remain open past 2050 in the absence of a nominated closure date and is correct as at 9 October 2025. AEMO = Australian Energy Market Operator. 'AEMO scenario 1' combines Integrated System Plan (ISP) Step Change scenario and WEM Electricity Statement of System Opportunities (ESOO). 'AEMO scenario 2' combines ISP Progressive Change scenario and WEM ESOO. 'No new policy' was modelled by Jacobs on behalf of Grattan. Full assumptions for this scenario are in Appendix B.

Sources: Declared closures: AEMO (2025). No new policy: Jacobs (2025). AEMO scenarios: AEMO (2024c) and AEMO (2024d).

---

[10] DCCEEW (2025a).

[11] Jacobs (2025) and CCA (2024).

capacity will be a combination of wind and solar, storage and batteries, combined with new transmission lines, and backed up by gas.[12]

Task 2: Decarbonise to meet climate targets. Decarbonising the electricity sector is essential to meet Australia's emissions reduction targets. The electricity sector is expected to deliver most of the 2030 target of reducing emissions by 43 per cent below 2005 levels.[13] In its advice to the government on the 2035 target, the Climate Change Authority noted that the largest share of achieving the 2035 minimum target of 62 per cent below 2005 levels would come from the electricity sector.[14]

Task 3: Expand to meet new demand. Even once coal has left the system, new capacity will be required to meet growing demand from electrification of other energy sources, whether in the industrial sector, in houses, or from transport (Figure 1.3 on page 8). Regardless of emissions, the economics of using electricity rather than burnable fuel is improving every year. In some sectors (household gas and petrol consumption, for example) it is already more economic to use electricity for the same service.

Task 4: Keep the lights on. Reliability of supply must be maintained as coal leaves the system. Back up will be needed when renewable production is low. This is why every reputable model of the future electricity system projects some combination of gas generation, storage, batteries, and transmission.[15]

1.5.2 Current policy has a use-by date

Current policy is supporting new capacity through the RET and the CIS, both of which will be gone, at least in their current form, by 2030. The Safeguard Mechanism could contribute, but not in its current form.

The RET: a successful industry policy but not a carbon policy

The RET has been in place (with some adjustments over time) since 2001. It is in essence an industry policy, with the stated primary objective 'to encourage the additional generation of electricity from renewable sources'.[16]

The RET places obligations on electricity retailers and large market customers to purchase a defined amount of electricity from renewable sources each year. This is backed by a system of tradable certificates (large-scale generation certificates, or LGCs), each of which represents one MWh of renewable electricity. This creates additional demand for renewable electricity, and a price premium, which (when renewable generators had higher capital costs than incumbent technology) helped make renewable generators more investable, because there was a guaranteed market for their output.

As part of an industry policy suite, the RET has been very successful.[17] But even though it has the secondary objective of reducing emissions, it is not a carbon price. It changes the economics of the electricity market by pushing in more renewable generation, not by making coal and gas generation more expensive proportional to their pollution impacts.

---

[12] Wood and Ha (2021).

[13] DCCEEW (2024a).

[14] Climate Change Authority (2025).

[15] Navigating the coal exit period in the electricity market is explored further in the 2024 Grattan report *Keeping the lights on* (Wood et al (2024)).

[16] The other objectives of the Act are to reduce emissions of greenhouse gases in the electricity sector; ensure that renewable energy sources are ecologically sustainable; and contribute to the achievement of Australia's greenhouse gas emissions reduction targets: Commmonwealth Government (2000).

[17] See the 2022 Grattan report *The next industrial revolution* for a longer discussion of the suite of industry policies that transformed the electricity market: Wood et al (2022).

The RET is slated to finish by 2030. The government is consulting on legislation to transition LGCs (which will no longer have value when the RET is concluded) to Renewable Electricity Guarantees of Origin (REGOs). REGOs will be voluntary, verified, and tradable certificates of renewable electricity generation designed to contribute to a durable framework for continuing renewable certification and trade. This may support an additional value stream for renewable energy generators, but does not price emissions.

The CIS: substituting for market reform

The CIS is a federal program that underwrites new renewable generation and storage projects. Recipients of support are selected by tender on a state-by-state basis. They are offered long-term revenue agreements whereby the government effectively underwrites a project against an agreed revenue ‘floor’ and ‘ceiling’. The program is intended to achieve 40 GW of new capacity by 2030, contributing to achievement of the 82 per cent renewable electricity target set by the federal government after the 2022 election.[18]

The CIS is a substitute for market reform, which was not undertaken in time to allow the market to signal properly the need for further investment to replace coal. The CIS is also a more politically attractive way to deliver the increased renewable electricity target (82 per cent by 2030) rather than increasing the RET, because it kept the cost away from household bills.

CIS tenders will be called for until 2027, because their primary role is to deliver investment in renewable generation and storage to meet the target of 82 per cent renewables by 2030.

---

[18] The modelling undertaken in this report assumes an earlier version of the CIS, targeting 23 GW of renewable generation and 9 GW of dispatchable capacity, as the modelling was specified before the renewed 40 GW target was announced in July 2025.

Box 2: The National Electricity Market review

The NEM review was announced in November 2024. It was asked to recommend wholesale market settings to promote investment in firmed renewable generation and storage capacity in the NEM after the end of Capacity Investment Scheme tenders in 2027.

The review’s draft report proposes keeping the structure of the NEM broadly the same, and adding features that better link the short-term (spot) wholesale market, medium-term derivatives markets, and long-term investment markets, ensuring they work together for consumers. The main recommendations include:

- requiring price-responsive resources such as batteries and large loads to be more visible to the market operator
- facilitating greater market participation by consumers
- creating a market-making obligation so that a wide range of derivative products are available to manage medium-term risk
- creating the Electricity Services Entry Mechanism (ESEM), which makes long-term revenue arrangements available to renewable project developers provided that short-term arrangements are covered by the market. The amount of contracts available would be driven by future state government renewable energy targets. These long-term revenue contracts are proposed to be progressively sold off such that the ESEM Administrator has minimal net liabilities. If the contracts cannot be sold, or are sold at a loss, the cost of this is passed on to consumers.

Fuel markets, carbon markets, and planning assessment reform are specifically excluded from the review’s scope.[a]

---

[a] DCCEEW (2025a).

The Safeguard: there in theory, but no impact on electricity

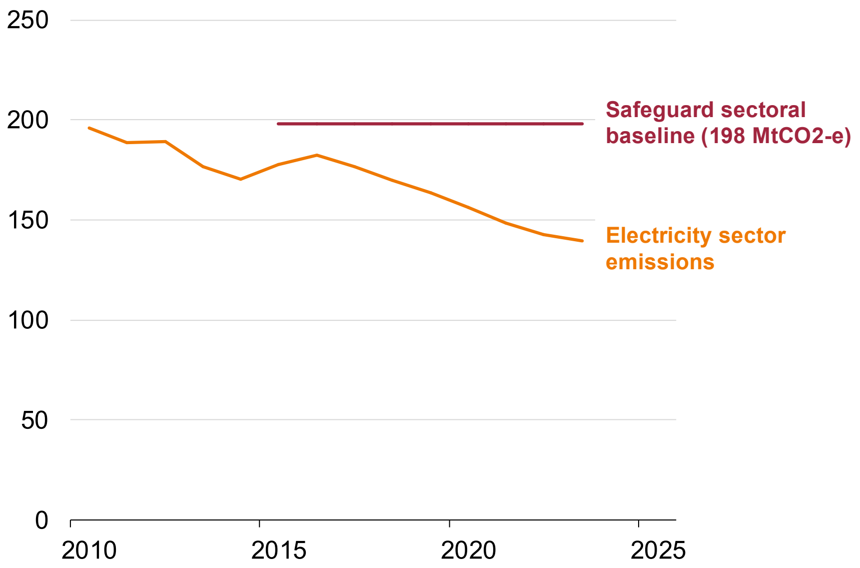
The Safeguard Mechanism was introduced in 2015. It applies to all 'facilities' (sites or collections of activities controlled by one corporation) that emit more than 100,000 tCO_2-e annually. These facilities must keep emissions below a 'baseline', which reflects the emissions intensity and volume of products they produce. Firms are awarded Safeguard Mechanism Credits (SMCs) for being below their baselines. If they are above their baselines, they must purchase and surrender SMCs or Australian Carbon Credit Units (ACCUs) to offset excess emissions. Baselines are lowered each year.

Grid-connected power stations are treated differently. The sector behaves more like a single entity, because production is centrally coordinated.[19] The Electricity Safeguard applies a collective baseline of 198 million tonnes to grid-connected electricity generators. If this baseline is exceeded, individual baselines will apply to each generator.

The electricity sector baseline has never been in danger of being breached (Figure 1.5). As a result, the Safeguard only affects the emissions of five large off-grid power stations in Western Australia and one in the Northern Territory, whose emissions total 1.5Mt CO2-e (about 1 per cent of total electricity emissions).

Figure 1.5: The Electricity Safeguard baseline is well above business-as-usual emissions

Electricity sector emissions ($MtCO_2$-e)



Notes: $MtCO_2$-e = millions of tonnes of carbon dioxide-equivalent. Electricity emissions exclude off-grid electricity generation, because this is not covered by the sectoral baseline.

Sources: DCCEEW (2024a) and Commonwealth Government (2015).

1.5.3 Proposed post-2030 market reforms do not solve for carbon

The federal government has commissioned a review of wholesale market settings in the National Electricity Market (NEM). The review has been asked to recommend future market settings to promote investment in firmed, renewable generation and storage capacity in the NEM following the conclusion of CIS tenders in 2027. The review is precluded from considering options that involve implementation of

---

[19] Department of Prime Minister & Cabinet (2016, pp. 31–32).

carbon trading schemes or carbon markets, or that entail governments supporting new fossil fuel generation.[20]

The review's draft report proposes a number of reforms to support efficient functioning of short-term spot markets, medium-term derivatives markets, and long-term investment markets.[21] The centrepiece of the proposed reforms is the Electricity Services Entry Mechanism (see Box 2 on page 12). The ESEM is similar to the CIS in that it solves for the same problem: renewable projects are difficult to finance because they have high capital costs, uncertain output, uncertain demand for their product, and uncertain competition from coal.

It is clear that a reliable, low-emissions electricity sector needs both the ESEM and a complementary carbon signal. Without a carbon signal, the ESEM may result in higher costs to consumers. And without the ESEM, long-term investment markets will not incorporate carbon risk efficiently.

Carbon policy would complement the ESEM and vice versa

The ESEM does not explicitly price carbon. The amount of new capacity it supports would be dictated by state government renewable energy targets, and (other than Victoria's) none of these stretch beyond 2030.

If implemented via the National Electricity Law, the implementing body (as yet undecided) would be required to have regard to the National Electricity Objective, which now includes reference to emissions targets.[22] But there is no structured mechanism for the ESEM implementing body to deal with the inevitable trade-off between two policy objectives – lower cost and lower emissions.[23] Similar ambiguity about government intentions around emissions tripped up the Energy Security Board in designing a capacity market (Box 1 on page 9).

The NEM review draft report calls on governments to clarify how their greenhouse gas emissions targets apply to projects procured to provide firming services, to provide certainty for investors.[24]

The draft report notes that an emissions-intensive firming project (for example, a gas peaker) would be fully exposed to uncertain costs associated with changes in emissions policy. Submissions to the review noted this risk is already affecting investment in firming resources and will continue to do so in the absence of clear guidance on how emissions are considered for firming generation.[25]

If risks are higher, ESEM contracts will cover the higher cost of financing. Because these costs are ultimately passed to consumers, an ESEM without a carbon signal next to it risks higher costs for consumers.

Conversely, the problems that the ESEM addresses are likely to persist even if carbon is explicitly priced in the electricity market, meaning that a carbon policy in the sector will work better if the ESEM is implemented.[26]

---

[20] DCCEEW (2025a).

[21] Nelson et al (2025).

[22] The National Electricity Objective promotes: 'efficient investment in, and efficient operation and use of, electricity services for the long-term interests of consumers of electricity with respect to... achievement of targets set by a participating jurisdiction for reducing Australia's greenhouse gas emissions; or that are likely to contribute to reducing Australia's greenhouse gas emissions.' Parliament of South Australia (1996).

[23] Guidance from ministers on the interim value of greenhouse gas emissions reduction (VER), currently \$79 per tCO_2-e, doesn't resolve this trade-off, it just anchors the cost to consumers of any policy changes made in the energy market to give effect to state and federal targets. (Value of emissions reduction inflated to 2025 dollars.) AEMC (2024).

[24] Nelson et al (2025, p. 191).

[25] Ibid (p. 191).

[26] The model used for energy market scenarios in this report assumes away the financing and contracting problems that the ESEM addresses. The ESEM could

1.6 Without an explicit carbon constraint policy, emissions will be too high for too long

Coal generators are being retired for financial and age reasons. But this is not happening fast enough to achieve emissions reductions consistent with Australia's obligations under the Paris Agreement.

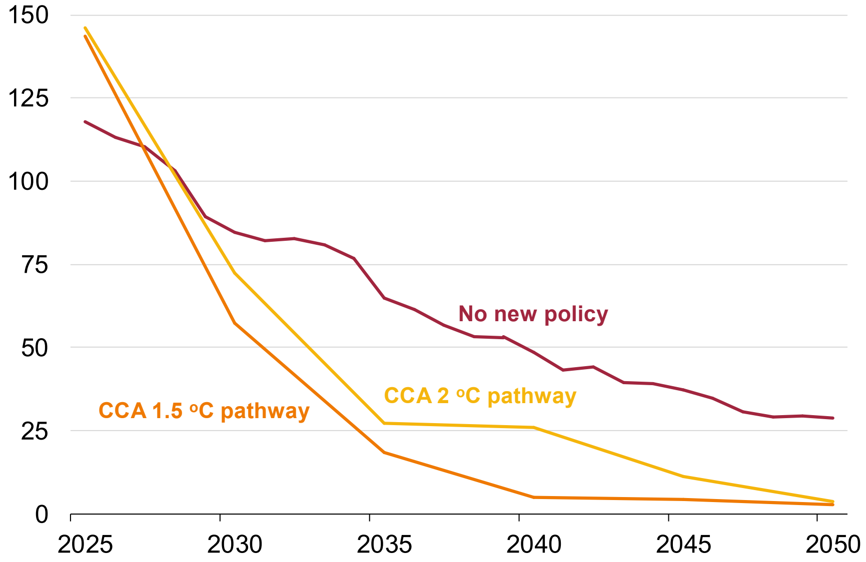
The Paris Agreement refers to two global temperature goals: holding the increase in the global average temperature to well below 2℃ above pre-industrial levels, and pursuing efforts to limit the temperature increase to 1.5℃.[27]

Linking Australia's targets directly to these goals can be fraught, because it involves taking a view on Australia's fair share of global effort. But global efforts to achieve these goals affect Australia, because they drive the price of technology. The Climate Change Authority uses illustrative pathways for decarbonisation of Australia's economy under two distinct sets of assumptions, about the domestic emissions trajectory and for global decarbonisation, as set out in Box 3 on the following page.

Figure 1.6 shows a projection of electricity emissions if there is no new policy action post-2030, contrasted with the emissions reductions needed to achieve the Climate Change Authority's pathways for the sector. The no-new-policy pathway is consistent with the coal retirement rates in Figure 1.4 on page 10, and an economically efficient build-out of renewables, storage, and gas to replace them. But 'just letting the market sort it out' will not put Australia on track for its 2035 emissions target, and still leaves emissions about 15 times higher in 2050 than is required.

Figure 1.6: Without policy change, electricity emissions will stay too high for too long

Electricity sector emissions ($MtCO_2$-e)



Notes: $MtCO_2$-e = millions of tonnes of carbon dioxide-equivalent. CCA = Climate Change Authority. CCA scenarios only report data every five years. For a full description of the assumptions behind the 'no new policy' scenario, see Appendix B.

Sources: Jacobs (2025), and CCA (2024).

---

thus be seen as a way to make the world behave more like an efficient economic model.

[27] Article 2, UNFCC (2015). Even though global temperatures in 2024 were more than 1.5℃ above pre-industrial levels, the goal remains 'well below 2℃'.

Carbon pricing should have a role in Australia’s electricity system over coming decades. The sector is facing a policy cliff in 2030, which if not rectified will send the sector off track for the 2035 target and net zero. The review of market settings in the National Electricity Market will help, but will not be sufficient. The following chapter shows that much has changed since carbon pricing was last tried in Australia, creating an opportunity for a fresh evaluation.

Box 3: Climate Change Authority targets and pathways

We used the Climate Change Authority’s pathways for the electricity sector to underpin our analysis, as set out in Appendix B on page 43. These pathways estimate emissions reductions trajectories under different global circumstances.

- The A50/G2 scenario is consistent with achieving Australia’s current emissions reduction targets in a world with less than 2℃ warming. Australia is not a leader in decarbonisation in this world. It reaches net zero in 2050, but many other developed nations reach net zero in 2040 or 2045.
- The A40/G1.5 scenario is consistent with a 75 per cent reduction on 2005 levels in 2035 and net zero by 2040, reflecting greater ambition and more rapid emissions reductions. Australian targets are consistent with greater ambition from other developed nations, as the world cooperates to limit warming to 1.5℃.

The domestic net emissions trajectories for each of the pathways are not directly linked to the global emissions budgets for the scenarios.

Our analysis in this report assesses the electricity decarbonisation against carbon budgets that reflect the CCA’s scenarios. For the rest of the report, we refer to our scenarios as ‘< 2℃’ and ‘1.5℃’, for convenience.

2 The world has changed since Australia last tried carbon pricing

The world has changed since the 2010s.

The cost of renewable energy has fallen considerably, partly driven in Australia by the Renewable Energy Target. Australia's electricity mix has become less emissions-intensive as more renewable generators are deployed and coal plants are closed.

The Safeguard Mechanism and the New Vehicle Efficiency Standard have priced emissions in the industrial and transport sectors, and offsetting and crediting have matured. Many of Australia's major trading partners have implemented their own carbon pricing schemes, and are signalling their willingness to use trade policy to ensure no unfair advantage accrues to countries that don't price carbon.

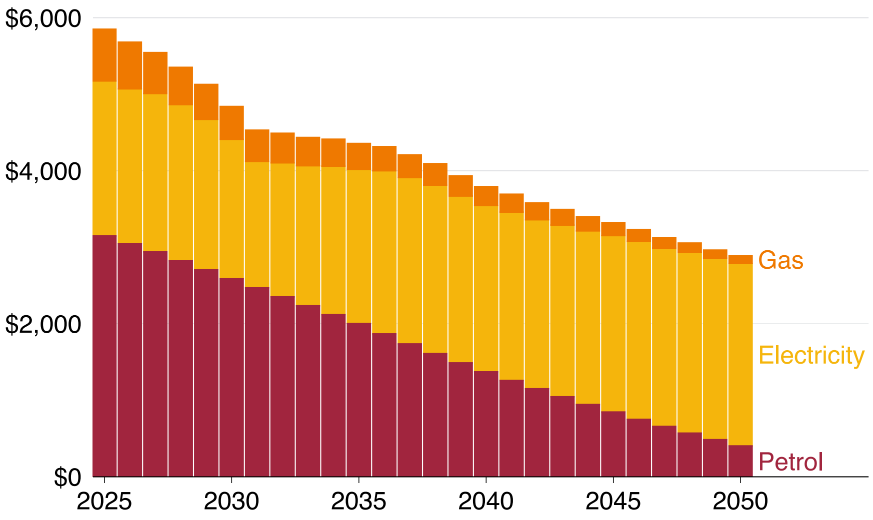
The benefits for consumers of the energy transition are also now much clearer. The energy mix and the way energy is delivered are changing rapidly due to electrification and the application of battery storage. This means that the impact of a carbon price now must be considered in the context of all energy sources that consumers use, not just electricity.

As more households upgrade to using electricity instead of gas and petrol, average household energy bills could fall by 50 per cent by 2050 (Figure 2.1). Even if a carbon price leads to a modest increase in electricity bills, the average household will still have a much smaller total energy bill then than now.

Provided that the carbon constraint is well-designed and governments are prepared to support technology access for all households, concerns about political barriers to carbon pricing should be manageable.

Figure 2.1: Household energy bills are set to halve by 2050

Average annual household energy costs in the 'no new policy' scenario, by fuel source ($2025)



Source: Grattan analysis. See Appendix D for further details.

2.1 Incentives have reduced emissions in the electricity sector

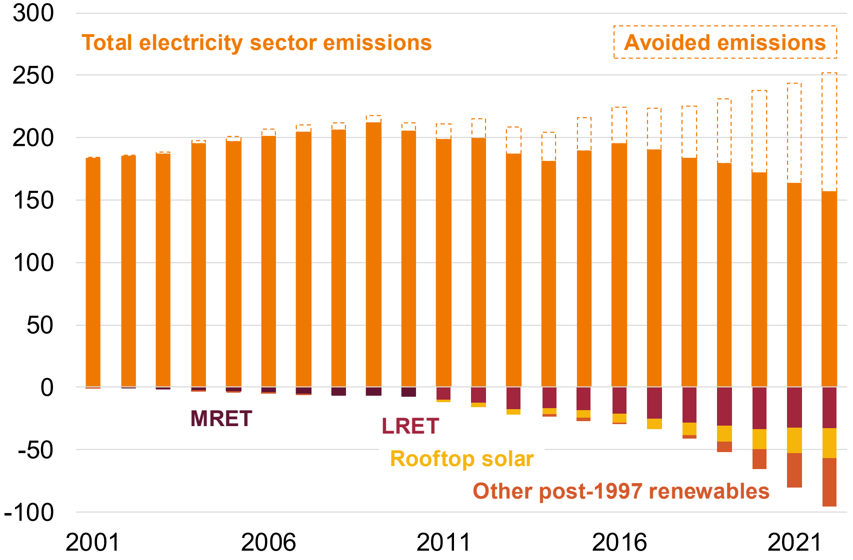
The primary driver of emissions reduction in the electricity sector in Australia since 2000 has been the RET (Figure 2.2).[28] The RET creates an incentive to build renewable energy generation, by granting a certificate for every megawatt-hour of renewable electricity generated after 2001.[29] These tradable certificates have monetary value, because electricity retailers are required to purchase an increasing number of them each year.

The outcome is to make new renewable generators more competitive with incumbent generators. The RET has driven renewables' share of Australia's electricity mix from about 8 per cent at the turn of the century to 36 per cent in 2024.[30]

The RET drives up the share of renewables, but that is not the same as driving down emissions. Because the RET started with very low targets, the emissions from electricity have not fallen as dramatically as the percentage of renewable electricity has grown. In fact, emissions increased from 2000 to 2009, in spite of the RET, and subsequent falls were also a consequence of the 2007-09 Global Financial Crisis (which reduced electricity consumption) and the 2012-14 economy-wide carbon price (which reduced emissions sharply, only for them to snap back when the carbon price was abolished).

Figure 2.2: Since 2009, electricity emissions have been falling as renewables take a greater share of generation

Electricity sector emissions and additional abatement by year (MtCO$_2$-e)



Notes: MtCO$_2$-e = millions of tonnes of carbon dioxide-equivalent. MRET = Mandatory Renewable Energy Target. LRET = Large-scale Renewable Energy Target. The LRET and small-scale solar scheme replaced the MRET in 2011. Abatement assumes that extra renewable generation in a given year would otherwise have been generated at the emissions intensity of the previous year.

Source: Grattan analysis of DCCEEW (2025b) and DCCEEW (2023).

---

28. In this report, we use 'Renewable Energy Target' and 'RET' to encompass all schemes legislated in the *Renewable Energy (Electricity) Act 2001*, including the Mandatory Renewable Energy Target (2001-2010), the Renewable Energy Target (2010-2011), the Large-scale Renewable Energy Target (LRET) (2011-present), and the Small-scale Renewable Energy Scheme (SRES) (2011-present).
29. For generators installed before 1997, certificates are issued only for generation above a baseline representing the generator's average output in 1994, 1995, and 1996.
30. DCCEEW (2025b).

2.1.1 The cost of renewable electricity has fallen considerably

The flow-on effect of greater deployment of renewable generation (both here and overseas) is that the costs have come down considerably.

In modelling done for the Carbon Pollution Reduction Scheme and RET in 2008, the assumed long-run marginal cost of onshore wind generation at a high capacity factor was $106 per MWh; and at a low capacity factor, $180 per MWh.[31] In 2025, for the same capacity factors, wind generation had long-run marginal costs of $80 per MWh and $132 per MWh.[32]

The cost of solar has fallen precipitously over the same period. Project capital costs for a large-scale solar farm were about $10.30 per watt in 2008; today they are $1.20.[33] While some of the fall in these costs has been offset by the need to pay for new transmission and firming, models consistently show that renewable energy, firmed with storage and backed up by gas-powered generation, is the lowest-cost way to supply electricity.[34]

2.1.2 New technologies are changing the market and the economics

The advent of digitisation, coupled with more decentralised, weather-dependent generation, as well as storage, has changed how the electricity market behaves. There are adverse consequences for emissions-intensive generation.

Prices in the wholesale market are more volatile than they used to be, and negative prices are common. Batteries are able to respond to changes in demand much faster than coal-fired generators, and faster than gas and hydro. The shift to 5-minute settlement[35] provides better price signals for a wider variety of generation that can cope with this volatility.

Because coal generators (and, to some extent, gas generators) are not able to respond quickly to volatile prices, they are losing the economic edge they had from sunk capital and (for coal at least) cheap fuel.

2.2 Carbon constraints now apply to large industry emissions and some transport emissions

In its first term, the Albanese Government introduced policies that create carbon prices in two sectors that currently produce material shares of Australia's emissions.

In 2023, the government introduced reforms to the Safeguard Mechanism. Facilities that emit more than 100,000 tCO_2-e per year now have individual caps on their emissions (called baselines). When they emit less than their cap, they are given a credit called a Safeguard Mechanism Credit (SMC); if they emit more than their cap, they must offset those emissions by purchasing an SMC, purchasing an Australian Carbon Credit Unit, or paying a penalty. Baselines are lowered over time, requiring facilities to pay for more and more of their emissions each year. The Safeguard was designed to cover the

---

[31] Roam Consulting (2008). 2008 figures expressed in 2024 dollars. High capacity factor = 48 per cent. Low capacity factor = 29 per cent. We selected these capacity factors for comparability with capacity factors used in the most recent GenCost report.

[32] CSIRO (2025).

[33] Both figures in 2024 dollars. Watt (2009) and Australian PV Institute (2023).

[34] AEMO (2024c).

[35] 5-minute settlement began in October 2021, and aligns the dispatch period (the time period over which the Australian Energy Market Operator (AEMO) determines demand and orders generators to meet it) with the settlement period (the period over which prices are determined). Before October 2021, the settlement period was 30 minutes. This was disadvantageous to modern, flexible, and fast-start technologies such as batteries and peaking gas; and also allowed some generators to game the system by withholding capacity so as to bid up the 30-minute price: Wood et al (2018).

electricity sector as well, but that part of the legislation is currently inactive.[36]

The Safeguard Mechanism applies also to large transportation companies. In 2023-24, these included Qantas, Virgin, Aurizon, and Pacific National.

The New Vehicle Efficiency Standard, which came into force on 1 January 2025, requires car companies to meet a national target for exhaust emissions from light vehicles. This target will be lowered over time. Similar to the Safeguard, if a car company sells more low- or zero-emissions models, it will receive credits. If it sells more high-emissions cars and doesn't meet its target as a result, it must buy credits or pay a penalty.

2.2.1 Offsetting and crediting are now mature systems

The *Carbon Credits (Carbon Farming Initiative) Act (2011)* established the rules for creating carbon credits, and became the underpinnings of the (now defunct) Emissions Reduction Fund. Australian Carbon Credit Units (ACCUs) are created and tracked using these rules.

Australia now has more than a decade of experience with generating, trading, and surrendering carbon credits. While ACCUs have not been without controversy,[37] and constant attention is required to maintain their integrity,[38] they are now embedded in the national emissions reduction framework.

2.3 Australia's trading partners are moving to price carbon

When Australia introduced its carbon price in 2012, the only other national-level schemes were the EU Emissions Trading Scheme (ETS) (introduced in 2005), the New Zealand ETS (2008), a Japanese carbon tax (2012), and several northern and eastern European carbon taxes implemented through the 1990s and early 2000s. Only 9 per cent of global greenhouse gas emissions were covered by a constraining policy.[39]

Now, about 27 per cent of global emissions are covered by carbon pricing instruments; more than half of this is China's national emissions trading scheme, and about three quarters is comprised of China, Japan, South Korea, and the EU, some of Australia's most significant trading partners.[40]

There is also growing interest in carbon border adjustment mechanisms, which place equivalent carbon prices on imports from countries that don't have carbon pricing.[41] This reduces the argument, commonly used against carbon pricing when last considered here, that Australian business will be less competitive if carbon is priced here.

2.4 Household energy cost economics have improved

What matters to consumers is how much they pay for *all* the energy they consume to get all the services they want. A combination of climate policies and economics has meant that the historical boundaries between the use of electricity, gas, and petrol have become

---

[36] See section 1.5.2 on page 13.

[37] Macintosh (2025).

[38] DCCEEW (2025c).

[39] World Bank (2025).

[40] Ibid.

[41] Carbon border adjustment mechanisms (CBAMs) are used to level the playing field for exporting firms and import-exposed firms that are facing a domestic carbon price. Importers must measure and pay for the Scope 1 production emissions at an equivalent rate to the domestic price. Exports can have all or part of the domestic price rebated. The EU CBAM will apply to EU importers from 2026, and the EU is currently considering expanding it to include Scope 2 emissions (electricity). In our region, CBAMs are under development in Taiwan and South Korea. The federal government commissioned a review of carbon leakage in 2024, including consideration of an Australian CBAM, but the final report is yet to be released.

blurred. To legitimately compare scenarios, we need to consider all the energy sources used by consumers, in a single bundle.

In 2010, Australian households had been getting their energy from the same sources for decades. For their cars, they bought petrol or diesel. For heating their homes and water, and for cooking, they used a mixture of gas and electricity. For everything else, they used electricity, generated mostly in large centralised fossil-fuel generators and delivered by poles and wires.

Since 2010 this has changed dramatically, and this trend is likely to accelerate as the energy sector transitions to net-zero emissions.

2.4.1 The trend to electrification is firmly established

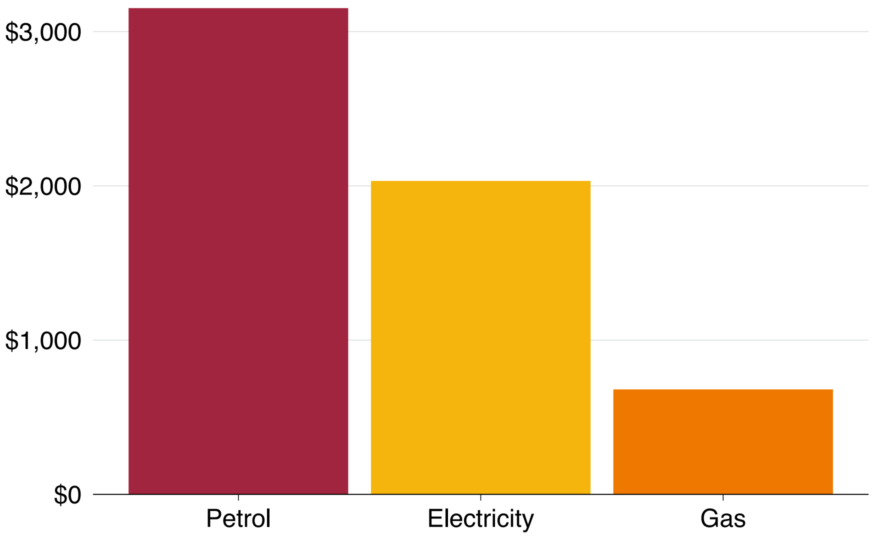
About 4 million households in Australia now get all or part of their electricity from rooftop solar, with this number expected to climb to about 7 million by 2050.[42] Some of these households are installing home batteries to give them more control over when they use this electricity.

The Australian Energy Market Operator (AEMO) expects 200,000 households and commercial businesses per year to remove their connection to the gas network to 2030, switching heating, cooking, and hot water service to electricity.[43] And Australians are taking up electric vehicles in increasing numbers; based on AEMO and CSIRO projections, by 2045 more than 70 per cent of the private vehicle fleet will be electric, up from about 1 per cent currently.[44]

Batteries and digitisation also allow much more minute-to-minute interaction with the grid, giving households unprecedented control over

Figure 2.3: Electricity forms just part of total household energy costs

Average 2025 household energy costs by fuel source



Source: Grattan analysis. See Appendix D for further details.

---

[42] DCCEEW (2024b) and Graham and Mediwaththe (2024).

[43] AEMO (2024b).

[44] AEMO (2024a), AEMO (2024d), and Graham et al (2024).

when they use electricity and what for. The result will mean lower costs and lower emissions by better utilisation of rooftop solar.

In 2025, about one-third of annual household energy spending is on electricity (Figure 2.3 on the previous page). Petrol or diesel makes up the largest part of household energy spending, and gas the smallest. Grattan modelling estimates that by 2050, electricity will make up about 80 per cent of household energy spending.[45]

2.4.2 Households are set to save from electrification

There are two reasons that households' total energy spending will fall as they upgrade to electric appliances and vehicles.

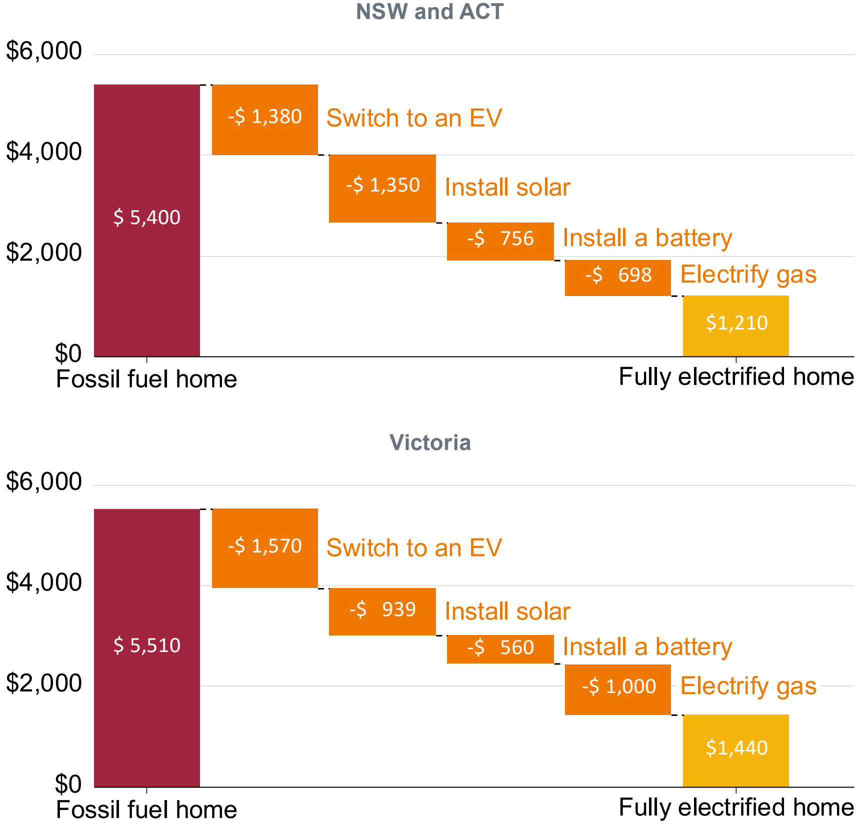
Firstly, burning fuels to supply an energy service is inherently inefficient. A portion of the energy contained in the fuel is lost in the process of conversion. When electricity is used, most of the energy in the electricity is turned into a useful service.[46]

Secondly, as the electricity system becomes more decentralised, it becomes more efficient, because less electricity is lost in the process of delivery to consumers.

The combination of these two factors means that as more households electrify, they will consume less energy to get equivalent services, and more of that energy will be supplied by electricity that is produced closer to the point of consumption.

Figure 2.4: Households can make large savings by switching to electricity and solar

Annual household energy costs, by household type in 2025



Notes: Costs represent the estimated total energy costs for a household in 2025 depending on their household type. The order of installing solar and a battery relative to other steps affects the size of the saving for that step. For this analysis, a fossil fuel home is one without a solar array or battery installed, with gas cooking and water and space heating, and with a single petrol car.

Source: Grattan analysis. See Appendix D for further details.

---

[45] The percentage of energy consumption attributable to electricity, petrol, and gas varies substantially by state. In particular, Victorians use far more gas for household heating than people in most other states. These averages reflect this through a weighting according to the number of household connections in each state.

[46] As an example, consider using a saucepan over a gas flame to heat water, versus an electric kettle. Heat from the gas flame is lost to the air; heat from the electric element all goes into the water.

Households are beginning to see the financial benefits of these changes. Today, the average NSW household with a petrol car, gas heating and cooking, and no solar or storage could reduce their energy costs from about $5,400 a year to about $1,200 by switching to electrified cooking and heating, replacing their petrol car with an electric vehicle, and installing a solar array and household battery (Figure 2.4 on the preceding page). This includes only operating costs – the capital cost barriers to these upgrades are addressed in more depth in Chapter 5.

For an idea of the magnitude of the potential savings available, the annual savings from switching from a petrol car to an EV is about $1,400 in NSW. If the 15 million passenger vehicles on Australia's roads were all to switch and receive this saving, the potential value to households just from electrifying their cars is in the order of $20 billion per year.[47]

When these economic benefits are applied to forecasts of energy demand – including forecasts of electrification uptake in vehicles, appliances, and heating – average household energy costs are set to halve by 2050 (Figure 2.1 on page 17). This translates to a saving of 51 per cent on current energy spending. For context, a carbon pricing policy which increased electricity bills by $100 a year in 2050 would mean this saving would be 49 per cent instead of 51 per cent.

---

[47] Grattan calculation based on ABS (2021a). The approach to calculations and more detailed economics of petrol, gas, and electricity switching is explained in Appendix D.

3 Reactivating the Safeguard in the electricity sector is the best option

When Australia last considered carbon pricing, the debate was derailed, and ultimately stopped, by politicisation of the costs, particularly higher electricity bills. Politics trumped policy, with the result that any mention of carbon pricing became taboo for any politician who wanted to be elected.

But it is now clear that, with good policy design, energy consumers could *benefit* from the energy transition. As demonstrated in Chapter 2, household energy bills are set to fall dramatically by 2050. This gives governments room to constrain carbon – consumers would get a slightly smaller, but still significant, saving, rather than swallowing a cost.

This does not mean Australia should jump straight to the same model of carbon pricing as was in place between 2012 and 2014. While an economy-wide carbon price may be ideal from a theoretical economic perspective, it may be too complex or political challenging to secure widespread support.

A better approach would be to start with policies that are already in place, and evolve them.

The Safeguard Mechanism, while ‘second-best’ in theoretical economic terms, is already in place, and includes provisions for the electricity sector to participate. It also has the potential to be improved over time to better constrain carbon and achieve a least-cost pathway to net zero. And because it was introduced by one side of politics (the Coalition) and reformed by the other (Labor), it has the best chance of maintaining cross-party support.

3.1 Carbon pricing is good policy

We identified six criteria for judging what makes a ‘good’ emissions reduction policy in the electricity sector:[48]

1. **Credibility:** ability to hit emissions reduction targets and budgets.
2. **Efficiency:** the policy can be designed to take full advantage of competition/markets to bring about lowest costs to the economy.
3. **Flexibility**: ability to adjust for changes in targets, politics, and technology.[49]
4. **Adaptability:** potential to harmonise over time with other carbon policies already operating.
5. **Public acceptability:** ability to be understood and accepted by the community.
6. **Political viability:** capacity to evolve from current policy settings and achieve bipartisan support.

A cap-and-trade carbon pricing scheme or a carbon tax would score well on criteria 1, 2, and 3. Where they would struggle is criteria 5 and 6. At present the major parties are unlikely to support either, and public support would be lukewarm at best.[50]

---

48. Adapted from Wood et al (2015).
49. This is more complex than stating the policy should be ‘technology-neutral’. Rather, it means the policy should not favour a particular means of achieving the desired objective, and should equally support all methods capable of achieving the objective. However, the objective itself may entail implicit technology bias. Aisbett et al (2021).
50. The Lowy Institute since 2021 has surveyed a nationally representative sample of Australian adults, asking whether they would support or oppose the federal

3.1.1 The Safeguard meets the criteria reasonably well

As described in Section 1.5.2 on page 13, the Safeguard Mechanism already makes provision for the electricity sector, but this part of the legislation in currently inactive.

Assessed against the criteria listed in Section 3.1, the Safeguard scores well.

1. **Credibility:** The Safeguard may not be as certain as a cap-and-trade emissions trading scheme to meet emissions reduction targets, because it uses intensity values to set emissions baselines. If output grows faster than intensity declines, emissions may rise.[51] But it is more certain to meet emissions reduction targets than a carbon tax.
2. **Efficiency:** The Safeguard includes trading and competition, which in principle lowers costs. However, use of intensity baselines makes it less efficient than a cap-and-trade scheme.[52]
3. **Flexibility:** The Safeguard is technology-neutral, and so can incorporate changing technology easily. It can also adjust for changes in targets.
4. **Adaptability:** The Safeguard can move towards an economy-wide scheme from its existing structure, by dropping the participation threshold to encompass more firms.
5. **Public acceptability:** At present, the Safeguard does not have negative connotations in the public mind. It is also relatively simple to explain and understand. It doesn't raise revenue for government, which is both a strength (avoids the negative connotations of a tax) and a weakness (less scope for government to provide compensation).
6. **Political viability:** The Safeguard was put in place by a Coalition government and reformed by a Labor one. This should mean it is well-positioned to endure beyond changes of government, with each being able to evolve settings to suit their agenda.

3.2 On balance, the Safeguard Mechanism is the most viable policy option to price electricity sector emissions

The Safeguard already covers 31 per cent of Australia's emissions,[53] so it would make sense to investigate how coverage could be expanded to include electricity emissions.

Its biggest advantage is that it would allow for trade-offs between reducing electricity emissions and reducing industrial emissions. This should reduce costs for both sectors, and the costs of achieving Australia's overall emissions reductions goals.

3.2.1 Reactivating the Safeguard would be reasonably straightforward

To reactivate the Safeguard in the electricity sector, the government would need to remove the exemption for the electricity sector from its 2022 reforms. It would also need to remove the sector-wide baseline of 198 million tonnes.

Then it would need to adjust the participation threshold (currently 100,000 tonnes) so that all grid-connected electricity generators were

---

government 'introducing an emissions trading scheme or a carbon tax'. Support hovers around 60 per cent: Neelam (2025).

[51] This happened with a similar scheme implemented in NSW between 2003 and 2012, the Greenhouse Gas Abatement Scheme (GGAS), which achieved its objective (a reduction in intensity) but not a large reduction in emissions (about 6 million tonnes in 11 years).

[52] In an intensity-based scheme, facilities that can increase production easily can benefit over those that can't. This is potentially inefficient, because it favours firms with flexible input costs over those that are capital-intensive. A cap-and-trade scheme would not discriminate in this way.

[53] Clean Energy Regulator (2024).

participating. Without this adjustment, renewable generators would be excluded.

Consistent with how the Safeguard operates in the industrial sector now, each generator would receive an individual baseline, calculated from its output (megawatt hours) and an emissions-intensity value. This value would begin at the Australian average emissions intensity in 2030. Generators that are above their baselines would need to obtain credits to offset these emissions. Generators that are below would be awarded credits.

As baselines were lowered, coal generators, and eventually gas generators, would pay renewable generators for credits. This is a subsidy for renewable generators – but one that is contained within the electricity market rather than coming from government. The effect would be to make lower-emissions generation a more attractive investment, and higher-emissions generation less attractive. Over time, this should achieve an efficient mix of generation to deliver the sector's carbon budget.

We modelled a baseline-and-credit scheme for the electricity sector that mimics these changes. The results are presented in Chapter 4.

4 Reactivating the Safeguard could help the transition a lot and cost consumers little

Among the many options to constrain carbon in the electricity sector, the Safeguard Mechanism comes the closest to being a good policy that is politically viable.

We wanted to test the potential impacts of the Safeguard compared to a 'no new policy' scenario.[54] In particular, we wanted to see how efficiently the Safeguard could decarbonise the grid, and what the impact on household energy costs would be.

We modelled a stylised policy scenario that could be used to reactivate the Safeguard, as well as a reference scenario where there is no policy to reduce emissions in the electricity sector after 2030. Details are in Box 5 on page 35.

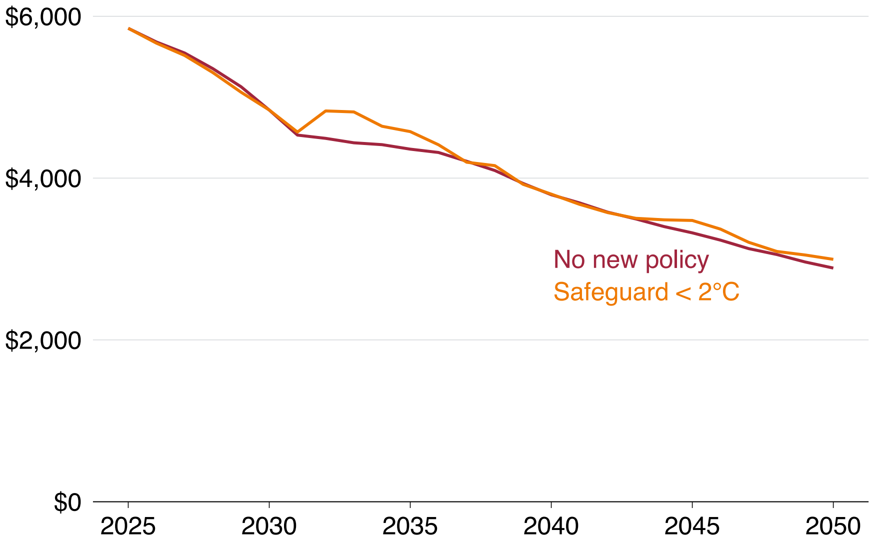
Under the reactivated Safeguard scenario, household electricity bills are $70 per year higher on average than under the 'no new policy' scenario. This is a difference of only about 3 per cent, and is not material within the bounds of the accuracy of a multi-decade model.

The projected higher costs in the Safeguard scenario are dwarfed by the 50 per cent savings households are expected to make by electrifying most of their energy use.

When the value of emissions reductions is considered, implementing the Safeguard is lower cost than the 'no new policy' scenario. Abatement is achieved at a reasonably low cost of $80 per tonne of emissions.

Figure 4.1: Households' energy bills will fall significantly between now and 2050, including under the Safeguard

Average annual household energy costs ($2025)



Source: Grattan analysis of Jacobs (2025). See Appendix D for further details.

---

[54] 'No new policy' means no additional policy to constrain emissions in the electricity sector. As explained in Chapter 1, implementing the recommendations of the NEM review may reduce the carbon intensity of the electricity sector, but will not explicitly solve for carbon, particularly for firming generation.

The Safeguard's effect on retail electricity prices is felt most strongly in the years 2030 to 2035, when there is an adjustment cost. After that, prices in both scenarios are similar. This effect largely occurs because of an adjustment shock to the wholesale price of electricity. The shock comes because 68 per cent of the electricity sector's emissions budget is consumed by the coal-intensive generation mix in place before 2030.

The low cost of emissions reduction in a world of falling total household energy bills driven by electrification provides safer political ground for governments to price carbon.

4.1 Household energy costs fall in both scenarios, and households are set to make big savings

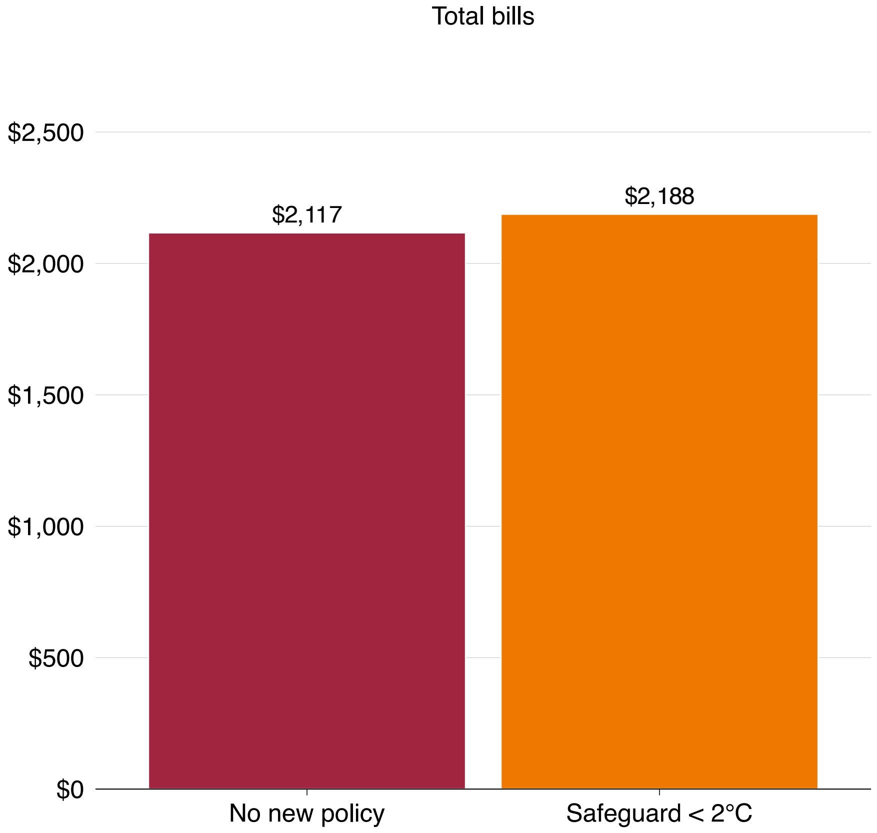
As discussed in Chapter 2, we expect total household energy bills (in today's dollars) to fall from an average of just over $5,800 in 2025 to an average of about $2,900 in 2050 – about half today's costs. Reactivating the electricity Safeguard would make little difference to the size of this saving.

The saving attributable to electrification by 2050 is about 51 per cent of today's energy bill. Under the Safeguard scenario, the saving is reduced by less than 2 percentage points – so instead of saving 51 per cent, consumers would save about 49 per cent (as illustrated in Figure 4.1 on the preceding page).[55] Over the period 2026-2050, the average household electricity bill would only be $70 higher (Figure 4.2).

This minimal effect comes about because consumers in fully electrified homes are projected to require much less energy to provide the same

Figure 4.2: Electricity bills would be only $70 higher on average under the Safeguard

Average annual household electricity bills in the National Electricity Market, 2026 to 2050 ($2025)



Notes: Average bill calculation based on the consumption and costs faced by all households. See Appendix D for further details.

Source: Grattan analysis of Jacobs (2025).

---

[55] In the Safeguard scenario, total energy bills are $5,851 in 2025, $3,802 in 2040, and $2,996 in 2050. In the 'no new policy' scenario, total energy bills are $5,851 in 2025, $3,794 in 2040, and $2,888 in 2050.

level of services. If they require much less energy, then they can pay a little more for each unit of energy, and still be better off.[56]

The Safeguard scenario presents a stark contrast to the impact of the carbon price in 2012, which was modelled to push up household electricity bills by an average of 7 per cent.[57]

4.2 The Safeguard can cut emissions efficiently

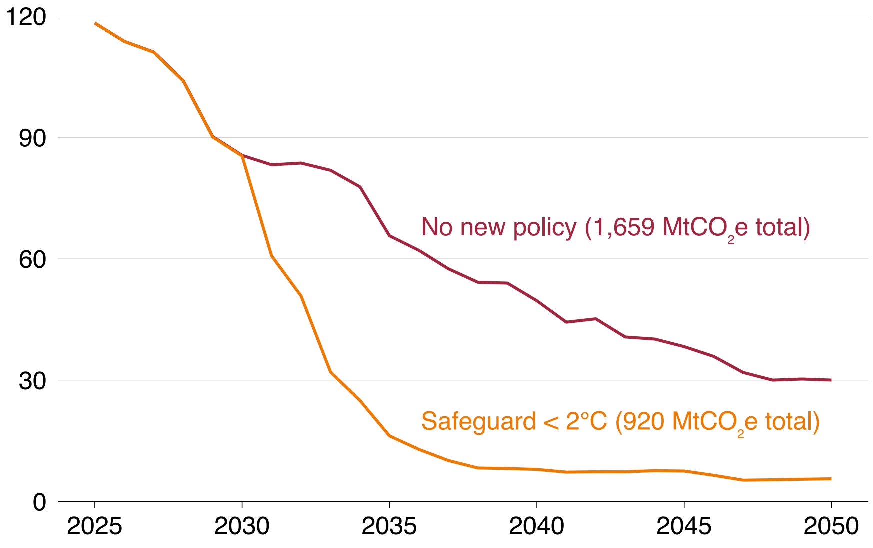
The test of how efficient a carbon policy is hinges on two factors: whether it can keep emissions within the emissions budget, and whether the total system cost of doing so is lower than achieving the same goal through other means.

Our Safeguard scenario achieved both these goals. Emissions fall quickly to achieve the emissions budget of 920 MtCO2-e (Figure 4.3). This is achieved by the exit of coal generation (which occurs by 2037 in the NEM and 2031 in the Western Australian grid) and its replacement by wind generation, which occurs much faster under the Safeguard scenario than under the 'no new policy' scenario. In the Safeguard scenario, all coal-fired generators have exited the market by 2037. By contrast, in the 'no new policy' scenario, coal capacity remains above 5 GW until 2041. In the NEM, over the 20 years from 2030 to 2050, the Safeguard produces 500 TWh less coal power than the 'no new policy' scenario, 120 TWh less gas, and 600 TWh more wind power.

The total system costs to reach this outcome are lower in the Safeguard scenario. When the value of carbon emissions reduction is included, the net present value of total costs is lower than in the 'no new policy' scenario (Figure 4.4 on the next page).

Figure 4.3: Emissions would fall quickly under the Safeguard

Annual and total Australian electricity sector emissions (MtCO$_2$-e), 2026 to 2050



Note: MtCO$_2$-e = millions of tonnes of carbon dioxide-equivalent.

Source: Grattan analysis of Jacobs (2025).

---

[56] It is possible that a sightly higher electricity price will affect the decision as to whether to electrify for poorer consumers. However, these decisions are driven as much by peer pressure as they are by price.

[57] Department of Treasury (2011). The carbon price in 2012 was $23 per tCO$_2$-e, equivalent to $32 today.

The average cost of emissions reduction is relatively low in the Safeguard scenario, at about $85 per tonne across the period 2026 to 2050. This figure compares favourably with the interim values of emissions reductions used by the Australian Energy Market Commission to guide decisions on energy market rules, currently $79 per tonne, and expected to rise to $443 by 2050.[58]

4.3 The effect on prices is limited

There are two price impacts to consider: what happens to the wholesale electricity price, and how this flows through to the retail electricity price. The wholesale price is only 20-to-30 per cent of the retail price, which incorporates other components not directly affected by the policy, including network costs, taxes, profit margins, and the impact of other policies. For this reason, effects on wholesale prices tend to be muted by the time these flow through to retail prices.

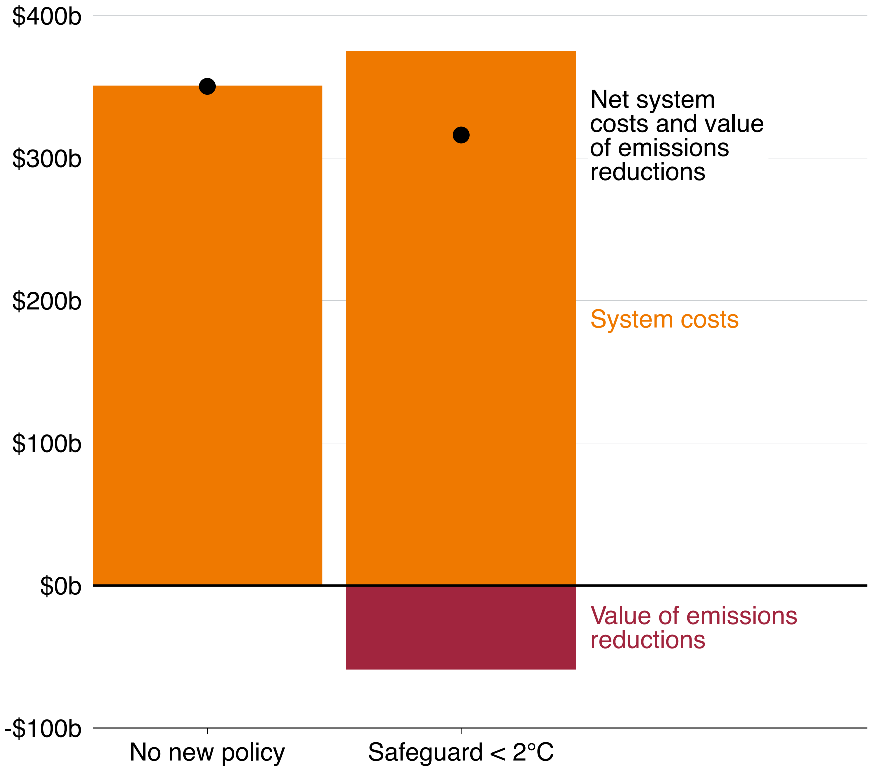
4.3.1 Wholesale prices

The 'no new policy' and Safeguard scenarios have different impacts on wholesale prices (Figure 4.5). Under both scenarios, wholesale prices fall to 2030, as more, cheaper, renewable generation enters the market to meet the Capacity Investment Scheme, and less gas is used.

After 2030, wholesale prices in the 'no new policy' scenario rise to return to the market-determined long-run marginal cost, without the additional renewable investment requirements of the 2030 target. In the Safeguard scenario, prices rise faster to reflect the additional cost of abatement imposed, before they stabilise at about $100 per MWh (see Box 4 on page 33 for more detail).[59]

Figure 4.4: Total system costs would be lower under the Safeguard

Net present value of system costs and emissions reductions ($2025, billions)



Notes: Total net system costs and value of emissions reductions is calculated by summing the present value of the total cost of building, fuelling, and operating generation, storage, and transmission assets. The present value of total emissions reductions is that incremental to the 'no new policy' scenario. The value of emissions reductions is calculated using Australian Energy Market Commission guidance values. Net present value is calculated using a discount rate of 7.4 per cent.

Source: Grattan analysis of Jacobs (2025) and AEMC (2024).

---

[58] Value of emissions reductions converted to 2025 dollars. AER (2024a).

[59] The Safeguard price rises faster in this model than it might in the real world, because there is no forward market for Safeguard Mechanism Credits (SMCs) in this model. Generators are not able to trade SMCs before the policy is

Almost all of the incremental cost of the Safeguard scenario relative to the ‘no new policy’ scenario occurs in the first five years of the policy. In the first five years of the new policy environment (2030 to 2035), wholesale prices in the ‘no new policy’ scenario are on average 20 per cent lower than today, while in the Safeguard scenario they are on average 2 per cent higher than today. Over the 20 years from 2030 to 2050, prices in the ‘no new policy’ scenario are on average 5 per cent higher than today; under the Safeguard they are 11 per cent higher.

4.3.2 Retail prices

The Safeguard scenario shows a similar, but not as dramatic, effect on retail energy prices as on wholesale energy prices.

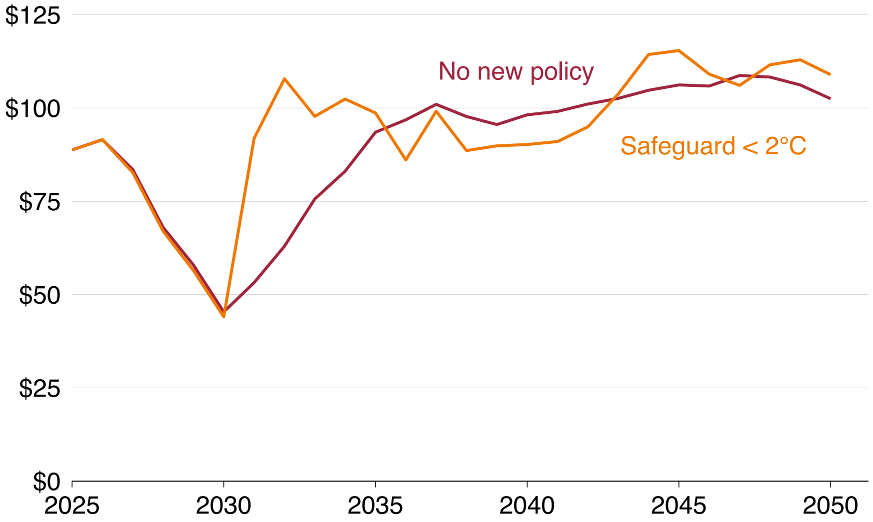
In both scenarios, prices fall to 2030 and then rise again, with prices rising sooner in the Safeguard scenario because of the adjustment cost of pricing carbon (Figure 4.6).

In the first five years of the new policy environment (2030 to 2035), retail prices in the ‘no new policy’ scenario are on average 13 per cent lower than today, while in the Safeguard they are on average 4 per cent lower than today. Over the 20 years from 2030 to 2050, prices in the ‘no new policy’ scenario are on average 2 per cent lower than today; in the Safeguard scenario, prices are 3 per cent higher.

The price effects also vary by state.

Figure 4.5: After an initial adjustment, wholesale prices are similar under both scenarios

Average time-weighted wholesale prices across major Australian grids ($ per MWh) ($2025)



Note: Average prices are calculated by weighting prices in each grid by total sent-out generation.

Source: Grattan analysis of Jacobs (2025).

---

implemented, nor can they predict with certainty what the price of SMCs will be, to guide efficient investment in new low-emissions capacity. However, in the real world there would probably be an increase in investment under the Safeguard in the years to 2030, in anticipation of the imposed Safeguard requirements. This would result in a shallower dip in wholesale prices to 2030, and a less steep rise after 2030.

- In Queensland, South Australia, and Tasmania, the average pattern holds – 'no new policy' prices are slightly lower, and Safeguard prices are slightly higher.

- In Victoria, prices are lower on average under both scenarios. This is driven in part by a reduction in relatively expensive gas generation by about 60 per cent by 2040, and another 20 per cent by 2050.

- In NSW and the ACT, prices are higher under both scenarios. NSW relies heavily on coal generation currently and is less well-positioned to benefit from strong winds than the southern coastline-hugging states.

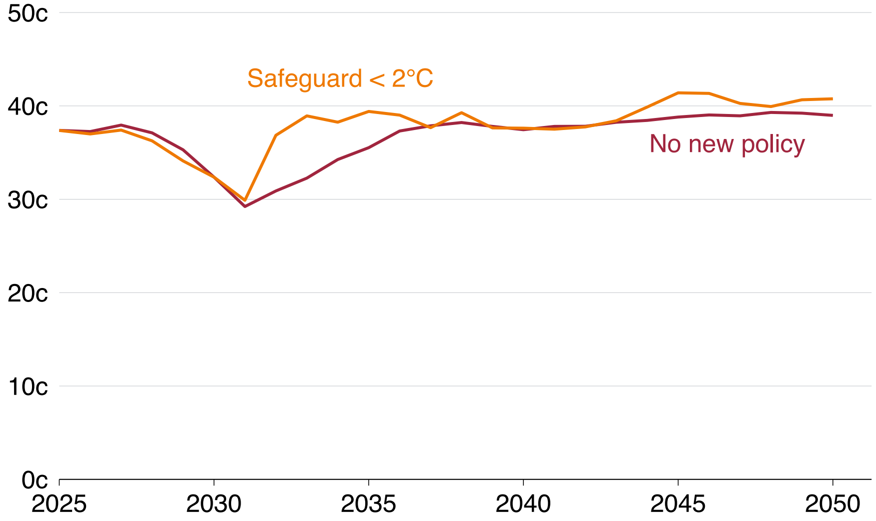
- In WA, prices are higher under both scenarios, in part due to that state's lower gas prices and less optimised environment for renewables. However, in WA the Safeguard makes prices nearly $40/MWh lower on average than the 'no new policy' scenario. This price decrease tracks the reduction in gas use for generation, suggesting that pushing in renewables uptake earlier could reduce overall costs.

Our model also forecasts results for the small grids in north-west WA (NWIS), the Northern Territory (DKIS), and northern Queensland (Mt Isa). These small grids become heavily dependent on gas generation, in part because they are not large enough to economically fund sufficiently reliable renewable generation.

These variations partly reflect underlying economics, and partly reflect modelling specifications – we have identified these differences to emphasise the different experiences of states with different natural endowments and different energy mixes. These differences should be considered when planning for an equitable energy transition.

Figure 4.6: Residential retail prices are similar under both scenarios

Average residential retail prices in the NEM (cents per kWh) ($2025)



Notes: Average prices are calculated by weighting prices in each state by the estimated residential billable volumes. See Appendix D for more details on how we estimated average residential electricity consumption and exports.

Source: Grattan analysis of Jacobs (2025).

4.3.3 There is an initial adjustment cost which may come as a shock

The wholesale and retail prices both experience a shock when the reactivated Safeguard begins to affect prices from 2030. This sharp jump occurs because the carbon impost on fossil-fuel generators drives up their cost of generation (Box 4).

The effect is particularly sharp because more than half of the sector's emissions budget has been consumed before 2030. As the model tries to solve for the remaining budget, it results in high prices for coal generators (because they must now pay for their emissions). As a result, they quickly become uneconomic to operate and leave the market, and are replaced by new renewable generation. Any gap is filled by gas generation, which is also now higher cost because it must also pay for its emissions.

This price shock could be reduced by accelerating policy development

The price shock is an artefact of forcing the model to achieve the Capacity Investment Scheme targets by 2030 (which pushes prices down by forcing more renewables into the market), while not managing the emissions from coal over that period.

It is possible that the shock would be lessened if the policy was introduced earlier, because the coal exit would start earlier but take place over a longer period.

Should households be compensated for the price shock?

The shock to household bills between 2031 and 2035 is about $1,200 over the five years. But because average household energy costs should have already fallen significantly by then (see Figure 4.1 on page 27), households are still better off in those years than now, even though they are worse off than they were in 2030.

Box 4: Wholesale price dynamics between 2025 and 2050 can be explained in three phases.

1. **2025-2030: Meeting Capacity Investment Scheme targets**
   Meeting the CIS targets forces every marginal GW of generation to be renewable. This pushes down the wholesale price as 45 GW of low-cost renewable generation is built and less gas is used.

2. **2030-2035: New policy environment commences**

   a) 'No new policy' scenario: Investment returns to normal and the price gradually returns to long-run, market-determined, marginal cost, close to the 2025 price.

   b) Safeguard scenario: The price spikes as the policy provokes a rapid change in demand for renewable generation. From 2031 to 2038, 7 GW of coal capacity exits the market and 31 GW of wind capacity enters. The higher costs of replacing coal with wind quickly leads to a higher wholesale price.

3. **2035-2050: Normalisation**

   a) 'No new policy' scenario: Price continues to follow its established trajectory.

   b) Safeguard scenario: The Safeguard price, with some variation, tracks the 'no new policy' price. Despite the increased cost of moving towards a lower-emissions grid faster, the lower marginal cost of renewable generation helps bring prices relatively lower.

This reduces the case for any compensation for the average household. However, the 'average' will be comprised of households that are fully electrified and those that aren't, and the latter would bear the brunt of price shocks.

This strengthens the case for governments to increase efforts to ensure all households can access the benefits of electrification. This is discussed further in Section 5.3 on page 38.

The shock may be sharper for commercial and industrial electricity users

Large commercial and industrial electricity users buy electricity on a contract basis. This means their prices are not as standardised as residential prices. In some cases, they are more exposed to changes in wholesale prices.

It is hard to predict the impact of a price change on individual businesses. The share of electricity in a business's cost structure, its capacity to adjust operations, its underlying competitiveness, and its exposure to competition all affect the impact, and these vary considerably.

4.4 The falling cost of the energy transition for households should remove a key political barrier to carbon pricing

Under our Safeguard scenario, the annual household energy bill would rise by only about 3 per cent ($70) per year on average between 2026 and 2050 (Figure 4.2 on page 28). But the impact on emissions would be substantial – by 2050, emissions in the electricity sector would be 6 million tonnes a year, compared to 30 million tonnes a year if no action is taken. Without this contribution to the national target, other sectors would have to pick up the slack.

Meanwhile, because of the benefits of electrification, households would be nearly $3,000 better off each year than they are today.

This should remove one of the key political barriers to carbon pricing.

Provided governments are prepared to put in the work to make the benefits of electrification available to everyone, they can afford to reactivate the Safeguard in the electricity sector, which will lower the costs of getting to net zero.

Box 5: How we modelled the impacts of the Safeguard Mechanism

We wanted to test two key questions. Firstly, how efficiently could the Safeguard Mechanism decarbonise the electricity grid? And secondly, what would its impact be on household electricity and energy costs?

To do this, we first set up a ‘no new policy’ scenario. This scenario assumes that, once the Capacity Investment Scheme has been completed, there is no new policy in the electricity sector aimed at reducing emissions.[a]

Then we set up the Safeguard policy scenario. This model implements a baseline-and-credit scheme confined to the electricity sector, where below-baseline generators (renewables, storage, and, in the early years, gas) receive credits for their generation, which they can then sell to above-baseline generators (coal and, in later years, gas).[b]

We modelled the Safeguard scenario for two levels of climate ambition between 2030 and 2050: a carbon budget consistent with global efforts to limit warming to 1.5℃, and a carbon budget consistent with limiting warming to 2℃. These budgets are based on CSIRO modelling for the Climate Change Authority (see Appendix B for more details).[c]

The model is constrained to meet the carbon budgets using the rules established for the stylised Safeguard, while maintaining the reliability standard.

The policy is announced in 2026, is ‘seen’ and acted on by market participants from 2028, and takes effect from 2030. The effect is that market participants make some small changes to their behaviour before 2030 in anticipation of benefits or costs after 2030; although because there is no market for Safeguard Mechanism Credits until the policy takes effect, responses are muted before 2030.

Full details of the assumptions for each scenario are in Appendix B. A description of how the model works is in Appendix C.

Throughout the report, we present the results of the 2℃ scenario. Limiting the emissions budget in the model to one consistent with 1.5℃ of warming would require building additional capacity of up to 24 GW per annum in order to meet the reliability standard, about four times higher than the highest-ever build rate of 5.9 GW of large-scale generation capacity added in 2023. In the 2℃ case the build requirement is still large, but the maximum build requirement is closer to 14 GW per annum and more achievable.[d]

Results for the 1.5℃ scenario are in Appendix E.

---

a. Energy market models assume no barriers to financing. This means that the recommendations of the NEM review are already built in to the model in the ‘no new policy’ case, and don’t need to be considered separately. As noted in Chapter 1, voluntary REGOs and the ESEM do nothing to penalise emissions.

b. In our model, generators that are above-baseline do not have access to Australian Carbon Credit Units.

c. CCA (2024).

d. Jacobs (2025) and Clean Energy Council (n.d.). This should not be interpreted as settling for lower ambition for climate action. But our modelling suggests that achieving targets consistent with 1.5℃ will require substantially stronger political and policy commitments, with the potential for materially higher short-term financial cost. The Safeguard may not be the best policy to use to achieve the tighter target, or there may need to be other, more directive policies sitting alongside it.

5 What governments should do next

An emissions constraint is needed in the electricity sector beyond 2030 to meet Australia's climate change objectives. As our analysis shows, emissions will remain too high for too long without one.

Cheaper deployed costs for renewable generation, coupled with savings to households from electrification, mean that it is possible to price carbon efficiently while total household energy bills fall. But it's also true that many households face barriers to electrifying, and these barriers need to be removed for these benefits to be realised.

The Safeguard Mechanism, which makes polluting more expensive as well as making cleaner generation cheaper, can deliver an electricity sector transformation at lower overall cost than just leaving it to the market. However, because our modelling used a stylised scenario restricted to the electricity sector, the federal government should do more work to test whether the results hold when this restriction is removed.

Governments should:

- Begin designing and consulting on policies to constrain emissions in the electricity sector from 2030, to complement measures recommended by the NEM review, and to keep costs low for consumers.
- Focus on an extended Safeguard Mechanism and test the effect on the wider economy beyond the limits of our analysis in the context of the review of the Safeguard.
- Maintain and extend programs to ensure that the benefits of electrification are available to all households, especially those on low incomes, renters, and apartment-dwellers.

Our model assumes there are no barriers to building new transmission lines to support a larger electricity system. This simplifying assumption does not reflect real-world experience. Federal, state, and territory governments should continue reforms to make planning approvals faster and easier, and build social licence in host communities.

Ruling out further consideration of constraining carbon in the electricity sector would mean throwing away the opportunity to achieve net zero at lower cost. No party that is committed to protecting Australia from the worst ravages of climate change, and that wants to see the country flourish in the 21st century, should do that.

5.1 Governments should start preparing a carbon constraint for electricity to help keep costs down

Our results show that if electricity markets are left to themselves after 2030, emissions will stay too high for too long.

The proposed reforms to the National Electricity Market, which are aimed at better linking the short-term (spot) wholesale market, medium-term derivatives markets, and long-term investment markets, do not solve this problem.

Indeed, the expert panel conducting the review called in its draft report for governments to clarify how their greenhouse gas emissions targets apply to firming capacity. Without this clarity, it is likely that costs to consumers to keep the lights on in a high-renewables grid will be higher.

There are multiple ways in which carbon could be managed in the electricity market, from carbon taxes and cap-and-trade schemes, to emission standards, offsetting requirements, bans, or phase out-dates.

The Safeguard Mechanism has advantages over all of the above. It is an existing policy, it uses the dynamics of the market to achieve a lower-cost pathway, and it can work across multiple sectors. As a national policy, it would avoid patchwork and inconsistent treatment of carbon emissions across states.

5.2 Before changing the Safeguard, the federal government should do further work

Our Safeguard scenario does not investigate some key considerations essential to policy change.

Firstly, we did not model the impact on compliance by other Safeguard facilities. Adding the electricity sector would affect both supply of and demand for Safeguard Mechanism Credits (SMCs) and Australian Carbon Credit Units (ACCUs), which may change the overall pace and cost of decarbonisation.

There would also be a second-order impact on Safeguard facilities from the changes to electricity prices. Higher electricity prices make electrification of industrial facilities (to avoid emissions from burning coal, gas, or diesel) less attractive. This dynamic could change the pace and pathways of decarbonisation in the industrial sector. Price impacts would also be felt by facilities that already use large amounts of electricity, such as aluminium smelters.[60]

Secondly, we did not allow the use of ACCUs, a key feature of the current Safeguard. Allowing ACCUs could affect the pace and pathways of change in the electricity sector, and the extent of this change would depend on the supply of, demand for, and price of ACCUs.

Thirdly, while we considered the impacts on average household energy costs, we did not consider the relative impacts on high- and low-income households. While average price impacts are small, the impact may be more pointed for particular households, particularly if they have less access to the benefits of electrification. We did not test impacts on commercial and industrial customers, which should also be a consideration.

And fourth, we asked the model to solve for a carbon budget, rather than imposing a declining baseline on each generator. To reactivate the Safeguard in the electricity sector, the government would need to decide on baselines and decline rates. The starting point and decline rate would affect the rate at which the sector decarbonises, and by extension, the rate of coal exit.[61]

In the government's review of the Safeguard Mechanism, it should consider all of these factors, as well as variable impacts by state.

5.2.1 Reactivating the Safeguard in the electricity sector could require rethinking elements of its design

In designing our Safeguard scenario, we had to deviate from current settings in the Safeguard.

Unlike the industrial sector, the electricity sector has significant members (and new entrants) that are zero emissions.

The current Safeguard limits participation to facilities that emit more than 100,000 tonnes of emissions annually. Applied to the electricity sector, this would capture all coal generation and 87 per cent of gas generation. But it would not capture any renewable generators, because these do not emit. If current settings were retained, expansion

---

[60] Electricity price impacts would also flow through to consideration of baseline adjustments made for trade-exposed industries. However, if the government was to adopt a carbon border adjustment mechanism, this would solve that problem.

[61] Noting that a shallow decline rate implies a larger share of the emissions budget, which in the context of the 2035 and net-zero targets means that another sector of the economy may have to reduce its emissions faster.

would bring in sources of emissions, but few sources of SMCs, and would not act as an incentive to build new renewable generation in the same way.

Current Safeguard settings assign new entrants a baseline that reflects world's best-practice emissions intensity of production. In the electricity sector, this value would be zero, because world's best practice is renewable. But a new entrant with a baseline of zero doesn't receive any SMCs, so has no additional financial incentive. A new entrant that has emissions (for example, a gas peaker) will effectively be taxed for all its production. In our model, we gave new entrants a baseline that reflected industry average, so that incentives for better performance were maintained.

As the economy moves towards net zero, zero-emissions facilities should become more common in all sectors. The Safeguard as currently structured doesn't encourage this shift. The federal government should examine incentives for zero- or very low-emissions facilities in the context of the 2026-27 Safeguard Review.

5.3 Governments should plan for all Australian homes to be all-electric

All-electric homes are cheaper to run and better for people's health. Gas alternatives such as hydrogen or biomethane are too costly and too far off for widespread use in homes and small businesses.

It's a big task. About five million households in Australia are on the gas network. There are many barriers to electrification, and all must be addressed.[62] They include the initial cost of upgrading houses, apartments, and rental properties from gas to all-electric, the different interests of renters and landlords, and a myriad of space, wiring, and logistical problems.

5.3.1 About half of all households face barriers to electrifying

About 30 per cent of homes are rented, so the heating, cooking, and water-heating appliances are not chosen by the occupants. If these homes use gas, it will be the landlords' choice as to if (and when) they are upgraded to cheaper-to-run electric appliances.[63]

Installing rooftop solar, batteries, and electric vehicle chargers is also the landlord's choice. All of these investments provide a financial benefit to the tenant, but require capital outlay by the landlord, which is unlikely to be recouped in the term of a single lease.[64]

Then there are owner-occupied households in multi-unit buildings (about 5 per cent of households),[65] which can be tricky to electrify due to communal water or space heating, which requires the consent of all unit owners to change over. Rooftop solar and batteries also may require the consent of all owners, as well as developing a benefit-sharing model. Electric vehicle charging can have costs to the body corporate or owners' corporation, which may not get consent from all owners.

---

[62] Detailed recommendations to remove barriers to household electrification can be found in Grattan Institute's 2023 report, *Getting off gas: Why, how, and who should pay*.

[63] The exception is rental homes in Victoria. From 2027, Victorian landlords will be required to replace gas hot-water systems and heaters with electric ones at the end of the appliance's life. Victorian Government (2025).

[64] A survey of more than 900 landlords testing reasons for not investing in rooftop solar for rental properties found the biggest hurdles were the lack of return on the investment (including not believing that tenants would pay more rent for the property and that the resale value would not be higher), not wanting to make existing tight margins tighter, and that the savings accrue to the tenant: Lang et al (2021).

[65] ABS (2021b).

Finally, about 24 per cent of households are in free-standing owner-occupied homes but are on low incomes or lack the upfront capital to invest in electrification.[66]

Public, community, and Indigenous housing all face similar barriers. For these households, governments are often the landlord (and therefore should take responsibility for ensuring occupants can access the benefits of electrification).

5.3.2 Uncoordinated electrification risks higher costs for some households

Large numbers of gas consumers upgrading to all-electric homes could cause severe gas price rises for those who are left.

While it varies substantially across Australia, a material share of the total gas bill covers the cost of providing the network to deliver the gas. Once constructed, the cost of running the network is much the same regardless of the number of users or the volume of gas they consume.

Uncoordinated and widespread electrification risks creating a 'death spiral', where customers that can electrify do so, leaving those remaining to bear more and more of the cost of the gas network (Figure 5.1).

The challenge for governments is to manage this transition safely and equitably.

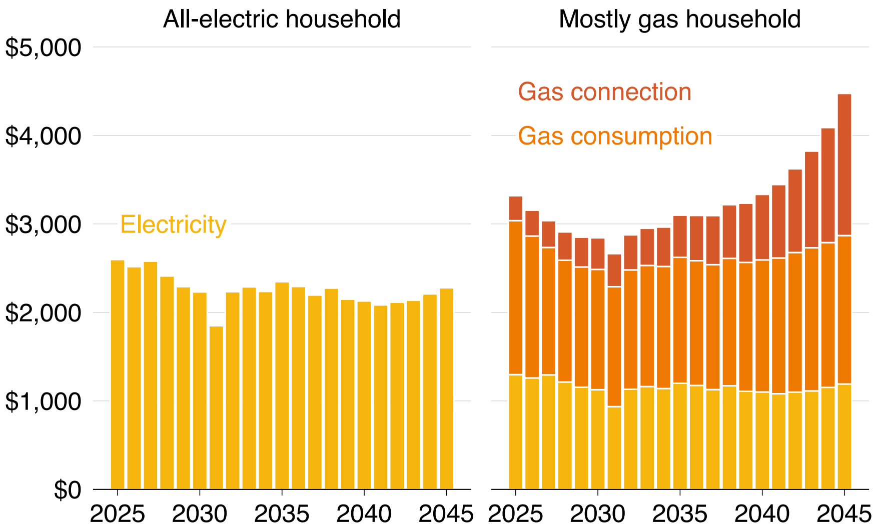
5.3.3 Governments should ensure all households get the benefit of electrification

In Grattan Institute's 2023 report, *Getting off gas: Why, how, and who should pay*,[67] we set out recommendations for a coordinated national approach to electrification of households. Governments should:

- provide certainty about direction and timing by setting dates for the end of gas;
- prepare and roll out long-term, consistent, targeted communications campaigns on why households should switch to all-electric, and how best to do it;
- pay for upgrades to social, community, and Indigenous housing, and provide low-interest loans or similar financing agreements for homeowners, and tax incentives for landlords; and, at a future date
- phase out the sale of natural gas appliances, so that the last remaining gas appliances are replaced with electric ones.

Figure 5.1: As connection charges grow, households that are stuck on gas will pay far more

Annual gas and electricity costs by household type ($2025)



Source: Grattan analysis. See Appendix D for further details.

---

[66] Ibid.

[67] Wood et al (2023).

These activities must be supported by plans to safely decommission the gas network, and upgrade the electricity grid so it can cope with the extra demand.

5.4 Ensure transmission is available to support new generation

Our model assumes there are no barriers to building new transmission lines to support a larger electricity system. This simplifying assumption does not reflect real-world experience.

Delays in bringing on new transmission are already acting as a brake on new renewable generation to replace ageing coal generators. Hurdles include unclear funding guidelines, drawn-out regulatory processes, social licence, difficulty in securing land along planned routes, contractor insolvency issues, skilled labour shortages, and supply chain constraints.[68]

Governments can influence only some of these issues. Federal, state, and territory governments should continue reforms to make planning approvals for transmission faster and easier, and build social licence in host communities.

5.5 Beyond an expanded Safeguard

As set out in Chapter 3, the Safeguard on balance provides the best pathway to introducing carbon pricing into the electricity sector. Because it already applies in the industrial sector, it allows for trade-offs to be made between reducing electricity emissions and reducing industrial emissions.

But the Safeguard is not the most economically efficient way to use emissions trading to achieve a least-cost pathway to net zero – that would be a cap-and-trade emissions trading scheme. As set out in Grattan Institute's 2016 report, *Climate Phoenix*,[69] there is a clear pathway from the Safeguard to harmonised cap-and-trade pricing across the economy, should a future government wish to take it.

---

[68] Allens (2024).

[69] Wood et al (2016).

Appendix A: Detailed policy scenarios

This appendix outlines the no-new-policy and Safeguard scenarios modelled for this report.

A.1 The no-new-policy scenario

Under this scenario current policy settings relating to energy markets and carbon mitigation remain in place. There is no new policy post 2030 to mitigate carbon emissions in the electricity sector.

Specific scenario assumptions include:

- The Large-scale Renewable Energy Target remains in place but expires as legislated at the end of 2030.
- The Capacity Investment Scheme is used to fund renewable energy and energy storage projects, funding 23 GW of new renewable energy capacity and 9 GW of energy storage capacity in the period to 2030 across the National Electricity Market (NEM), the Wholesale Electricity Market (WEM), which supplies electricity to the south-west of Western Australia, and the Darwin-Katherine interconnected system (DKIS). Apart from projects already successful under the scheme tenders, we allow the model to choose what technologies make up the rest of the capacity required. Additional capacity is based on the model's selection of the least-cost mix of technologies.
- State energy policies are not considered.
- Announced retirement dates are met.

A.2 The Safeguard scenario

In our scenario, the electricity sector baseline is reduced from 198 million tCO2-e per annum to zero on 1 July 2030. This triggers every grid-connected generator whose emissions are above 100,000 tCO2-e per annum to become an individual facility. However, this precludes any participation (and therefore Safeguard Mechanism Credits, or SMCs) from renewable generators, because their emissions are zero. It also excludes many of the smaller gas generators whose emissions are less than 100,000 tCO2-e annually.

To allow all generators to participate (which should achieve the most efficient outcome with respect to the emissions budget), we removed the 100,000 tCO2-e threshold, so that all generators become Safeguard Facilities, subject to a facility baseline and eligible to create SMCs.

Individual facility baselines are calculated from the facility output (MWh of electricity) and an emissions intensity value. The emissions intensity value starts at the grid average emissions intensity in 2030. Generators who are above their baselines must obtain SMCs to offset these emissions; generators who are below are awarded SMCs.

We did not allow generators to use Australian Carbon Credit Units (ACCUs) to offset above-baseline emissions. This is a simplifying assumption, made because of the lack of consistent and reliable forward supply and price information for ACCUs. Because there are no ACCUs, there is no access to the cost-containment mechanism.

Because we were only concerned with effects in the electricity sector, we did not allow SMCs from electricity to be traded outside the electricity sector, nor did we allow generators to surrender SMCs created outside the electricity sector. This is a simplifying assumption, made to avoid having to model likely emissions reductions and Safeguard liabilities in the mining, industrial, transport, and waste sectors.

Costs are passed on to all consumers via the wholesale price of electricity, with no exemptions for emissions-intensive trade-exposed industries.

We did not set a penalty for non-compliance – it was assumed to be so high that it would always be cheaper for an entity to meet its baseline.

Appendix B: Determining carbon budgets for the electricity sector

We modelled a decarbonisation pathway for the electricity sector that is consistent with the A50/G2 scenario described in the Climate Change Authority's 2024 Sector Pathways Report.[70] This scenario represents climate action that is aligned with Australia's existing emissions targets and net zero by 2050. As a sensitivity test, we also modelled a scenario in which Australia takes more ambitious action to reach net zero by 2040 and limits its emissions contribution to an amount consistent with 1.5℃ of global warming.

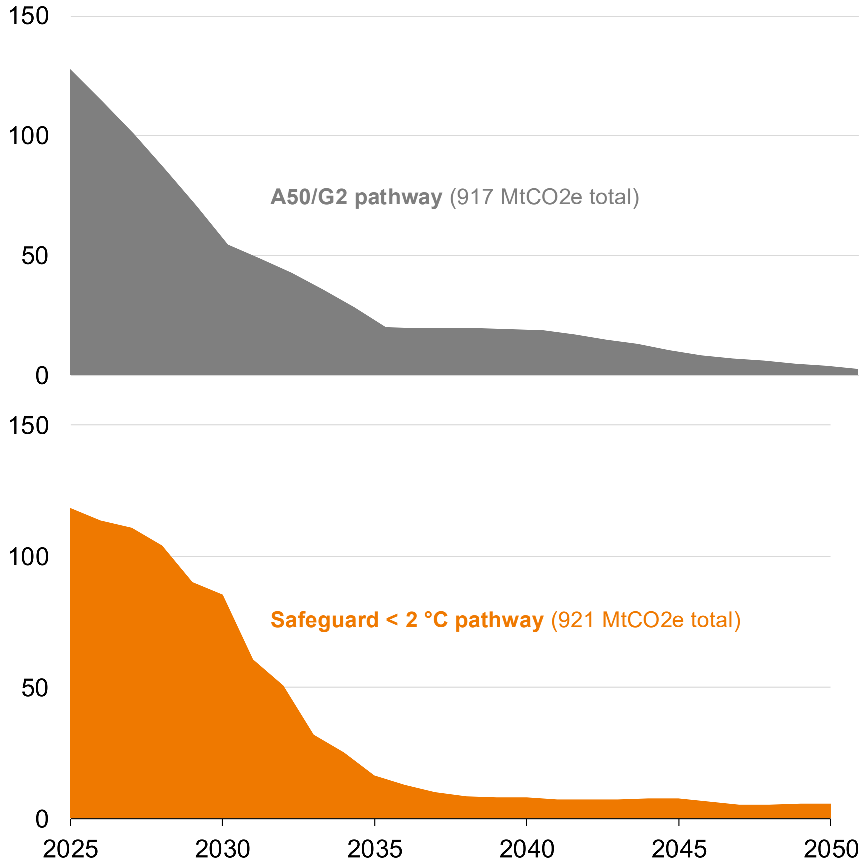
The carbon budget we have chosen is indicative only and does not consider interactions with other parts of the economy. The carbon budget used should not be considered as outlining the optimal decarbonisation path for Australia.

The carbon emissions projected in the Climate Change Authority's Sector Pathways Report are based on a particular scenario of electricity demand. Because this scenario does not align with the demand assumptions used in our modelling, we used the emissions intensity of the sector, rather than the absolute emissions, to determine the carbon budget. The A50/G2 emissions intensity pathway sets out how rapidly the electricity sector must reduce its emissions intensity to enable other sectors to transition away from fossil fuels through electrification and meet Australia's current emissions targets.

The emissions budget for the electricity sector was determined by multiplying the A50/G2 emissions intensity by the demand of the national electricity markets, as predicted by AEMO and Jacobs. This calculation produced a total emissions budget for 2025 to 2050. The total emissions budget for the electricity sector in the 2℃ scenarios

Figure B.1: Cumulative emissions from policy scenarios are within 4 Mt CO2e of the Climate Change Authority's electricity sector emissions

Emissions ($MtCO_2$-e)



Source: Grattan analysis of Jacobs (2025).

---

[70] CCA (2024).

was 917 Mt. The total emissions budget for the electricity sector in the 1.5℃ scenarios was 719 Mt.

B.0.1 The carbon budget differs to those used in the Integrated System Plan

The Integrated System Plan sets carbon budgets for 2026-27 to 2049-50. These are 727 MtCO2-e in the ‘slow growth’ scenario (consistent with global temperature rise of 2.6℃), 583 MtCO2-e in the ‘step change’ scenario (consistent with global temperature rise of 1.8℃), and 303 MtCO2-e in ’accelerated transition’ scenario (consistent with global temperature rise of 1.5℃).

These differ from our budgets because:

1. They only apply to the NEM, whereas our budgets apply to the whole country.
2. They apply over a different timeframe.
3. They are consistent with different global temperature goals.

Appendix C: Description of Jacobs energy market model

This appendix summarises Jacobs' approach to the energy market modelling and the key limitations of the model. Jacobs' own report provides more detail and can be read alongside Grattan's report for more detail on the approach, assumptions, and caveats.

Grattan commissioned Jacobs to run an Australia-wide electricity market study. The modelling covered all major grids: the National Electricity Market (NEM), the Wholesale Electricity Market in south-west WA (WEM), the North West Interconnected System in the Pilbara (NWIS), the Darwin-Katherine interconnected system in the NT (DKIS), and the Mt Isa grid. The study tested how different carbon pricing policies would affect electricity supply, costs, and emissions under carbon budgets aligned with 1.5℃ and 2℃ warming.

The analysis was done using Strategist, a licensed dynamic programming tool that simulates least-cost capacity expansion and dispatch across each market. Strategist factors in fuel costs, technology efficiencies, capital costs, and emissions intensity over long horizons using typical weather conditions. Two in-house Jacobs tools complemented this:

- REMMA (Renewable Energy Market Modelling and Assessment) evaluates renewable generator profitability and portfolio dynamics under different policy scenarios.
- TRAM (Thermal Retirement Assessment Model) tests the economic viability of thermal generators and timing of their retirement based on profitability, age, technical limits, and market conditions. In practice, this determines how quickly coal and gas exits the system under different policy settings.

C.1 Core assumptions

Jacobs' modelling applied a consistent set of assumptions across markets:

- **Demand and technology:** Regional forecasts and CSIRO GenCost data underpin load growth and technology cost trends.
- **Policy foresight:** Generators are assumed to have perfect foresight, with full credibility of carbon pricing policies announced in 2026 and commencing in 2030.
- **Capacity planning:** New capacity is added to meet reserve margins, including demand-side response.
- **Generator behaviour:** Generators act rationally, retiring uneconomic assets and bidding at cost.
- **Renewable entry:** Limited by profitability; frequent zero or negative prices constrain entry and can trigger retirements.
- **Price formation:** Long-term prices are capped at the cost of new entry, while short-term prices reflect market dynamics.
- **Transmission:** Upgrades are included to relieve constraints and enable inter-regional flows.
- **Simplifications:** Ramp rates, start-up costs, and wider economic feedback effects are excluded.
- **Policy horizon:** The model runs from 2025 to 2050, with carbon pricing options active from 2030.

The dynamic programming method in Strategist selects new capacity on a least-cost basis. In Jacobs' experience, the model has been generally accurate in the prediction of the future generation mix, with the main deviations from predicted investment the result of:

- economies of scale
- pre-emptive new entry
- fuel supply arrangements
- interconnection upgrades included in the Strategist modelling as development options in competition with new generation capacity.

Future wholesale electricity prices and related market outcomes are driven by the supply and demand balance, with long-term prices being effectively capped at the cost of new entry on the assumption that prices above this level provide economic signals for new generation to enter the market. Consequently, assumptions on the fuel costs, unit efficiencies, and capital costs of new plant and emissions intensity threshold will have a noticeable impact on long-term price forecasts.

Year-to-year prices will deviate from the new-entry cost level based on the timing of new entry. In periods when new entry is not required, the market prices reflect the cost of generation to meet regional loads, and the bidding behaviour of the market participants as affected by market power.

Negative price period prices are limited in the modelling for the following reasons:

- Jacobs models hourly demand profiles for typical weeks in each month of the projection period.
- The modelling is optimised over average weather conditions (50 per cent probability of exceedance) so does not model outcomes for when we have warmer than normal days in winter or summer.
- Modelling includes transmission and interconnector upgrades, which will relieve network constraints and remove bottlenecks on interconnectors.
- There is significant uptake of storage and EV charging (in the long term) which means that middle-of-day demand is boosted.
- Continuing uptake of solar photovoltaic (PV) in the models is limited by the level of profitable entry. If there are too many zero or negative price periods, then prospective new plants may not earn enough revenue to recover capital and investment costs, and hence they do not enter the market. Similarly, if there are too many zero price periods, then eventually some incumbent thermal plants become unprofitable and are retired.

Key assumptions used in the modelling include:

- Capacity is installed to meet the target reserve margin in each region. Some of this peaking capacity may represent a demand-side response rather than physical generation assets.
- Wind generation is based on observed wind power generation profiles for each region for 2019.
- Generators behave rationally, with uneconomic capacity withdrawn from the market and bidding strategies limited by the cost of new entry. This is a conservative assumption because there have been periods when prices have exceeded new entry costs when averaged over 12 months.
- Infrequently used peaking resources are bid near the market price cap or removed from the simulation to represent strategic bidding of these resources when demand is moderate or low.
- The LRET target requires 33,000 GWh of renewable generation annually until 2030, and was first met in 2020.

C.2 Retail prices

Jacobs built retail price projections on top of wholesale forecasts, incorporating all major cost components:

- **Network charges:** regulated transmission and distribution costs.
- **Retailer costs and margins:** operating expenses, customer services, and commercial margins.
- **Policy and scheme costs:** obligations such as renewable energy targets or efficiency schemes.
- **Loss factors:** adjustments for electricity lost in transmission and distribution.
- **Risk premiums:** allowances for market and operational risk.
- **Contracting practices:** hedging smooths wholesale volatility, so retail prices move more gradually than spot prices.

C.3 Key limitations

The modelling is designed to illustrate the relative performance of policy options under defined emissions constraints. Results are projections, not forecasts. Main limitations and assumptions include the following:

- **Operational simplifications:** excludes short-term dynamics such as ramp rates and start-up costs for thermal plants, which are considered negligible over the 25-year horizon.
- **Perfect foresight:** investment and dispatch decisions assume perfect market foresight, including of future fuel and capital costs.
- **Credible policies:** assumes policies announced in 2026 are implemented in 2030.
- **Carbon budgets:** fixed for 2025–2050, based on Climate Change Authority guidance.
- **Economic scope:** does not include indirect or second-round impacts on the wider economy.
- **Construction bottlenecks:** many of the policies result in rapid construction to replace the coal fleet in a short space of time. In practice this rapid construction may increase the price of inputs due to ‘bottlenecks’ in construction. As these increases would be reasonably uniform across scenarios and small relative to the large overall levels of investment across the scenarios, they were not estimated here.
- **Policy horizon:** modelling ends in 2050, without accounting for future policy evolution.
- **Demand and technology uncertainty:** outcomes are sensitive to demand growth and technology costs; social costs and unforeseen coal plant issues are excluded.
- **Uncertainty over time:** projections become less reliable further into the horizon.
- **Gas supply:** results focus on electricity-sector responses, not wider gas market dynamics.

Appendix D: Modelling household consumption and costs

Throughout this report, we present energy costs and savings for the average household and for different household types. Household types are defined by the type of appliances and technology they use to consume and generate energy. This appendix describes how we defined these households and our methodology for calculating the costs they face for their energy consumption.

D.1 Defining average household consumption

The average household that we present in this report represents an estimate of the total residential consumption of electricity, gas, and petrol over time, divided by the total number of households. The average household does not represent a real or typical household, but instead estimates the consumption and costs faced by all households, on average. Consistent with the assumptions used for the electricity market modelling, our estimates represent projected residential consumption from AEMO's forecasts of electricity and gas use[71] divided by the forecast number of households.[72]

Using these forecasts, we estimate the changing energy use of Australian households from 2025 to 2050. Further details on the assumptions used are provided in Table D.1.

D.1.1 Average household time-of-use profiles

AEMO's projections in the 2024 Electricity Statement of Opportunities (ESOO) provide us with underlying electricity demand and total rooftop solar (PV) generation for households, but do not capture what proportion of the electricity consumed by households is imported from the grid, generated and consumed on-site, or exported back to the grid. As consumers face different prices for electricity imports and exports, we need to model the way household consumption changes throughout the day and the effect of rooftop PV and battery systems on household demand. These daily patterns of demand are called time-of-use profiles (see Figure D.1 for an example of our modelled time-of use profiles).

To do this, we break down the components of residential demand into three categories:

- Household electricity demand based on projections of current energy mix (**Baseline demand**)
- Additional electricity demand associated with switching gas appliances over to electric (**Electrification demand**)
- Household demand from electric vehicles (**EV demand**)

We then segment our consumers into those without rooftop PV, those with rooftop PV, and those with both rooftop PV and battery systems, and estimate the effect of these technologies on household consumption and exports. Our average consumer represents a weighted average of each of these consumer segments according to AEMO and CSIRO forecasts.

Baseline demand

We derive time-of-use electricity profiles for average household cooking, water heating, space heating, and appliance use from the 2021 Residential Baseline Study (RBS).[73] These profiles are then

---

[71] AEMO (2024a) and AEMO (2024d).

[72] AEMO (2024e) and AEMO (2024f).

[73] EnergyConsult (2022).

scaled to equal the underlying residential demand per household, excluding electrification and EV demand, as forecast by AEMO.[74]

Due to the under-representation of electrical heating load in Victoria in the RBS, time-of-use load profiles for heating and cooling in Victoria were sourced from the 'MyTown Microgrid' study of residential load profiles in the Victorian town of Heyfield.[75]

Electrification demand

As part of the transition to net zero, consumers are increasingly switching from gas to electric appliances. The time-of-use profile of the electrified demand will look different to the current baseline demand.[76]

To estimate the time-of-use profile of electrified demand, we use the baseline time-of-use profiles (above) for cooking, water heating, and space heating. The profiles are then weighted by the total expected electrification demand for each end use, to derive a single time-of-use profile for electrified load. The weights are calculated from the current gas consumption for each end use, by state, converted into electrical demand using assumptions about relative appliance efficiencies for gas and electric appliances (see Table D.3).

EV demand

To align petrol and electric vehicle consumption, we assume all households own the average number of vehicles.[77] The number of passenger vehicles per household is derived from 2021 ABS data,[78] and each vehicle is driven the average distance each year.[79] The proportion of vehicle kilometres that are met by petrol or electricity is determined by AEMO projections of the composition of the vehicle fleet.[80] See Table D.1 for more details.

Rooftop PV and batteries

A proportion of households generate electricity with rooftop PV and shift the time that they consume electricity using batteries. To determine average household costs we need to estimate what proportion of households have access to these technologies and the electricity demand of these households.

We determine the proportion of households that have access to PV and batteries using forecasts from AEMO and CSIRO.

For homes with rooftop PV, we subtract the estimated PV generation profile from the sum of average baseline, electrification, and EV demand for each hour of the day. This way we calculate the total electricity imported from and exported to the grid.

For households with solar and batteries, we assume batteries operate on a simple 'solar-shift' algorithm that charges the battery when there is excess solar, and discharges the battery when the household would otherwise import electricity, until the battery is discharged. See Table D.1 for more details on assumed battery capacity and characteristics.

---

[74] AEMO (2024a) and AEMO (2024d).

[75] Mohseni et al (2023).

[76] For example, in Victoria most households use gas to heat their home, so current data on the use of electricity in Victoria does not include a large proportion of the heating load. As Victorian's electrify their heating systems, the time of day that most electricity is used will change.

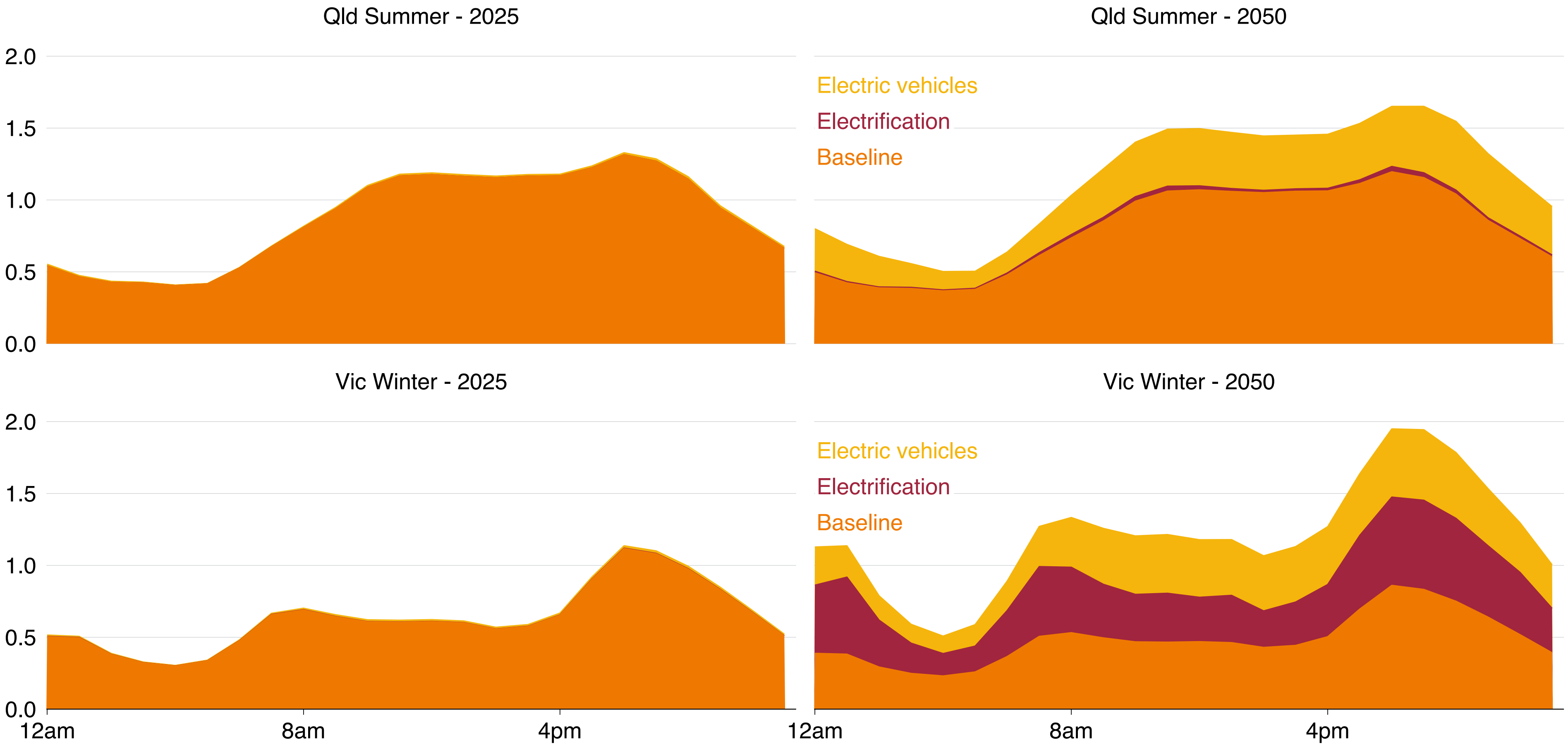
[77] We only include passenger vehicles and do not include residential use of small commercial vehicles.

[78] ABS (2021a) and ABS (2024).

[79] ABS (2018).

[80] AEMO (2024g) and AEMO (2024h).

Figure D.1: Underlying electricity demand will change substantially over time
Average time-of-use demand for a household without solar (kilowatts)



Source: Grattan analysis.

Table D.1: Key assumptions for average household energy consumption

Assumption	Details
Average annual household electricity demand	AEMO forecasts of residential underlying demand (the sum of residential delivered and rooftop PV generation) divided by the forecast number of household connections.[81] Demand from electric vehicles was treated separately: see electric vehicle consumption below.
Total number of residential connections	The number of households in each jurisdiction is taken from AEMO residential connections forecasts.[82] Forecasts for the WA South-West Interconnected System (SWIS) only include new connections, so the existing number of connections were taken from the 2023 Synergy retail performance report.[83]
Baseline time-of-use load profiles	Derived from the 2020 average time-of-use demand of households in the 2021 Residential Baseline Study (RBS).[84] Due to the under representation of electrical heating load in Victoria in the RBS, time-of-use load profiles for heating and cooling in Victoria were sourced from the 'MyTown Microgrid' study of residential load profiles in the town of Heyfield, Victoria.[85]
Electrification time of-use load profiles	Time-of-use profiles for electrification demand were derived from the baseline time-of-use profiles (above) for cooking, water heating, and space heating. Profiles were weighted by the total expected electrification demand for each end use. See Appendix D.1.1 for more detail.
Average household gas consumption	AEMO forecasts of residential and commercial demand from the Gas Statement of Opportunities and Tariff V demand from the Western Australia Gas Statement of Opportunities.[86] The proportion of residential and commercial demand that is attributable to residential customers was estimated using Australian Energy Regulator (AER) consumption benchmarks[87] and residential connections data from regulatory performance reporting documents.[88] This proportion is assumed to be constant over time.

Continued on next page

---

[81] AEMO (2024a) and AEMO (2024d).
[82] AEMO (2024e) and AEMO (2024f).
[83] Synergy (2023).
[84] EnergyConsult (2022).
[85] Mohseni et al (2023).
[86] AEMO (2024b) and AEMO (2024i).
[87] Frontier Economics (2020).
[88] AER (2024b), Essential Services Comission (2024), Tasmanian Economic Regulator (2025), and Economic Regulation Authority (2025).

Table D.1 – *continued from previous page*

Assumption	**Details**
Number of motor vehicles per household	Held constant at 1.5 vehicles throughout the forecast period. This reflects the Australian average number of passenger vehicles per household in 2021.[89]
Average distance travelled per vehicle	Each vehicle is assumed to be driven the average number of kilometres for that state, taken from the ABS Survey of Motor Vehicle Use.[90] We use survey data from the 2017-18 financial year, to avoid effects of the COVID-19 pandemic, and deflate the distance travelled by 10 per cent, consistent with CSIRO vehicle projections.[91]
Average fuel efficiency (Internal Combustion Engine vehicles)	Average fuel efficiency has remained flat over the past decade.[92] Any efficiency improvements have been compensated for by larger vehicle size. Increased uptake of non-plug-in hybrids and continued efficiency improvements may result in a decline in fuel consumption per kilometre over the longer term. To conservatively estimate electric vehicle savings, we take the average fuel efficiency of the ICE (petrol/diesel) passenger car fleet in 2020[93] and assume a 1.5 per cent per annum improvement in fuel efficiency over the forecast period. This is in line with longer-term historical trends.[94]
Electrical vehicle demand per vehicle	Electric vehicle time-of-use charging profiles were based on a weighted average of vehicle size and charging behaviour type from the 2024 ESOO Electric Vehicle Workbook.[95] Annual consumption per vehicle was derived from electric vehicle efficiency projections from CSIRO,[96] multiplied by the average distance travelled per vehicle (above). The charging profiles were then scaled so that their totals were equal to the calculated annual consumption.

Continued on next page

---

[89] ABS (2021a) and ABS (2024).
[90] ABS (2018).
[91] Graham et al (2024, p. 32).
[92] ABS (2020).
[93] Ibid.
[94] Terrill et al (2021).
[95] AEMO (2024g) and AEMO (2024h).
[96] Graham et al (2024, p. 30).

Table D.1 – *continued from previous page*

Assumption	Details
Household rooftop PV	Total behind-the-meter household rooftop PV generation was taken from AEMO projections.[97] This generation was distributed evenly among households with PV installations. The proportion of households with rooftop PV was taken from CSIRO forecasts.[98] Time-of-use profiles for PV generation were derived using the US government 'PVWatts Calculator' tool.[99] Profiles for each state were taken from the respective capital city and scaled to reflect total generation per installation. Curtailment rates are taken from each modelled scenario completed by Jacobs.[100]
Household batteries	Total degraded residential battery capacity is derived from AEMO forecasts of embedded energy storage capacity.[101] The total degraded capacity is deflated by 7 per cent to represent the proportion of storage capacity that is expected to be attributed to small-commercial users.[102] Due to a lack of data on individual installation sizes, total battery capacity is assumed to be comprised of 11 kilowatt-hour systems and is allocated to a proportion of the households with PV installed. Due to data limitations, the prevalence of household batteries in the SWIS is assumed to be equal to the calculated average prevalence in the NEM. Battery characteristics such as round-trip efficiency and maximum power are taken from CSIRO assumptions.[103] Battery behaviour is assumed to follow a simple 'solar-shift' algorithm that charges the battery when there is excess solar, and discharges the battery when the household would otherwise import electricity, until the battery is discharged.

---

[97] AEMO (2024e) and AEMO (2024f).
[98] Graham and Mediwaththe (2024).
[99] NREL (2025).
[100] Jacobs (2025).
[101] AEMO (2024e).
[102] Graham and Mediwaththe (2024, pp. 52, 53).
[103] Graham and Mediwaththe (2022, p. 60).

D.2 Defining households types and their consumption

We modelled a number of different household types to understand the different costs they face, the benefits of electrification, and the benefits of access to rooftop PV and batteries. To do this, we estimated average household energy consumption for each major household end use (cooking, space heating, water heating, transport), depending on whether electricity, gas, or petrol is used to fuel the usage. We then modelled the overall energy consumption of different household types by adding these estimates together. Table D.2 shows the different types of households that we modelled.

We defined our household types and their energy usage predominantly by using the RBS.[104] The RBS represents average energy use across all households in each state, each using a mix of fuels. To estimate the household energy consumption of a home with a single fuel source for each end use, we converted energy use between fuels using assumptions about the types of appliances that would be substituted between electricity and gas users (see Table D.3 for more details).

Table D.2: Household types that we modelled

Variable	Possible values	Example A	Example B
Cooking	{Gas, Electric}	Electric	Gas
Space heating	{Gas, Electric}	Electric	Electric
Water heating	{Gas, Electric}	Electric	Gas
PV	{True, False}	True	True
Battery	{True, False}	True	False
Electric vehicles	All positive real numbers	1	0
ICE vehicles	All positive real numbers	0	2
State	NSW and ACT, Qld, Vic, SA, WA, and Tas	NSW and ACT	Qld

---

[104] EnergyConsult (2022).

Table D.3: Key assumptions for estimating energy consumption of different household types

Assumption	Details
Average annual household electricity and gas demand	Derived from the 2021 RBS.[105] The reference year for our household consumption is 2020,[106] and is adjusted only for energy efficiency over the forward period (see below). This means our estimates should only be used to compare the relative consumption and costs of different household types and not as a forecast of future household consumption. Transport demand is modelled separately.
Relative efficiencies of gas and electric appliances	**Cooking:** Electric cooktops were assumed to be 57 per cent more efficient than gas cooktops.[107]
	Water heating: Water heating efficiencies were based on the most common appliance type for gas and electricity (electric storage and gas instantaneous water heaters)[108] to best reflect the average consumption for a single-fuel home. Electric storage systems were assumed to be 19 per cent more efficient than gas instantaneous systems.[109]
	Space heating: Space heating efficiencies were also based on the most common appliance types (reverse cycle air conditioning and ducted gas systems). The coefficient of performance of reverse cycle systems was assumed to be 3.65, and 0.88 for ducted gas systems.[110] Ducted gas systems were assumed to have losses of 20 per cent due to ducting.
Time-of-use load profiles	Derived from the 2020 average time-of-use demand of households in the 2021 RBS.[111] Due to the under-representation of electrical heating load in Victoria in the RBS, time-of-use load profiles for heating and cooling in Victoria were sourced from the 'MyTown Microgrid' study of residential load profiles in the town of Heyfield, Victoria.[112]

Continued on next page

---

[105] Ibid.

[106] The RBS is a bottom-up study that estimates household energy consumption based on estimates of appliance and housing stock and does not reflect observed changes in demand. The impact of the COVID-19 pandemic is not included in these estimates.

[107] Frontier Energy (2019).

[108] EnergyConsult (2022).

[109] Tidemann et al (2022, p. 3).

[110] Ibid (p. 3).

[111] EnergyConsult (2022).

[112] Mohseni et al (2023).

Table D.3 – *continued from previous page*

Assumption	**Details**
Average household gas consumption	AEMO forecasts of residential and commercial demand from the Gas Statement of Opportunities and Tariff V demand from the Western Australia Gas Statement of Opportunities.[113] The proportion of residential and commercial demand that is attributable to residential customers was estimated using AER consumption benchmarks[114] and residential connections data from regulatory performance reporting documents.[115] This proportion is assumed to be constant over time.
Average distance travelled per vehicle	The same assumption as used for household averages. Found in Table D.1
Average fuel efficiency (ICE vehicles)	The same assumption as used for household averages. Found in Table D.1
Electrical vehicle demand per vehicle	The same assumption as used for household averages. Found in Table D.1
Household rooftop PV	Households with PV were assumed to have a 7 kilowatt system installed. Time-of-use profiles for PV generation were derived using the US government 'PVWatts Calculator' tool.[116] Profiles for each state were taken from the respective capital city and scaled to reflect average capacity factors modelled by AEMO.[117]
Household batteries	Households with batteries are assumed to have an 11 kilowatt system installed. Battery characteristics such as round-trip efficiency and maximum power are taken from CSIRO assumptions.[118] Battery behaviour is assumed to follow a simple 'solar-shift' algorithm that charges the battery when there is excess solar, and discharges the battery when the household would otherwise import electricity, until the battery is discharged.

---

[113] AEMO (2024b) and AEMO (2024i).

[114] Frontier Economics (2020).

[115] AER (2024b), Essential Services Comission (2024), Tasmanian Economic Regulator (2025), and Economic Regulation Authority (2025).

[116] NREL (2025).

[117] Graham and Mediwaththe (2024, p. 57).

[118] Graham and Mediwaththe (2022, p. 60).

D.3 Calculating energy bills

D.3.1 Electricity

Retail electricity tariffs in each state were selected from the best offers from the 'big three' retailers (AGL, EnergyAustralia, and Origin Energy).[119] The best offer was determined using government comparison sites where available.[120] Electricity tariffs were then scaled over the forecast period using modelled retail prices received from Jacobs.[121]

Feed-in tariffs for rooftop solar were taken from Jacobs' forecasts and are assumed to decline to zero in all jurisdictions by 2030.[122]

D.3.2 Gas

The starting point for retail gas prices was also taken from the best offers from the 'big three' retailers, using the same comparison sites as for electricity. The component of the gas bill that is charged based on the quantity of gas consumed was then scaled according to wholesale gas price forecasts by ACIL Allen for the 2024 Gas Statement of Opportunities.[123]

Residential gas bills also include a supply charge that represents the gas distribution network costs to supply the home with energy. As consumers switch from gas to electricity, these network costs will be paid for by a diminishing pool of households, and prices will increase. To approximate the change in supply charges over time, we assume that the charges increase proportionally to the decrease in the number of residential gas customers in each state. This leads to substantial increases in supply charges to those left on the network, as shown in Figure D.2. This is a relatively simplistic assumption, and may not reflect how the costs of the gas network are actually distributed as gas use declines. The assumption also does not take into account changes in the network asset base that will also occur as network utilisation decreases. Despite this simplicity, our results are comparable with other recent projections.[124] Because our model does not account for the likely decline in overall gas network costs, our consumer bill estimates past 2040 are likely to be slightly inflated. Because gas represents a very small portion of household energy costs beyond 2040, this is unlikely to substantially alter our results. Our household type comparisons are only included for gas households out to 2040.

The number of residential customers that remain in each state is estimated using consumption benchmarks from Frontier Economics,[125] gas connections data from regulatory performance reports,[126] and the 2024 Gas Statement of Opportunities.[127] Gas consumption per connection is assumed to be constant over time.

D.3.3 Petrol

Petrol prices were based on 2025 March quarter prices in the capital city of each state[128] and were held constant in real terms over the modelled period.

---

[119] AGL, EnergyAustralia, and Origin Energy collectively serve most electricity customers in the NEM: AER 2025.

[120] NSW, Qld, ACT, and SA: AER n.d. Vic: DEECA (2025). WA and Tas: Wattever 2025.

[121] Jacobs (2025).

[122] Ibid.

[123] ACIL Allen (2023).

[124] Graham et al (2023) and Dynamic Analysis (2024).

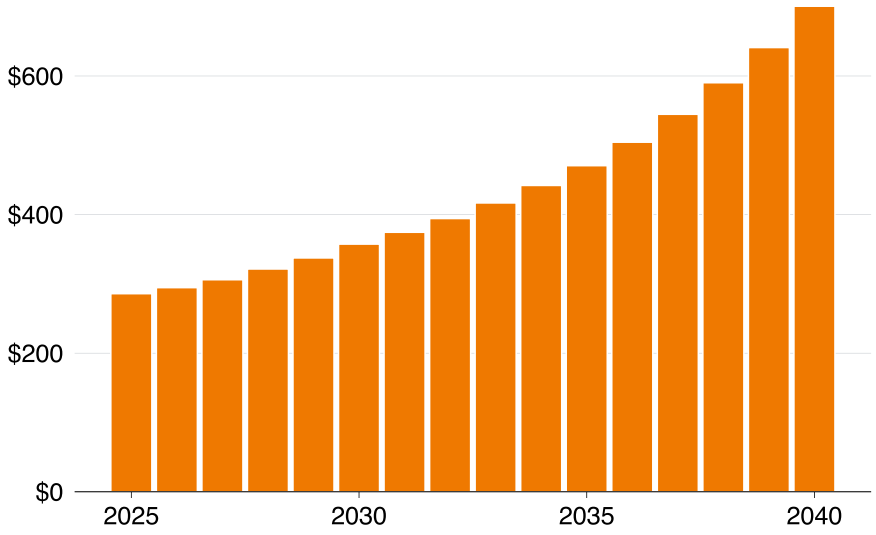
[125] Frontier Economics (2020).

[126] AER (2024b), Essential Services Comission (2024), Tasmanian Economic Regulator (2025), and Economic Regulation Authority (2025).

[127] AEMO (2024b) and AEMO (2024i).

[128] ACCC (2025).

Figure D.2: Residential gas network charges are set to rise rapidly
Projected annual average residential network charges in the NEM, 2025 to 2040 ($2025)

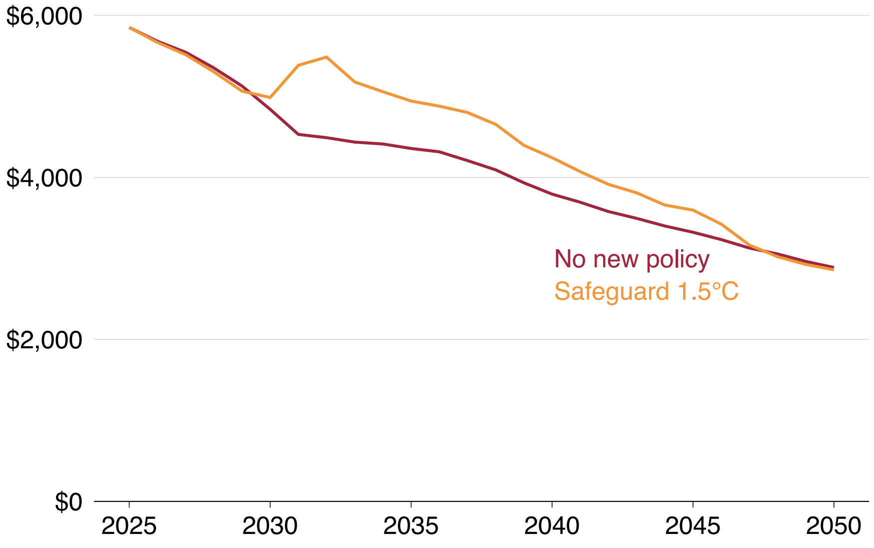


Source: Grattan analysis. See Appendix B for further details.

Appendix E: Alternative set of results for 1.5 degrees of warming

Figure E.1: Total energy costs fall significantly to 2050, and there is marginal difference under the Safeguard

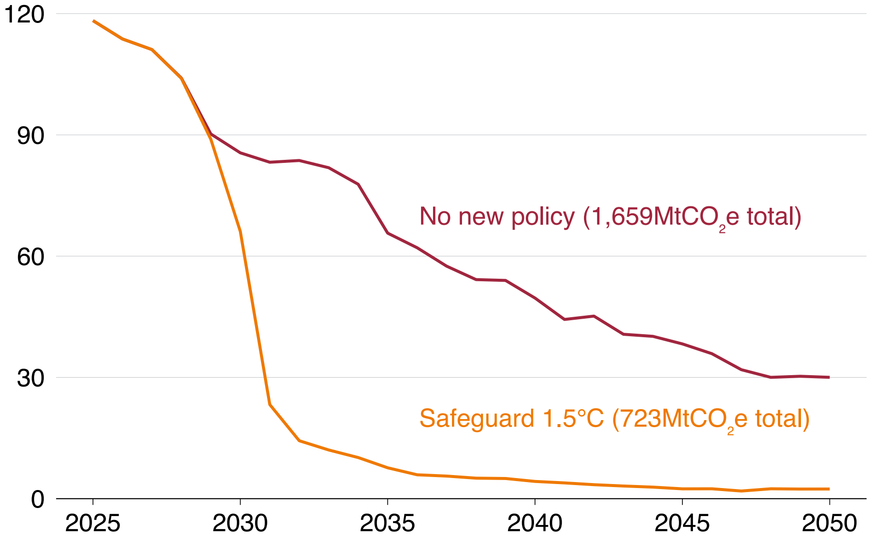
Average annual household energy costs ($2025)



Source: Grattan analysis of Jacobs (2025). See Appendix D for further details.

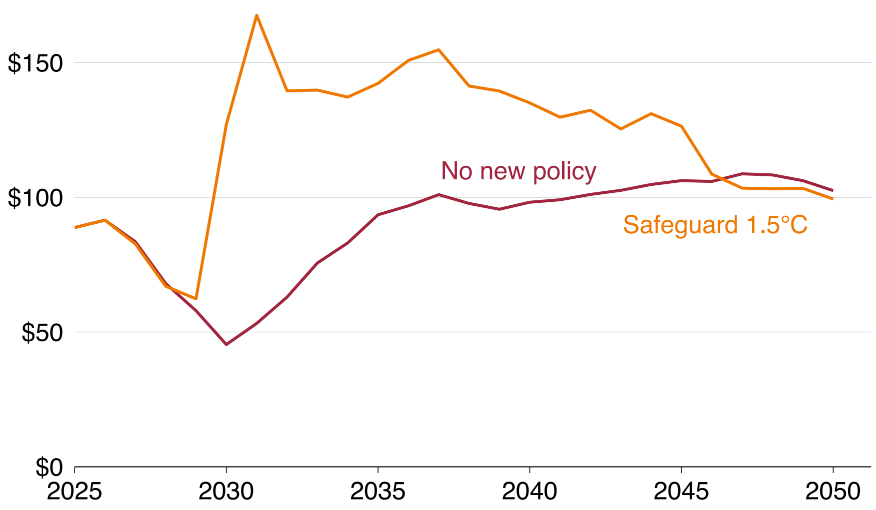
Figure E.2: Emissions fall more rapidly in the 1.5℃ scenario, limited to less than half the 'no new policy' scenario emissions

Annual and total Australian electricity sector emissions, 2026 to 2050 (MtCO2-e)



Source: Grattan analysis of Jacobs (ibid).

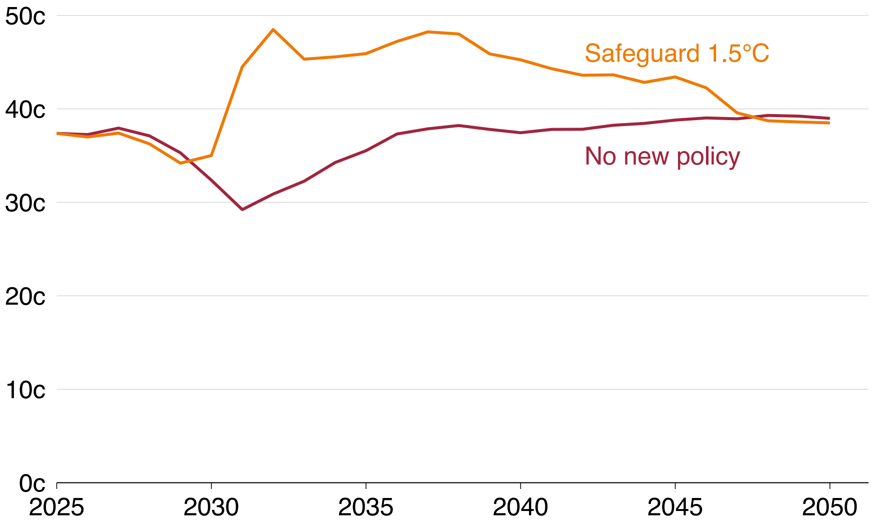
Figure E.3: Wholesale prices are more volatile in the Safeguard scenario
Average time-weighted wholesale price across major Australian grids, dollars per MWh ($2025)



Note: Average prices are calculated by weighting prices in each grid by total sent out generation.

Source: Grattan analysis of Jacobs (2025).

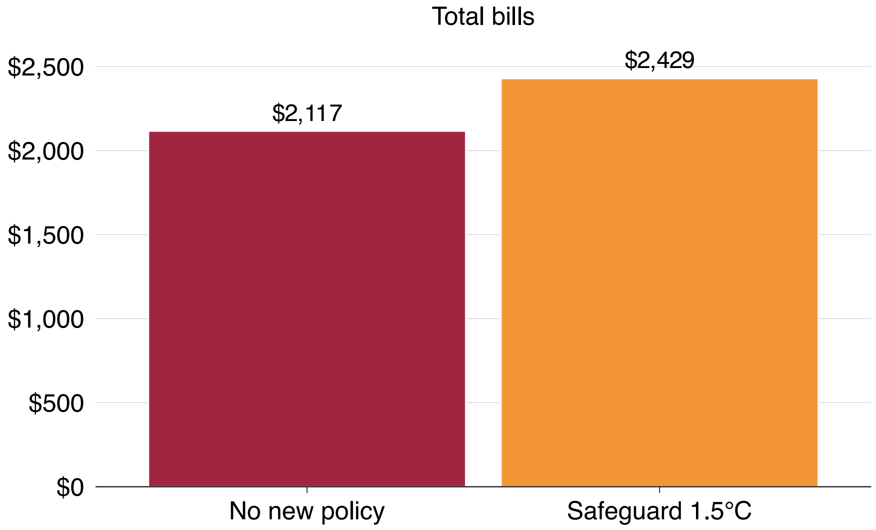
Figure E.4: Safeguard retail prices spike and remain higher until around 2050
Average residential retail prices in the NEM, cents per kWh ($2025)



Note: Average prices are calculated by weighting prices in each state by the estimated residential billable volumes. See Appendix D for more details on how we estimated average residential electricity consumption and exports.

Source: Grattan analysis of Jacobs (ibid).

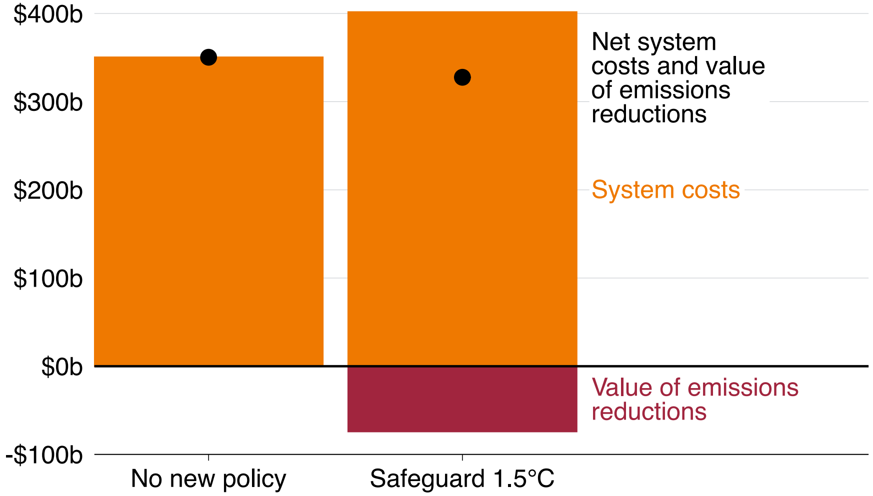
Figure E.5: The Safeguard is relatively more expensive in the 1.5°C scenario due to a higher adjustment cost
Average annual household electricity bill in the NEM ($2025)



Note: Simple average over the period from 2025 to 2050 used.

Source: Grattan analysis of Jacobs (2025).

Figure E.6: However, the Safeguard is still efficient in the 1.5°C scenario
Net present value of system costs and emissions reductions ($2025)



Notes: Total net system costs and value of emissions reductions is calculated by summing the present value of the total cost of building, fuelling, and operating generation, storage, and transmission assets. The present value of total emissions reductions is that incremental to the 'no new policy' scenario. The value of emissions reductions is calculated using Australian Energy Regulator (AER) guidance values. Net present value is calculated using a discount rate of 7.4 per cent.

Source: Grattan analysis of Jacobs (ibid) and AEMC (2024).

Bibliography

ABS (2018). *Survey of Motor Vehicle Use, Australia*. Australian Bureau of Statistics. https://www.abs.gov.au/statistics/industry/tourism-and-transport/survey-motor-vehicle-use-australia/12-months-ended-30-june-2018.

——— (2020). *Survey of Motor Vehicle Use, Australia*. Australian Bureau of Statistics. https://www.abs.gov.au/statistics/industry/tourism-and-transport/survey-motor-vehicle-use-australia/12-months-ended-30-june-2020.

——— (2021a). *Motor Vehicle Census, Australia*. Australian Bureau of Statistics. https://www.abs.gov.au/statistics/industry/tourism-and-transport/motor-vehicle-census-australia/latest-release#data-downloads.

——— (2021b). *ABS Survey of Income and Housing 2021*.

——— (2024). *Household and Family Projections, Australia: 2021 - 2046*. Australian Bureau of Statistics. https://www.abs.gov.au/statistics/people/population/household-and-family-projections-australia/2021-2046.

ACCC (2025). *Report on the Australian petroleum market - March Quarter 2025*. Australian Competition & Consumer Comission, p. 16. https://www.accc.gov.au/system/files/australian-petroleum-market-report-march-2025.pdf.

ACIL Allen (2023). *Natural gas price forecasts for the Final 2023 IASR and for the 2024 GSOO*. Report to Australian Energy Market Operator. https://aemo.com.au/-/media/files/major-publications/isp/2023/iasr-supporting-material/acil-allen-natural-gas-price-forecasts.pdf?la=en.

AEMC (2024). *How the national energy objectives shape our decisions*. https://www.aemc.gov.au/sites/default/files/2024-03/AEMC%20guide%20on%20how%20energy%20objectives%20shape%20our%20decisions%20clean%20200324.pdf.

AEMO (2024a). *2024 NEM Electricity Statement of Opportunities*. Australian Energy Market Operator. https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/nem_esoo/2024/2024-electricity-statement-of-opportunities.pdf?la=en&hash=2B6B6AB803D0C5F626A90CF0D60F6374.

——— (2024b). *2024 Gas Statement of Opportunities for Australia's East Coast Gas Market*. Australian Energy Market Operator. https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/gsoo/2024/aemo-2024-gas-statement-of-opportunities-gsoo-report.pdf?la=en.

——— (2024c). *AEMO ISP 2024*. Australian Energy Market Operator. https://www.aemo.com.au/-/media/files/major-publications/isp/2024/2024-integrated-system-plan-isp.pdf?rev=b811f5d66df24e0a980ce0df8eaa5687&sc_lang=en.

——— (2024d). *2024 WEM Electricity Statement of Opportunities*. Australian Energy Market Operator. https://aemo.com.au/-/media/files/electricity/wem/planning_and_forecasting/esoo/2024/2024-wem-electricity-statement-of-opportunities.pdf?la=en.

——— (2024e). *2024 ESOO Forecasting Assumptions Update Workbook*. Australian Energy Market Operator. https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/nem_esoo/2024/2024-forecasting-assumptions-update-workbook.xlsx?la=en.

——— (2024f). *2024 WEM ESOO Data Register*. Australian Energy Market Operator. https://aemo.com.au/-/media/files/electricity/wem/planning_and_forecasting/esoo/2024/2024-wem-esoo-data-register.xlsx?la=en.

——— (2024g). *2024 Electric Vehicle workbook*. Australian Energy Market Operator. https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/nem_esoo/2024/2024-electric-vehicle-workbook.xlsx?la=en.

——— (2024h). *2024 WEM ESOO EV Projections*. Australian Energy Market Operator. https://aemo.com.au/-/media/files/electricity/wem/planning_and_forecasting/esoo/2024/2024-wem-esoo-ev-projections.xlsx?la=en.

——— (2024i). *2024 WA Gas Statement of Opportunities*. Australian Energy Market Operator. https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/wa_gsoo/2024/2024-wa-gas-statement-of-opportunities.pdf?la=en.

AEMO (2025). *Generating Unit Expected Closure Year July 2025*. Publisher: Australian Energy Market Operator. https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/generation-information.

AER (n.d.). *Energy Made Easy*. Australian Energy Regulator. https://www.energymadeeasy.gov.au/.

——— (2024a). *Valuing emissions reduction - Final guidance and explanatory statement*. Australian Energy Regulator. https://www.aer.gov.au/system/files/2024-05/AER%20-%20Valuing%20emissions%20reduction%20-%20Final%20guidance%20and%20explanatory%20statement%20-%20May%202024.pdf (visited on 07/08/2025).

——— (2024b). *Retail energy market performance update for Quarter 3, 2023–24*. Australian Energy Regulator. https://www.aer.gov.au/publications/reports/performance/retail-energy-market-performance-update-quarter-3-2023-24.

——— (2025). *Quarterly retail performance report, January - March 2025, Q3 2024–25*. Australian Energy Regulator. https://www.aer.gov.au/system/files/2025-06/Key%20trends%20-%20Quarter%203%202024%E2%80%9325%20retail%20performance%20data.pdf.

Aisbett et al (2021). Aisbett, E., Cheng, W., and Beck, F. J. 'Green Industrial Policy and Technology Neutrality: Odd Couple or Unholy Marriage?' *ANU Grand Challenge Zero Carbon Energy for the Asia Pacific*. https://espace.library.uq.edu.au/view/UQ:45d8e5a.

Allens (2024). *Transmission and future grid*. https://www.allens.com.au/insights-news/explore/2024/seizing-opportunities-in-the-energy-transition/transmission-and-future-grid/.

Australian PV Institute (2023). *National Survey Report of PV Power Applications in Australia*. Australian PV Institute. https://apvi.org.au/wp-content/uploads/2024/10/National-Survey-Report-of-PV-Power-Applications-in-AUSTRALIA-2023-v1.pdf.

BITRE (2023). *Road Vehicles Australia 2023*. Publisher: Bureau of Infrastructure, Transport, and Resource Economics. https://www.bitre.gov.au/publications/2024/road-vehicles-australia-january-2023-re-issue.

CCA (2024). *CCA Sector Pathways Review*. Climate Change Authority. https://www.climatechangeauthority.gov.au/sites/default/files/documents/2024-09/2024SectorPathwaysReviewSummary.pdf (visited on 01/09/2025).

CER (2025). *Safeguard Data 2023-24*. Publisher: Clean Energy Regulator. https://cer.gov.au/markets/reports-and-data/safeguard-data.

Clean Energy Council (n.d.). *Clean Energy Australia 2025*. Clean Energy Council. https://cleanenergycouncil.org.au/getmedia/f40cd064-1427-4b87-afb0-7e89f4e1b3b4/clean-energy-australia-report-2025.pdf.

Clean Energy Regulator (2024). *2023-24 Safeguard Data Insights*. Clean Energy Regulator. https://cer.gov.au/document/2023-24-safeguard-data-insights-0 (visited on 11/09/2025).

Climate Change Authority (2025). *2035 targets advice*. Climate Change Authority. https://www.climatechangeauthority.gov.au/sites/default/files/documents/2025-09/2035%20Targets%20Advice%20Report.pdf.

Commmonwealth Government (2000). *Renewable Energy (Electricity) Act*. https://www.austlii.edu.au/cgi-bin/viewdoc/au/legis/cth/consol_act/rea2000283/s3.html.

Commonwealth Government (2015). *Safeguard Mechanism Rule*. https://webarchive.nla.gov.au/awa/20160110091439/https://www.environment.gov.au/system/files/pages/dbabd13c-f8f1-49cd-ab40-621f056de35a/files/es-safeguard-rule.pdf.

CSIRO (2025). *GenCost 2024-25*. Commonwealth Scientific and Industrial Research Organisation. https://www.csiro.au/en/research/technology-space/energy/Electricity-transition/GenCost (visited on 02/09/2025).

DCCEEW (2023). *Greenhouse Gas Inventories 2023*. https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-accounts-2023/state-and-territory-greenhouse-gas-inventories-2023-emissions.

——— (2024a). *Australia's emissions projections 2024*. Department of Climate Change, Energy, the Environment, and Water. https://www.dcceew.gov.au/sites/default/files/documents/australias-emissions-projections-2024.pdf.

DCCEEW (2024b). *Australia hits rooftop solar milestone*. Department of Climate Change, Energy, the Environment, and Water. https://www.energy.gov.au/news/australia-hits-rooftop-solar-milestone (visited on 01/09/2025).

——— (2025a). *NEM Review Terms of Reference*. https://www.dcceew.gov.au/sites/default/files/documents/final-terms-reference-nem-wms-review.pdf (visited on 02/09/2025).

——— (2025b). *Australian Energy Statistics*. https://www.energy.gov.au/energy-data/australian-energy-statistics (visited on 01/09/2025).

——— (2025c). *Implementing reforms to the ACCU Scheme*. https://www.dcceew.gov.au/climate-change/emissions-reduction/accu-scheme/reviews-and-reforms/implementation (visited on 03/09/2025).

DEECA (2025). *Victorian Energy Compare*. Publisher: Department of Energy, Environment and Climate Action Victorian Government. https://compare.energy.vic.gov.au/ (visited on 05/07/2025).

Department of Prime Minister & Cabinet (2016). *Regulatory Impact Statement of the Safeguard Mechanism Rule*. https://oia.pmc.gov.au/sites/default/files/posts/2016/01/Safeguard-mechanism-for-the-Emissions-Reduction-Fund-RIS.pdf (visited on 09/09/2025).

Department of Treasury (2011). *The impact of a carbon price on household expenditure as modelled by Treasury for the Clean Energy Future Package announced on 10 July 2011 by the Government*. https://treasury.gov.au/sites/default/files/2019-03/Modelling_carbon_price.pdf (visited on 12/09/2025).

Dynamic Analysis (2024). *Turning down the gas: Minimising consumer risk*. Report for Energy Consumers Australia. https://www.aer.gov.au/system/files/2024-10/ECA%20-%20Submission%20on%20JGN%202025-30%20Access%20Arrangement%20Proposal%20-%20Attachment%20-%20Dynamic%20Analysis%20Report%20-%20September%202024.pdf (visited on 09/04/2025).

Economic Regulation Authority (2025). *Energy reports retailer data - 2014 onwards*. Western Australia. https://www.erawa.com.au/cproot/24632/4/energy-reports-retailer-data-2014-onwards.XLSX (visited on 01/06/2025).

EnergyConsult (2022). *Residential Baseline Study 2021*. Department of Industry, Science, Energy and Resources. https://www.energyrating.gov.au/industry-information/publications/report-2021-residential-baseline-study-australia-and-new-zealand-2000-2040.

ESB (2022). *Energy Security Board Capacity Mechanism: High-Level Design Paper*. Energy Security Board. https://www.energy.gov.au/sites/default/files/2022-06/Capacity%20mechanism%20high-level%20design%20consultation%20paper.pdf (visited on 01/09/2025).

Essential Services Comission (2024). *Victorian Energy Market Dashboard FY 2023-24*. https://www.esc.vic.gov.au/electricity-and-gas/victorian-energy-market-reporting-hub/victorian-energy-market-insights/energy-market-dashboard.

Frontier Economics (2020). *Residential energy consumption benchmarks*. Australian Energy Regulator. https://www.aer.gov.au/system/files/Residential%20energy%20consumption%20benchmarks%20-%209%20December%202020_0.pdf (visited on 24/07/2025).

Frontier Energy (2019). *Residential Cooktop Performance and Energy Comparison Study*. https://cao-94612.s3.amazonaws.com/documents/Induction-Range-Final-Report-July-2019.pdf.

Graham, P. and Mediwaththe, C. (2022). *Small-scale solar PV and battery projections 2022*. CSIRO. https://publications.csiro.au/publications/publication/PIcsiro:EP2022-5296.

Graham et al (2023). Graham, P., Havas, L., Foster, J., and Meher-Homji, Z. *Consumer impacts of the energy transition: modelling report*. Report for Energy Consumers Australia. CSIRO and Dynamic Analysis. https://energyconsumersaustralia.com.au/sites/default/files/wp-documents/CSIRO-Technical-Report-Stepping-Up.pdf (visited on 20/02/2025).

Graham, P. and Mediwaththe, C. (2024). *Small-scale solar PV and battery projections 2024*. CSIRO. https://aemo.com.au/-/media/files/major-publications/isp/2025/CSIRO-2024-Solar-PV-and-Battery-Projections-Report.pdf.

Graham et al (2024). Graham, P., Mediwaththe, C., and Green, D. *Electric vehicle projections 2024*. CSIRO. https://aemo.com.au/-/media/files/major-publications/isp/2025/stage-2/electric-vehicle-projections-2024.pdf.

Jacobs (2025). *Jacobs Energy Market Modelling*. https://grattan.edu.au/wp-content/uploads/2025/10/Jacobs-Modelling-the-Impact-of-Carbon-Pricing-on-Australia-Final-clean.pdf.

Lang et al (2021). Lang, M., Lane, R., Zhao, K., Tham, S., Woolfe, K., and Raven, R. ‘Systematic review: Landlords’ willingness to retrofit energy efficiency improvements’. *Journal of Cleaner Production*. https://www.sciencedirect.com/science/article/pii/S0959652621012609.

Macintosh, A. (2025). *As Australia’s carbon offset industry grapples with integrity concerns, how can companies genuinely tackle climate change?* Publisher: The Conversation. http://theconversation.com/as-australias-carbon-offset-industry-grapples-with-integrity-concerns-how-can-companies-genuinely-tackle-climate-change-257124.

Mohseni et al (2023). Mohseni, S., Rutovitz, J., Smith, H., and McCoy, T. *Residential load profiles for Heyfield, Victoria*. Prepared for the Regional and Remote Communities Reliability Fund. https://www.heyfieldcommunity.org.au/_files/ugd/2ec4c2_64c6865778a848ecaba94a8cc67b6d88.pdf (visited on 23/07/2025).

Neelam, R. (2025). *Lowy Institute Poll 2025*. Lowy Institute. https://poll.lowyinstitute.org/files/lowyinsitutepoll-2025.pdf (visited on 11/09/2025).

Nelson et al (2025). Nelson, T., Conboy, P., Hancock, A., and Hirschhorn, P. *National Electricity Market wholesale market settings review*. https://storage.googleapis.com/files-au-climate/climate-au/p/prj36f491a5284dc4c74959e/page/NEM_Review_Draft_Report_August_2025_Final_2.pdf.

NREL (2025). *PVWatts Calculator*. US National Renewable Energy Laboratory. https://pvwatts.nrel.gov/ (visited on 29/07/2025).

Parliament of South Australia (1996). *National Electricity (South Australia) Act 1996*. https://www.legislation.sa.gov.au/__legislation/lz/c/a/national%20electricity%20(south%20australia)%20act%201996/current/1996.44.auth.pdf.

Roam Consulting (2008). *Modelling of Carbon Pricing Scenarios*. Australian Government Department of Climate Change. https://webarchive.nla.gov.au/awa/20110602083527/http://www.climatechange.gov.au/en/government/initiatives/cprs/cprs-progress/esas/~/media/publications/esas/roam-report.ashx (visited on 02/09/2025).

Synergy (2023). *2023 Electricity Performance Reporting Datasheet - Retail Indicators*. Synergy. https://www.synergy.net.au/-/media/Files/PDF-Library/Synergy-electricity-retail-licence-ERL1-performance-report-datasheet-2022_2023.pdf.

Tasmanian Economic Regulator (2025). *Energy in Tasmania Report 2023-24*. pp. 44, 47. https://www.economicregulator.tas.gov.au/Documents/25%20437%20Energy%20in%20Tasmania%202023-24.pdf.

Terrill et al (2021). Terrill, M., Burfurd, I., and Fox, L. *The Grattan car plan: practical policies for cleaner transport and better cities*. Grattan Institute. ISBN: 978-0-6452739-2-2. https://grattan.edu.au/wp-content/uploads/2021/10/Grattan-Car-Plan.pdf.

Tidemann et al (2022). Tidemann, C., Rayner, J., and Cheung, H. *Switch and save: How gas is costing households*. Climate Council. https://www.climatecouncil.org.au/wp-content/uploads/2022/10/CC_MVSA0323-CC-Report-Switch-and-Save-Gas-vs-Electricity_V6-FA-Screen-Single.pdf (visited on 30/07/2025).

UNFCC (2015). *Paris Agreement*. https://unfccc.int/sites/default/files/english_paris_agreement.pdf (visited on 08/09/2025).

Victorian Government (2025). *New electrification and efficiency standards and regulations for Victorian buildings*. https://www.energy.vic.gov.au/households/electric-and-efficiency-standards-for-buildings (visited on 03/09/2025).

Watt, D. M. (2009). *National Survey Report of PV Power Applications in Australia 2008*. Australian PV Association. https://apvi.org.au/wp-content/uploads/2014/04/2008-PV-in-Australia-Report.pdf.

Wattever (2025). *Compare electricity from every retailer and find the best deal*. https://wattever.com.au/compare/ (visited on 05/07/2025).

Wood et al (2015). Wood, T., Blowers, D., and Moran, G. *Post-Paris: Australia’s climate policy options*. Grattan Institute. https://grattan.edu.au/wp-content/uploads/2015/12/934-Post-Paris-Australia-climate-policy-options.pdf (visited on 06/02/2025).

Wood et al (2016). Wood, T., Blowers, D., Moran, G., and McCamish, T. *Climate phoenix: a sustainable Australian climate policy*. Report No. 2016-6. Grattan Institute. https://grattan.edu.au/report/climate-phoenix-a-sustainable-australian-climate-policy/.

Wood et al (2018). Wood, T., Blowers, D., and Percival, L. *Mostly working: Australia's wholesale electricity market*. Report No. 2018-08. Grattan Institute. https://grattan.edu.au/wp-content/uploads/2018/06/905-Mostly-working.pdf.

Wood, T. and Ha, J. (2021). *Go for Net Zero*. Grattan Institute. https://grattan.edu.au/wp-content/uploads/2021/04/Go-for-net-zero-Grattan-Report.pdf (visited on 27/08/2025).

Wood et al (2021). Wood, T., Reeve, A., and Ha, J. *Towards net zero: practical policies to offset carbon emissions*. Grattan Institute. https://grattan.edu.au/wp-content/uploads/2021/10/Towards-net-zero-Practical-policies-to-offset-carbon-emissions.pdf (visited on 27/08/2025).

Wood et al (2022). Wood, T., Reeve, A., and Suckling, E. *The next industrial revolution: transforming Australia to flourish in a net-zero world*. Grattan Institute. https://grattan.edu.au/wp-content/uploads/2022/07/Next-industrial-revolution-Grattan-report.pdf (visited on 01/09/2025).

Wood et al (2023) ______ . *Getting Off Gas*. Grattan Institute. https://grattan.edu.au/report/getting-off-gas/.

Wood et al (2024). Wood, T., Reeve, A., and Yan, R. *Keeping the lights on: how Australia should navigate the era of coal closures and prepare for what comes next*. en. Grattan Institute. https://grattan.edu.au/wp-content/uploads/2024/04/Keeping-the-lights-on-Grattan-Institute-Report.pdf (visited on 01/09/2025).

World Bank (2025). *World Bank Carbon Pricing Dashboard*. https://carbonpricingdashboard.worldbank.org/ (visited on 02/09/2025).

Grattan Institute Report No. 2025-08, October 2025

This report was written by Alison Reeve, Tony Wood, Dominic Jones, and Ben Jefferson. It was edited by Paul Austin. Jacobs provided energy modelling expertise, made possible through the generous financial support of Frank Macindoe.

We would like to thank the members of Grattan Institute's Energy Program Reference Group for their helpful comments, as well as numerous government and industry participants and officials for their input.

Grattan Institute is an independent think tank focused on Australian public policy. Our work is independent, practical, and rigorous. We aim to improve policy by engaging with decision makers and the broader community.

We acknowledge and celebrate the First Nations people on whose traditional lands we meet and work, and whose cultures are among the oldest in human history.

For further information on Grattan's programs, or to join our mailing list, please go to: www.grattan.edu.au. You can donate to support future Grattan reports here: www.grattan.edu.au/donate.

This report may be cited as: Reeve, A., Wood, T., Jones, D., and Jefferson, B. (2025). *Bills down, emissions down*. Grattan Institute.

ISBN: 978-1-7641250-0-0