The Electrification Tipping Point

The energy, economic, and emissions impacts of electrifying Australia's homes and vehicles.

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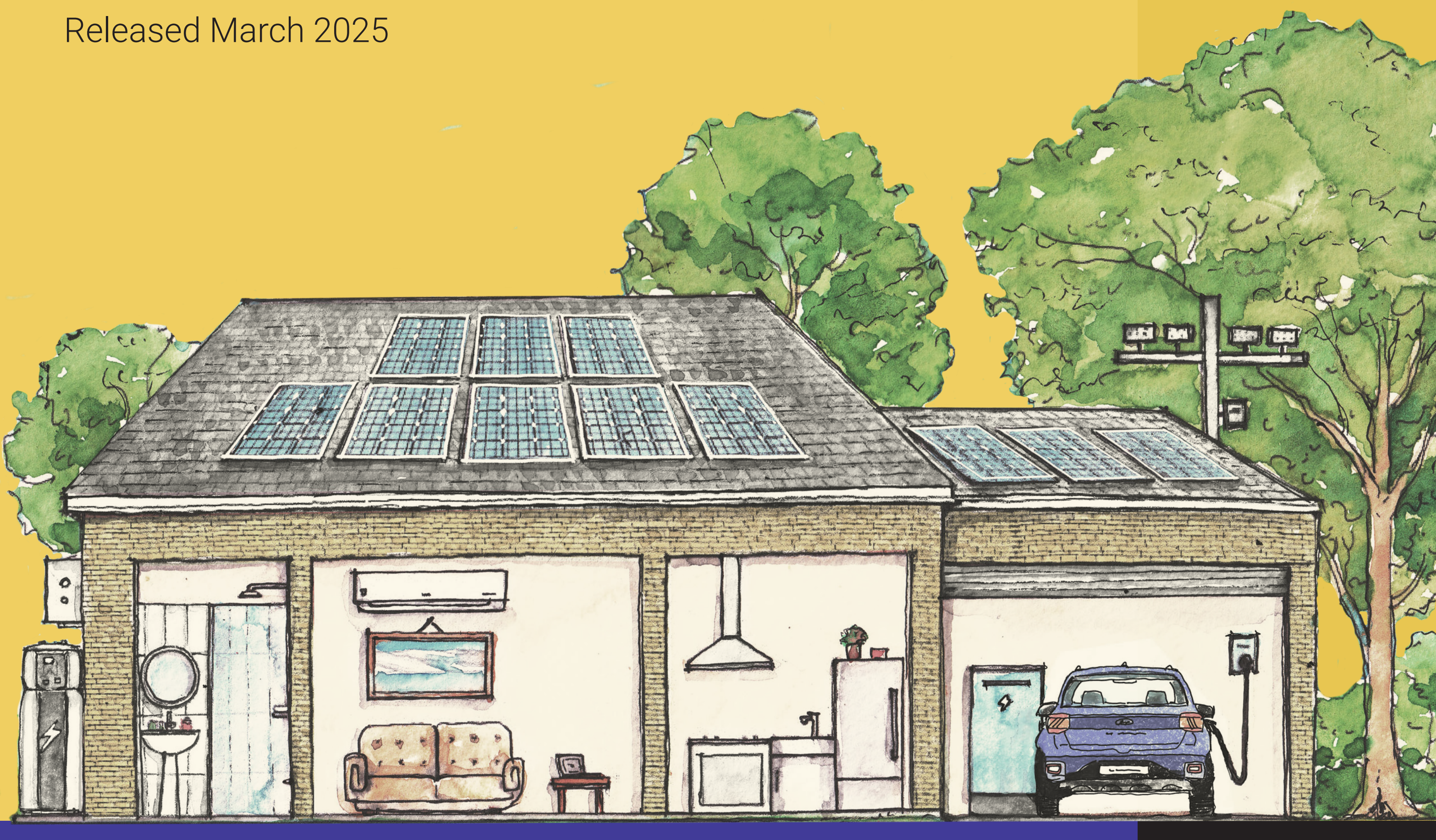

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About Rewiring Australia

Rewiring Australia is a non-profit, independent, non-partisan organisation dedicated to representing the people, households and communities in the energy system. We empirically demonstrate and openly communicate the cost savings, emissions reductions, and energy system benefits of electrification. Rewiring Australia has reached millions of Australians with our work. We deliver practical climate progress through our research, advocacy, and working on the ground with communities to help electrify everything.

Summary

Rewiring Australia has completed new modelling of the economic and emissions impacts of consumer choices about appliances, vehicles, solar and batteries - the main decisions by made consumers that impact emissions and energy bills.

Australia has crossed the Electrification Tipping Point

Australia is one of the first countries worldwide to pass an “electrification tipping point” in home energy economics. The electrification of homes and vehicles can now deliver both cost of living savings and emissions reductions simultaneously - a win-win. This includes the upfront costs, and total costs of bills and financing over 15 years.

An electrified home will spend

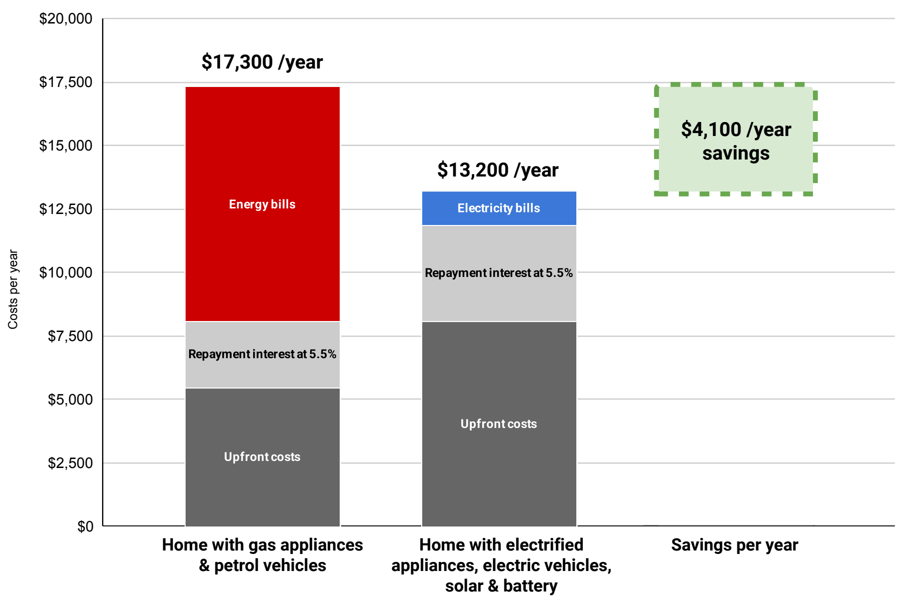
$4,100

less per year on average than a home with gas appliances and petrol vehicles.

Looking forward over 15 years, a typical Australian household using gas heating, gas water heating, gas cooking, and petrol vehicles will spend an average of $9,200 a year on energy bills (including petrol), versus $1,300 per year for that same household electrified. As illustrated in Figure 1, when the upfront costs are accounted for, the electrified household will still spend $4,100 less per year on average. The electric home includes electric heat pumps for space heating and water heating, electric cooktop, electric vehicles, rooftop solar and a battery. Including vehicles as part of household energy modelling is crucial for accurately understanding the current and future energy system. The electrified home also saves 9,600 kgCO2e of emissions per year or 115,000 kg over 15 years.

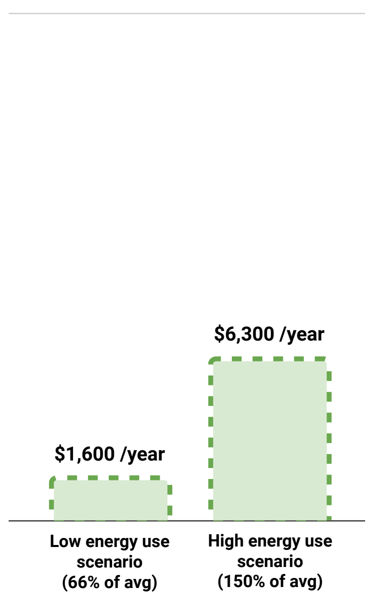
Figure 1

Electrified vs fossil fuel home energy cost comparison (per year)
Gas home and petrol vehicles versus electrified home and vehicles with solar and battery compared over 15 year lifetime



Source notes: Rewiring Australia analysis. Residential Baseline Study 2021 average home energy needs. ABS motor vehicle survey 2018 average driving per vehicle. 1.8 vehicles per home. 2025 energy prices adjusted for future years based on historic real inflation of each energy type from the Consumer Price Index. $2025. 9kW solar install and 10kWh battery on electrified home.

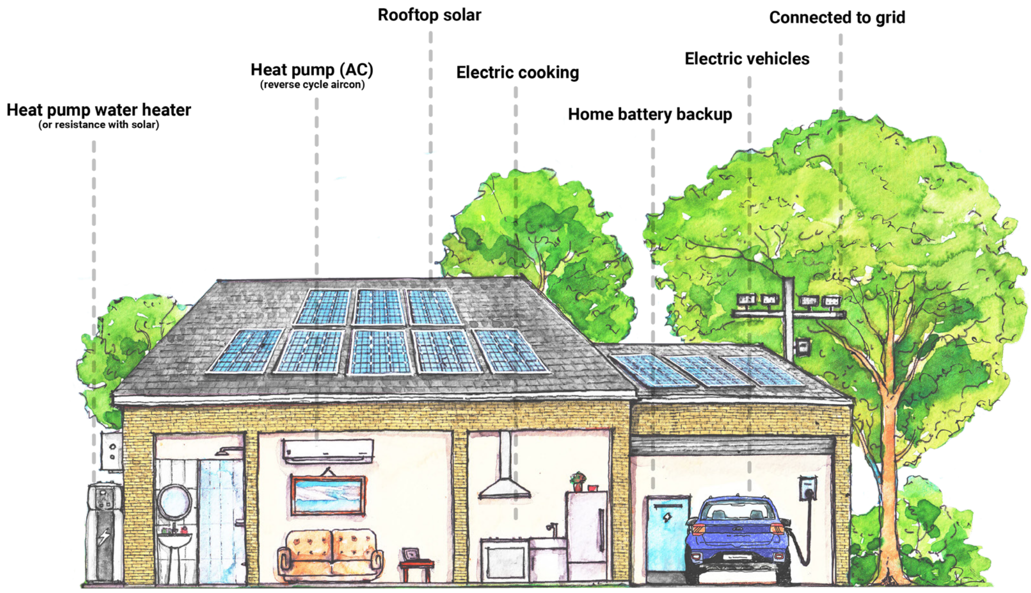
Savings comparison energy use
Higher driving and appliance usage versus lower.



Source notes: Based on comparison of lower and higher appliance usage and lower and higher driving distances than the average.

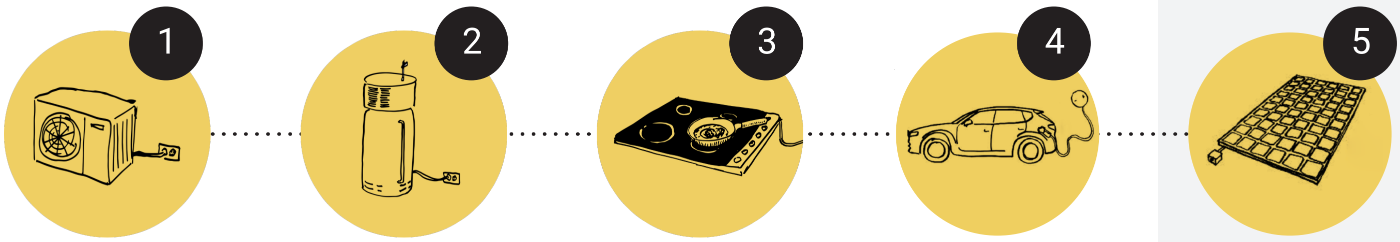
The economic tipping point has been reached for each appliance or vehicle purchase decision and for the whole home. There is some variation across the country as a result of household size, location and more. Smaller inner city homes with less heating and less driving are likely to save less than average, and regional homes with longer driving distances can save more. The tipping point has been passed for typical homes in all states and territories.

Reaching this point emphasises that rapid household electrification should not be seen as a cost of solving climate change, but rather as a nation-building investment opportunity to deliver lower bills, lower emissions and improve national energy productivity. The focus of electrification policy should now be on practical deployment on the ground - how to make it go faster. This includes making our finance (loan) systems more suitable for electrification and making it practical for Australians in all situations to make their next energy decision electric. It further emphasises the need to update our electricity market to accurately reward the capital investment contributions of households. Australia has a unique, timely opportunity to lead the world on climate ambition and cost of living reduction.



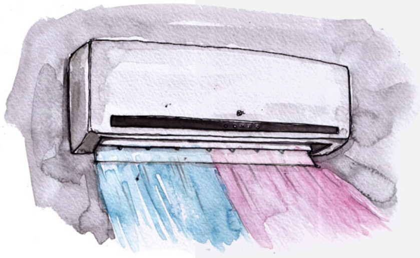
5 decisions made in homes collectively are the largest emissions source in the Australian economy

Household 'dinner table decisions' about how to heat our home and our water, how to cook, what vehicles to drive, and where to get our electricity from collectively make up around 20% of Australia's emissions. More than any other area of the economy. Making each of these future purchasing decisions electric, represents a win-win emissions reduction opportunity that will save money, and therefore be negative dollars per ton of emissions reduced. We estimate this represents the purchasing of around 50 million electric vehicles and appliances over the next 15 - 25 years.
Read more on page 16.



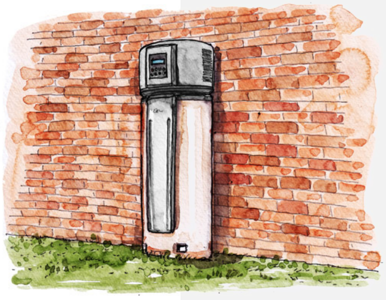
Each electric purchase decision now saves money

Space heating



The lowest cost, and lowest emission way to heat Australian homes is now through heat pumps (or reverse cycle air conditioning). Heat pumps save an average of **$530** in bills per year in 2025 compared to heating with gas, and over a 15 year lifetime with upfront costs included, save an average of **$8,500**. Read more on page 22.

Water heating

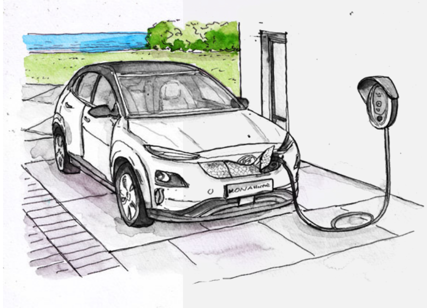


The lowest cost, and lowest emission way to provide water heating in Australian homes is now through heat pump hot water heaters that use as much solar as they can. This saves an average of **$250** in bills per year in 2025 compared to water heating with instant gas, or **$400** if the home has solar, and over a 15 year lifetime with upfront costs included, saves **$2,500**, or **$5,400** with solar. Read more on page 28.

Cooking

Electric cooking is 2 - 3 times more efficient than gas, and can save about **$20 - $30** a year on bills. If it's the last appliance to be electrified, the home can disconnect from the gas network and save about **$250** a year on gas supply charges, or **$4,700** over 15 years. More importantly, electric cooking avoids the negative health impacts associated with gas cooktops. Read more on page 34.

Driving



Electric driving is now the lowest cost way to drive including upfront costs. Driving an electric vehicle can save **$1,500** per year in driving costs in 2025, or **$2,500** with solar. Saving **$17,000** over 15 years with upfront costs compared to a similar petrol car, or **$35,000** charging with solar. Solar charging is the equivalent of paying **$0.13/Litre** in a petrol car, grid electricity charging is equivalent to **$0.80/Litre** (petrol prices are currently around **$1.90/Litre**). Read more on page 39.

Solar and batteries

Rooftop solar is the lowest cost delivered energy for homes. Even a fossil fuel home can save an average of **$980** per year from purchasing solar including repaying the upfront costs. With an electrified home, using more of that cheap electricity in more electric appliances and vehicles, results in saving an average **$2,200** per year. Batteries are now often economic for the Australian homes, both can help flatten future bills in a surprising anti-inflationary way. Read more on page 45.

Governments need to make electrification practical for every Australian

Reaching the electrification tipping point emphasises the importance of facilitating electrification for every Australian. Today, not everyone can access the benefits of electrification on a level playing field. Low-income households will find it harder to electrify because of upfront costs and access to finance, yet will get the greatest relative financial benefit if they do electrify because they spend a higher proportion of their income on energy bills. Renters and apartments face some of the largest barriers to electrification, often with lack of access to solar and electric vehicle charging at home, and where they are low income households, this compounds the equity impact. The everyday purchasing experience does not yet make clear that the electric option can result in large cost savings for the home.

Swapping fuels for finance

Fossil fuel machines often have a lower upfront capital cost, but a much higher operational cost. For example, an electric car might be $5,000 to $15,000 more expensive than a similar petrol car, yet if that extra upfront cost is divided over the lifetime of the car, then it will often be lower than the refuelling costs of a petrol vehicle - swapping fuels for finance. This includes the charging costs of the electric vehicle.

Our finance system works in a way that ignores this fuel cost. For example, a $10,000 solar installation at the start of a mortgage can save that household about $30,000 by the end of their mortgage. Yet getting $10,000 added to a mortgage limit can be difficult even if, thanks to the money you'll save on electricity, the decision would clearly increase the home's disposable income and make the mortgage easier and less risky to repay.

The same is true of vehicles. If you are approved for $30,000 of vehicle finance, and an electric vehicle will save you $10,000 over the finance period, then it should be clear that you should be approved for a $40,000 electric vehicle or $30,000 petrol vehicle. Yet this isn't the case today, because banks and finance providers often more or less ignore energy economics. In this way our financing system fundamentally favours fossil fuels, where upfront costs are low and long term costs are high and more volatile.

The other critical issue is that access to capital (and loans) is unevenly distributed across the Australian people. High-income homes can get easier access to loans, at lower interest rates, than low-income homes. Mortgage holders can redraw their loan to get lower interest vehicle finance than renters.

The speed and fairness of the energy transition will be heavily determined by access to finance. Australia already makes flexible, deferred finance widely available to students to invest in education regardless of their income - with benefits for them, and for the whole country. Similarly, flexible deferred electrification finance would have large benefits for households, especially those on low incomes, and for the whole country's energy system and climate.

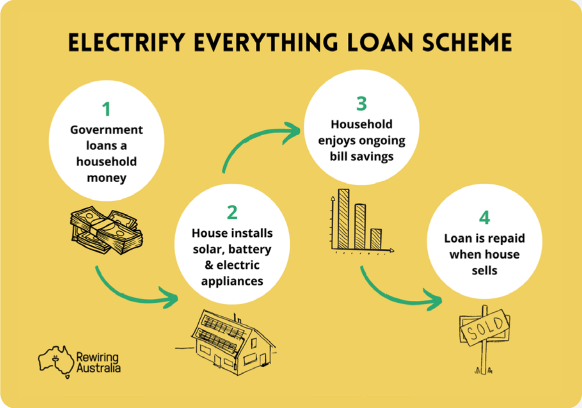
Fuels

↓

Finance

Swapping expensive fuels for finance on electrification where both the bills and repayments are lower cost than the fuels can save Australians thousands.

Past governments have created universal health care through Medicare and universal tertiary education through HECS. Rewiring Australia's proposed policy, the Electrify Everything Loan Scheme (EELS[1]) has been a collaboration with Rewiring Australia, ANU (Australian National University), and Professor Bruce Chapman, the architect of the original HECS higher education loan scheme. Like education, electrification is an upfront investment in the future with both private and public benefits, and if it can be financed in a way that allows people to repay when they're best able to, it becomes more accessible to everyone.



Supporting households to make the decision to electrify

This report demonstrates that the underlying economics are not the main barrier to electrification in Australia. Upfront costs and finance access are one crucial barrier discussed above. Another barrier is what we refer to as practical facilitation or making it an easy decision for households. This refers to the purchasing experience of everyday Australians.

People need to know to plan for the switch

It's crucial to build widespread awareness in Australia that the switch to electric machines is both a useful way to lower bills, and a wise investment in a world that is moving away from fossil fuels.

This awareness matters because some pivotal electrification decisions are made in an urgent moment. The most common one for households: the water heater breaks down, the family are having cold showers, and the purchaser is busy. In these cases, a like-for-like replacement is usually the fastest and easiest option. But the costs of that decision will last for a decade or more. Therefore we need education that starts before the breakdown point. With over 1 million new gas appliances sold every year,[2] there is an urgent need for widespread education campaigns to demonstrate the economic, health and environmental benefits of upgrading away from gas-fuelled appliances to electric alternatives and to avoid more households from being locked into years of high energy costs and high emissions.

Communities and trusted voices can help educate others

With mistrust and confusion identified as some of the key impediments to electrification, there is a need for trusted, independent voices. Community groups around Australia are starting to tackle this problem. For example, the Electrify Boroondara group in Melbourne have created stickers that go onto existing gas water heaters to provide a prompt when it breaks down - with clear information on the benefits and a simple way to find an installer for a heat pump water heater. Community and local voices have an vital role to play, because perhaps the most crucial pathway to awareness and education is word-of-mouth - people discussing their choices and options with their friends and family, both generally and at purchase times. This makes community pilots and initiatives a critical part of the

1 https://www.rewiringaustralia.org/eels
2 https://ieefa.org/resources/managing-transition-all-electric-homes

electrification picture where trusted conversations can update older social, economic and cultural assumptions.

The government also provides efficiency star stickers on many appliances, and these could help raise awareness of the benefits of electrification. However, these star ratings do not accurately reflect actual costs or emissions impacts, especially if considering solar power or the rapid reductions expected in grid electricity emissions. Even a relatively inefficient conventional electric resistance water heater, if run mostly on solar power, will still be lower cost and lower emissions than a gas system. Making sure consumer resources like this provide detailed cost and emissions information at the point of purchase could result in faster electrification and more bill savings for Australians. Similarly, vehicles could have the same type of stickers, making consumers aware of the $7,000 - $12,000 they might save on petrol costs over a 5 year lease by choosing an electric vehicle, or the $23,000 - $40,000 they might save over a 15 year vehicle lifetime.

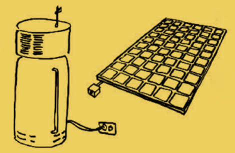
Tradies are often the crucial advisor at the point of purchase

Hot water systems and air conditioners are frequently bought from an installer, or sometimes by a builder, rather than directly by a consumer 'off the shelf'. These installers and builders are key influencers for decisions. It is crucial for them to understand and communicate both the financial benefits and the long-term realities of the energy system which mean that going electric will be a better choice for their customers.

This is not a simple task. These providers want to deliver a quality reliable service based on their past experience, and are appropriately conservative about adopting newer technologies like heat pumps. Speed of delivery is often high on the customer's mind; delays or complications from an upgrade to electric can add risks and costs to the work. Installers also need to win the trust of their customers that they are providing them with good value - and the higher up-front cost, especially of heat pump equipment, could come across as 'upselling' to customers who don't want this option already.

There should be clear information, training and incentives for tradies to advise and support people to make the switch to electric. Training should be provided on key electrification upgrades - hot water, cooking, EV charger installation and gas disconnection. Rebates or certificate schemes to rebalance the costs and recognise the future emissions benefits can play an important role.

There is also an important role for emerging tools like online quoting systems that help lay out the potential long term costs for different options. These can provide an independent source of information to support installers' recommendations. For example, a gas water heater might be $1,900 to install, with a heat pump closer to $4,000. Yet over 15 years the gas water heater might spend $8,000 on gas, compared to just $3,900 if the heat pump is powered by the grid, or $1,000 if the heat pump is powered by mostly solar. So over a 15 year period, a gas water heater could cost around $10,000 in total, whereas a solar powered heat pump only $5,000. This difference should be made very clear to consumers at the purchase point, not rely on them having knowledge of energy economics.

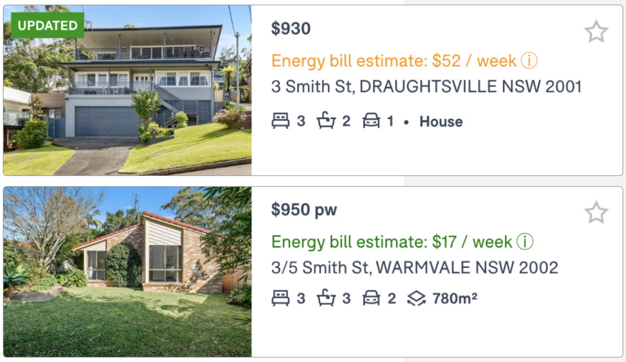


While a gas water heater might be cheaper upfront than an electric heat pump, over a 15 year lifetime the electric heat pump could save

$5,000

These 'total product costs' including bills need to be made more clear to consumers when they are making purchasing decisions.

Increase general transparency of energy costs



The lower bills that result from electrification and efficient appliances are also opaque and hidden at another crucial point: when purchasing or leasing a home. People buying or renting a home should know what bills to expect, and making this information clear and required on real estate listings could help drive important improvements in Australia's housing.

This is particularly important for renters who can't usually make electrification changes themselves. This creates the 'split incentive' problem: the landlord chooses and pays for appliances, but the renter benefits from lower bills. Finance schemes could help remove upfront cost barriers, especially for low income landlords, but other reforms are required to electrify rentals at scale and speed.

There could be minimum standards that require landlords to electrify their properties over time. This would include a requirement for landlords to install electrified appliances when any gas appliance is replaced and also provide a clear framework enabling renters to request and access solar and battery upgrades.

Improving disclosure to renters about current energy bills, electrification status and home quality is another key immediate opportunity to drive the longer term improvement of Australia's housing. Openly showing the expected energy bills of rental properties in the advertisement listings could help address the split incentive by rewarding landlords for making bill-reducing investments that make their property more competitive when listed.

Optimising the energy system for households

Rooftop solar is already often the biggest single energy source on the grid during the day. The Australian communities of the future will generate even more of this cheap and zero emissions energy, and it will be available around the clock thanks to the rapidly falling cost of battery storage.

We could use this energy to supply lots of the increased electricity demand from vehicles and homes as they electrify. Maximising the use of this local energy, and minimising the need for costly upgrades to grid infrastructure, would result in a much cheaper electricity system.

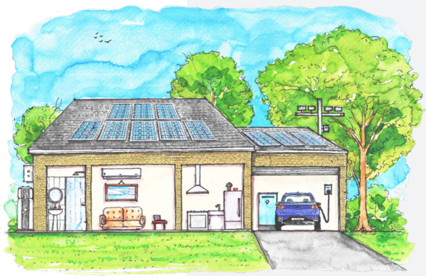
There are a number of important ways we should update the system to deliver this outcome:

✔ Network utilisation should be a focus for distributors and market regulators

The conventional, historical approach to building the distribution grid on our streets was pretty simple: build enough poles and wires for whatever moment puts the highest demand on the grid (similar to sizing a highway for peak hour). The cost of building this system is paid for in our energy bills, and makes up about 40% of the underlying costs. Fortunately, we've got a lot of spare carrying capacity in the networks we already have, even on the most energy-intensive days of the year, in no small part due to solar energy and efficiency reducing the expected increase in demand over the past decade. Networks today have relatively low utilisation, which we now have the opportunity to significantly increase with distributed energy resources, enabling lower network bills for homes going forward.

There will be more demand on the grid in coming years thanks to electrification. But in 2025 we also have new ways to do more with what we already have. There are lots of ways we could 'flex' and manage the timing of energy demand - by managing EV charging, hot water heating, and adding batteries to the system - to reduce that peak demand, and using the network more evenly throughout the day. As we add more EVs and electrified homes with solar, this opportunity only gets greater.

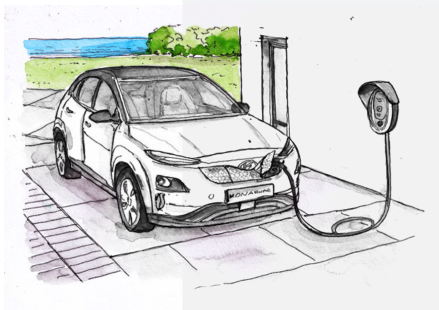
Flexible homes can make a massive contribution to a lowest-cost system



Homes and businesses can now generate their own energy for lower cost than they can buy it from the network, and can move that energy around (with batteries or smart appliances) to lower their peak while still saving money. In this sense, adding more "room" or capacity to the network can now be done by consumers at minimal cost.

Moreover, if you're willing to sell energy from your home battery or car back into the grid at peak times, then at a technical level, this is basically the same as reducing your neighbour's peak usage, and takes the load off your local grid. Economically, it makes sense to reward that energy with the same peak fee that's being charged to your neighbour. This would put consumers on a level playing field with other energy players - and it's the kind of clear investment signal needed for consumers to invest in batteries which are 10-15 year assets.

We can also use 'nudges' to get more midday demand



As people switch to EVs and get used to charging their cars rather than refuelling them, we can help people form habits that align with these cheaper sunny hours. If public EV charging is widely available and lower cost during the day - for example at workplaces, shopping centres and commuter car parks - this helps form the 'habits' that people can adopt around charging. EV charging equipment in general should default to a very low cost 'eco' mode that provides 'best effort' charging based on the availability of cheap energy and network capacity, with a button to instead opt for 'priority' charging at a higher price for people who need a fast charge. Pushing this load into the middle of the day will allow our existing networks to support much higher overall demand without needing upgrades.

We need a smarter grid that does more with less

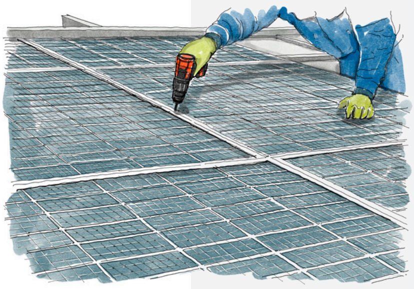
The distribution networks need to invest in much smarter approaches (and systems) to make more use of the energy generation, storage and flexibility in the consumer and community assets connected to the grid. They should also have real-time access to the meter data - an asset that's already paid for by energy bills, but with the data still locked up in metering companies. If we rewarded network companies based on different metrics - perhaps how much energy overall they move around (utilisation of the assets), or how much local green energy they serve - they'd be more closely aligned with the consumers they are supplying and with lowering future bills for all Australians.

We can push flexible demand into midday using prices

It's still important for many households to have access to simple, reliable, 'set and forget' energy pricing. But for a number of energy demand drivers of the future - especially electric vehicle charging - this imperative should be balanced with the enormous role they can play in reducing the cost of the energy system.

This can take the form of home energy plans (and, perhaps more importantly, commercial and workplace energy plans) that reward people for charging their car or heating their water during cheaper sunny hours. 'Solar soak' tariffs that offer pricing discounts during the middle of the day are already becoming common, and use of these tariffs should be strongly encouraged, if not required, for all home EV charging equipment and hot water systems.

Encourage household and neighbourhood energy assets with streamlined deployment and local pricing benefits



Rooftop solar energy nestled within our communities and cities is really cheap - partly because it's fast and efficient to construct and connect, and partly because it makes energy close to where it's needed anyway. The same could be true of batteries in our neighbourhoods if we can streamline the building and connection processes, enabling the benefits of solar to be shared with shaded homes and apartments that can't get solar. Plus, unlike solar, they can act much more flexibly to take the strain off the grid when required. Clear land planning frameworks would help batteries and EV chargers in neighbourhoods be built faster and more often. Connection procedures that take days instead of months, based on standardised grid connection equipment, testing and communication, would ensure they work safely with the grid. Pricing rewards could be offered for adding batteries to parts of the network where existing infrastructure is under pressure - paying more for energy that's supplied when it reduces the strain on local transformers and substations.

Electrifying to strengthen the Australian workforce

Electrification of our households and communities is an opportunity to leverage Australia's unique strengths and resources. We already have a thriving and competitive solar installation industry that leads the world, which is now expanding into batteries, EV chargers and other electrification installs. Australia also has strong supply chains for all the machines we need to install. Accelerating electrification increases the benefits on offer: more savings to households, higher productivity in our transport and supply chains, a more skilled workforce for the future, and more money staying on our shores for reinvestment.

Running our transport on local solar instead of imported oil

We pay about $60 billion per year to foreign countries for their oil.[3] The switch to EVs means we can power our transport on Australian sunshine instead, and spend that $60 billion within our communities. Some of that spending will go to local solar generators, including households, some of it to trades to install that solar; most of it is savings for consumers and businesses on their petrol bills, meaning more money for everyone to spend in the local economy, and lower supply chain costs for goods moved across our huge country.

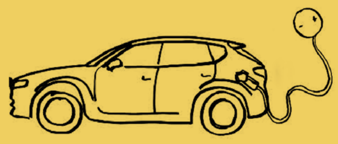
Supporting and encouraging the switch to electric vehicles could include:

- Policies that encourage car makers to bring more electric models to Australia
- National EV charging infrastructure to make the switch to electric easier
- Vehicle-To-Grid features that help cars to power homes and the grid when they're not driving
- Specific information and resources targeted to the drivers that drive the most to encourage them to switch. Long commuters can save the most, earliest, while having the most impact on emissions.

Australia spends about

$60 bn

per year importing oil from overseas. Switching to electric vehicles and powering them with Australian renewable electricity, like rooftop solar, could save that money and keep more of it in our communities.



Supporting tradies to upgrade our homes

The hard work of household electrification is done by the tradies who actually install the upgrades. We need to make sure they have the people, skills and resources they need to get the job done.

This support could include:

- Specific training and new skills for home electrification installs
- Incentives for apprentices and recruitment into the industry to help avoid workforce shortages
- Incentives for tradies to adopt electric utes and vans as they enter the market - perhaps via an incentive offered to high-kilometre drivers suggested above.

3 https://www.industry.gov.au/publications/resources-and-energy-quarterly-december-2024

Introduction

In 2021 Rewiring Australia published its first household electrification study 'Castles & Cars'. This paper delves into greater detail on electrification economics, covers new ground, and updates the prices of energy and products to 2025 - providing up to date context on Australia's journey to zero emissions households.

Independent studies confirm electrification economics

Since the original release of 'Castles & Cars', several government and independent studies have confirmed that electrification saves consumers money:

- ACIL Allen modelled electrification of space heating, water heating and cooking in the ACT[1]. It found an average $450 per year in savings from electrification of appliances and using solar across 12 scenarios analysed, but not using ideal appliances and assuming no batteries. Not including electric vehicles.

- In 2022 the Climate Council published research on the household economics of electrification which found state variation, with up to $1899 per annum savings in Hobart, and other states mostly clustered around $1000 per year without solar. Solar adds up to $800 savings[2]. Not including electric vehicles.

- In 2023 the Grattan Institute published a large piece of research comprising both economic and emissions analysis and policy proposals for winding up household gas distribution networks. This showed state variation and found appliance savings (without solar) of around $1200 per annum in Melbourne, $400 in Sydney/Brisbane and an outlier of -$17 per annum in Perth due to low gas prices[3]. Not including electric vehicles.

- The Victorian Government published data showing $1405 in per annum savings from switching to electric appliances plus $385 per annum with solar.[4] Not including electric vehicles.

- Energy Consumers Australia commissioned CSIRO and Dynamic Analysis to model household electrification and energy efficiency[5] and presented these findings in a report that includes comprehensive policy recommendations[6]. The study found that in 2030 household savings would be in the order of $1250 per annum from solar plus battery, $1440 per annum from EV ownership (including solar savings and cost of finance) and $290 per annum from electrification of gas appliances.

- The Climateworks Centre published a policy paper[7] and technical report[8] which found up to $1845 savings per annum from thermal efficiency and electrification savings without solar, plus up to $1642 per annum savings from solar. Not including electric vehicles.

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1 ACIL Allen (2020) *Household energy choice in the ACT*
2 Climate Council (2022) *Switch And Save: How Gas Is Costing Households*
3 Grattan Institute (2023) *Getting off gas: why, how, and who should pay?*
4 State of Victoria Department of Energy, Environment and Climate Action (2023) *Embracing electricity to cut your bills at home*
5 Graham, Havas, Foster and Meher-Homji (2023) *Consumer impacts of the energy transition: modelling report*
6 Energy Consumers Australia and CSIRO, *Stepping Up: A smoother pathway to decarbonising homes:*
7 Climateworks Centre (2023) *Climate-ready homes: Building the case for a renovation wave in Australia - Climateworks Centre*
8 Climateworks Centre (2023) *Renovation Pathways: Method and assumptions*

The importance of vehicles in home electrification modelling

Conventionally in both emissions accounting and energy systems analysis, transport and residential sectors have been treated differently. This may have made sense when transport energy was sourced primarily from petrol stations and residential energy primarily from electricity and gas networks. However the electrification of cars now sector-couples the transport and residential energy sectors. Most vehicles in Australia are parked at home, and as they become electric the electricity that powers them won't come from the transport sector. It in large part comes from the home.

In some sense, electric vehicles are becoming another home appliance, and this is only likely to increase as Vehicle-To-Grid becomes widespread and cars act to provide backup power and peak reduction to households. This means energy decisions made within the household - like how much solar to buy - will also directly relate to transport. The "right size" of solar system won't just be relevant to the appliances in the home, but also relevant to the vehicles in the driveway, which overtime will become the largest energy load the home has. The importance of this is not just limited to household purchasing decisions, or energy economics, but extends to emissions accounting. As we show later in this report, decisions made by households are responsible for a much larger portion of the nation's emissions than conventionally thought. Once vehicles and electricity consumption are included, they represent the largest "sector" of emissions reduction opportunity.

Throughout this report we provide individual appliance and vehicle estimates, and near the end of this report we provide appliance only estimates for a full home without vehicles. Though it is worth noting there are more homes with multiple vehicles than homes with none.

The impacts of forward pricing on electrification modelling

Once a household has electrified and is powering a lot of its needs with solar and a battery, energy costs are largely fixed into the future, because the finance payments are predictable and known in advance. Conversely we know that electricity, gas, and petrol prices rise with inflation. Factoring in this anti-inflationary aspect of electrification of household energy use increases the savings over the long term.

Throughout this report we provide pricing and savings in multiple forms, both yearly and 15 year numbers. While most of the yearly outputs are based on 2025 energy pricing, the longer term numbers account for some inflation (real, not nominal, in 2025 dollars) of energy prices. This is an important consideration when homes are installing solar and batteries - which lock pricing in over time, because while the prices of other forms of energy have been rising faster than inflation, solar has not. Purchasing a solar install that is warrantied for 30 years essentially means locking in the price of energy (during daylight hours) over those years. Including accounting for degradation and a replacement inverter. Purchasing a battery locks in the price of storing energy over its lifetime. While the rest of the home electricity use continues to rise, like supply charges and remaining grid electricity volume costs.

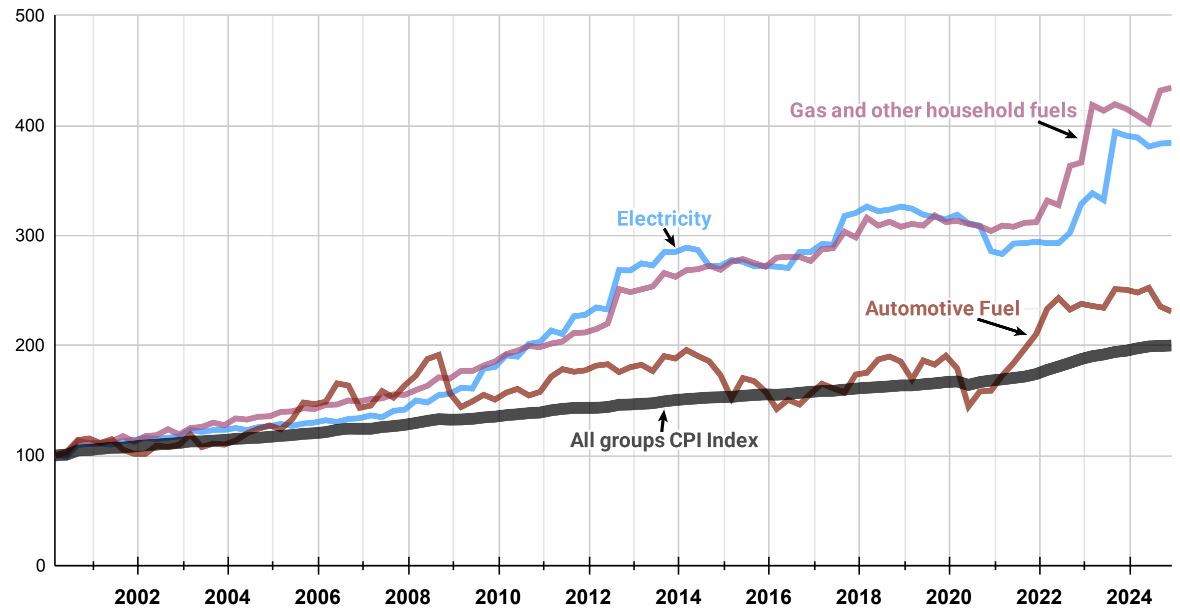
In this report, for 15 year numbers we use the historic "real" inflation rate of energy prices - calculated as the historic rate of an energy type's inflation minus the historic rate of general all groups CPI inflation - alongside flat forward pricing of solar/batteries installed financed in the first year. This is arguably conservative, because the flat forward price competes against the nominal inflation of energy costs, not just real inflation.

In nominal terms, shown in Figure 3 on the next page, financed solar and battery purchases result in relatively flat pricing for that part of the home's energy. Note we include a mix of solar, batteries, and grid electricity in some lines, which leads to a small rise based on inflating grid prices. As one unit of grid electricity gets more expensive, the solar/battery repayments do not. In real terms, this results in negative (or lowering) pricing of the solar/battery install compared to grid electricity. Note the electricity prices shown here are nominal, and therefore not the forward pricing forecasts used for number outputs in this model as discussed above.

Figure 2

Household energy type inflation comparison over 25 years - indexed to 100

All of the shown energy types have risen at or faster than the rate of inflation (all groups CPI index)



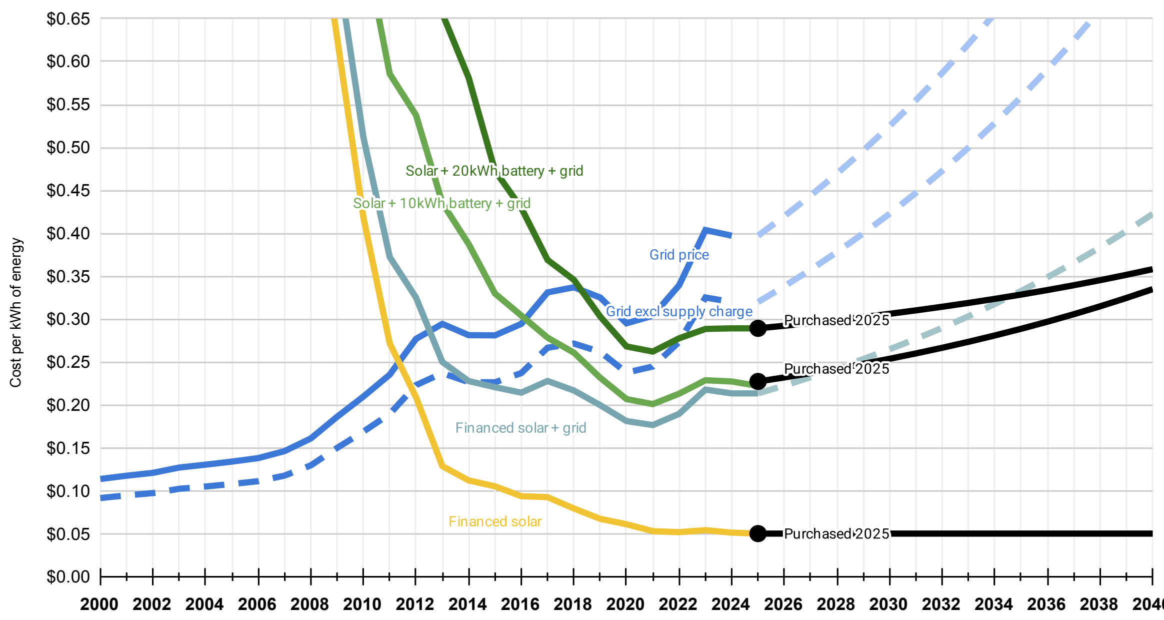
Source notes: Rewiring Australia analysis. ABS Consumer Price Index December 2024 Quarter. Adjusted for 2023-2024 bill rebates in various states.

Figure 2 (above) shows the historic costs of energy for households, rising faster than inflation, figure 3 (below) shows the price of grid electricity over time for households with forward inflation compared to the price of solar and batteries financed.

Figure 3

Home electricity cost comparison from different sources ($/kWh 2025)

2025 energy pricing, historic and future pricing based on ABS Quarterly CPI. 2025 solar and battery pricing financed at 5.5%.



Source notes: Rewiring Australia analysis. ABS Quarterly CPI History 2024. 2025 energy prices adjusted forward with historic nominal inflation rate per year. Micah Ziegler and Jessika Trancik (2021) battery price history adjusted to Australian battery pricing. SolarChoice price history back to 2012, IEA PVPS in earlier years. 30 year solar lifetime, financed at 5.5% interest, 0.5% degradation per year, 17.15% capacity factor from SolarAnalytics. 15 year battery lifetime, 80% utilisation degrading to 44% year 15, 90% round trip efficiency, financed at 5.5% interest. Average home energy use profile based on fully electrified home and vehicles. 50% self consumption of solar.

The path ahead: adoption curves

In this paper we primarily focus on the difference between a fossil fuel home (gas heating, gas water heating, gas cooking, and petrol vehicles) and an electrified home (heat pump space heating, heat pump water heating, electric cooktop, electric vehicles).

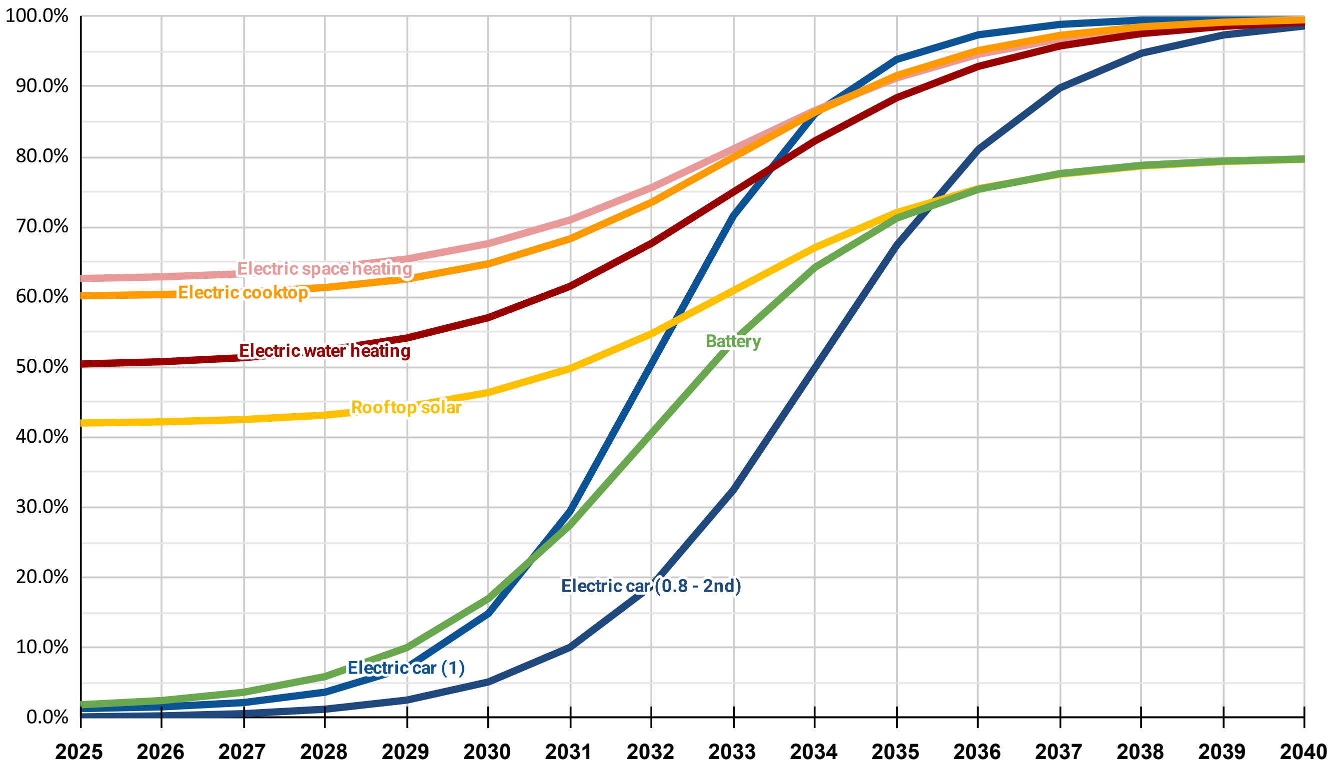
However it should be noted that households throughout Australia are at different levels of electrification. More than 60% of homes already have electric space heating, over 50% have electric water heating, though most is not heat pump water heating (7%), around 60% of homes have electric cooking, and around 0.6% of the total vehicle fleet is electric. Looking at solar and batteries, around 40% of occupied homes have solar already, and 1.3% batteries.

Below we plot example adoption curves - which we note in this paper are not used for any calculations - showing what the journey might look like if Australia achieved zero household (including vehicle) emissions by 2040. This is to emphasise that in a range of areas, we are well on our way, though will still need to accelerate adoption to be on this timeline. If every new appliance and vehicle purchase made at the product's end of life over the next 15 years was electric, that would likely get us there. It is not expected to happen all at once, but accelerating adoption to keep in-line with climate targets is feasible and likely to be of minimal if any net-cost - given the savings electrification brings.

Figure 4

Home electrification adoption curves to reach zero emissions by 2040

Australia is already well on it's way on multiple fronts, though will need acceleration accross all.



Source notes: Rewiring Australia analysis. CER solar, battery, and heat pump hot water installation numbers. BITRE vehicle numbers adjusted to 2025. Space heating, water heating, and cooktop numbers from Residential Baseline Study 2021 adjusted to 2025. "0.8" electric car refers to the second car in the average home with 1.8 vehicles. For example, the family SUV may be replaced at a faster rate than the family ute which has less electric replacement options.

Emissions: households are underappreciated

Reaching the electrification tipping point means, on average, residential emissions reductions can now be seen as negative dollars per ton - they can be reduced while saving money. This is important because to date Australia has not prioritised community emissions reduction, which should be seen as one of the fastest and most effective ways to accelerate Australia's climate action.

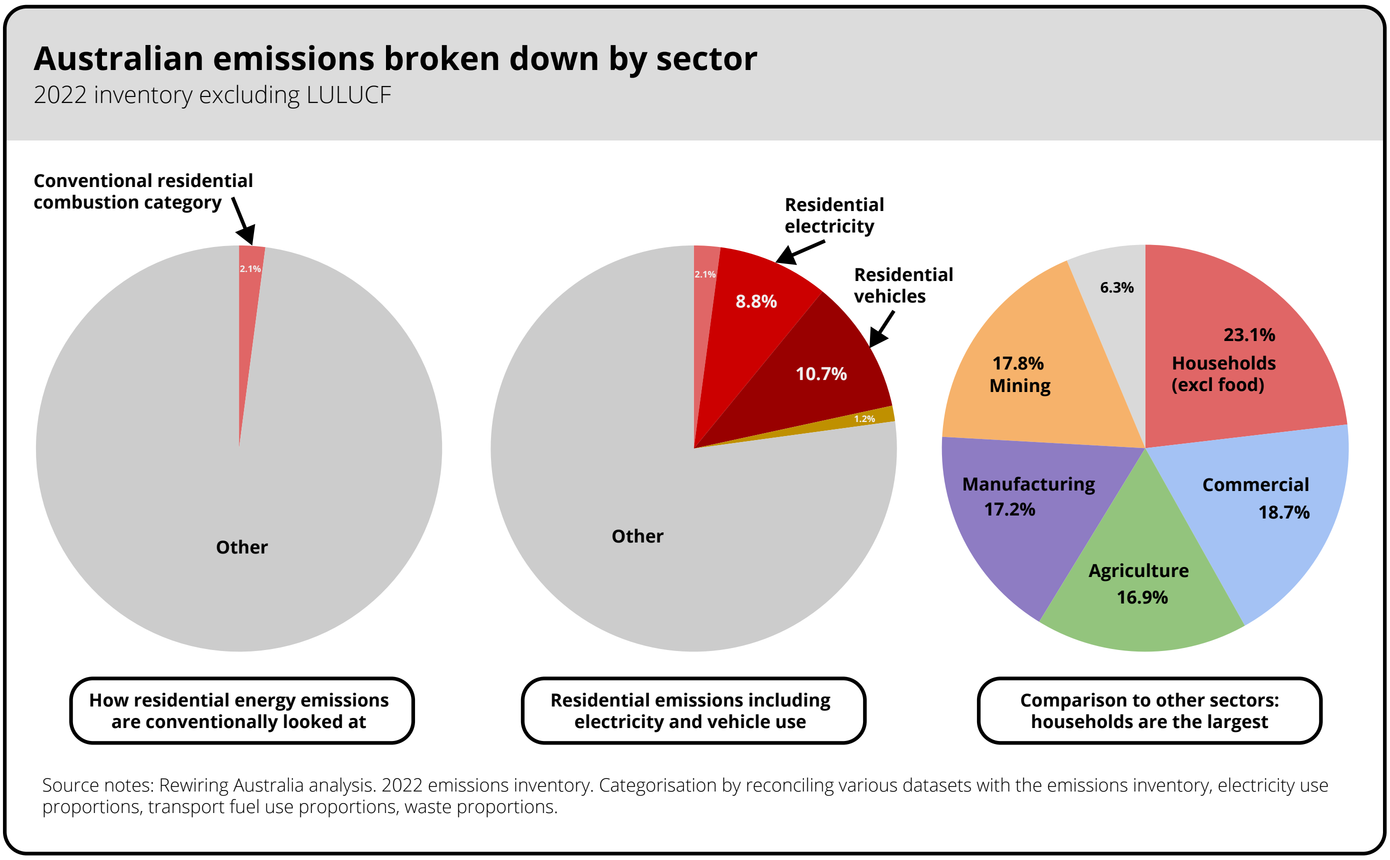
Technological progress offers us low-hanging fruit

Emissions reduction opportunity is often closely related to technological progress - and consumer products are at the forefront of that innovation. This paper demonstrates that our homes and cars can now be electrified while saving money. The same is not necessarily true of industry decarbonisation today. Zero emissions planes are not within close reach in comparison to zero emission electric cars. Zero emissions animal agriculture is not necessarily within reach today either. Climate change is a cumulative emissions problem, the more emissions we can eliminate early, the more impact on long-term warming. This makes it vital to identify the low hanging fruit of emissions reduction and go fast in those areas while solutions are developed for more difficult areas. The small fossil fuel 'machines' in our homes - our appliances and vehicles - are ripe for rapid electrification.

Australia's emissions through a new lens

Here we investigate Australia's emissions profile through a new lens - the decisions that enable emissions reduction. Conventional emissions profiles are built upon economic categorisation of a nation, which can skew perspective away from where the decisions to reduce emissions are made. For example, the "Road Transport" section of our emissions profile will not necessarily be decarbonised by decisions made by that sector (e.g. petrol stations). It will mostly be decarbonised by decisions made around dinner tables about which car to purchase next. Gas pipeline distribution emissions, or LPG bottle delivery truck diesel emissions, will likely be the result of homes deciding to do their heating and cooking with electricity rather than gas - not an emissions reduction decision done by the Gas or LPG company. Figure 5 compares the conventional "residential combustion" category, to the size of the residential emissions including the proportion of the light vehicle fleet that parks at homes, and the proportion of electricity used by homes. Residential emissions are a significantly larger portion than conventionally thought.

Figure 5



What is home electrification?

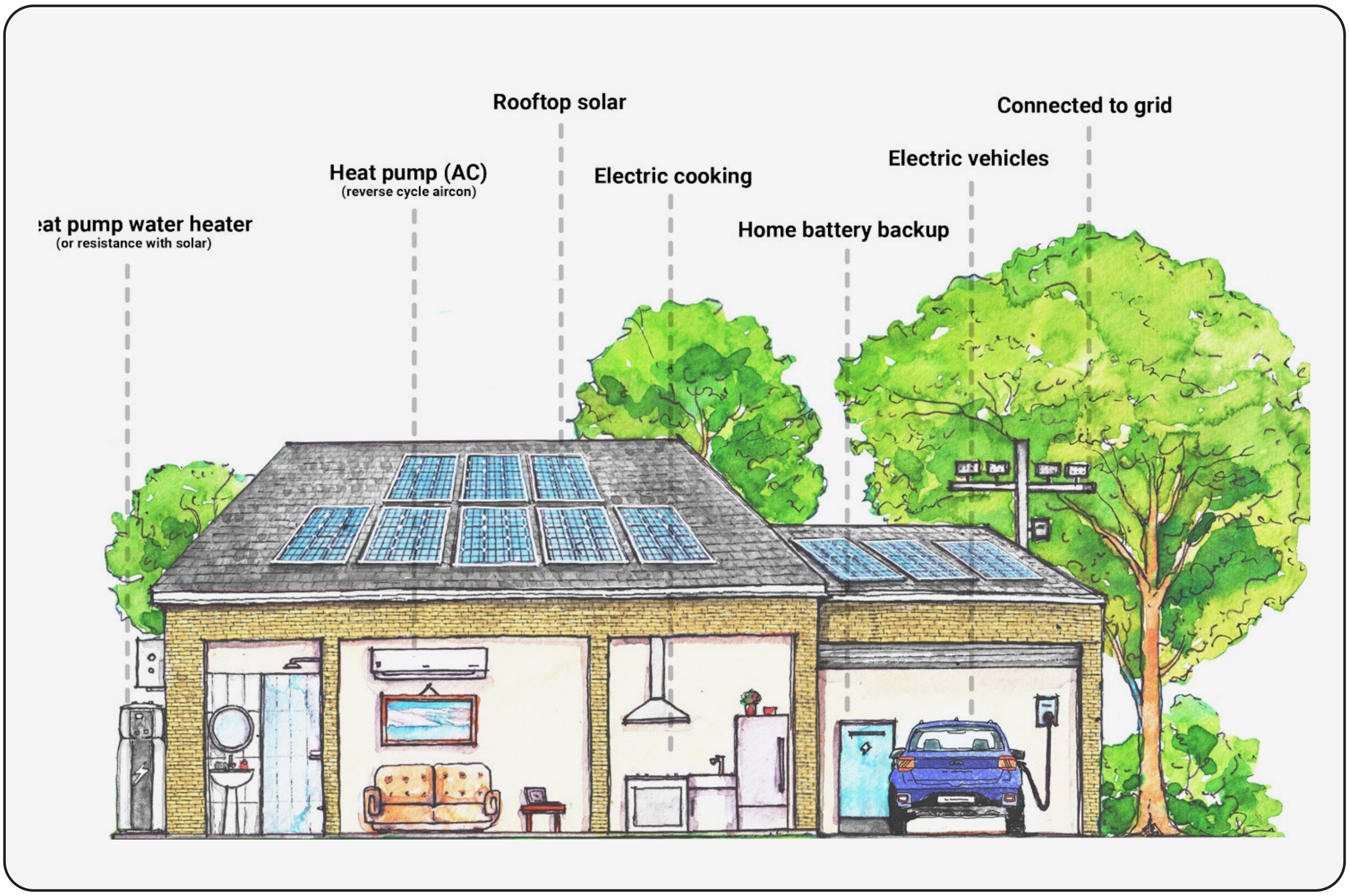
Our lights, dishwashers, fridges, phones and more already run on electricity, but there are still a lot of households in Australia that burn fossil fuels for water heating, space heating, cooking and driving. An electric home swaps those fossil fuel machines for more efficient electric equivalents and, if possible, adds solar panels to generate its own electricity and batteries to store that electricity for when it's needed.

Residential electrification primarily focuses on 5 "machine" decisions made by households:

- What is used to heat the home (e.g. heat pump, gas, wood fire)
- What is used for water heating (e.g. heat pump, electric tank, gas instant or tank)
- What is used to cook with (e.g. electric induction, electric resistance, or gas)
- What vehicles to drive (e.g. electric, petrol, diesel)
- Where to get electricity (e.g. solar, battery, and grid electricity)

These few decisions effectively determine almost all of the energy emissions of a household, and most of the households total emissions. Perhaps surprisingly given conventional emissions approaches, households combined are one of the largest emissions sources in the Australian economy. These decisions also determine a significant portion of every home's cost-of-living, and can help determine its resilience to natural disasters.

Figure 6



How does electrification work?

Electric machines are - in general - significantly more efficient than their fossil fuel counterparts. This is important to understand as it drives many of the cost savings available through electrification. In a fossil fuel system, when a fuel is being burned, heat is lost that does not go directly into the task at hand. For example, in a petrol vehicle, only about 16%–25% of the energy in petrol is turned into moving the car.[9] Petrol and diesel engines work by producing thousands of small explosions to drive the vehicle. This heats the engine up, creating waste heat and vibrations that among other things waste energy that does not get converted into driving the car forward. In contrast, an electric vehicle converts about 87%–91% of the electrical energy it uses into motion at the wheels.[10] An electric car is therefore about four times more efficient at converting energy into motion.

Electric efficiency gains are not just seen in vehicles. Heat pumps (also known as reverse cycle air conditioners) can provide about 3–5 times the amount of heating for the same amount of input energy as gas heaters (known as the coefficient of performance or COP). Most space heating options for homes have a coefficient of performance below 1.0, with electric resistance near 1.0,[11] gas about 0.61 - 0.90[3], and wood fires about 0.60 - 0.90[3]. Heat pumps have an COP that is about 2.50 - 6.60[3] in Australia, changing by region with colder regions having lower efficiency generally. Even in cold regions, heat pumps often exceed a 2.0 coefficient of performance, meaning they are still two or three times as efficient as most other heating options. Similar efficiency advantages are seen in the electrification of water heating with heat pump water heaters.

Electrification increases energy efficiency at a fundamental level, and does so at a scale often much greater than conventional energy saving methods. Globally, decades have been spent trying to make fossil fuel vehicles and appliances more efficient, with small gains that pale in comparison to the gains made through electrification. Years have been spent looking for small gains in efficiency, with that efficiency often associated with sacrifice like shorter showers or heating less. This report demonstrates that electrification can provide greater efficiency gains without rationing. It demonstrates that in energy efficiency and emissions reduction, we don't need to be perfect if we are electric.

In addition to better energy utilisation, electrification has substantially better material utilisation than fossil fuels, and the materials required are available and highly recyclable.[12] Embedded emissions (from the manufacturing of products) have also been considered and studied. While some products like electric vehicles have more manufacturing upfront emissions than their fossil fuel counterparts, this is quickly made up for by not burning fossil fuels for operation which creates substantially more emissions than the manufacturing process itself. Over the operating lifetime of an electric vehicle, total emissions are significantly lower.[13] The economics of electrification reveal the potential for significant cost savings for homes, demonstrated over the following pages. Next time a fossil fuel appliance or vehicle is retired from use, homes can save money on their energy bills by replacing it with an electric alternative. In some cases early replacement will save more money because of the higher operating costs of fossil fuel appliances and vehicles. Electrification presents the opportunity to fundamentally increase energy productivity in Australia.

9 https://www.fueleconomy.gov/feg/atv.shtml
10 https://www.fueleconomy.gov/feg/atv-ev.shtml
11 https://www.energyrating.gov.au/sites/default/files/2022-12/product_profile_-_residential_space_heaters_in_australia_and_new_zealand_0.pdf
12 https://www.cell.com/joule/fulltext/S2542-4351(23)00001-6
13 European Federation for Transport and Environment, 2022, https://www.transportenvironment.org/discover/how-clean-are-electric-cars/

Electrification data by machine type

Space heating

Space heating is the largest energy use in the average Australia home, though this varies by region, with some regions needing significantly less heating (e.g. QLD, NT). Note, it is the largest energy use “in” the home, though is the second largest when compared to vehicle use by the average home.

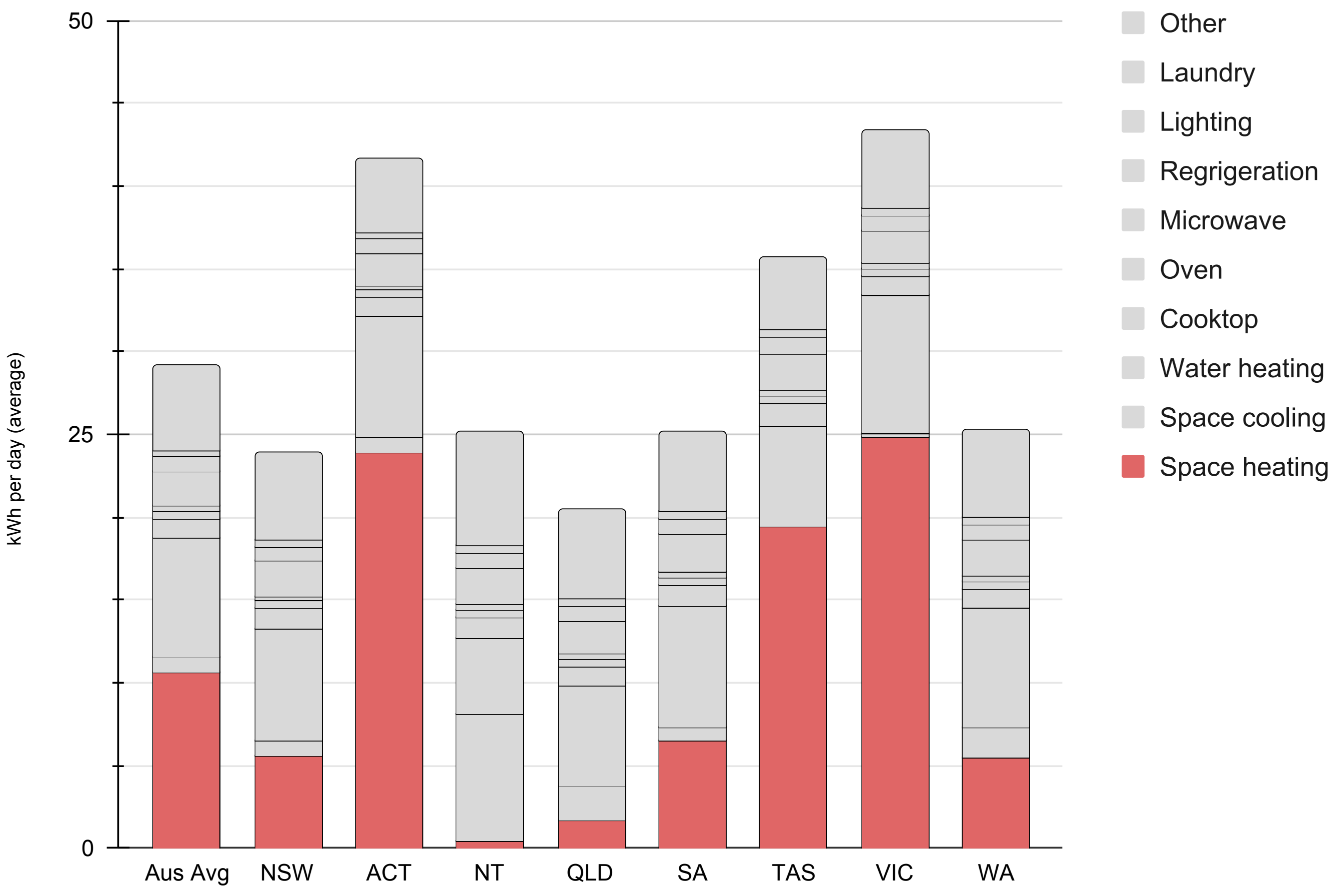
In this section we compare major heating options for Australian homes, including their energy use, their upfront costs, operational costs (bills), and their emissions. We find that the lowest cost heating option in Australia is heat pump space heating, also known as reverse cycle air conditioning (the heating cycle available on many air conditioners).

Figure 7 gives context to the proportion of space heating energy use in different states, and how it compares to the rest of the energy use in the home by appliances - excluding vehicles in this example.

Figure 7

Space heating energy use compared to other appliances in the home

Rewiring Australia analysis, Residential Baseline Study 2021



Source notes: based on existing energy data including multiple sources of energy (electricity, wood, gas, LPG). For this reason the total energy “needs” of a home in any region will differ based on the efficiency of the most common machines used in that region. Additional energy on top of this is wasted with fossil fuel electricity generation (thermal generation waste), and this additional energy use is not shown in this chart in order to make understanding proportional energy use in households easier.

Energy use

Space heating efficiency is often referred to as COP (Coefficient Of Performance), which is a measure of how much heat is provided from the heating source in question. Resistive electric heaters operate at very close to 100% efficiency: for every 1 unit of electricity, approximately 1 unit of heat is provided to the home (a COP of 1). For most heating types, the COP is below 1.0, for example gas heaters often operate at an efficiency of around 80% (a COP of 0.8). This means that out of the energy that is in the gas, 80% of it is turned into heat within the room. The rest is wasted. Wood fires often have an even lower efficiency, of around 65% - this is perhaps easier to imagine, as some portion of the heat in a wood fire “escapes” out of the chimney and does not go towards heating the home.

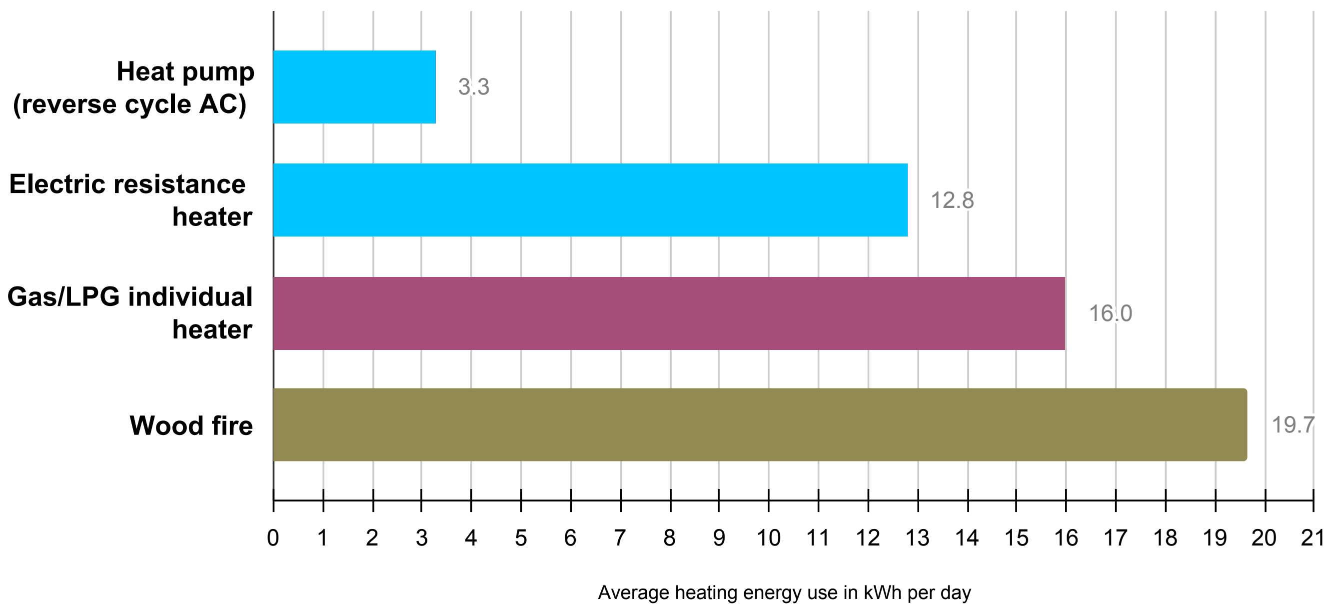
Heat pumps (or Reverse Cycle Air Conditioners) use a fundamentally different heating method to gas and wood (which use combustion), or electric resistive (which uses electrical resistance). Heat pumps “pump” a refrigerant between indoors and outdoors, using the temperature difference between both sides to compress and decompress the refrigerant liquid which has a low boiling point - they move heat from the outside air into your living room. This process can produce both heating and cooling, depending on which direction the cycle is happening. In this case, the “reverse” cycle of the air conditioner is what produces heating. In many countries, where heating is more important than cooling, they are referred to as “heat pumps”, in Australia they are often referred to as Air Conditioners. Note, only Reverse Cycle Air Conditioners can switch between cooling and heating cycles.

This method enables heat pumps to achieve significantly higher performance than conventional heating options - often able to achieve a COP of 4.0. Heat pumps operate more efficiently at higher temperatures, and this COP changes by region in Australia. Though even in cold regions, the COP can often exceed 2.5, still more than double the efficiency of conventional heating options. The efficiency of common heating options is shown below in terms of their energy use per day, note this efficiency in real world use changes by the individual appliance quality and efficiency.

Figure 8

Space heating energy use comparison by device - kWh per day

Rewiring Australia analysis, Residential Baseline Study 2021. Average Australian heating needs.



Source notes: Rewiring Australia analysis. Residential Baseline Study 2021, heat pump COP 4.0, resistance 1.0, gas/LPG 0.8, wood fire 0.65.

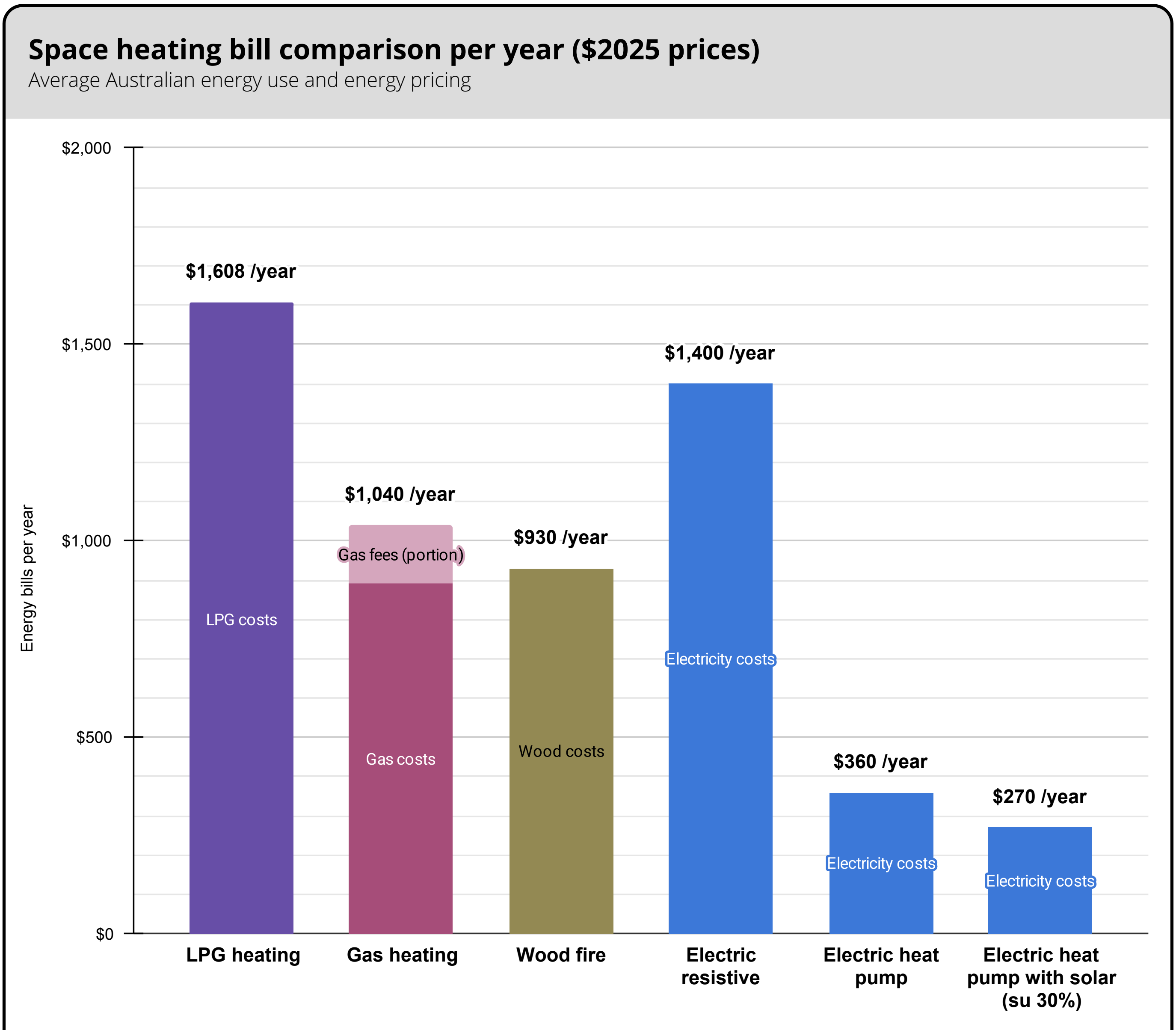
Cost comparison

Operating cost comparison

First we compare the operating costs (or bills) of major heating types. The efficiency of each device combines with the cost of each energy source to produce the operating costs.

Figure 9, shows the yearly bill comparison at today's electricity, gas, LPG and wood pricing, using the average heating needs of an Australian home. These costs vary by location, energy retailer, and other factors. Heat pump space heating is the lowest cost on bills, and including even a small amount of solar improves costs even further. Though we note heating is often done at night, outside the solar window, and as such is less able to utilise solar compared to water heaters or electric vehicles both of which can be "shifted" into the solar window to save people money.

Figure 9



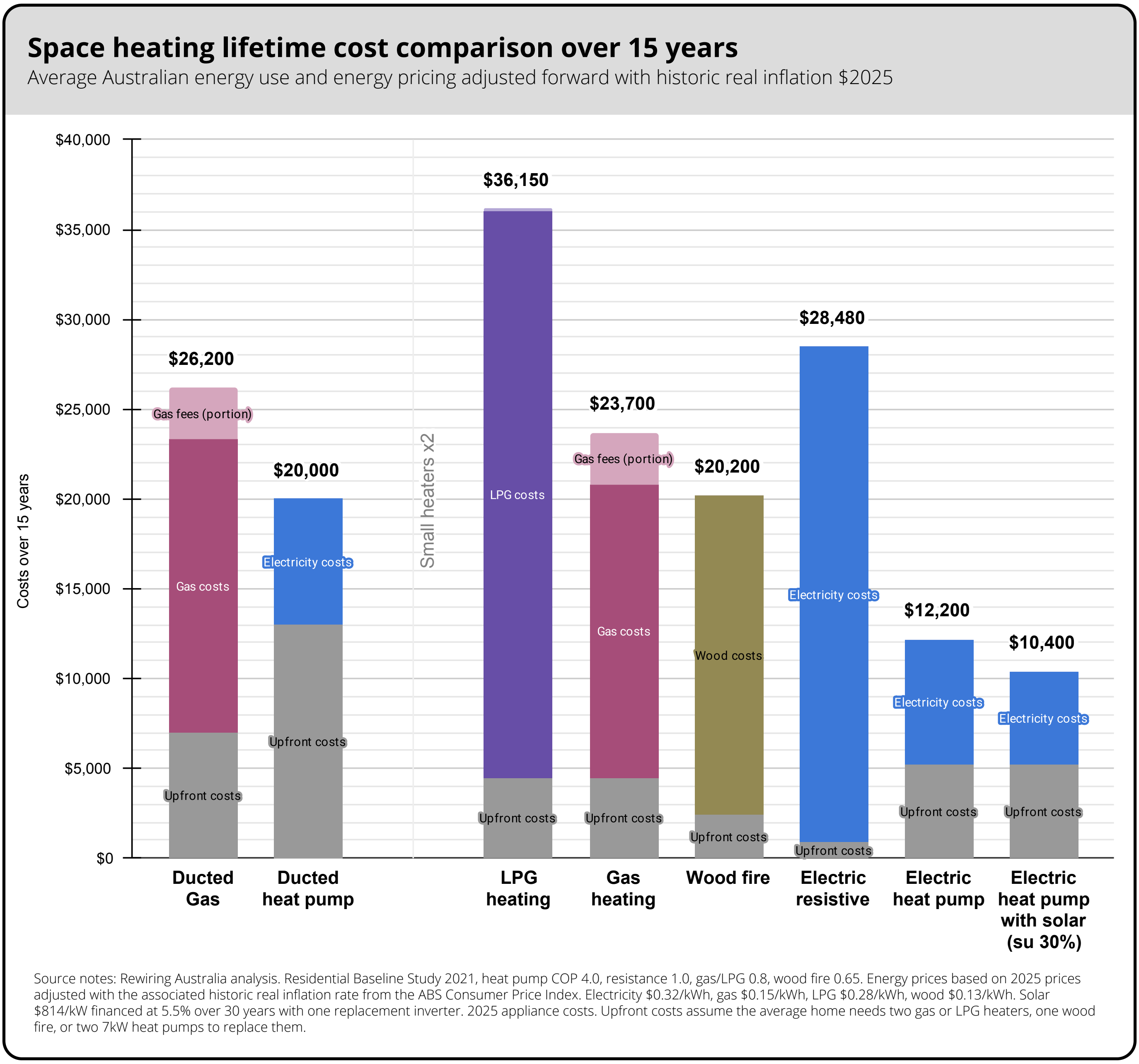
Source notes: Rewiring Australia analysis. Residential Baseline Study 2021, heat pump COP 4.0, resistance 1.0, gas/LPG 0.8, wood fire 0.65. Electricity price $0.32/kWh, gas $0.15/kWh, LPG $0.28/kWh, wood $0.13/kWh. Solar $814/kW financed at 5.5% over 30 years with one replacement inverter.

Total upfront and operating cost comparison

Here we compare the total costs of each heating option over an assumed 15 year lifetime. This takes into account today's costs of energy, and costs of energy over the next 15 years rising at the rate of their respective historic inflation in real 2025 dollars.

Figure 10 shows the total upfront and operating costs over a 15 year operational lifetime. Heat pumps are still the lowest cost option, and the savings they generate over their lifetime can be significant. Note in this example we show a new ducted install on the left, comparing both gas and heat pumps, and on the right we show a comparison of smaller conventional heaters. For LPG, Gas, and Heat Pumps we assume two devices are needed to heat the home, and the energy use is the Australian average space heating needs. For the wood fire we assume just one device, and the electric resistive heaters often much smaller ~2kW devices, we assume 4 would be needed. Note the number of heating devices needed will change by regional temperatures (higher upfront and operational costs in cold regions), and in many cases homes will have a mix of devices - for example a wood fire and a heat pump. Retrofit installations can be higher in cost, for example retrofitting ducted gas in Victoria, though an often seen solution is installing individual heat pumps in those cases instead of a centralised solution.

Figure 10



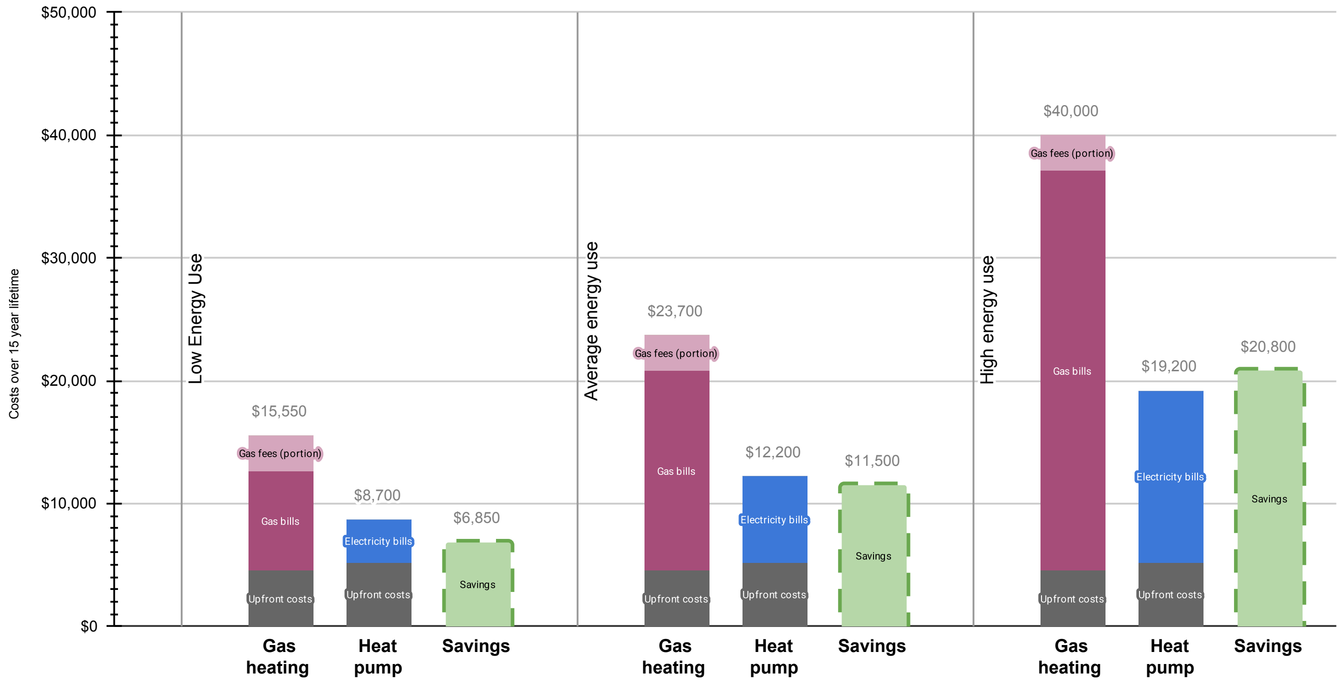
The impact of energy use on costs/savings

While the upfront costs of each heating option can change by region and heating needs, this is unlikely to vary as much as operational costs, which creates an interesting savings dynamic. The more energy the home is using before electrification, the more savings it may experience after electrification. While there may be different numbers of heaters required in a colder region, the main difference is likely to be how much heating is done - or how long the heater is turned on. For example in a warmer region the heater may only be on for a small portion of winter, whereas in a colder region it may be on for almost the full year. As electrification options generally have significantly lower operating costs (or bills), higher energy usage to start with often means higher savings when switching. The chart below compares costs in different usage scenarios, low scenario (half average usage), average scenario, and high scenario (double average usage).

Figure 11

Space heating comparison of 15 year savings with different energy usage

Average home is 2.6 people, low scenario is half of the average, high scenario is twice the average energy use.



Source notes: Rewiring Australia analysis. Residential Baseline Study 2021, heat pump COP 4.0, resistance 1.0, gas/LPG 0.8, wood fire 0.65. Energy prices based on 2024 prices adjusted with the associated historic real inflation rate from the ABS Consumer Price Index. Electricity $0.32/kWh, gas $0.15/kWh, LPG $0.28/kWh, wood $0.13/kWh. Solar $814/kW financed at 5.5% over 30 years with one replacement inverter. 2025 appliance costs. Upfront costs assume the average home needs two gas or LPG heaters, one wood fire, or two 7kW heat pumps to replace them.

Emissions comparison

When purchasing a new gas or LPG heater, a home is likely locking in thousands of kilograms of emissions that will occur as gas is used in the heater over its lifetime. These are referred to as “committed emissions”. By purchasing an electric heat pump, a home is avoiding those committed emissions while saving money. When it comes to purchasing decisions, emissions can be more accurately thought of as committed emissions, because the purchase of an appliance may only happen once every 15 years or so, and switching in the middle of its life is less likely - creating the lock in effect of emissions based on a single decision.

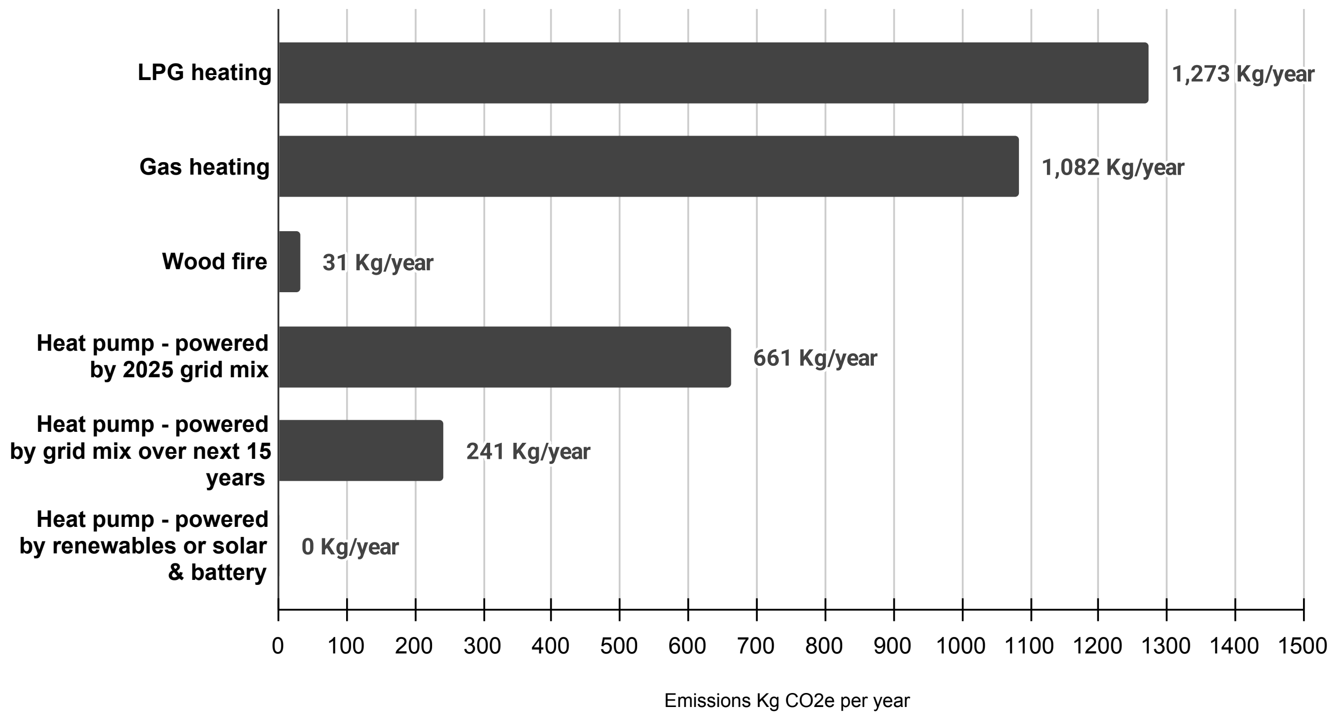
Comparing emissions with electric machines requires understanding the source of the electricity they use, today’s electricity (in Australia) is still generated with a significant amount of fossil fuels, and is becoming cleaner as more renewables come online. Households do not necessarily share the same electricity mix as industry or businesses, for example, homes with rooftop solar often produce more energy from their rooftop than is used by their home, however still need to consume grid electricity.

Figure 10 below compares each appliance choice, and for electric appliances, compares three different electricity sources - today’s grid mix, the decarbonising grid mix over the next 15 years, and for a home that generates its own clean electricity and stores it in a battery.

Figure 12

Emissions comparison of home heating options

Based on average home energy use, homes with higher energy use will have higher emissions.



Source notes: Rewiring Australia analysis, Residential Baseline Study 2021, DCCEEW Emissions Projections 2023.

Water heating

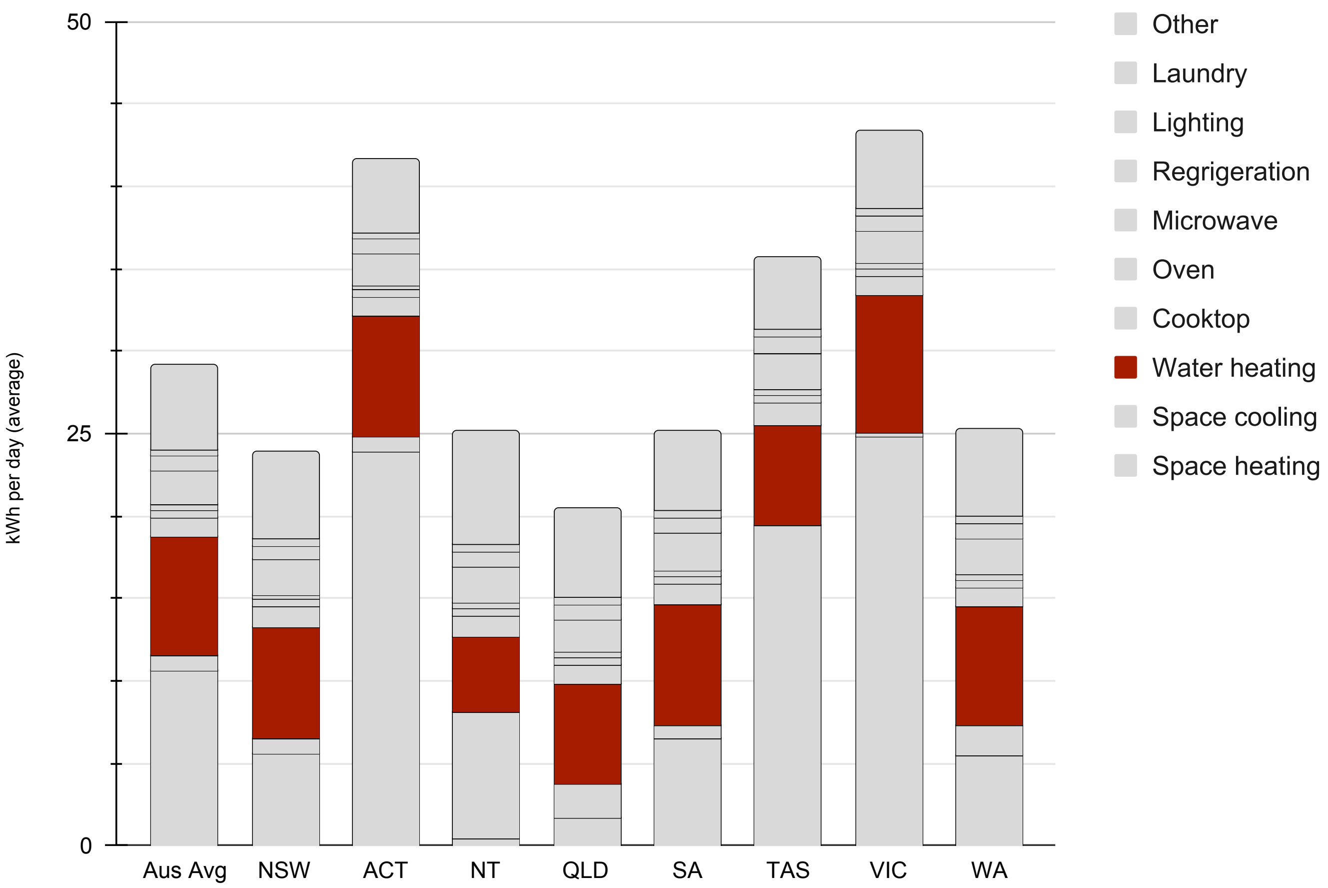
Water heating is the second largest energy use within the average Australian home, though this varies by region and space heating needs of the home. In some regions water heating is the largest energy use in the home. We note again that this comparison only considers appliances within the home, vehicles are for most homes a larger energy user than any individual appliance - this will be covered in the vehicles section.

In this section we compare major water heating options for Australian homes, including their energy use, their upfront costs, operational costs (bills), and their emissions. We find that the lowest cost option in Australia is heat pump water heating with solar lowering those bills even further.

Figure 13

Water heating energy use compared to other appliances in the home

Rewiring Australia analysis, Residential Baseline Stufdy 2021



Source notes: based on existing energy data including multiple sources of energy (electricity, wood, gas, LPG). For this reason the total energy "needs" of a home in any region will differ based on the efficiency of the most common machines used in that region. Additional energy on top of this is wasted with fossil fuel electricity generation (thermal generation waste), and this additional energy use is not shown in this chart in order to make understanding proportional energy use in households easier.

Energy use

Similar to space heating, water heating efficiency is often referred to as COP (Coefficient Of Performance), which is a measure of how much heat is extracted by the heating method in question. For most water heating types, the COP is below 1.0. Instant gas water heaters are more efficient than gas tank water heaters, testing data from the Australian Federal Government's Minimum EnergyPerformance Scheme (MEPS) and Energy Rating system database shows that both gas and electric water heaters often operate at a lower COP than advertised.[14]

Gas instant water heaters are advertised, as up to about 0.95 COP, though real world performance appears closer to 0.80, with gas tank water heaters around 0.70. These COPs will vary based on device brand, quality, and installation. Other factors in the home may need to be accounted for like pipe distances and radiative losses.

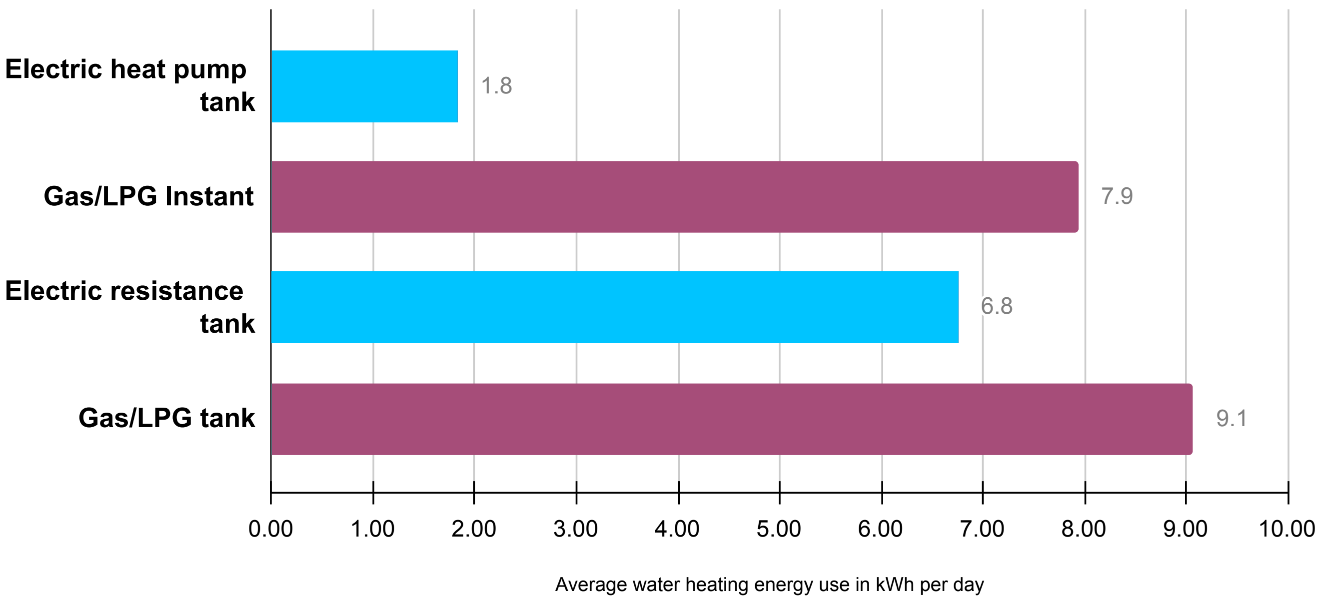
For the purpose of this comparison we assume electric resistive tank water heaters operate at 0.94 efficiency. Though this calculation is not used in the primary home comparison which uses a heat pump water heater not a resistive tank water heater.

Heat pump water heater tanks - similar to space heating heat pumps - have varying COPs based on regional temperature, quality of device, refrigerant used and other factors. Heat pump water heaters are already available with COPs stated* at 450% and 520%.[15] However, as with gas water heaters, real world testing performance appears in general to be lower than advertised COPs once accounting for usage conditions. Here we use a heat pump water heater COP of 3.48, calculated based on data published by the Australian Federal Government for Small Scale Technology Certificates. We note that while the exact COP of any device will vary and exact device calculations can be done, the trend does not vary. Heat pump water heaters are in general 3 - 5 times more efficient than gas water heaters.

Figure 14

Water heating energy use comparison by device

Rewiring Australia analysis, Residential Baseline Study 2021, average Australian home energy needs



Source notes: Rewiring Australia analysis. Residential Baseline Study 2021, heat pump COP 3.48, resistance tank 0.94, gas/LPG instant 0.80, gas.LPG tank 0.70.

14 https://reg.energyrating.gov.au/comparator/product_types/
15 https://blog.rheem.com.au/blog/what-does-coefficient-of-performance-cop-mean-on-a-heat-pump-water-heater/

Cost comparison

Operating cost comparison

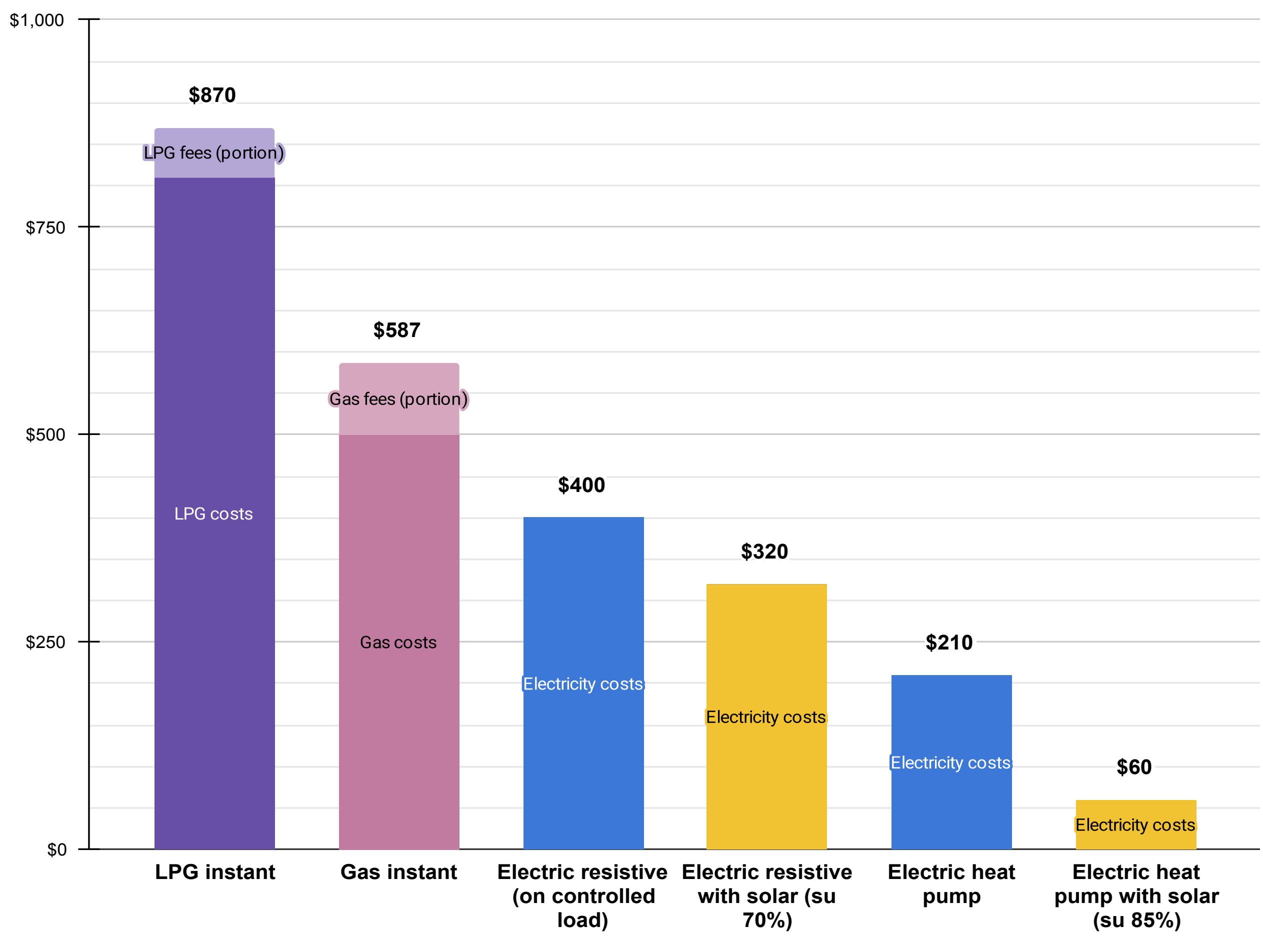
Here we compare the operating costs (or bills) of major water heating types. The efficiency of each device combines with the cost of each energy source to produce the operating costs.

While space heating cannot generally use significant amounts of solar power because heating is often required in the evening when the sun doesn't shine, water heating benefits from being a very flexible electricity load. This enables an electric tank water heater to become what is called a "thermal battery", where water can be heated up in the cheapest part of the day with solar, staying warm for use later and topping up with grid or battery electricity where necessary. This enables significantly lower water heating costs for homes that also have solar, as can be seen in both the resistive with solar option, and the heat pump with solar option shown below.

Figure 15 shows the yearly bill comparison at today's electricity, gas pricing and LPG pricing, using the average water heating needs of an Australian home. Note the costs of LPG, gas, and electricity have all historically risen faster than inflation, whereas solar has both fallen in cost and once purchased - remains around the same cost over its life. This means that over time in future years, these operating costs are expected to change slightly with the solar options saving more money than the others, and this is accounted for in the next section.

Figure 15

Water heating bill comparison per year ($2025 prices)
Average Australian energy use and energy pricing



Source notes: Rewiring Australia analysis. Residential Baseline Study 2021, heat pump COP 3.48, resistance tank 0.94, gas/LPG instant 0.80, gas/LPG tank 0.70. Electricity $0.32/kWh, gas $0.15/kWh, LPG $0.28/kWh, wood $0.13/kWh. Solar $814/kW financed at 5.5% over 30 years with replacement inverter. su = solar utilisation.

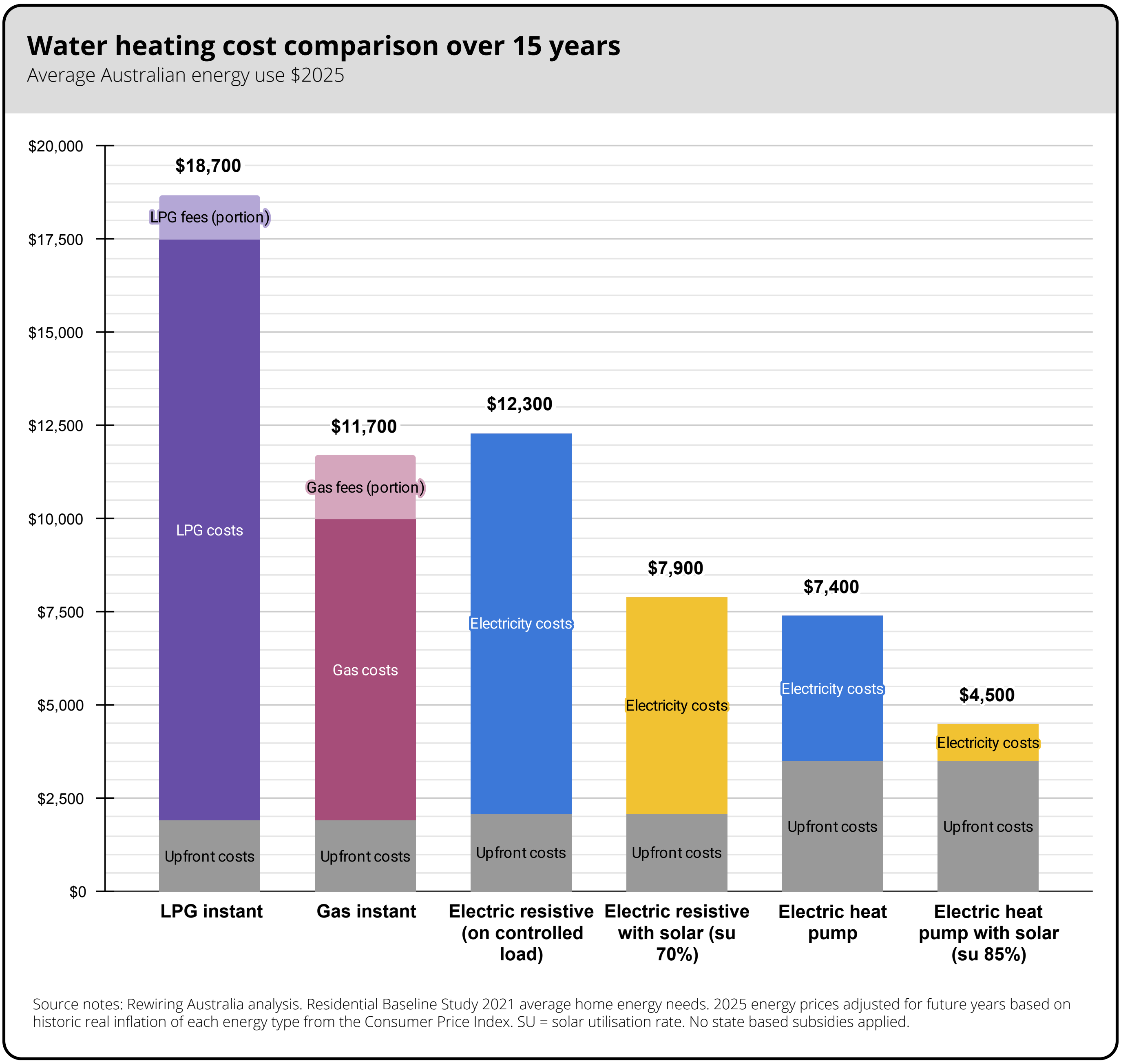
Total upfront and operating cost comparison

Here we compare the upfront and operating costs of each heating option over an assumed 15 year lifetime. This takes into account today's costs of energy, and predicted costs of energy over the next 15 years rising at their historic average real inflation rate. The numbers shown are real 2025 dollars.

Figure 16 shows the total upfront and operating costs over a 15 year operational lifetime. Heat pumps are still the lowest cost option, and the savings they generate over their lifetime can be significant.

One of the key insights from this longer perspective on water heaters is that while heat pump water heaters have a much higher upfront cost compared to gas water heaters (or electric resistive), that increase in upfront cost is more than paid back over time through savings on operating costs. In some respects, these costs combined represent the actual cost of a water heater. When a consumer is buying a water heater that will last many years, a gas water heater locks that home into using gas (and paying high bills) to heat their water. Whereas a heat pump can offer much lower total water heating costs. This also highlights the need for ways to spread that upfront cost over time (finance) to help consumers realise these savings on their bills from day one.

Figure 16



The impact of energy use on costs/savings

The upfront costs of water heater options often do not change much with usage or occupancy of the home. A smaller water heater might be slightly cheaper, but usually similar in cost to a larger option, and most homes generally have only one water heater.

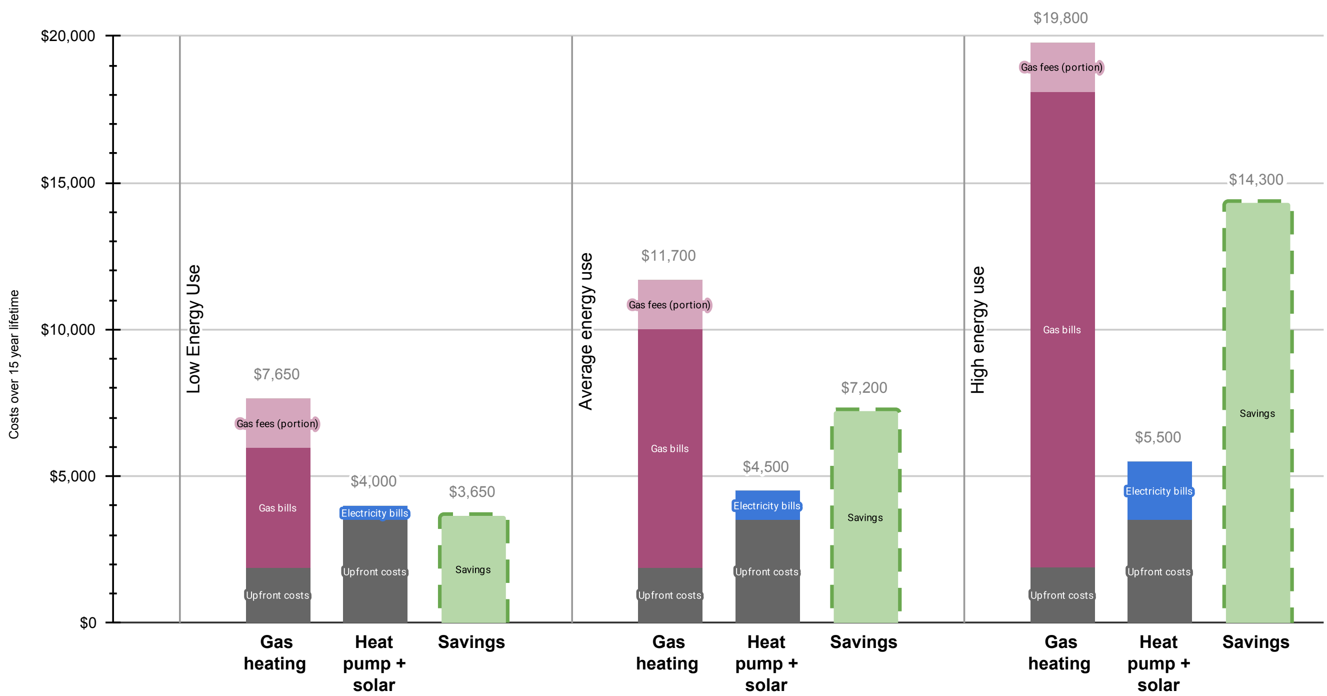
This means the upfront costs largely remain similar for a small home with 2 people, or a large home with 6 people. As electrification options generally have significantly lower operating costs (or bills), higher energy usage to start with often means higher savings - as the upfront costs don't change but the operating costs do.

The chart below compares costs in different usage scenarios, low scenario (half average usage), average usage, and high scenario (double average usage). While the upfront costs of each option shown here are the same, the savings over 15 years are very different.

Figure 17

Water heating comparison of 15 year savings with different energy usage

Average home is 2.6 people, low scenario is half of the average, high scenario is twice the average energy use.



Source notes: Rewiring Australia analysis. Residential Baseline Study 2021, heat pump COP 3.48, resistance tank 0.94, gas/LPG instant 0.80, gas/LPG tank 0.70. Energy prices based on 2025 prices adjusted with the associated historic real inflation rate from the ABS Consumer Price Index. Electricity $0.32/kWh, gas $0.15/kWh, LPG $0.28/kWh, wood $0.13/kWh. Solar $814/kW financed at 5.5% over 30 years with one replacement inverter. 2025 appliance costs. su = solar utilisation.

Emissions comparison

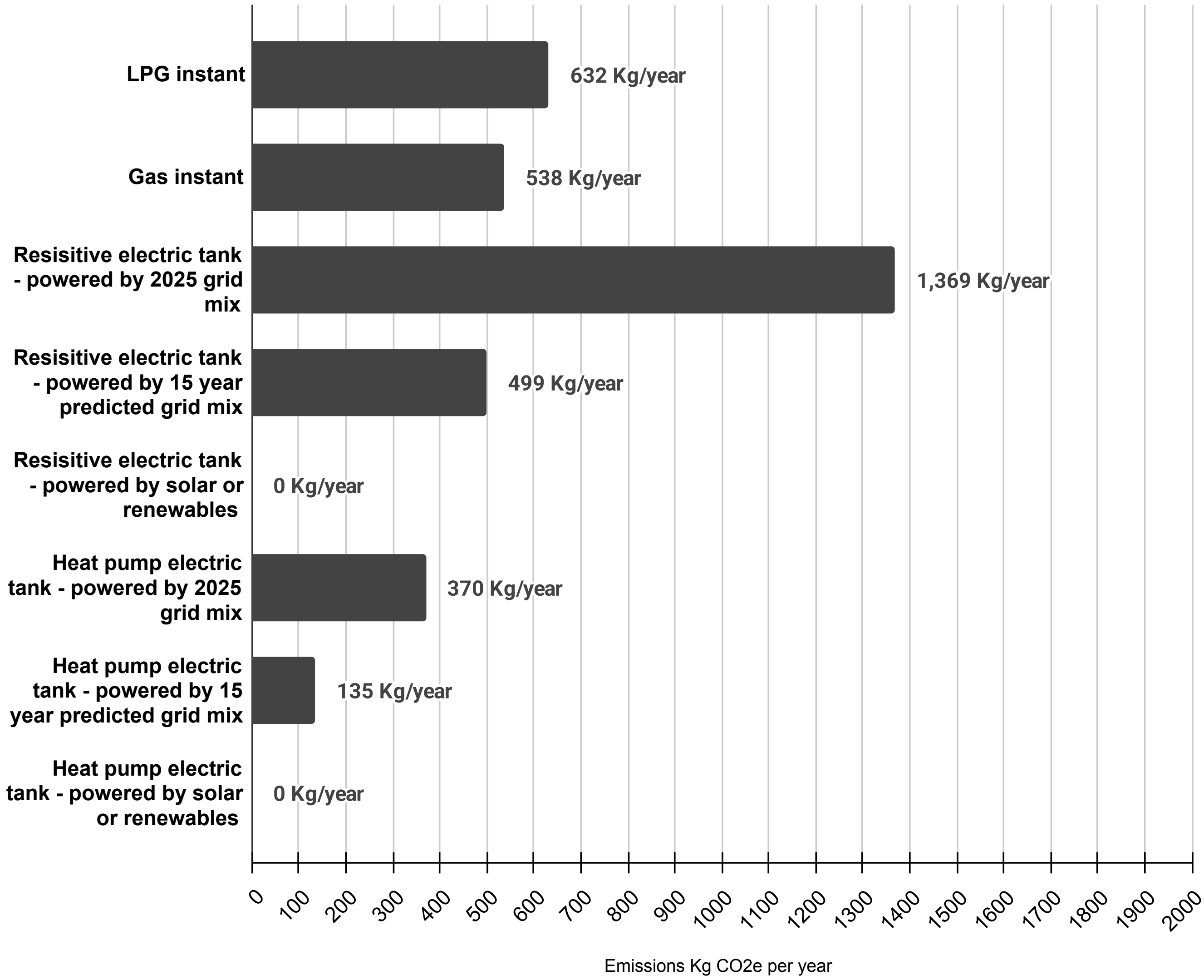
When purchasing a new gas or LPG water heater, a home is locking in thousands of kilograms of emissions that will occur as gas is used in the heater over its lifetime. By purchasing an electric appliance, a home is avoiding those committed emissions.

Figure 18 below compares each water heating appliance choice, and for electric appliances, compares three different electricity sources - today's grid mix, the grid mix as it decarbonises over the next 15 years, and for a home that generates its own clean electricity and stores it in a battery, or buys renewable electricity.

Figure 18

Emissions comparison of water heating options

Based on average home energy use, homes with higher energy use will have higher emissions.



Source notes: Rewiring Australia analysis, Residential Baseline Study 2021, DCCEEW Emissions Projections 2023.

Cooktops

Cooktop energy use is generally quite low in comparison to other household energy use. While electric cooking can save money on energy bills, a larger saving will often come from being able to disconnect from the gas network and avoid paying gas "connection" fees. For example, with water heating and space heating the savings from electrification over gas are large and clear, and the one remaining gas usage in the home then may be cooking, in which case electrifying the cooking will also save on all of the gas connection fees.

Perhaps more importantly than the economics and the emissions are the now well known negative health impacts on children caused by gas cooking in the home.[16 17 18]

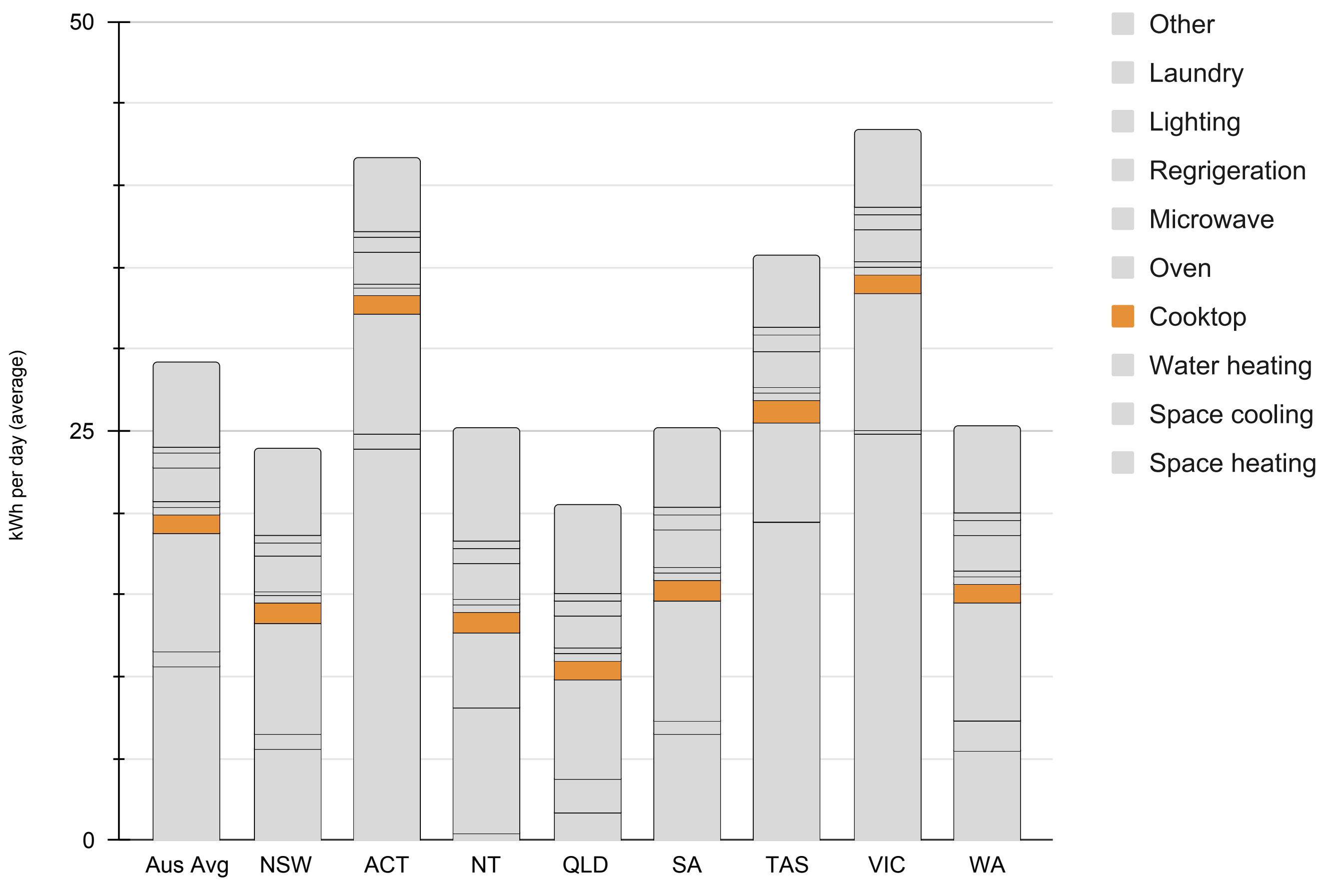
This section compares the energy use, economics, and emissions of cooking options in the home, though does not delve into the health implications.

Figure 19 shows that, across Australian states, it is estimated that the energy used for cooking remains largely the same.

Figure 19

Cooktop energy use compared to other appliances in the home

Rewiring Australia analysis, Residential Baseline Stufdy 2021



Source notes: based on existing energy data including multiple sources of energy (electricity, wood, gas, LPG). For this reason the total energy "needs" of a home in any region will differ based on the efficiency of the most common machines used in that region. Additional energy on top of this is wasted with fossil fuel electricity generation (thermal generation waste), and this additional energy use is not shown in this chart in order to make understanding proportional energy use in households easier.

16 https://academic.oup.com/ije/article/42/6/1724/737113?login=false
17 https://www.mdpi.com/1660-4601/20/1/75
18 https://www.tandfonline.com/doi/abs/10.1080/10473289.1992.10467018

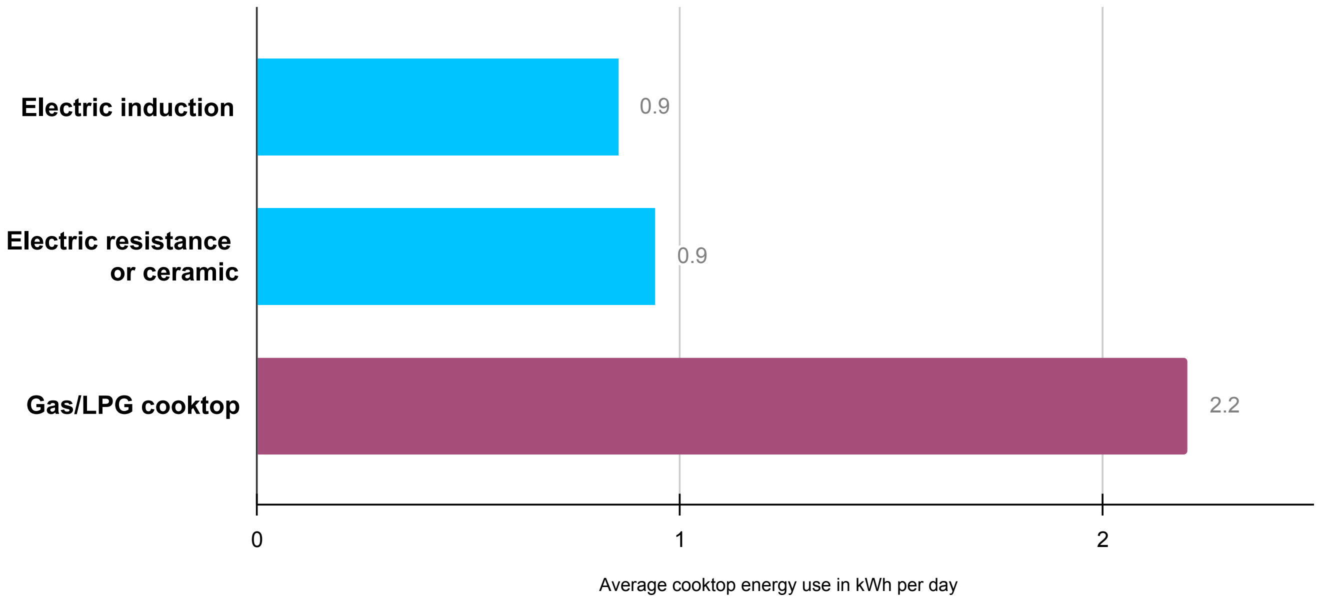
Energy use

Gas or LPG cooktops have an efficiency of around 30%, meaning only about 30% of the energy in the gas is transferred to the food, the rest is lost as waste heat. Electric cooktops are significantly more energy efficient, with ceramic resistance cooktops about 71% efficient, and induction cooktops about 79% efficient.[19] Induction cooktops are the most efficient as less heat is lost to the surrounding room, and more heat is transferred directly into the pot/pan and then the food, using less energy overall to provide the same outcome.

Figure 20

Cooktop energy use comparison by device

Rewiring Australia analysis, Residential Baseline Study 2021, average Australian home energy needs



Source notes: Rewiring Australia analysis. Residential Baseline Study 2021, induction cooktop efficiency 0.79, resistance cooktop 0.71, gas/LPG cooktop 0.30.

19 Residential Cooktop Performance and Energy Comparison Study July 2019 Frontier Energy

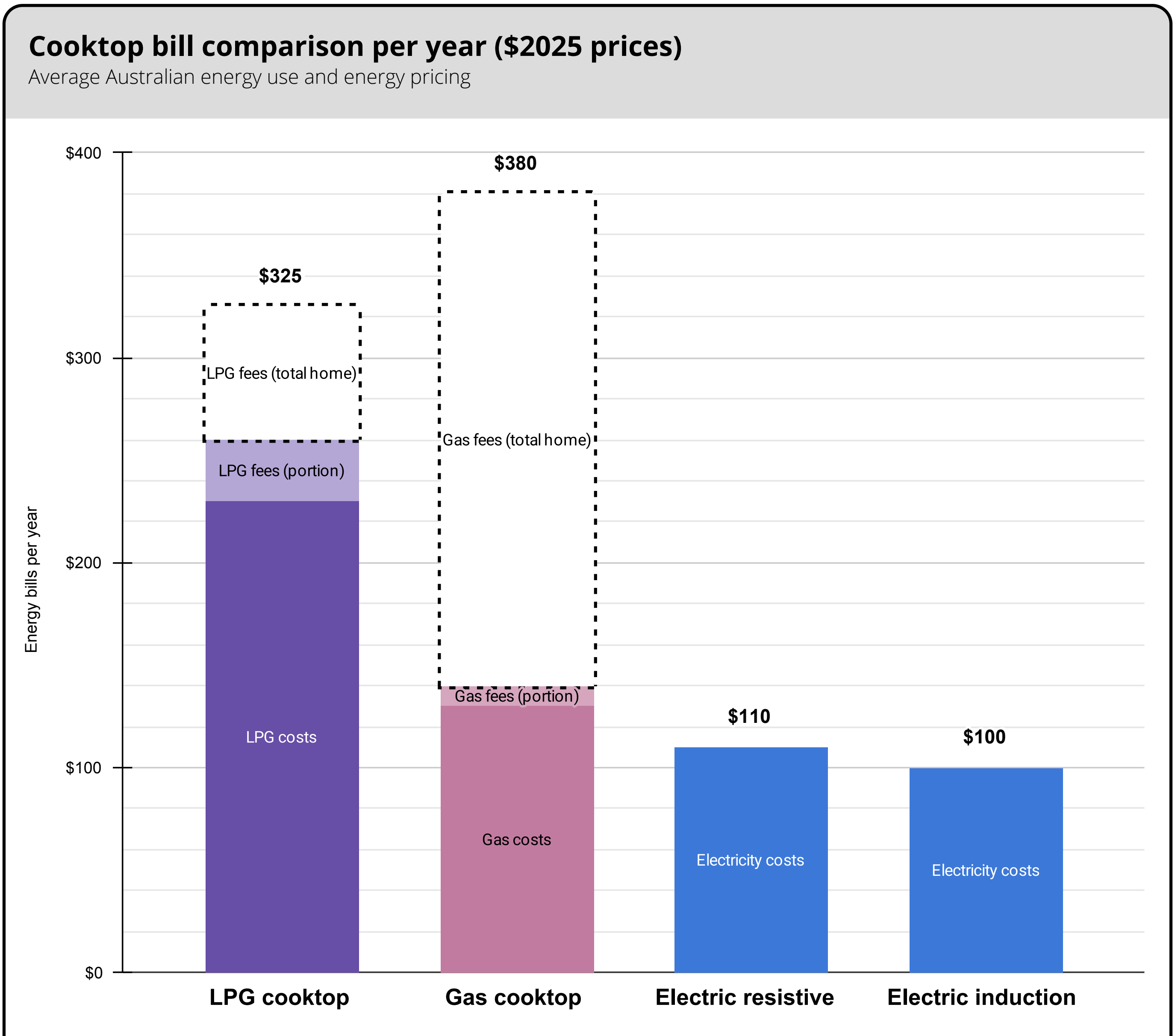
Cost comparison

Operating cost comparison

Here we compare the operating cost of different cooktop types at today's energy pricing. As gas fixed costs can be shared by multiple appliances, a dotted bar is used. If the gas cooktop is the last gas appliance in the home, all of the disconnection savings may apply at this point which is what the dotted bar shows. For example, a home using gas water heating and cooking shares the gas “connection fees” between two appliances, the water heater and the cooktop. As shown earlier in this paper, the water heater economics are clearly in favour of electrification. At the point the water heater is replaced, then all the gas connection fees are only there for the cooktop, meaning replacing the cooktop can unlock those savings as well.

Electric cooking is the cheapest option.

Figure 21



Source notes: Rewiring Australia analysis. Residential Baseline Study 2021, induction cooktop efficiency 0.79, resistance cooktop 0.71, gas/LPG cooktop 0.30. Electricity $0.32/kWh, gas $0.15/kWh, LPG $0.28/kWh, wood $0.13/kWh.

Total upfront and operating cost comparison

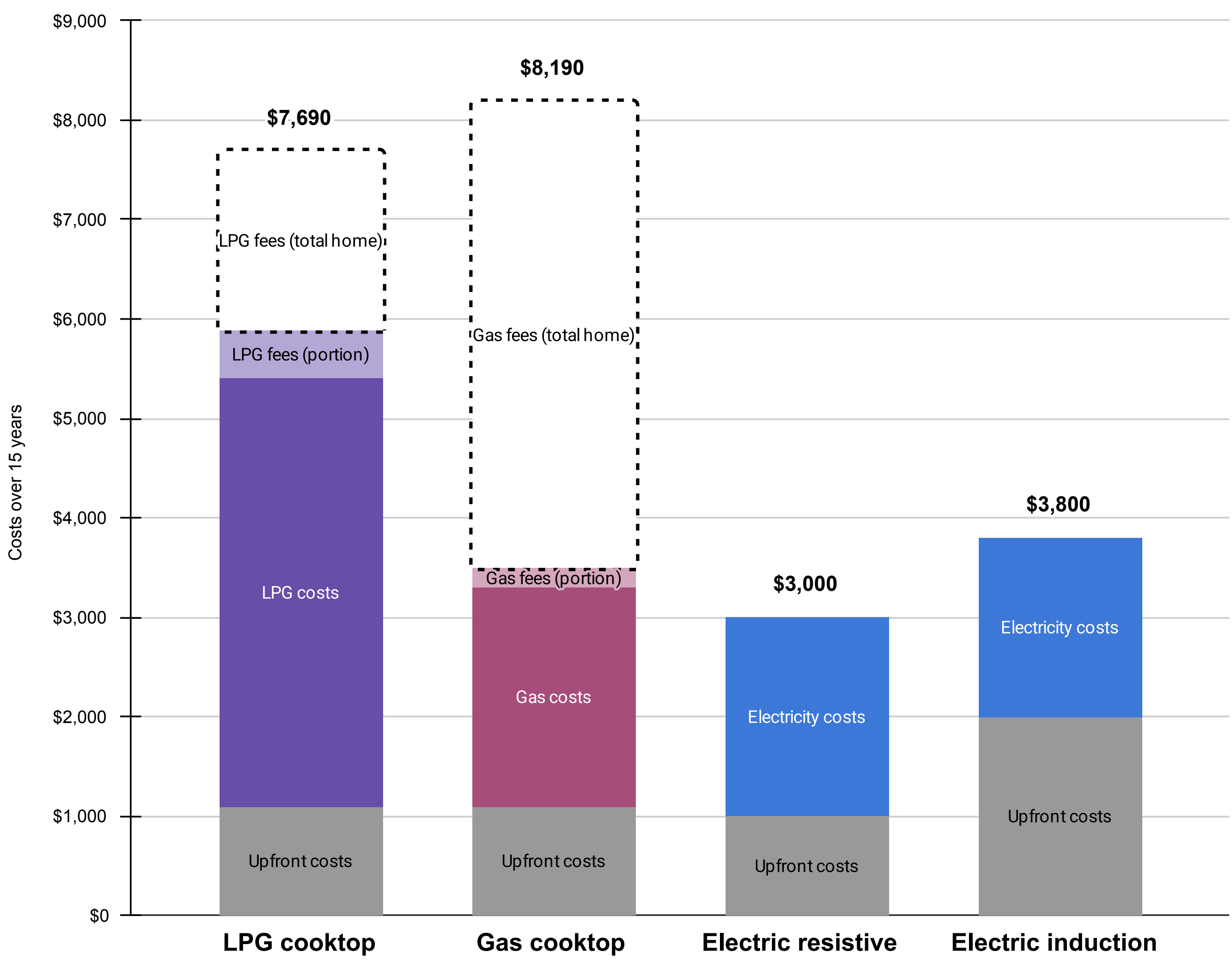
Here we compare the upfront and operating costs of cooktop types over a 15 year operational lifetime. This takes into account today's costs of energy, and predicted costs of energy over the next 15 years rising at their historic average real inflation rate. The numbers shown are real 2025 dollars.

Again, with upfront costs included, electric cooking is the lowest cost.

Figure 22

Cooktop lifetime cost comparison over 15 years

Average Australian energy use and energy pricing adjusted forward with historic inflation $2025



Source notes: Rewiring Australia analysis. Residential Baseline Study 2021, induction cooktop efficiency 0.79, resistance cooktop 0.71, gas/LPG cooktop 0.30. Energy prices based on 2025 prices adjusted with the associated historic real inflation rate from the ABS Consumer Price Index. Electricity $0.32/kWh, gas $0.15/kWh, LPG $0.28/kWh, wood $0.13/kWh. 2025 appliance costs.

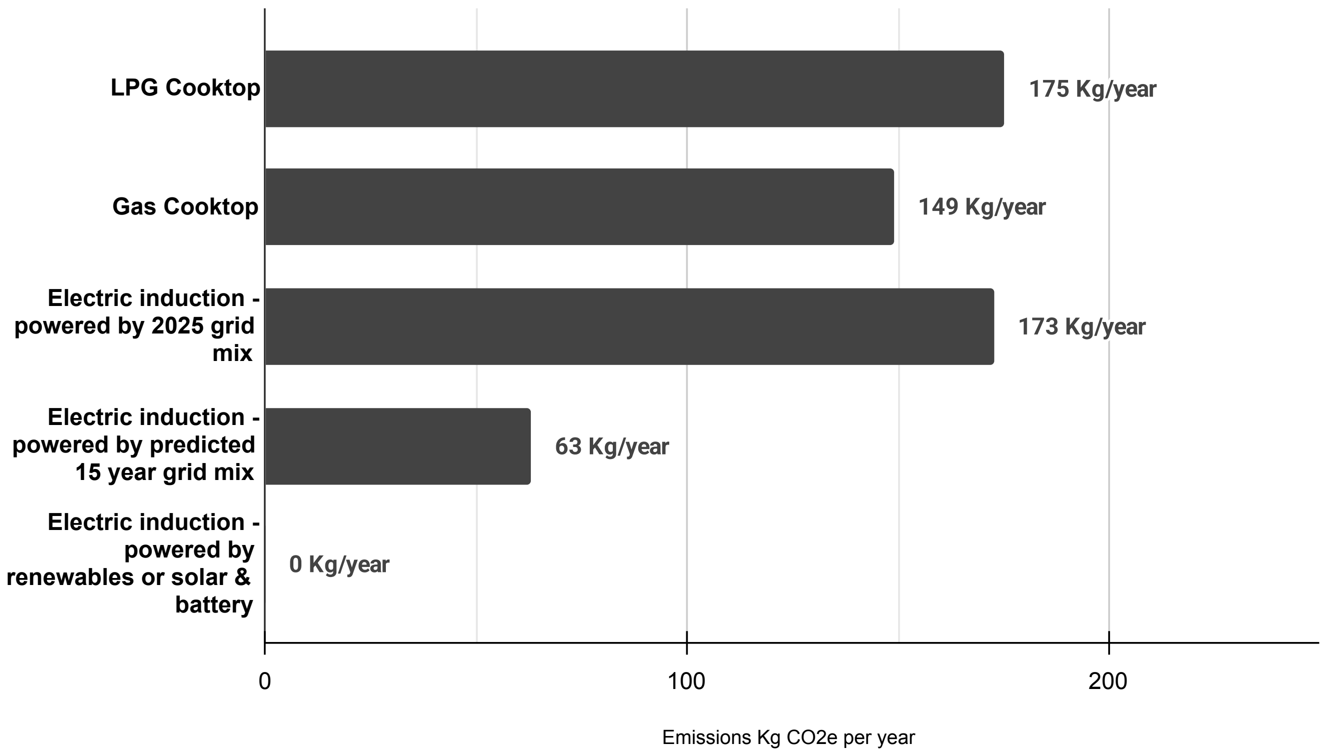
Emissions comparison

Here we compare the yearly emissions for each cooktop type. Figure 23 below compares emissions from each appliance choice, and for electric induction, compares three different electricity sources - today's grid mix, the grid mix as it decarbonises over the next 15 years, and for a home that generates its own clean electricity and stores it in a battery or buys renewable electricity.

Figure 23

Emissions comparison of cooktop options

Based on average home energy use, homes with higher energy use will have higher emissions.



Source notes: Rewiring Australia analysis, Residential Baseline Study 2021, DCCEEW Emissions Projections 2023.

Vehicles

Vehicles are usually the largest energy use for homes that have them - which is most homes. While often looked at as "separate" to residential energy in analysis, electrification couples (or joins) the transport sector with the residential energy sector, as most electric vehicle charging happens at home and therefore transport sector energy becomes household energy.

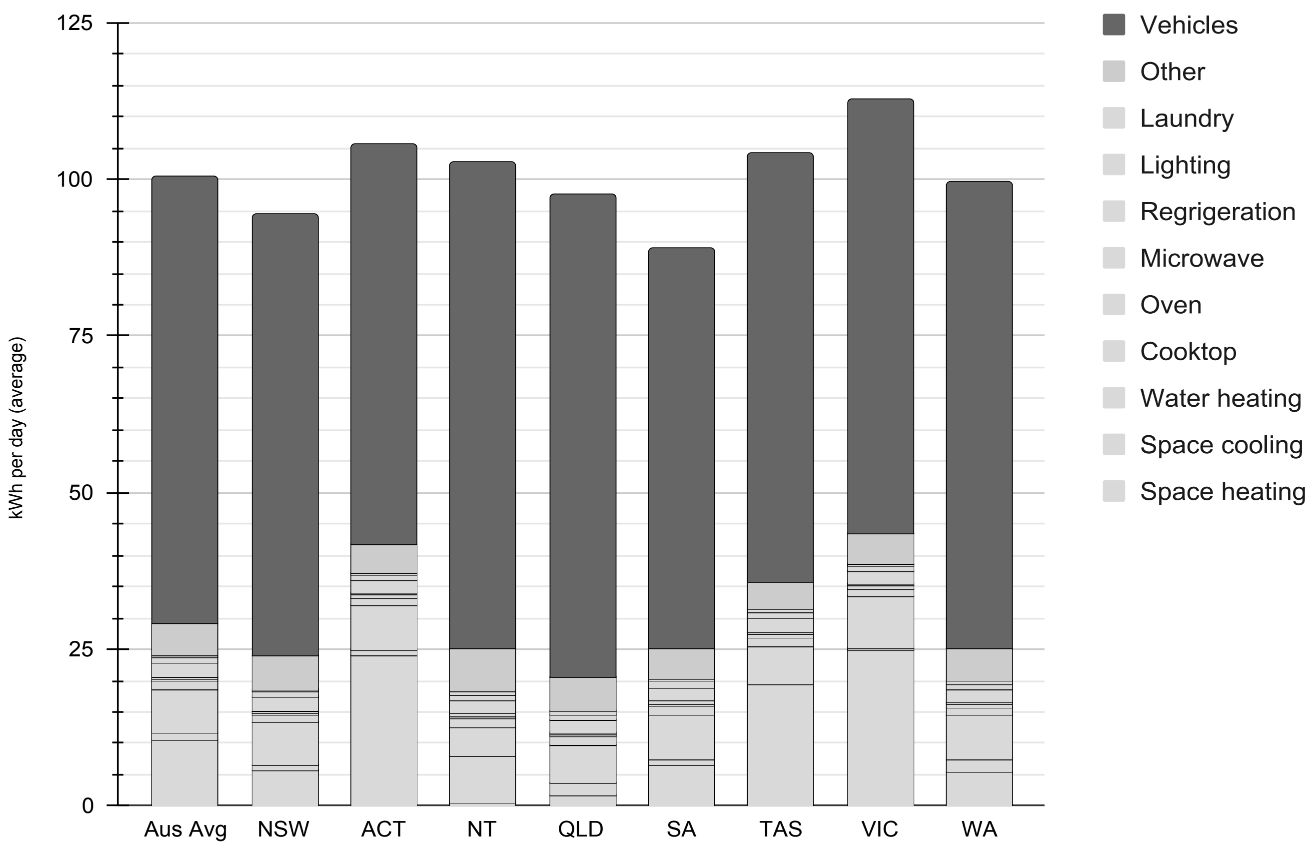
This sector coupling effect is important to consider for both energy system planning and emissions reduction planning. For example, it is unlikely that the decarbonisation of the transport sector will come from petrol stations, nor will the energy required to power that decarbonisation. The decision to drive an electric vehicle is likely a dinner table decision by homes, and whether that home has solar and a battery (also a dinner table decision) will help in meeting the energy requirements of the electric vehicles in the home. It is possible that significantly less electricity infrastructure will be needed if large amounts of vehicle charging happens at home, with self-generated electricity. Charging from rooftop solar in Australia is already lower cost than charging anywhere else.

In this section we compare petrol and electric vehicles, including their energy efficiency, their economics, and their emissions. Figure 24 shows the average vehicle energy use in each state compared to the rest of the home. An average home has about 1.8 vehicles, and as can be seen in contrast to the previous state-based appliance only charts, vehicle energy is by far the largest energy user related to the home.

Figure 24

Vehicle energy use compared to other appliances in the home

Rewiring Australia analysis, Residential Baseline Study 2021, ABS Motor Vehicle Survey 2018



Source notes: based on existing energy data including multiple sources of energy (electricity, wood, gas, LPG, petrol, diesel). For this reason the total energy "needs" of a home in any region will differ based on the efficiency of the most common machines used in that region. Additional energy on top of this is wasted with fossil fuel electricity generation (thermal generation waste), and this additional energy use is not shown in this chart in order to make understanding proportional energy use in households easier.

Energy use

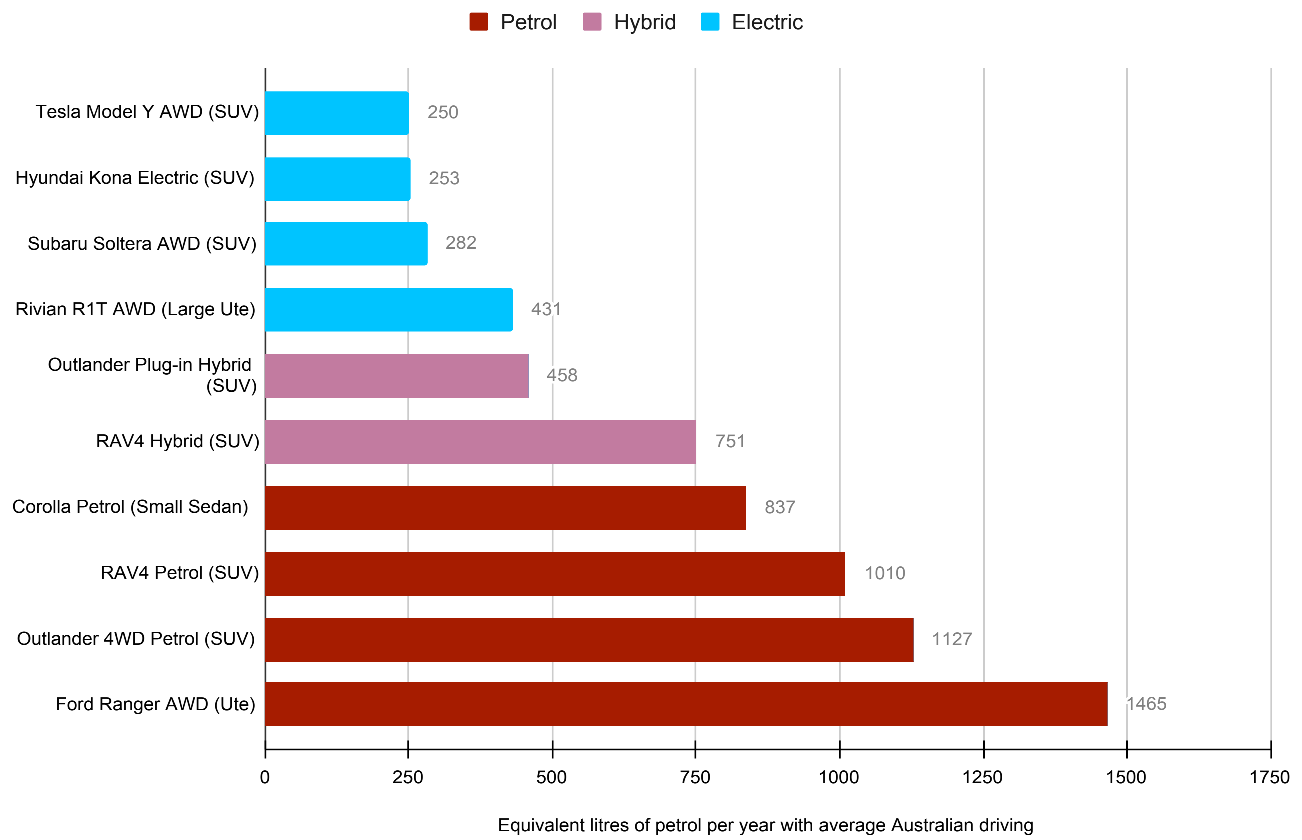
Petrol and diesel vehicles are significantly less efficient than electric vehicles at converting energy into motion. An average petrol vehicle converts about 21%[20] of the energy in petrol into motion at the wheels (or moving the car forward). Hybrid vehicles are usually not much better, at about 31%.[21] Even newer hybrid vehicles (HEVs) consume about 70% of the petrol of conventional petrol vehicles. Plug-in hybrid vehicles (PHEVs) change in petrol consumption based on battery size and behaviour of the driver, though are still largely expected to achieve significantly less efficiency (and more emissions) than electric vehicles.

An electric vehicle ends up converting about 91%[22] of the electricity supplied into forward motion, notably this includes charging losses and regenerative braking. Electric vehicles regenerate energy while braking, which recovers about 22% of the energy to increase overall efficiency. Effectively this means that for slowing down, an electric vehicle can use both brakes and regenerative motor braking, where it regains some of the energy it used to accelerate. Energy used for braking in a petrol car is generally lost and not recoverable. Overall, electric drivetrains are about 4 times more efficient than their petrol counterparts, this also is apparent when directly comparing example vehicle efficiencies in similar classes as done in Figure 25. An interesting comparison is that even a large electric ute is still nearly twice as efficient as a small Toyota Corolla Sedan. Comparing two similar vehicles, a petrol Toyota RAV4 to an electric Tesla Model Y AWD, shows that the electric vehicle is over three times more efficient than the hybrid (HEV) RAV4, and four times (or 400%) more efficient than the petrol RAV4.

Figure 25

Vehicle energy use compared in equivalent litres of petrol per year

Rewiring Australia analysis, US Gov EPA Fuel Economy database.



Source notes: Rewiring Australia analysis, based on popular Australian vehicles compared using the energy consumption figures provided by the US Government EPA MPG fuel economy database. Average driving from the 2018 ABS Motor Vehicle Survey.

20 https://www.fueleconomy.gov/feg/atv.shtml
21 https://www.fueleconomy.gov/feg/atv-hev.shtml
22 https://www.fueleconomy.gov/feg/atv-ev.shtml

Cost comparison

Operating cost comparison

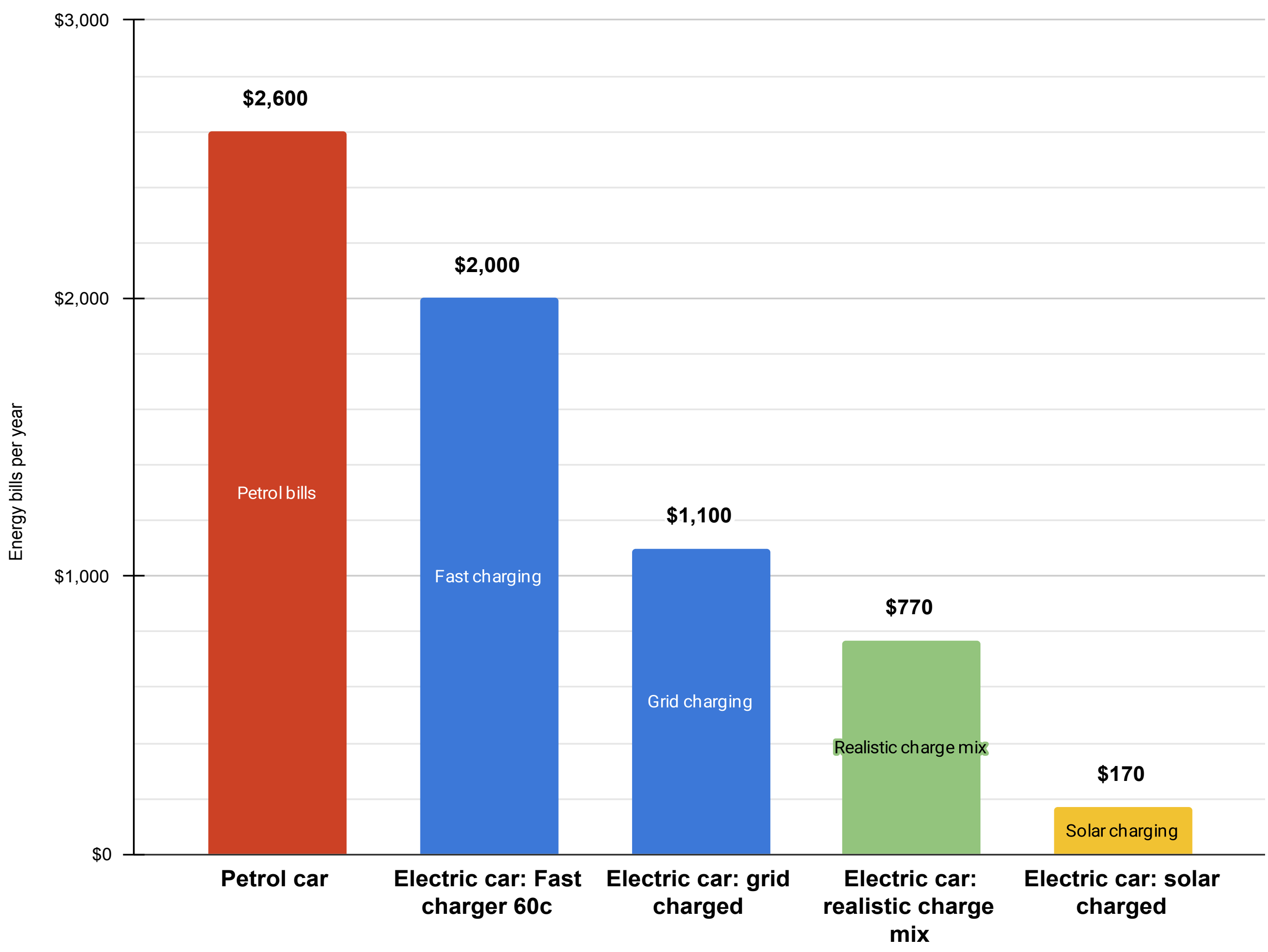
Here we compare yearly operational costs (bills) of vehicle types at current energy prices. Electric vehicles are lower cost to operate, though their cost of operation depends on how they are charged. Charging with public chargers is the most expensive, still in general cheaper than petrol, followed by charging at home with the grid which is less than half the cost of fuelling an equivalent petrol vehicle. Charging with home solar is the cheapest, even accounting for the capital costs of the solar panels (solar power is cheaper than grid electricity in Australia).

The green column shows what is perhaps a more realistic mix of electricity sources, with some solar charging, some grid charging, and some fast public charging. It should also be noted that EV charging retail plans can offer off-peak charging rates that are cheaper than grid electricity averages, which lower charging costs further but likely not as low as charging with solar.

Figure 26

Driving fuel/charging comparison per year ($2025 prices)

Average Australian driving and energy pricing



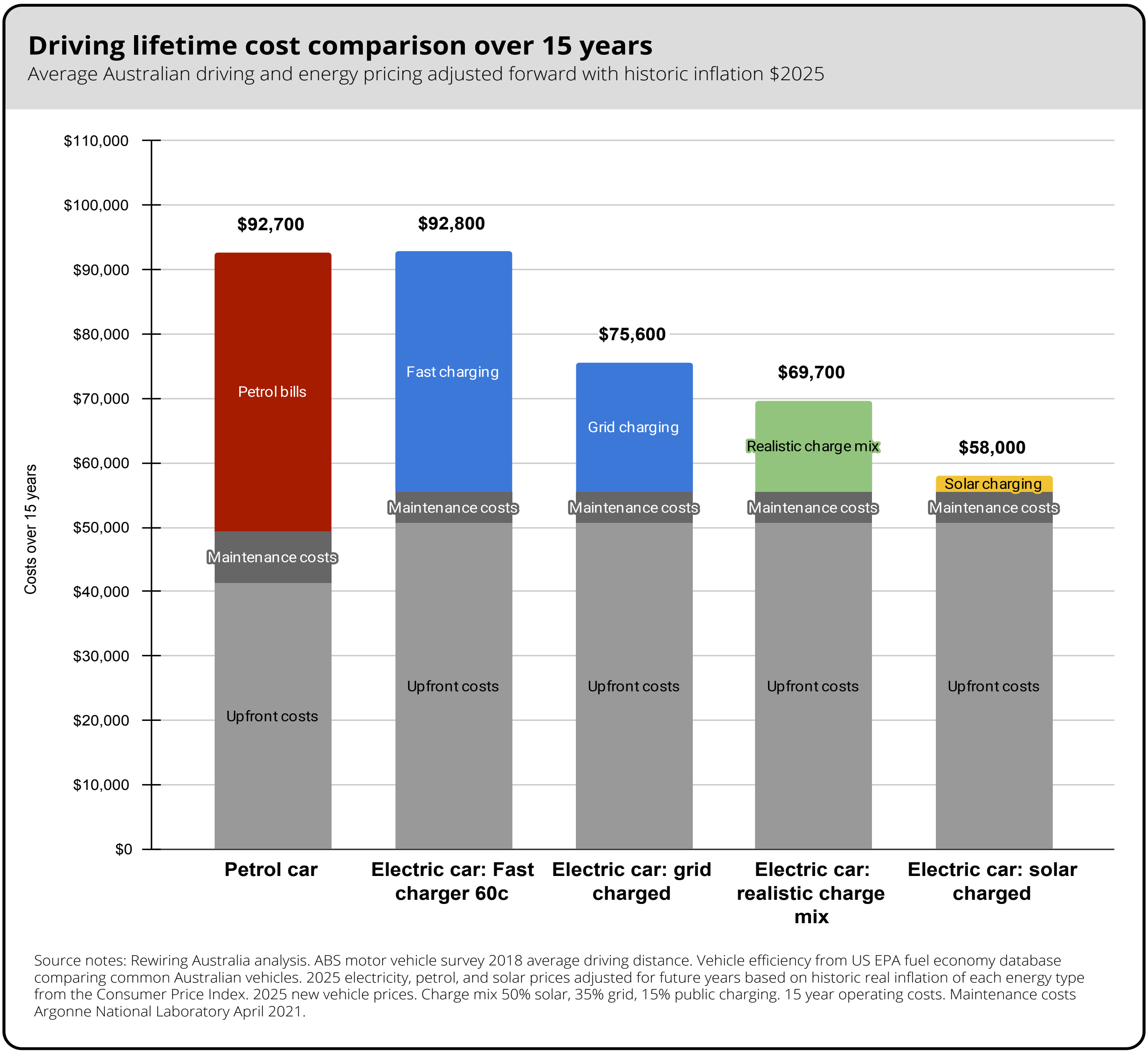
Source notes: Rewiring Australia analysis. ABS motor vehicle survey 2018 average driving distance. Vehicle efficiency from US EPA fuel economy database comparing common Australian vehicles. 2025 electricity, petrol, and solar prices. Charge mix 50% solar, 35% grid, 15% public charging.

Total costs (operational and upfront)

Here we compare vehicle costs over a 15 year operational lifetime, including the upfront costs to purchase the vehicle, maintenance costs, and the energy costs to fuel/charge the vehicle. It's clear that electric vehicles have already passed the point where over their lifetime they are lower cost on average than petrol vehicles. Charging from solar alone is clearly the lowest cost, and given electric vehicles are now often purchased with 200km - 500km of range (about two weeks of average driving), finding time in those two weeks to charge vehicles on a sunny day has clear benefits.

Here it is worth noting that the upfront costs of vehicles are influenced by more factors than just economics. To build the upfront price average we compare a range of new vehicle prices for popular vehicles in Australia and their electric alternatives. A common question is of second hand vehicles. Second hand vehicles currently have availability constraints in Australia, but economically the picture for second hand vehicles is generally similar, sometimes even better than new vehicles. This is because the operational costs represent many thousands (or tens of thousands) of dollars in savings, and the question is "do those savings pay for any higher upfront cost of a second hand electric car?". As the price of vehicles being compared drops, the operation savings have a higher proportional savings impact on the upfront cost of the vehicle.

Figure 27



Impact of driving distance on cost comparison

As the upfront cost of vehicles remains the same no matter how far they drive, the driving distance of a vehicle makes a substantial difference to how much is saved from switching to electric. Today electric vehicles have a higher upfront cost, and a much lower operating cost - meaning the more driving a petrol vehicle does, the more savings could be achieved by switching to electric.

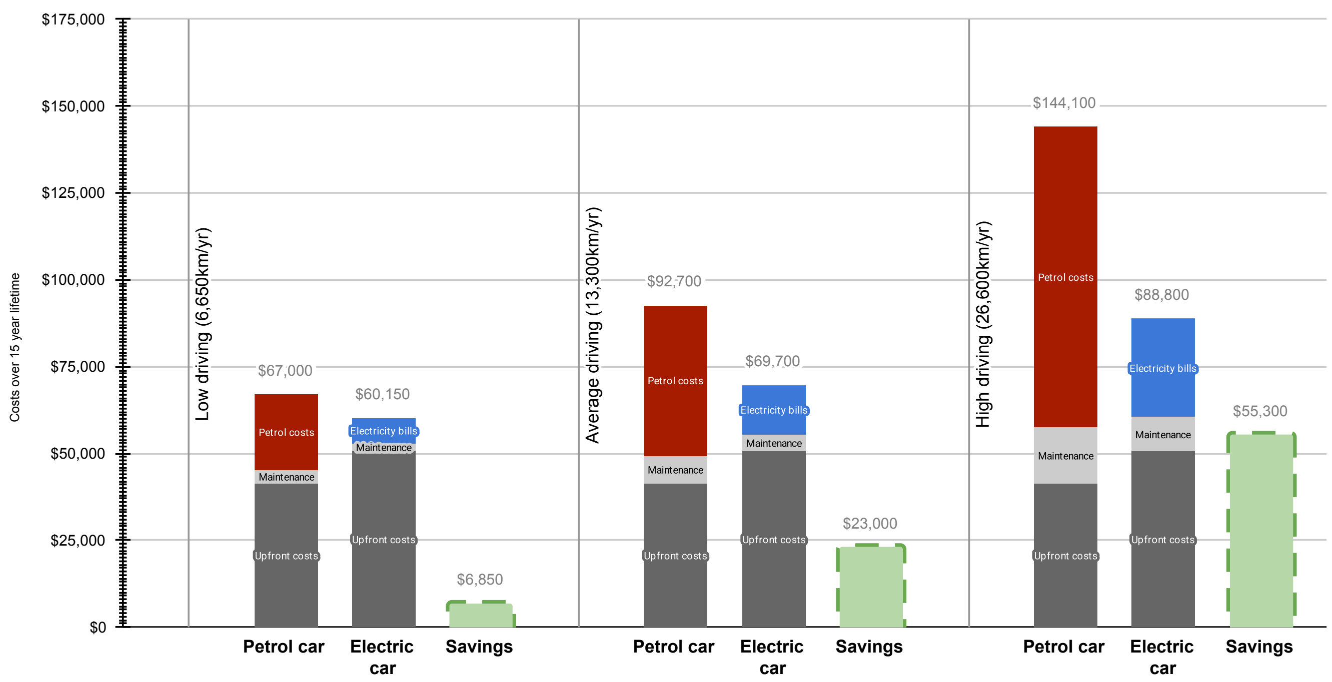
In this context, long-distance commuters can likely afford to switch to electric vehicles earlier than people who only drive short distances. Though even with relatively short distances savings are still likely to be available. The left hand section of the chart below shows that even with half the average driving distance, the electric vehicle still saves money. Though going below half of average driving into rarely used cars, it may not make savings. As electric vehicles continue to drop in upfront cost, it is predicted that in the near future all new vehicle purchases will be more economic if electric, also known as reaching the electric vehicle parity point.

Today we have crossed the electric vehicle tipping point in Australia for lifetime economics of the vehicle, upfront and operational costs, but the upfront cost is still more expensive on average for electric vehicles. This highlights the role of finance and spreading that cost to get more Australians into electric vehicles that will save them on cost of living significantly over time.

Figure 28

Vehicle comparison of 15 year savings with different energy usage

Average driving is 13,300km per year, low scenario is 6,650km, high scenario is 26,600km.



Source notes: Rewiring Australia analysis. ABS motor vehicle survey 2018 average driving distance. Vehicle efficiency from US EPA fuel economy database comparing common Australian vehicles. 2025 electricity, petrol, and solar prices adjusted for future years based on historic real inflation of each energy type from the Consumer Price Index. 2025 new vehicle prices. Charge mix 50% solar, 35% grid, 15% public charging. 15 year operating costs. Maintenance costs Argonne National Laboratory April 2021.

Emissions comparison

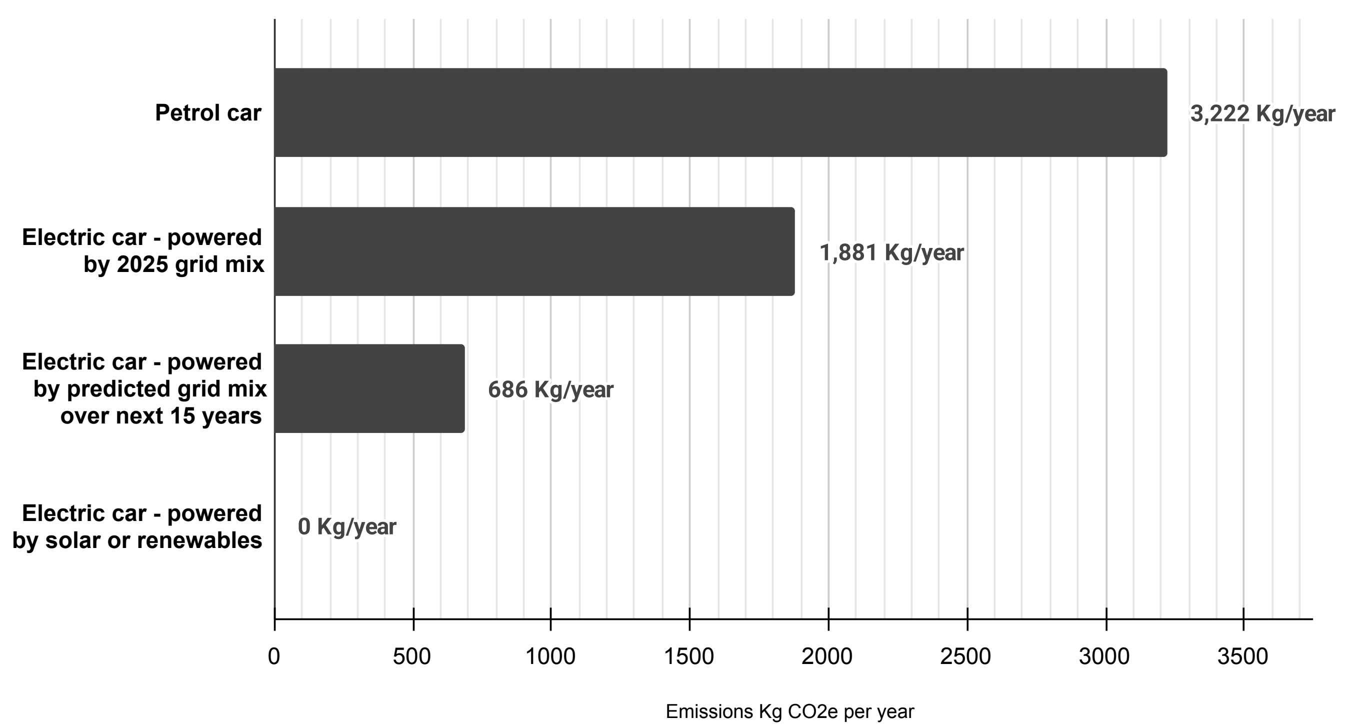
Here we compare the emissions of each vehicle type driving the average distance per year. Note these emissions will rise and fall significantly based on driving distance in the same way that fuelling/charging bills do (shown above). The operational emissions of an electric vehicle will also change significantly based on where the electricity to charge it came from. Here we show three different examples of sources of electricity.

Vehicle emissions related to the home deserve significant focus. They are often seen as a different sector, but because electric vehicles park at home, and mostly charge at home, household electricity decisions will impact and help reduce emissions of the vehicle fleet. For example it won't be energy from a petrol station that powers electric vehicles, it will mostly be energy from households, like rooftop solar or their grid connection. Adding rooftop solar to a home can help add the additional renewable energy capacity to power the vehicles the home converts to electric.

Figure 29

Emissions comparison of vehicles - petrol versus electric

Based on average driving, longer than average driving distances will increase emissions.



Source notes: Rewiring Australia analysis, ABS Motor Vehicle Survey 2018 driving distance, DCCEEW Emissions Projections 2023.

Embodied emissions

Electric vehicles (like practically all products) also have emissions during the production process. Because electric vehicles have large energy dense batteries, their production emissions can exceed the production emissions of a petrol vehicle. However, the operational emissions savings of electric vehicles usually more than make up for any increased production emissions. It is also worth emphasising, that these production emissions are mostly caused by non-electrified production methods, which over time are becoming more electrified, and as they do, production emissions will also fall.[23]

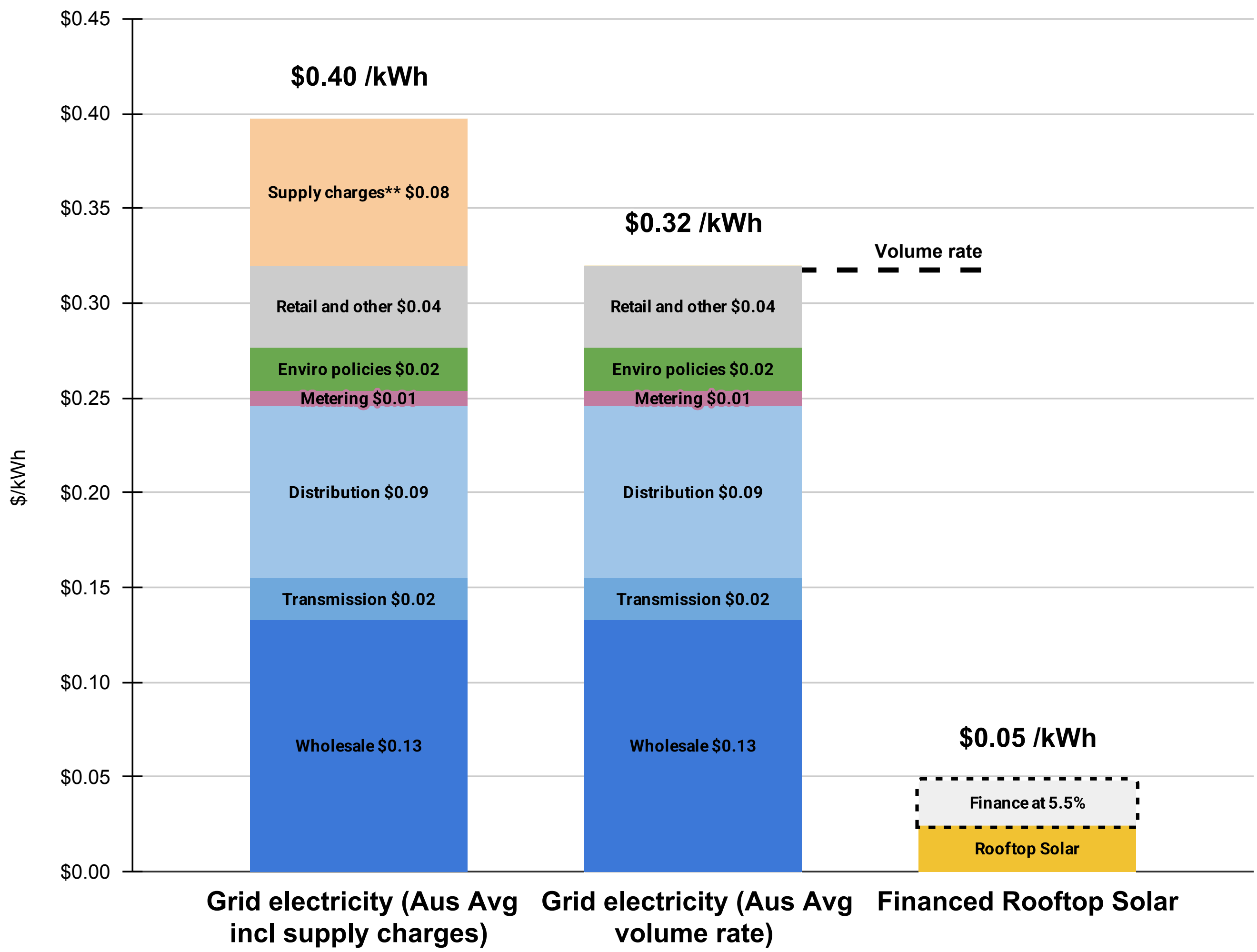
23 https://www.transportenvironment.org/discover/how-clean-are-electric-cars/

Rooftop solar

Rooftop solar is the lowest cost electricity source for Australian homes
Australian rooftop solar delivers energy to households for around 5 cents per kWh after financing. This compares to the roughly 32 cents per kWh charged for grid electricity, in addition to the daily "supply charges" for being connected to the grid. Even when removing the Australian STC subsidies from the calculation, rooftop solar still remains significantly cheaper (<10 cents/kWh). This is important to consider, because as our homes electrify and switch their fossil fuel use to electricity, they will need more electricity. Getting as much of this extra electricity from solar is likely to create significantly lower bills for homes.

Figure 30

Residential delivered energy price comparison 2025
Rewiring Australia analysis, SolarAnalytics, AEMC Price Trends, Canstar, SolarChoice.



Source notes: Solar pricing based on capacity factor of 17.15%, 30 year operational lifetime, 0.5% degredatin per year and one replacement inverter. Financed over 30 years at 5.5% interest. Note solar homes will usually remain connected to the grid, and as such continue to pay supply charges. Therefore the better comparison point is the volume rate excluding supply charges.

Delivered energy costs - grid scale solar versus rooftop solar

It is important to consider the costs to the end consumer when looking at the lowest cost energy system, and the lowest cost-of-living option for households. Large scale or grid-scale solar is often more "efficient" than rooftop solar - it can generate energy at lower cost because of installations that track the sun and economies of scale - but by the time that energy actually reaches households it is more expensive than a household installing its own solar. There are multiple reasons for this, one being the additional costs a consumer pays for energy coming through their meter, which includes transmission and distribution costs and retailer costs. Line losses and generation profit margins also contribute.

This paper is not meant to be an exhaustive comparison of grid-scale and rooftop solar. Both will likely be required at scale to deliver a zero-emissions energy system. However, maximising the deployment at scale of rooftop solar for homes is likely to deliver the lowest cost of living, more resilient communities, and a lower cost energy system for Australians. We note that historically energy modelling has significantly underappreciated the "delivered" energy costs - what people actually pay - instead focusing on wholesale generation prices. This creates a bias that does not bring out the realities of Australia's energy system, that consumers can (and do) produce their own energy for cheaper than they can buy it. Modelling with delivered energy costs is important to understand a lowest cost energy system from the perspective of the people who pay for it - consumers.

We still need the grid

This paper in no way suggests that homes should go "off grid". Keeping homes on the grid is likely to lead to a significantly lower cost and more robust energy system. It's important to consider the additional electricity needed as we transition off gas and petrol/diesel to electricity. While this will be an overall reduction in primary energy, it will require an increase in electricity. Rooftop solar can play a large role in providing additional zero-emissions electricity for a low cost to consumers. Batteries can support solar, but grid electricity should still be an essential part of the energy mix in balancing a system with large levels of localised rooftop solar and storage. It is likely to be vital that pricing mechanisms encourage customers to stay on the grid as the falling costs of solar and storage make it economically easier for homes to choose to go off grid. Customers leaving the grid will not only increase the cost of grid electricity for everyone else on the grid, raising equity concerns, it will also waste the value to the system these resources can provide to lower system costs. We should design a grid that encourages and works in harmony with customer resources, recognising they will be a large part of the energy system as homes act in their own economic interest and install solar and batteries en masse.

How solar is financed will make a big difference

Conventional energy infrastructure is financed by large organisations, and then charged incrementally back to consumers. Effectively turning large scale investments into the per unit electricity prices we see on bills. Thinking about rooftop solar this way is important to make sure all Australians have access to the lowest cost energy for their home. Purchasing solar outright requires a home to take a cost of living hit from the upfront cost, in exchange for cost of living savings in the future. Not all homes will be able to afford this upfront cost, yet if it can be financed rooftop solar can save virtually all homes money from day one. It is crucial we consider this new role that homes will play as "energy infrastructure" and create the financing mechanisms that enable low cost energy for all homes, leaving no homes behind.

Flattening energy prices

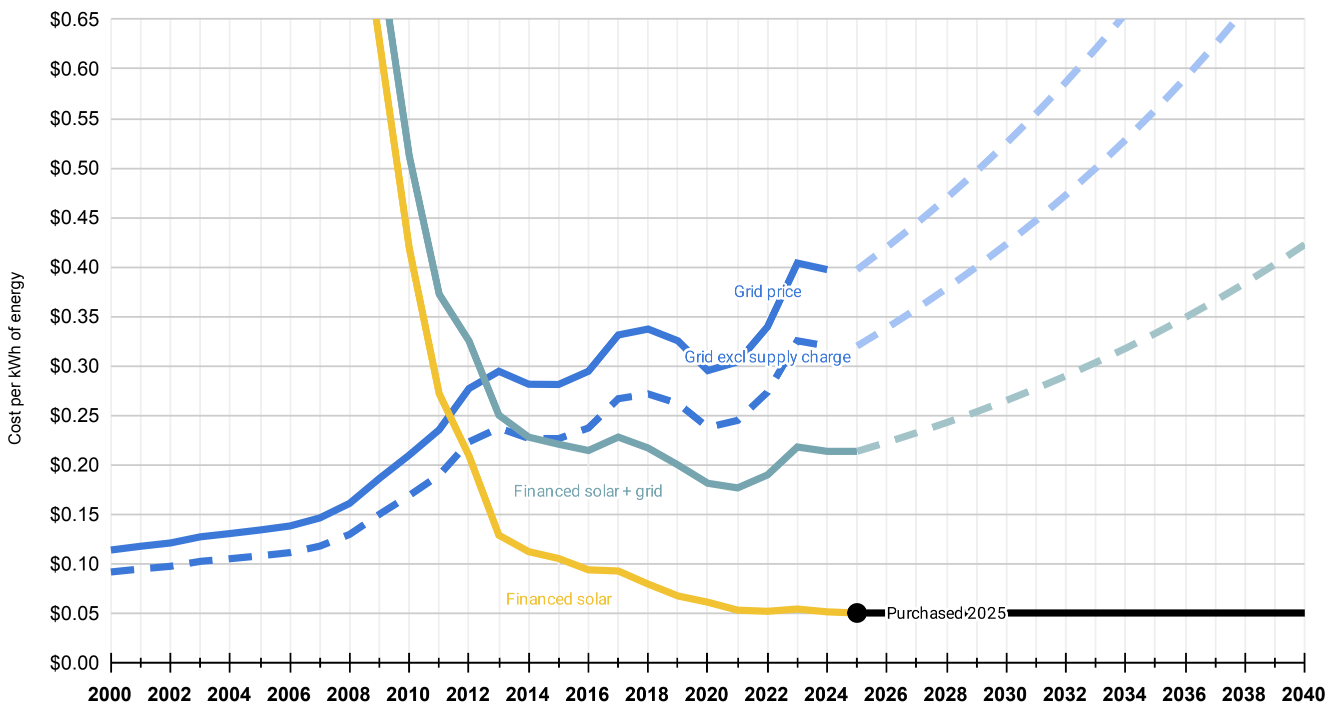
When comparing the energy costs of rooftop solar to grid electricity, it is also important to consider the lifetime of the solar install, and the likely price of grid electricity over that time. Solar panels often come warrantied for 25 or 30 years, including some warrantied for 40 years.[24] The price of grid electricity has historically risen at above the rate of inflation.[25] This means that the cost of solar today does not compete against "today's" electricity prices alone, it also competes against the price over the next 30 years. Buying solar is in some sense buying 30 years of energy upfront, so the price stays flat while that energy is provided over its lifetime. Financed over a long period, the energy coming from solar panels looks like the flat black line shown below. Interestingly the value of that energy is going up over time when compared to the grid, making the solar decision save more every year.

In reality most homes will also need to still be connected to the grid, and will still use significant amounts of grid electricity when the sun doesn't shine. This is shown in the teal line in the chart below. While it is not as flat as the solar only line, it rises at a slower rate than grid electricity prices alone. Adding a battery to this flattens prices further, which is explored in the next section.

Figure 31

Home electricity cost comparison from different sources ($/kWh 2025)

2025 energy pricing, historic and future pricing based on ABS Quarterly CPI. 2025 solar pricing financed at 5.5%.



Source notes: Rewiring Australia analysis. ABS Quarterly CPI History 2024. 2025 energy prices adjusted forward with historic nominal inflation rate per year. SolarChoice price history back to 2012, IEA PVPS in earlier years. 30 year solar lifetime, financed at 5.5% interest, 0.5% degradation per year with one replacement inverter, 17.15% capacity factor from SolarAnalytics. Average home energy use profile based on fully electrified home and vehicles. 50% self consumption of solar.

24 https://sunpower.maxeon.com/int/solar-panel-products/warranty
25 https://www.abs.gov.au/statistics/economy/price-indexes-and-inflation/consumer-price-index-australia/latest-release

Home batteries

Home batteries are becoming economic for homes in Australia

The price of batteries has declined rapidly in recent years, falling as much as 97% in the last 30 years.[26] This battery price decline has not necessarily fully flowed through to home batteries, but has contributed significantly to them being lower cost and widely available.

Today, home batteries can now save money for many Australian homes, especially if they have solar. Batteries can both lower bills and significantly improve resilience to grid outages, natural disasters, and to price shocks in electricity prices (financial resilience). Battery prices are expected to continue to decline, and it is expected that they will become economically obvious decisions for most homes with solar over time, depending on how grid prices evolve and what other options there are for homes (like shared usage of community batteries).

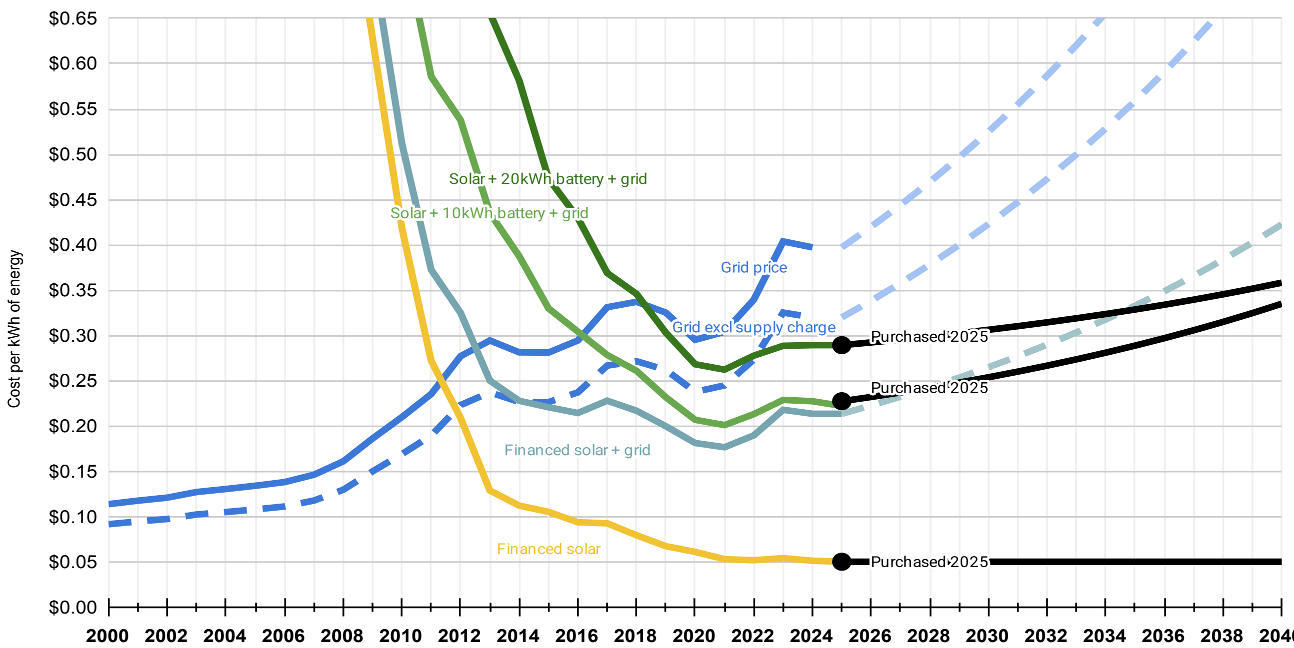
Further flattening of energy bills

Like solar, batteries compete against more than just today's grid price, they also compete against the grid price over the lifetime of the battery. Furthermore, batteries don't compete against the "average" grid price, but against the peak grid price. Below we show examples of homes installing a small battery and a big battery with their solar installation, and the predicted forward costs. It can be seen that in both these cases, the financed costs of solar and battery in addition to remaining grid use, are combined lower than cost of grid electricity to homes today, and significantly lower going forward as electricity prices are expected to continue to rise. The size of the battery has an interesting effect on how "flat" the energy bills are going forward for the home. Battery lifetimes, usage, retail plan rates and more have a significant impact on how economic batteries are today.

Figure 32

Home electricity cost comparison from different sources ($/kWh 2025)

2025 energy pricing, historic and future pricing based on ABS Quarterly CPI. 2025 solar and battery pricing financed at 5.5%.



Source notes: Rewiring Australia analysis. ABS Quarterly CPI History 2024. 2025 energy prices adjusted forward with historic nominal inflation rate per year. Micah Ziegler and Jessika Trancik (2021) battery price history adjusted to Australian battery pricing. SolarChoice price history back to 2012, IEA PVPS in earlier years. 30 year solar lifetime, financed at 5.5% interest, 0.5% degradation per year, 17.15% capacity factor from SolarAnalytics. 15 year battery lifetime, 80% utilisation degrading to 44% year 15, 90% round trip efficiency, financed at 5.5% interest. Average home energy use profile based on fully electrified home and vehicles. 50% self consumption of solar.

26 https://ourworldindata.org/battery-price-decline

Full household electrification

The electrification choices on appliances and vehicles come together, along with the rest of the already electric appliances in homes, to form the full electrification economics we compare here. Most homes already have a significant amount of electric appliances, for example fridges, lights, washing machines, microwaves, TVs and so on. This means saving money on energy for the home - for example with rooftop solar - also saves money on already electric devices like refrigeration and washing. Here we compare the full household energy, economics, and emissions under a range of scenarios.

Energy use

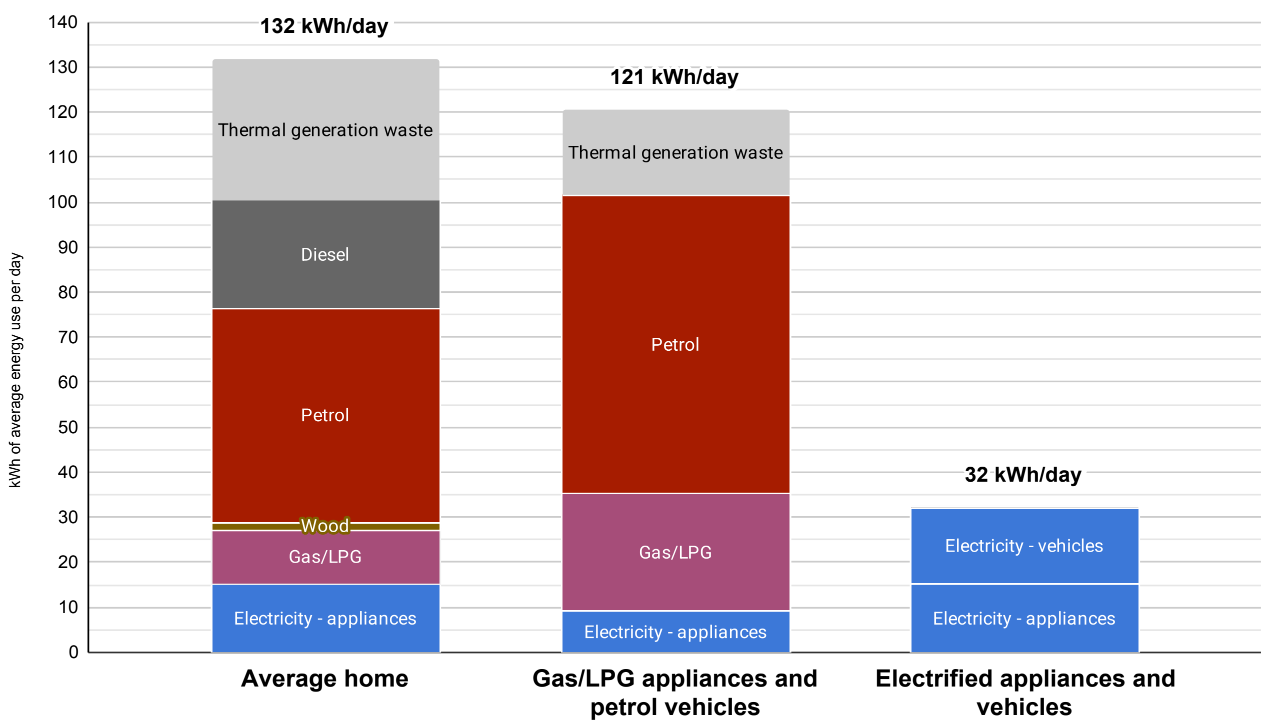
First we compare energy use in an average home, an average gas and petrol home, and an average electrified home. For context, the average home is a mix of the many different appliances and fuel types used around Australia, for example if 800,000 Australian homes have a wood fire, then there are about 0.08 wood fires in an average home. This is interesting for looking at energy use, but not a realistic comparison for an individual home, which makes specific appliance choices, like a heat pump or gas heater, and petrol or electric car. Though homes sometimes have a mix of heating devices. The second home we compare, and the one used in many comparisons in this paper, is a "gas and petrol" home. A home that has chosen to use gas space heating, gas water heating, gas cooking, and petrol cars. We then compare this to an electrified home, that has chosen to use heat pump space heating, heat pump water heating, electric cooking and electric vehicles.

Electrification significantly reduces energy use to about a third of what it was - before accounting for any conventional efficiency measures like insulation or behaviour changes. This demonstrates the substantial potential of electrification as an energy efficiency measure for the Australian economy - and combined with costs, an energy productivity measure.

Figure 33

Average energy use by home type in Australia

Average Australian energy use and driving distance



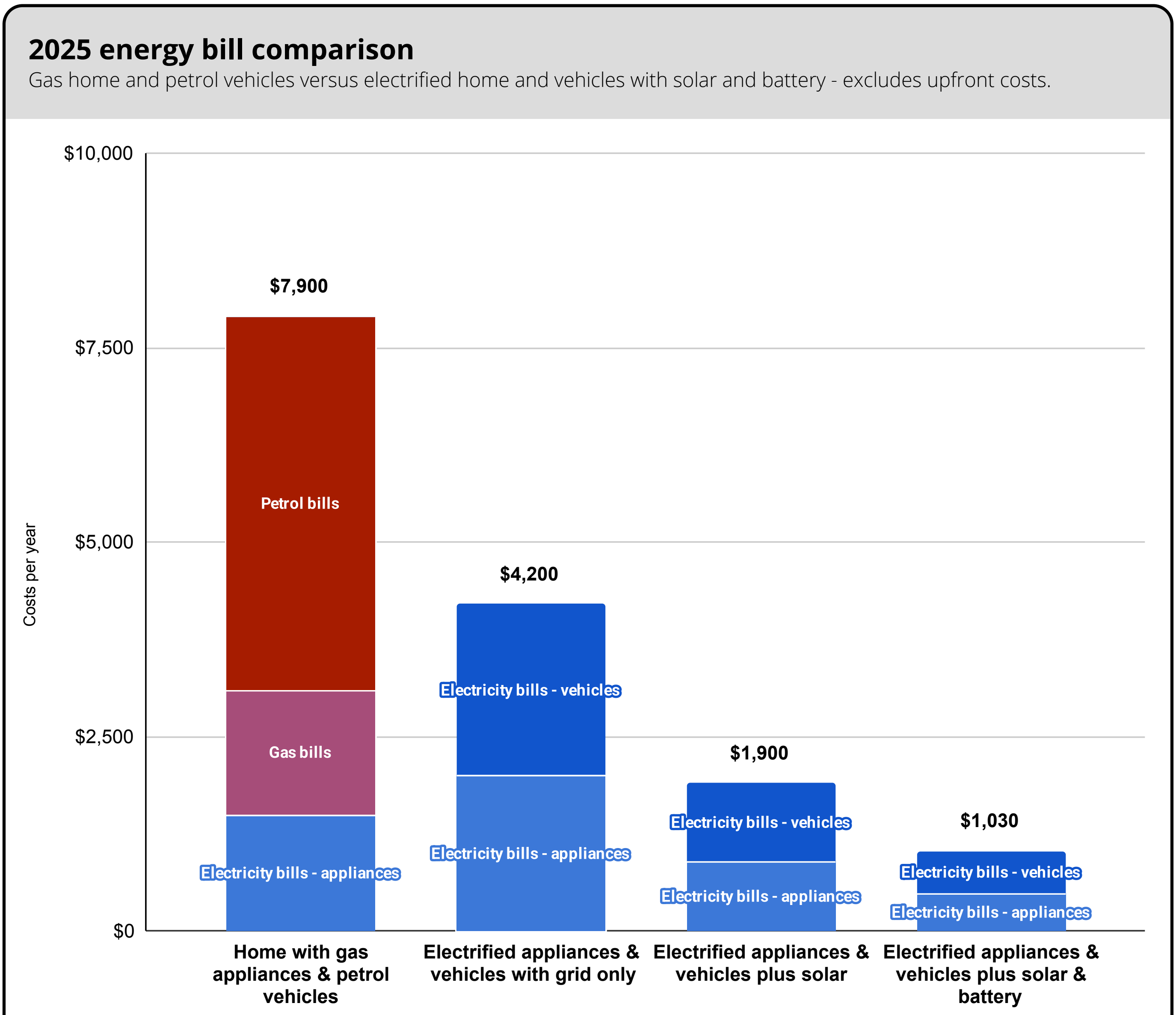
Source notes: Rewiring Australia analysis. Residential Baseline Study 2021 average home energy needs. ABS motor vehicle survey 2018 average driving per vehicle. 1.8 vehicles per home.

Operating cost comparison

Here we compare the operating costs (energy bills) of a fossil fuel home compared to an electrified home. The electrified home is compared with three options for supply of electricity, grid only, solar + grid, and solar + battery + grid. This shows that adding solar and a battery helps create the lowest ongoing energy bills, though all options are lower cost than a fossil fuel home.

Note these operating costs are based on average energy use and average driving, every home is different and usage will vary, along with climate, average driving, and appliance choices. It clearly shows the substantial economic advantage of electrification, lowering energy bills by thousands every year. In the next section, we include the upfront costs in these economics for the full comparison.

Figure 34



Source notes: Rewiring Australia analysis. Residential Baseline Study 2021 average home energy needs. ABS motor vehicle survey 2018 average driving per vehicle. 1.8 vehicles per home. 2025 energy prices. 9kW solar install and 10kWh battery on electrified home.

Total costs operational and upfront

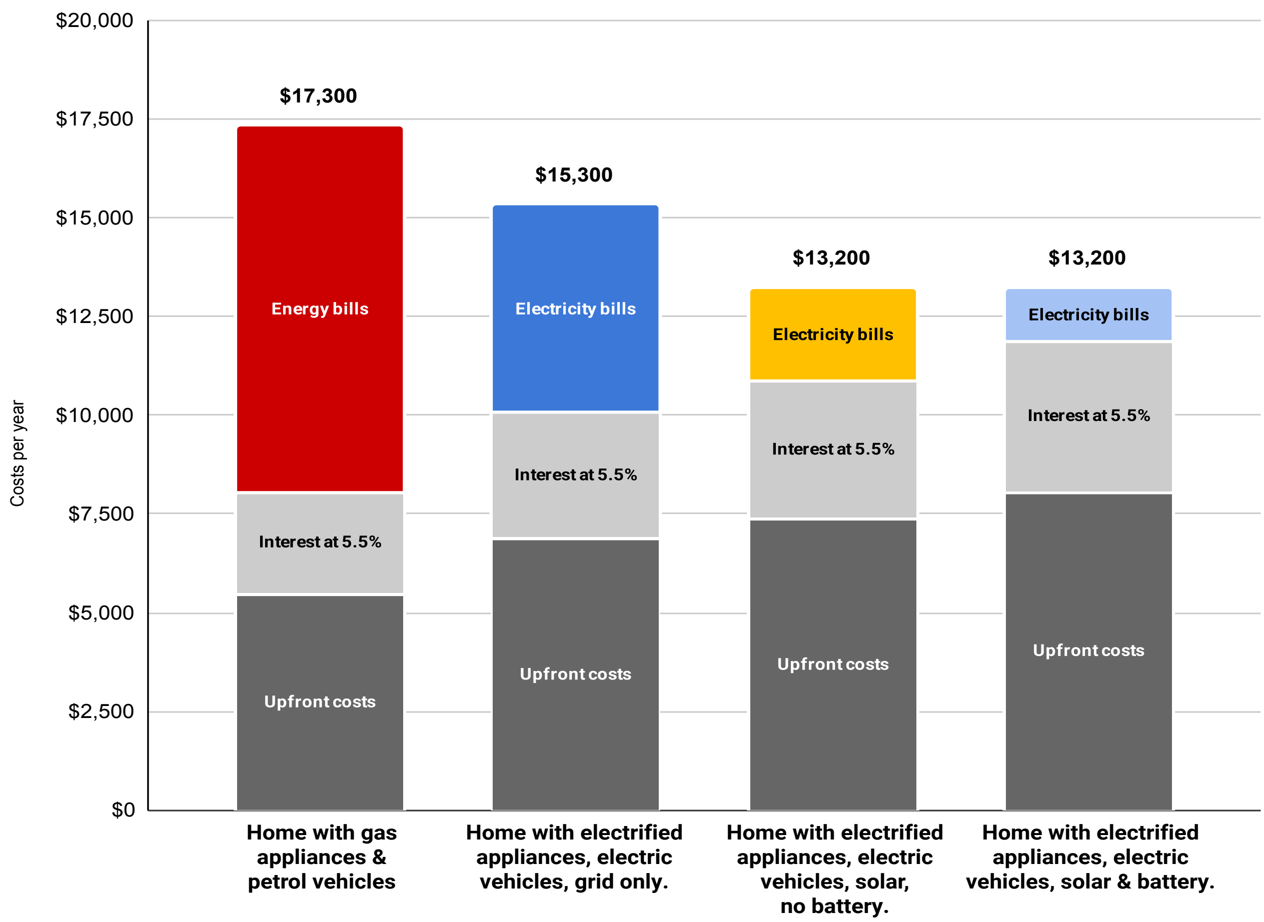
Here we compare the operational and upfront costs of a gas and petrol home versus an electrified home. We also include financing costs to spread the payments over the lifetime of the purchases. The chart shown is these costs divided into yearly repayments and energy bills. It's apparent that an electrified home running just off grid electricity is still cheaper than a fossil fuelled home, and adding rooftop solar improves that significantly again. Adding a battery makes the total costs similar in this example, though enables lower ongoing energy bills. Note this example does not include the battery being rewarded additionally for export or market services, which is likely to improve economics.

All of these are dependent on the upfront costs paid for the appliances, vehicles, solar and battery chosen by the home. We have aimed to pick middle-ground quality products in all cases, though costs will vary with homes being able to choose both cheaper options and more expensive options. In this example we use 5.5% finance, similar to historic mortgage rates, and finance terms of the approximate lifetime of the machine - 15 years. It's worth noting that households may choose shorter repayment terms and therefore lower their total interest paid, or may get higher interest rates and increase the interest paid.

It is clear that we are now past the point where the "average" home can electrify while saving money and emissions at the same time. We are past the electrification tipping point.

Figure 35

Electrified vs fossil fuel home energy comparison costs per year
Gas home and petrol vehicles versus electrified home and vehicles

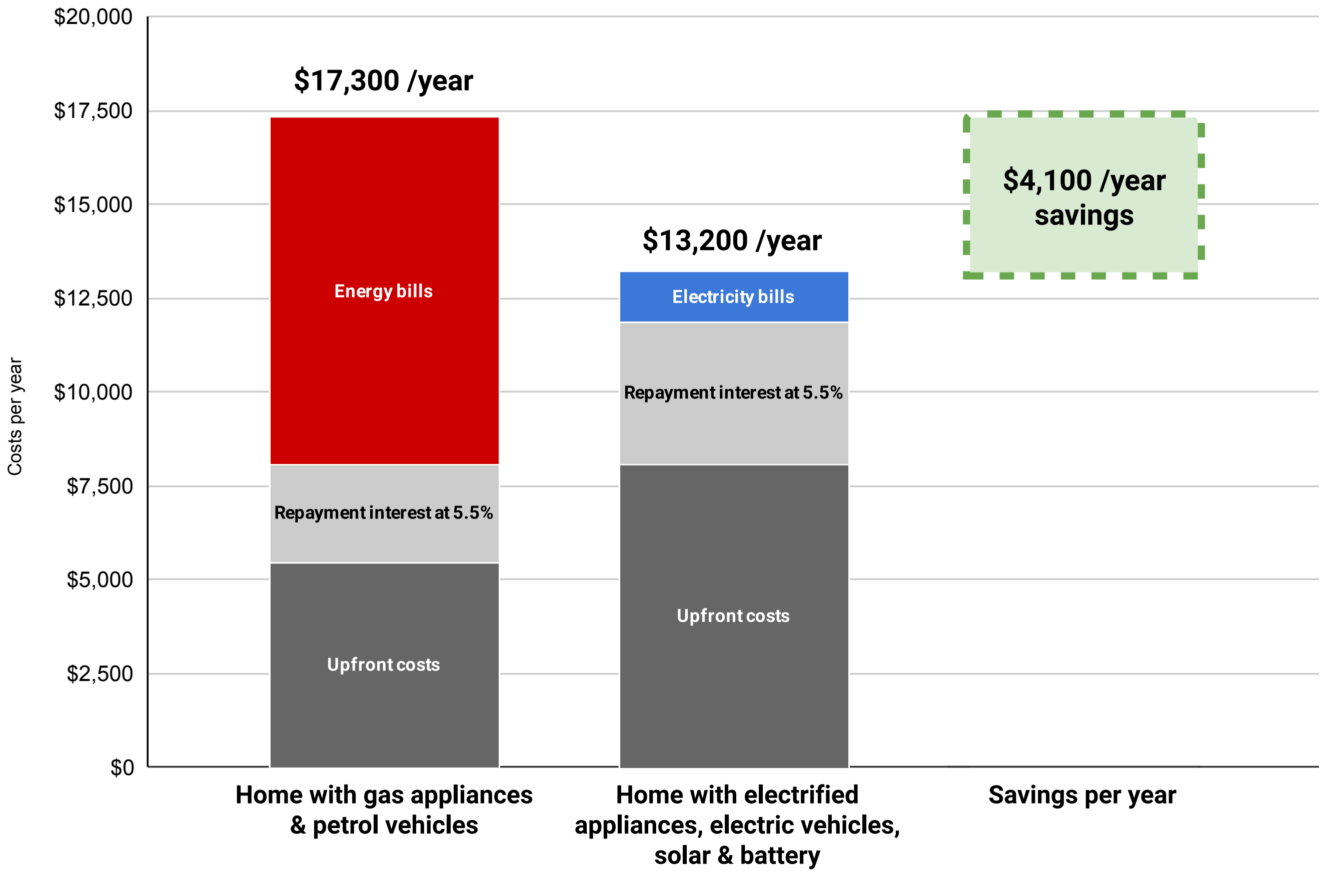


Source notes: Rewiring Australia analysis. Residential Baseline Study 2021 average home energy needs. ABS motor vehicle survey 2018 average driving per vehicle. 1.8 vehicles per home. 2025 energy prices adjusted for future years based on historic real inflation of each energy type from the Consumer Price Index. 9kW solar install and 10kWh battery on electrified home. Assumed lifetime and finance term 15 years, split annually.

Figure 36

Electrified vs fossil fuel home energy cost comparison (per year)

Gas home and petrol vehicles versus electrified home and vehicles with solar and battery compared over 15 year lifetime

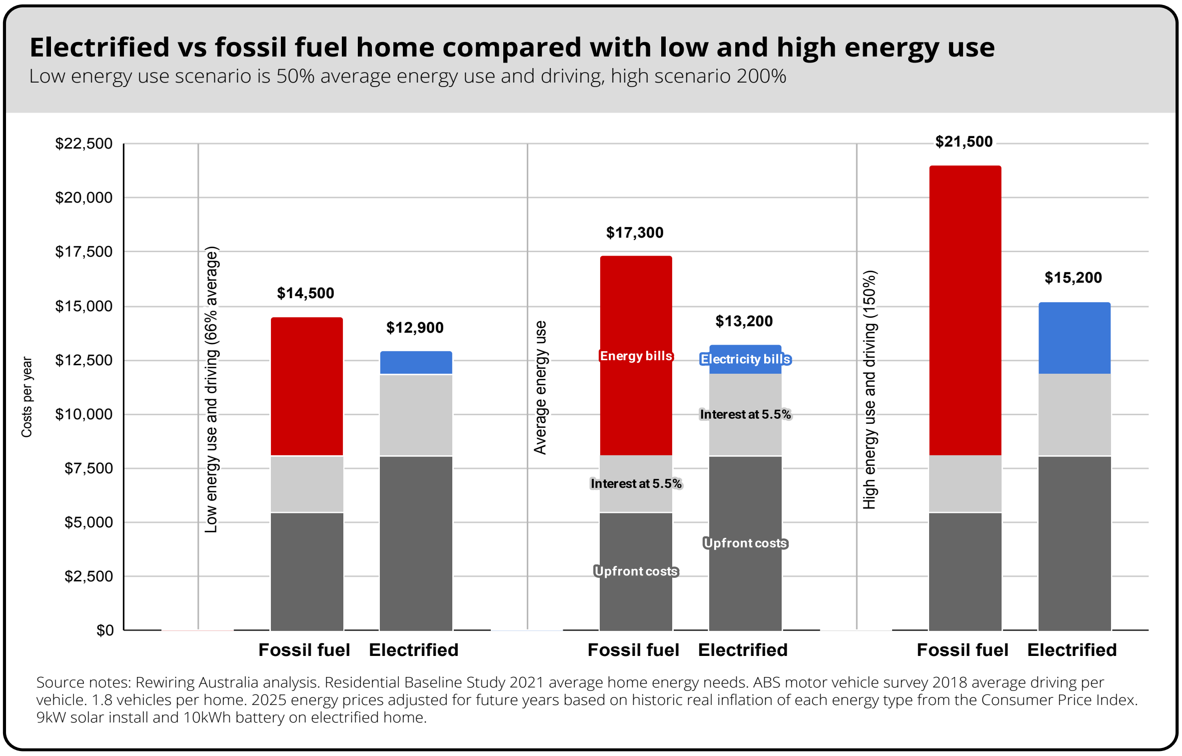


Source notes: Rewiring Australia analysis. Residential Baseline Study 2021 average home energy needs. ABS motor vehicle survey 2018 average driving per vehicle. 1.8 vehicles per home. 2025 energy prices adjusted for future years based on historic real inflation of each energy type from the Consumer Price Index. $2025. 9kW solar install and 10kWh battery on electrified home.

Comparisons for variation in energy usage

Electrification economics change with energy usage amounts, for example more people in the home leads to higher energy usage with often similar upfront costs, creating higher savings, and more driving leads to more fuel savings.

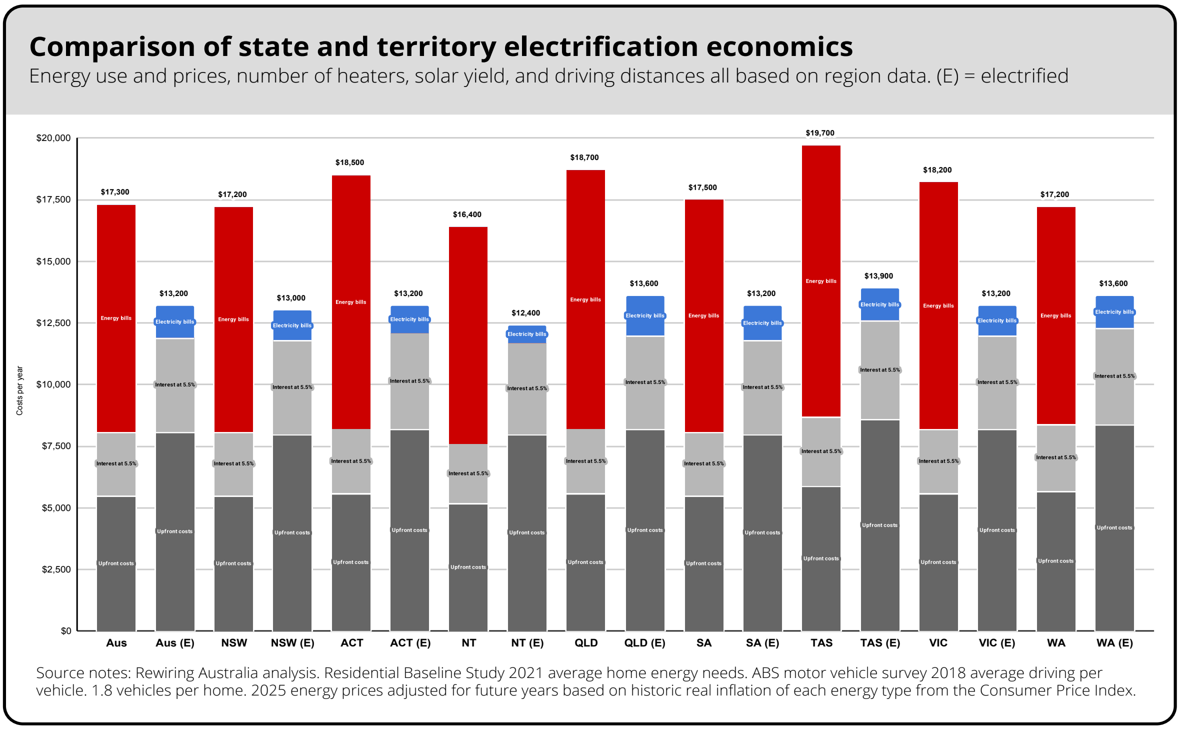
Figure 37



Location comparisons

States and territories have different energy requirements and prices. The main numbers in this paper are a weighted average for Australia as a whole. While the economics vary, all have crossed the electrification tipping point.

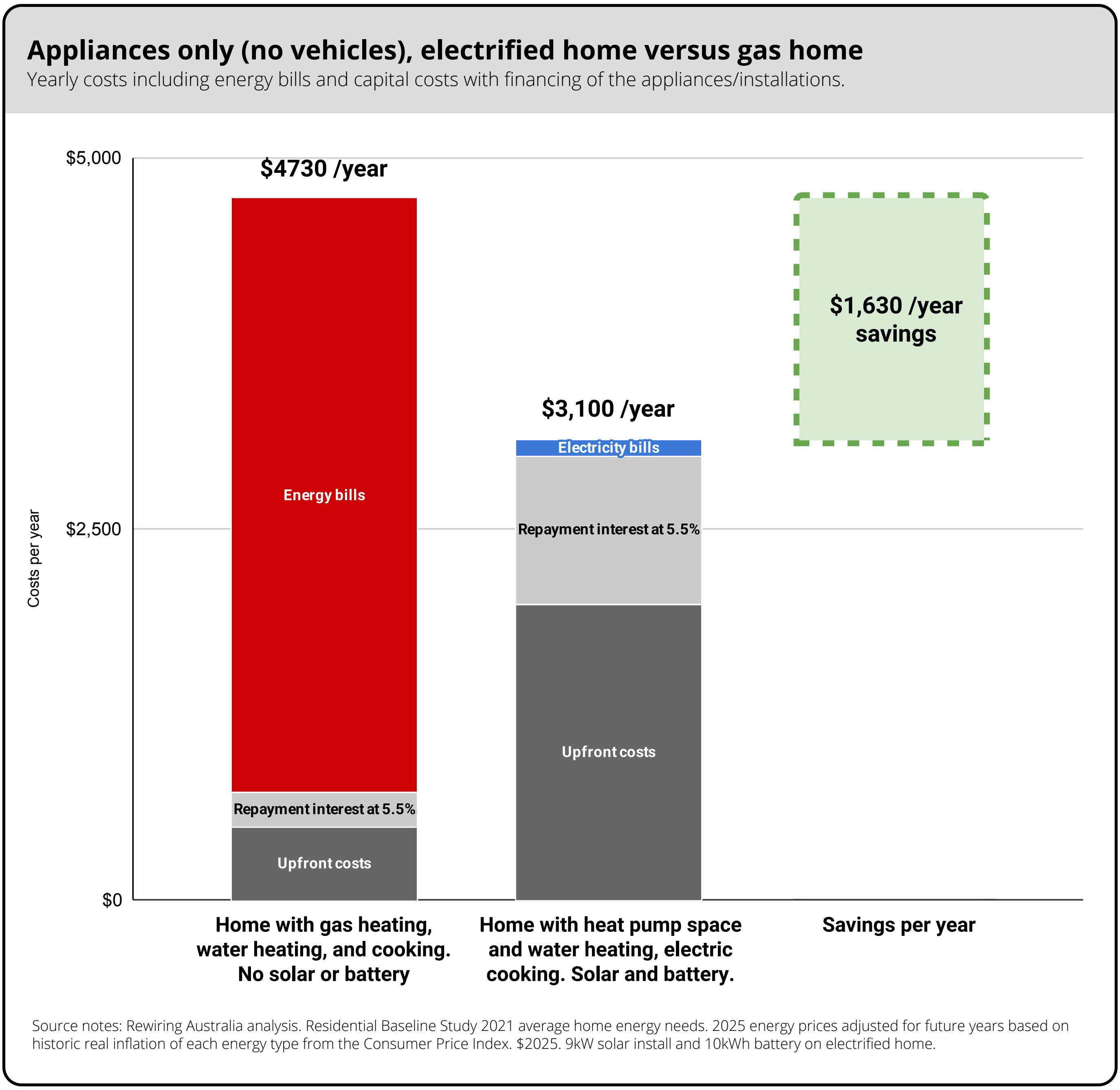
Figure 38



Appliance only comparison

Most Australian homes have vehicles - with most having more than one. For this reason and the importance of understanding future home energy use as a sector coupled mix of residential and transport, we include vehicles in most of our comparisons in this paper. For further investigation, here we show the "appliance only" economics of electrification.

Figure 39



Economies of scale

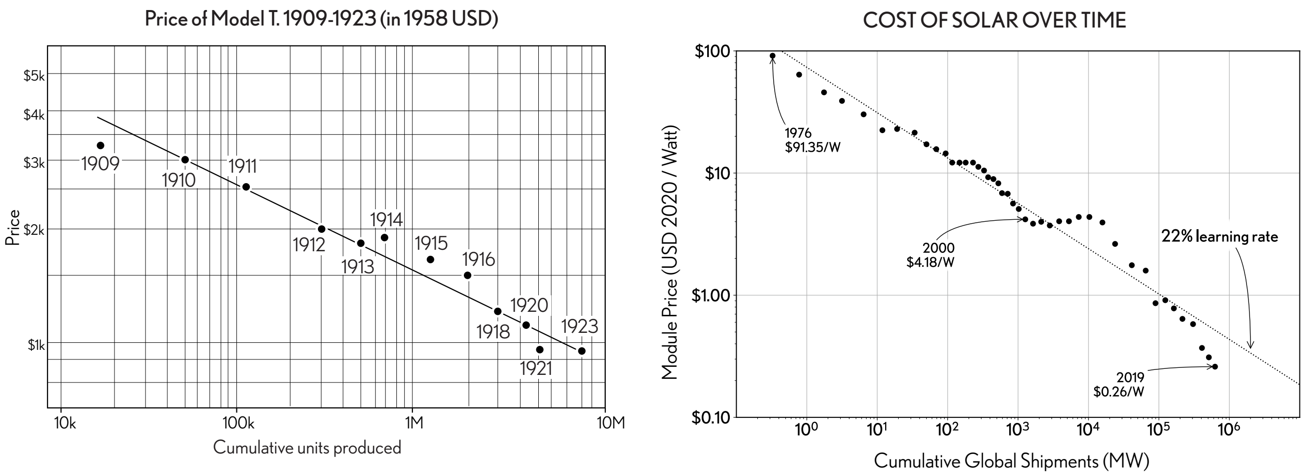
Renewable energy technologies continue to drop in price. It is vital to take this into account when planning for and building out the nation's energy system. Energy-economy modelling has historically underestimated the rate of decline in prices for renewable technologies.[27]

When understanding the falling prices of rooftop solar, batteries, heat pumps, and electric vehicles, it is important to understand the historical context of technology development. As a technology increases in adoption and the scale of manufacturing increases, prices often fall significantly. This is known as the learning curve or experience curve, where the cost of producing a technology reduces as a function of cumulative experience in terms of units produced.[28] This is especially relevant for mass-produced technologies that are relatively simple to assemble and do not involve significant customisation, such as solar panels, heat pumps and electric vehicles.[29] The chart below illustrates this for the Ford Model T manufacturing between 1909 and 1923, and the similar trend of solar cells in more recent years. These price drops are seen across many technologies, computers, batteries, electric vehicles and more.

Figure 40

Learning rates of the Ford Model T (left) and solar modules (right)

As more of each are produced, the price per unit drops significantly



Source notes: From the book "Electrify" - Saul Griffith, MIT Press

27 Way, R., Ives, M. C., Mealy, P., & Farmer, J. D. (2022). Empirically grounded technology forecasts and the energy transition. Joule, 6(9), 2057-2082. https://www.cell.com/joule/fulltext/S2542-4351(22)00410-X

28 Grubb et al. (2021). The New Economics of Innovation and Transition: Evaluating Opportunities and Risks. EEIST. https://eeist.co.uk/eeist-reports/the-new-economicsof-innovation-and-transition-evaluating-opportunities-and-risks/

29 Malhotra, A., & Schmidt, T. S. (2020). Accelerating low-carbon innovation. Joule, 4(11), 2259-2267

How economies of scale impact electrification economics

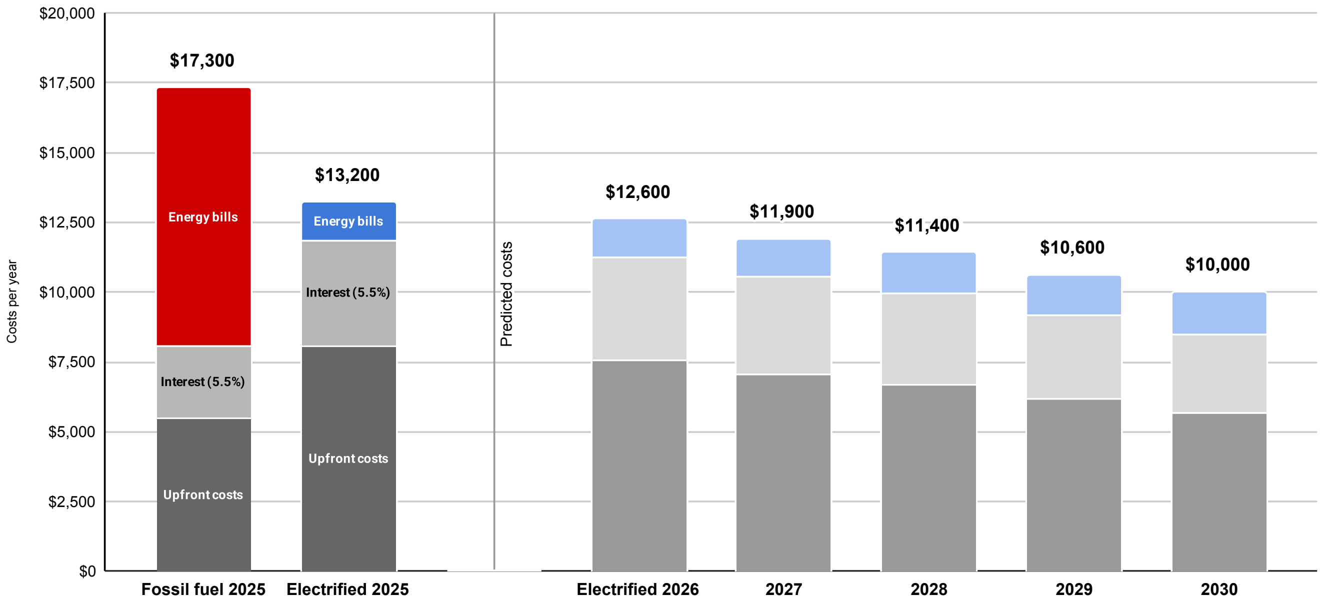
The prices of electric vehicles, solar, and batteries are falling worldwide. Taking this into account is important when we look at both the future of the energy system and the future of household energy choices. Below we look at the same electrification economics as earlier in this paper, combined with the forecast price drops across these technologies.

Electrification gets cheaper by the year. Many households can likely electrify today and save money, and those that aren't yet economically able to justify electrification likely soon will be as prices fall - as long as they have the finance access and can easily make those electrification choices.

Figure 41

Forecast electrified home costs with economies of scale (learning rates)

The costs of electrified homes and vehicles are expected to continue to decline



Source notes: Rewiring Australia analysis. Residential Baseline Study 2021 average home energy needs. ABS motor vehicle survey 2018 average driving per vehicle. 1.8 vehicles per home. 2025 energy prices adjusted for future years based on historic real inflation of each energy type from the Consumer Price Index. Future capital costs based on Bloomberg NEF EV cost parity forecast 2021, NREL solar and battery forecasts, all adjusted to Australian product prices and conditions. Solar includes the sunsetting of Australia's STC rebate scheme.

While these examples compare full electrification economics, most homes will likely electrify gradually. For example buying one electric vehicle in 2025, and replacing the other vehicle in the home with another electric vehicle in 2027. Similarly, their gas water heater may break in 2026, and they may already have solar from 2018. These decisions are often spread across when machines reach their natural end of life, or when homes have a reason to upgrade them (e.g. renovation). While this paper primarily focuses on replacement at end of life, replacement before end of life is demonstrably better from an emissions perspective. There are now various cases where this is also true from an economic perspective. For example, it may save a home money to replace a gas water heater well before its natural end of life, because the savings from not paying for gas can exceed any additional cost of early replacement.

In this paper we are simplifying are complex process influenced by multiple household decisions. Every home is different, and on its own electrification journey. What's clear now is that as they need to replace their next appliance or vehicle, an electrified option can save them money and emissions simultaneously.

Appendix: Methodology

Energy use

Appliance energy use

We derive average household energy use across different appliances through the Australian and New Zealand Residential Baseline Study 2021, published November 2022. https://www.energyrating.gov.au/industry-information/publications/report-2021-residential-baseline-studyaustralia-and-new-zealand-2000-2040

We then use energy efficiency factors / coefficient of performance across each appliance type to calculate the base energy requirements needed by a home depending on what appliances it uses/chooses, and its location based heating requirements.

Heat pump space heating Coefficient Of Performance (COP) is set for national average numbers at 4.0, and is individually set for states and territories for their own individual analysis.

- NSW at 4.0
- ACT at 3.66
- NT at 4.23
- QLD at 4.11
- SA at 4.0
- TAS at 3.66
- VIC at 3.89
- WA at 4.0

Note heat pump COP changes by regional temperature and by individual device performance.

Space heating energy factors for other heating appliances are set at the following values:

- Resistive electric heating: 100%
- Gas/LPG space heating: 80%
- Wood fire heating: 65%

Water heating heat pump COP is set at 3.48 for the national average, and the following for individual regions:
- NSW at 3.5
- ACT at 3.2
- NT at 3.7
- QLD at 3.6
- SA at 3.5
- TAS at 3.2
- VIC at 3.4
- WA at 3.5

Note Heat Pump water heaters are already available with average COPs stated at 450% & 520%.[30] Though real world device performance in home conditions can vary. Individual device selection, refrigerant used, and other factors will influence the COP. The COPs used in the model are calculated based on data published by the Australian Federal Government for Small Scale Technology Certificates.[31] As is current practice by some heat pump vendors, the COP is calculated by determining the energy savings reflected by the STC credit, in comparison to the energy purchased

30 https://blog.rheem.com.au/blog/what-does-coefficient-of-performance-cop-mean-on-a-heat-pump-water-heater/
31 https://cer.gov.au/schemes/renewable-energy-target/small-scale-renewable-energy-scheme/small-scale-renewable-energy-systems/solar-water-heaters/register-solar-water-heaters#air-source-heat-pump-models

by a reference medium load electric water heater with assumed COP of 1.0 as defined in AS4234 (2021).[32] Heat pump performance varies by refrigerant type, brand and model and ambient conditions. The COPs outlined in the Table above were calculated from STC credits as outlined above, as well as predicted market share per refrigerant type,[33] adjustment to account for STCs being rounded down to the nearest integer when certified, and Australian ambient condition weather Zones as defined in AS4234 (2021) applied to cities and States.

- Electric Resistive Tank water heating is assumed at 0.94

Gas/LPG instant water heating: 0.80

- Gas/LPG tank water heating: 0.70 (though not used in model)

Gas water heater COPs are based on data from the Australian Federal Government's Minimum Energy Performance Scheme (MEPS) and Energy Rating system database[34] [35] , including annual performance of gas equipment determined by tests in accordance with AS4552 (2010). COPs determined from these tests are significantly lower than quoted by vendor 'performance' data. Acknowledgements and thank you to Matt Martin from Electrify Adelaide for offering support with water heating COP research.

Cooktop efficiency is sourced from the Frontier Energy Residential Cooktop Performance and Energy Comparison Study Report # 501318071-R0. Published July 2019.[36]

- Electric resistive/ceramic cooktop: 71.4%
- Induction cooktop: 78.5%
- Gas/LPG cooktop: 30.4%

Electric oven efficiency is assumed at 95% and gas/LPG oven 90%, microwave at 65%.
For the primary comparisons in this paper, we assume the oven is already electric in both homes and it is therefore not a machine that needs to be electrified.

Vehicle energy use

We derive average vehicle energy use through the Australian Bureau of Statistics (ABS) Survey Motor Vehicle Survey use 2018. 2018 is used as the follow up study could have been impacted by COVID-19 lockdowns changing driving. The assumption used is that average driving has returned to pre-covid levels.[37]

The amount of vehicles per home is sourced from the ABS Census 2021, set at 1.83 for the national average, and at individually representative numbers for states and territories

- AUS: 1.83
- NSW: 1.8
- ACT: 1.8
- NT: 1.8
- QLD: 1.9
- SA: 1.8
- TAS: 1.9
- VIC: 1.8
- WA: 1.9

32 AS4234 (2021) – 'Heated Water Systems – Calculation of Energy Consumption'
33 'Heat Pumps – Emerging Trends in the Australian Market', Expert Group for the Department of Climate Change, Energy, the Environment and Water, September 2023
34 https://www.energyrating.gov.au/industry-information/products/gas-water-heaters
35 https://reg.energyrating.gov.au/comparator/product_types/
36 https://cao-94612.s3.amazonaws.com/documents/Induction-Range-Final-Report-July-2019.pdf
37 https://www.abs.gov.au/statistics/industry/tourism-and-transport/survey-motor-vehicle-use-australia/12-months-ended-30-june-2018#data-download

We use vehicle efficiency data for comparative energy use from the US Department of Energy EPA fuel economy database to calculate the different energy requirements across vehicle types. fueleconomy.gov. This dataset is used because it is a detailed comparison of driving efficiency differences between vehicles and expected to be more realistic than "claimed" efficiency from vehicle manufacturers. We use individual vehicle efficiencies across a range of vehicles that are popular in Australia to determine an average difference in efficiency between a petrol vehicle and an electric vehicle of similar size. For electric vehicles this includes charging losses.

Where EPA data is not available for some electric vehicles in Australia (e.g. BYD), we use the EVDB real range energy consumption estimate.[38] Where the energy consumption is not available for any remaining vehicles through either of these methods (few) we use manufacturer estimates provided in vehicle documentation or a similar vehicle's efficiency as an index.

The average miles per gallon (MPG) for an internal combustion engine (ICE) vehicle used is 30.0, the average MPG for an electric vehicle used is 116.8. This is then converted into litres per kilometre and an energy ratio for the average vehicle. Therefore an electric vehicle uses an average of 25.7% of the energy to drive the same distance as a similarly sized ICE vehicle. This aligns with comparisons of popular similar vehicles, though note individual vehicles vary some electric vehicles are much more efficient than other electric vehicles, and some petrol vehicles are more efficient than other petrol vehicles.

Hybrid vehicle petrol use is derived from a comparison of modern hybrid vehicles compared to the same non-hybrid variant of the same vehicle, and is set at 70% petrol use of the equivalent non-hybrid vehicle.

Energy Prices

Electricity pricing

Electricity pricing varies between locations, retail plans, times of the year and more. We determine average electricity prices to be used for each state and territory and nationally. We determine this from a comparison of current electricity prices in each region. This includes a comparison of AEMO NEM wholesale prices, AEMC price breakdown estimates, network pricing structures, and retail plan comparisons from both online and through analysis provided by Solar Analytics plan comparisons.

- https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/data-nem/data-dashboard-nem
- https://www.aemc.gov.au/news-centre/data-portal/price-trends/2021/trends-national-supply-chain-components
- https://www.horizonpower.com.au/globalassets/media/documents/pricing/electricity-fees-and-charges-brochure-202425.pdf?v=4a07c0
- https://utilicom.nt.gov.au/publications/correspondence-directions-and-notices/pre-2025/electricity-pricing-order-1-july-2024-30-june-2025
- https://www.westernpower.com.au/about/regulation/network-access-prices/
- https://www.wa.gov.au/organisation/energy-policy-wa/household-electricity-pricing
- https://www.canstarblue.com.au/electricity/electricity-costs-kwh/
- https://www.canstarblue.com.au/electricity/electricity-supply-charges/
- https://www.finder.com.au/average-cost-of-electricity
- SolarAnalytics Price Comparison December 2024

38 https://ev-database.org/car/1782/BYD-ATTO-3

Electricity pricing for 2025 is set at the following:

- AUS: volume rate: $0.32/kWh, fixed rate: $432 per year.
- NSW: volume rate: $0.34/kWh, fixed rate: $465 per year.
- ACT: volume rate: $0.26/kWh, fixed rate: $441 per year.
- NT: volume rate: $0.28/kWh, fixed rate: $210 per year.
- QLD: volume rate: $0.32/kWh, fixed rate: $450 per year.
- SA: volume rate: $0.44/kWh, fixed rate: $415 per year.
- TAS: volume rate: $0.30/kWh, fixed rate: $435 per year.
- VIC: volume rate: $0.27/kWh, fixed rate: $396 per year.
- WA: volume rate: $0.31/kWh, fixed rate: $414 per year.

Gas pricing

Gas pricing is determined from a comparison of sources for current (2025) residential gas pricing. This includes online gas price comparisons (e.g.https://wattever.com.au/compare-best-gas-rates/) of individual state/territory and retailer specific gas rates, AER wholesale gas price data (https://www.aer.gov.au/industry/registers/charts/gas-market-prices).

Gas pricing for 2025 is set at the following:

- AUS: volume rate: $0.146/kWh, fixed rate: $247 per year.
- NSW: volume rate: $0.153/kWh, fixed rate: $244 per year.
- ACT: volume rate: $0.159/kWh, fixed rate: $260 per year.
- NT: N/A
- QLD: volume rate: $0.209/kWh, fixed rate: $247 per year.
- SA: volume rate: $0.202/kWh, fixed rate: $297 per year.
- TAS: volume rate: $0.194/kWh, fixed rate: $235 per year.
- VIC: volume rate: $0.133/kWh, fixed rate: $296 per year.
- WA: volume rate: $0.115/kWh, fixed rate: $80 per year.

LPG pricing

LPG pricing is determined from a comparison of sources for current (2025) residential LPG bottle prices. This includes online comparisons e.g.
- https://www.originenergy.com.au/lpg/offers ,
- https://plusgas.com.au/blog/how-much-is-a-45kg-gas-bottle-for-home/,
- https://www.horizonpower.com.au/globalassets/media/documents/community/projects/hopopw0180_residential_lpg_factsheet_fa_web.pdf?v=498e10.

We assume two bottles per home, which applies to the fixed rental costs

LPG pricing for 2025 is set at the following:

- AUS: volume rate: $0.28/kWh, fixed rate: $95.47 per year.
- NSW: volume rate: $0.31/kWh, fixed rate: $96.0 per year.
- ACT: volume rate: $0.28/kWh, fixed rate: $96.0 per year.
- NT: volume rate: $0.40/kWh, fixed rate: $105.0 per year.
- QLD: volume rate: $0.30/kWh, fixed rate: $95.0 per year.
- SA: volume rate: $0.30/kWh, fixed rate: $99.0 per year.
- TAS: volume rate: $0.24/kWh, fixed rate: $96.0 per year.
- VIC: volume rate: $0.26/kWh, fixed rate: $96.0 per year.
- WA: volume rate: $0.22/kWh, fixed rate: $90.0 per year.

Wood pricing

Wood pricing is determined from a comparison of multiple online wood prices across each state and territory. The wood pricing for 2025 is set at the following:

- AUS: $0.13/kWh
- NSW: $0.14/kWh
- ACT: $0.094/kWh
- NT: $0.151/kWh (uses QLD figure as minimal data available - low heating needs)
- QLD: $0.151/kWh
- SA: $0.111/kWh
- TAS: $0.067/kWh
- VIC: $0.11/kWh
- WA: $0.14/kWh

Petrol and Diesel pricing

Petrol and diesel pricing is derived from the Australian Institute of Petroleum data tables on pump prices for the most recent year. https://www.aip.com.au/pricing/pump-prices. For conversion to kWh pricing, 9.5 kWh/Litre is used for petrol, and 10.7 kWh/Litre for diesel.

The petrol and diesel prices used for 2025 are:

- AUS: Petrol $1.89/L, Diesel $1.91/L.
- NSW: Petrol $1.90/L, Diesel $1.92/L.
- ACT: Petrol $1.90/L, Diesel $1.92/L.
- NT: Petrol $1.98/L, Diesel $2.11/L.
- QLD: Petrol $1.92/L, Diesel $1.92/L.
- SA: Petrol $1.83/L, Diesel $1.89/L.
- TAS: Petrol $1.89/L, Diesel $1.94/L.
- VIC: Petrol $1.89/L, Diesel $1.92/L.
- WA: Petrol $1.82/L, Diesel $1.87/L.

Solar pricing

Solar pricing is derived from the state and territory pricing from https://www.solarchoice.net.au/solar-panels/solar-power-system-prices/. Accessed January 2025. Per kWh pricing is determined by calculating the lifetime generation of the solar panels over 30 years, solar panels now come warrantied often and 25 or 30 years, and up to 40 years (https://sunpower.maxeon.com/int/solar-panel-products/warranty). One replacement inverter is included at $2,000. Degradation is assumed at 0.5% per year.

Solar capacity factor is derived from real world solar performance data from across Australia provided by SolarAnalytics. Capacity factor by region is set at:

- AUS: 17.15%
- NSW: 16.29%
- ACT: 16.32%
- NT: 18.98%
- QLD: 18.68%
- SA: 17.88%
- TAS: 15.86%
- VIC: 15.37%
- WA: 21.04%

The solar pricing used by location is:

- AUS: $814/kW, $0.025/kWh + financing costs (weighted average of regions)
- NSW: $791/kW, $0.025/kWh + financing costs
- ACT: $821/kW, $0.026/kWh + financing costs
- NT: $1,306/kW, $0.033/kWh + financing costs
- QLD: $811/kW, $0.023/kWh + financing costs
- SA: $805/kW, $0.023/kWh + financing costs
- TAS: $949/kW, $0.030/kWh + financing costs
- VIC: $792/kW, $0.027/kWh + financing costs
- WA: $882/kW, $0.021/kWh + financing costs

Battery pricing

Battery pricing is determined from a comparison of online battery prices on https://www.solarchoice.net.au/solar-batteries/price/ and https://www.solarquotes.com.au/battery-storage/cost/. Installed battery pricing is set at $1,100 per kWh. Battery operational lifetime is assumed at 15 years with one cycle per day using only 80% of capacity, with accelerating degradation down to using only 44% of capacity in year 15. Batteries usually come warranted for at least 10 years of operation, so we assume at minimum they will last 10 years, and some already have 15 year warranties. The assumption used is that given the warranty the minimum lifetime is 10 years, or some 15 that have 15 year warranties, and products are generally expected to outlast their warranty (e.g. petrol vehicle warranties are often around 3 - 5 years).

Appliance pricing

Appliance pricing is derived from a detailed online pricing comparison of available products in Australia from common stores and suppliers. Over 250 appliances and pricing from different stores are compared. Installation pricing is less openly available for comparison, the installation costs used are derived from online installation cost estimates in addition to on the ground pricing estimates from installers reported directly. Appliance lifetimes are assumed at 15 years per device.

Device quality and price point is an important consideration when modelling product prices. In these comparisons, we aimed to pick popular, middle of the range products, some premium, some more affordable. We did not aim to select extremely cheap (e.g. low quality) products but instead a reasonable sample of what people are likely to buy. Product prices vary widely, and it is clear that all products could both be purchased as more affordable options that may lose some quality and longevity, and more premium expensive options which could increase quality and longevity.

Space heaters

- Heat pump large (6kW - 8kW) pricing per heater: $1,700 per device, $900 per install.
- Heat pump small (2kW - 4kW) pricing per heater: $900 per device, $799 per install.
- Heat pump ducted medium size home: $13,000 installed.
- Gas/LPG heater large (5 - 7kW) pricing: $1,740 per device, $500 per install.
- Gas/LPG heater small (~3kW) pricing: $1,100 per device, $500 per install.
- Gas ducted heating system pricing: $7,000 installed.
- Resistance heaters per device: $220 per device.
- Wood fire per device: $1,400 per device, $1,000 per install.

For household comparison scenarios, the power output of different devices is compared to determine how many of each device can be replaced with another. Resistance/bar heaters are often around 1-2kW, so it is assumed that one 7kW heat pump replaces three resistance heaters. Wood fires can be 15kW individually, so it is assumed that two heat pumps are needed to replace one wood fire. One heat pump is assumed to replace one gas/LPG heater one for one. A different number of necessary heating devices is assumed for an average size home in each region. For Australia nationally, this is 2 large heat pumps. NSW: 2, ACT: 3, NT: 0, QLD: 1, SA: 2, TAS: 3, VIC: 3, WA: 2. Note this is for an average home 2 - 3 people, larger homes may require more heating devices, smaller homes less.

Water heaters

- Heat pump water heater: $3,500 installed *includes national subsidy as installation quotes online often include fully installed cost. For reference our device only comparison came out at $3,000 per device.
- Resistance tank water heater medium/large: $1,400 per device, $700 per install.
- Resistance tank water heater small: $1,000 per device, $700 per install.
- Gas/LPG instant water heater: $1,200 per device, $700 per install.
- Gas/LPG storage water heater: $1,600 per device, $600 per intall.

Cooktops

- Resistance/ceramic cooktop: $600 per device, $400 per install.
- Induction cooktop: $1,400 per device, $600 per install.
- Gas/LPG cooktop: $700 per device, $400 per install.

Switchboard upgrades

Switchboard upgrades at the home level are assumed at an additional $2,500 for any electrified home. We believe this is likely to be a high estimate for an "average" home, because many homes do not necessarily need a switchboard upgrade to electrify. Though this number can account for other new wiring that may be needed to an existing switchboard, this should also be part of installation costs already included in appliance quotations.

Gas disconnection fees

Gas disconnection fees tradework for the electrified home is assumed at $150.

Vehicle pricing

Vehicle pricing is determined from a detailed comparison of 25 popular vehicles in the Australian market, compared to similar sized and specified electric vehicles available in Australia. This included comparing smaller vehicles (for example Suzuki Swift and the Nissan Leaf) alongside popular SUV vehicles both in 2WD and AWD (for example Mitsubishi Outlander AWD and Tesla Model Y AWD).

The average price of a new petrol vehicle used is $41,300 and the average price of a new electric vehicle used is $48,600. One electric vehicle charger is assumed per home at $1,000 per device and $1,000 per install. Vehicle lifetimes are assumed at 15 years.

Note vehicle purchase decisions are often determined by more than just economics, people choose cars for many other reasons. For example, someone buying a Mercedes or Volvo can likely already afford an electric car with no difference in upfront costs. For this reason individualised electric vehicle economics will vary based on car choice significantly, though the fuel savings (and therefore total vehicle discount) from switching to electric vehicles remains largely the same across all vehicles, with small differences based on efficiency.

Historic pricing and forecast pricing

Electricity, gas, LPG, petrol, diesel, and wood

The historic pricing of each of these energy sources is derived from today's prices adjusted to the individual Consumer Price Index (ABS) category for each respective item, or the closest respective category. The default forecast future pricing for each of these energy sources is derived by assuming the same historic average "real" inflation rate as seen since the year 2000 in each energy type's respective index.

Solar

Historic solar pricing in Australia is sourced from the solar pricing indexes provided by SolarChoice (https://www.solarchoice.net.au/solar-panels/solar-power-system-prices/). Where data is not available further back in time, the global module price for solar is used as an index for the Australian price of the closest year (https://ourworldindata.org/grapher/solar-pv-prices).

Solar forecast pricing includes the sunsetting of the Australia STC rebate for solar, and solar pricing forecasts are indexed by the National Renewable Energy Laboratory Residential PV ATB Advanced forecast: (https://atb.nrel.gov/electricity/2023/residential_pv#capital_expenditures_(capex)) with acknowledgement that forecasts for renewable energy have consistently underestimate the pace at which renewable energy falls in price with economies of scale (https://www.cell.com/joule/fulltext/S2542-4351(22)00410-X).

Battery

Battery price history is based on Ziegler, M. S.; Trancik, J. E. Re-Examining Rates of Lithium-Ion Battery Technology Improvement and Cost Decline. Energy Environ. Sci. 2021, 14, 1635–1651. DOI: 10.1039/D0EE02681F https://pubs.rsc.org/en/content/articlelanding/2021/ee/d0ee02681f https://doi.org/10.7910/DVN/9FEJ7C adjusted to current Australian battery prices.

Forecast battery prices are based on the National Renewable Energy Laboratory Residential Battery Storage Advanced cost forecast: https://atb.nrel.gov/electricity/2023/residential_battery_storage which is used as an index and adjusted to Australian battery prices.

Heat pumps

Heat pump price forecasts are based on the IEA SDS heat pump price trajectory (https://www.iea.org/data-and-statistics/charts/cumulative-capacity-and-capital-cost-learning-curve-for-vapour-compression-applications-in-the-sustainable-development-scenario-2019-2070).

Electric vehicles

Electric vehicle price forecasts are based on an index derived from BloombergNEF “Hitting the EV inflection point” published May 2021: https://www.transportenvironment.org/wp-content/uploads/2021/08/2021_05_05_Electric_vehicle_price_parity_and_adoption_in_Europe_Final.pdf adjusted to Australian EV prices today.

Financing and interest rates

The primary financing rate used for purchases is 5.5%pa. For total household numbers, the finance terms used are 15 years for appliances, batteries, and vehicles, and solar. Solar is expected to last well over 15 years, but for simplification of understanding in the full household calculations all purchases are financed over the same time period. In the individual solar and appliance numbers, and CPI comparison charts, solar is financed over an assumed 30 year warrantied lifetime with one replacement inverter in this time at $2000.

Subsidies

The only subsidies included are the national level STC program. The forward numbers used include the sunsetting/conclusion of this scheme after 2030. The STC price is set at $39.85. State or LGA based subsidies are not directly included in the calculations and would improve electrification savings further. Some hot water heat pump subsidies which are built into public water heating installation quotes may be included.