



Submission to the Senate Inquiry on Residential Electrification 2023
Senate Standing Committee on Economics

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About Rewiring Australia

Rewiring Australia advocates for rapid electrification to address climate change, create jobs, green exports and save households money. Rewiring Australia is a non-profit research and advocacy organisation dedicated to representing the people, households and communities in the energy system. We deliver practical climate progress by working with government, industry, and communities to electrify everything. We empirically demonstrate and communicate the cost savings, emissions reductions, and energy system benefits of electrification. The research of Rewiring Australia's chief scientist, Dr Saul Griffith, has been influential on energy policy in Australia and the United States of America. Rewiring Australia has reached millions of Australians with our work. Our work has four core pillars: education & communications, advocacy, data-driven research and deployment projects.

1. Summary of Recommendations

Financing electrification

1. Issue a new Clean Energy Finance Corporation Investment Mandate Direction to enable the HEUF to reach lower income households.
2. Deploy some HEUF loans via pilots of innovative funding models including on-bill financing and income contingent loans and use this to design options for a large-scale finance package to significantly accelerate electrification over 10 years, particularly among low and medium income households.

Upfront costs

3. Amplify, boost, support, coordinate and broaden state based rebates, incentives, and Energy Efficiency Obligation schemes.
4. Broaden the rebates and price incentives beyond solar PV and heat pumps to electrification equipment such as battery storage, induction cooking appliances that replace gas cooking, demand flexibility enabled space heating that replaces gas heating and smart EV charging equipment.

Renters

5. Encourage states and territories to incorporate minimum energy performance standards into rental standards.
6. Introduce an instant tax write-off for landlords electrifying rental properties.
7. Support measures that increase transparency for renters around energy costs.
8. Work with states and territories to expand the Victorian scheme that provides electrification funding for rental properties.

Social housing

9. Work with states and territories to electrify all social housing by 2030.

New builds

10. Update the National Construction Code standards for new builds to require electric appliances and no reticulated gas connections.
11. Move to a 7-Star Standard for new home construction, to take into account home energy appliances and drive greater energy efficiency from the point of design.
12. Introduce gas disconnection bonds to offset the cost of disconnecting from gas.

Strata buildings

13. Update the National Construction Code to ban gas connections to new apartment developments.
14. Provide targeted grants and tailored finance products to support the electrification of apartment buildings.

Electric Vehicles

15. Introduce vehicle emissions standards to drive EV supply and adoption.
16. Set a medium-term target for no new ICEs sold by 2027 for petrol and 2030 for diesel engines, with defined exceptions for emergency and remote applications including national parks management, fire services etc. with encouragement of qualified bio-diesel.
17. Provide concessional finance support to incentivise low and middle income consumers to choose EVs.
18. Accelerate vehicle-to-grid (V2G) development and deployment.
19. Plan and fund for community generation infrastructure and community charging infrastructure.

Education

20. Partner with state, territory and local governments to deliver national education and awareness campaigns and provide accurate information on relative full ownership costs (purchase and operation) of electric appliances, compared to fossil fuel machines.
21. Work with manufacturers, appliance retailers, property managers, retail outlets and energy retailers to provide information at the point of sale and lease.

Appliance standards

22. Harmonise and update regulatory standards for appliances including GEMS Act, and Australian Standards technical standards to encourage electrification, DER integration and demand flexibility trading readiness.

National plan

23. Implement a National Electrification Plan and supporting governance arrangements.

Electricity market design

24. Undertake electricity market reform and redesign.
25. Create a new market structure that is fit for purpose for the climate emergency.
26. Develop market design principles that support rapid decarbonisation.
27. Create an Office of Electrification and Efficiency.
28. Fix the Wholesale Demand Response Mechanism to encourage commercial and industrial demand response and extend the Mechanism to DER.

Gas substitution

29. Design and implement a national gas substitution roadmap.

Community energy

30. Establish lighthouse electrified pilot suburbs.
31. Invest in the development of Community Energy Zones.

Orchestration

32. Design and implement an orchestration roadmap.

Workforce

33. Provide direct funding for energy transition Registered Training Organisations
34. Require government-funded projects and companies who receive government funding to deliver on training mandates.
35. Fund mentoring and support for apprentices to improve completion rates.
36. Improve the attraction and retention of apprentices and trainees; including those not traditionally represented in the industry (women, First Nations and CALD workers).

2. Introduction

Rewiring Australia welcomes the opportunity to make a submission to the Senate Economics References Committee's inquiry into Residential Electrification. Our submission draws on original research led by Dr Saul Griffith, which was first published in October 2021¹. Our research demonstrates that electrification reduces energy costs for households, accelerates emissions reduction, creates jobs, reduces the cost of abatement across the economy and increases energy security.

This submission advocates for large government investment in electrification and complementary policies. This investment would unlock hundreds of billions of dollars in private investment in solar, EVs and electric machines for households. It would reduce energy price inflation and eliminate energy emissions.

We define "household electrification" as upgrading homes by replacing fossil fuel machines with efficient electric equivalents powered by rooftop solar complemented by grid electricity, which is increasingly renewable energy powered. The key machines are outlined in the table below. Less common fossil fuel machines such as lawnmowers, gas pool heaters, and ICE recreational vehicles should also be replaced with efficient electric machines, however, for the sake of efficiency, this submission focuses on the key household items to be electrified.

Table 2-1 Electrification occurs when households are powered by electric machines that use renewable energy

Household item	Fossil fuel machine	Electric machine
Vehicle	Petrol or diesel cars often referred collectively as an internal combustion engine (ICE) vehicle	Electric vehicles
Vehicle charger	n/a	Electric vehicle chargers
Water heater	Gas hot water heater	Heat pumps (most efficient) or; Resistant hot water heaters (less efficient) or; Rooftop solar hot water (less efficient)
Space heater	Gas heating including ducted heating or stand-alone heaters; Other combustion heaters; Less efficient electric heaters are not technically fossil fuel machines but should also be considered for replacement with more efficient heating (and cooling) heat pumps	Heat pump space heaters, also referred to as reverse cycle air conditioners (highest efficiency)

¹ Griffith, S., (2021) *Castles and Cars. Savings in the Suburbs through Electrifying Everything*. Rewiring Australia. Retrieved from [Castles and Cars Rewiring Australia Discussion Paper](#)

Cooking	Gas stoves and ovens	Induction stovetops (most efficient) or; Electric resistance stovetops (less efficient)
Energy generation	n/a	Rooftop solar
Energy storage	n/a	Household batteries

There is no agreed nomenclature for these machines or the household electrification process. The Australian energy market bodies are shifting their terminology from ‘distributed energy resources (DER)’ to ‘consumer energy resources’. In other countries, these machines are sometimes called ‘transactive energy resources’ or ‘prosumer devices’. The terminology does not matter; what is important is simply that we are reorienting energy policy from an overemphasis on hundreds of large-scale assets to take into consideration millions of small assets, principally owned by consumers and located where they live and work. We use the term ‘electrification’ because it is concise and readily understood by Australians.

Electrification is financially positive because renewable energy, EVs and other electric machines, such as heat pumps, are becoming cheaper than conventional technologies in both their purchase price and operating costs. That is a revolutionary breakthrough for policy and politics. It means technology cost trends will inevitably replace fossil fuels with clean, electric energy.

The challenge of electrification is twofold. First, falling technology costs alone will not drive electrification fast enough to meet our 1.5-degree carbon budget. Second, upfront capital costs and other logistical barriers will make electrification harder for some households, including renters, apartment dwellers, and people on fixed, low or precarious incomes will be locked out of the financial benefits of electrification. This Senate Economics References Committee inquiry is an opportunity to explore pathways to accelerate electrification while also making it accessible and equitable.

We are in a climate emergency

While this Inquiry is focused on the economic opportunities of electrification, it is also important to spotlight the critical role electrification will play in Australia meeting emission reduction targets. We face a climate emergency and need to drastically reduce our emissions in order to maintain an inhabitable world.

The world is seeing an alarming rise in global temperature and extreme weather events. NASA’s Goddard Institute of Space Studies announced that 2023 was Earth’s hottest summer since records began in 1880². A 2020 UN report found a sharp increase in climate-related natural disasters and extreme weather events. Between 2000 and 2019, disaster events claimed over 1.2 million lives and

² Goddard Institute of Space Studies, (2023) ‘Summer JJA (2023) global temperature anomaly’, *GISS Surface Temperature Analysis (GIS TEMP v4)*, New York, National Aeronautics and Space Administration, <https://data.giss.nasa.gov/gistemp/>,

affected 4.2 billion people, costing almost US\$3 trillion in economic loss globally³.

In Australia, the CSIRO's 2022 State of the Climate report predicts an increase in the number of dangerous fire weather days, extreme heat days, drought and heavy short-term rainfall events leading to flooding⁴.

It is clear that we need to reduce emissions urgently, and it is well established that the energy system needs to move first. However, the pace of progress from the transition to renewables has started to fall behind the timelines needed to deploy utility renewables and transmission.

Electrification is the principal means by which we can continue to live high energy-intensive lives while also eliminated emission. Globally, 80% of the climate problem is an energy problem⁵, and for the vast majority of that energy economy, electrification is the solution.

Electrification offers significant economic opportunities Australia

The Australian Government has committed the country to reduce emissions by 43% by 2030 and increase renewable grid electricity to 82% by the same date. This is an interim step to reaching net zero. State, Territory and local governments across the country have also announced their own emissions targets.

In addition to hitting reduction targets, the Government aspires to deliver economic growth powered by the transition. The goal is to make Australia a renewable energy superpower that generates several hundred per cent as much electricity as we currently consume at ultra-low cost and leveraging that for both new industries and enhanced productivity across the economy from lower input costs. At the same time, the Government is responding to the US *Inflation Reduction Act* to encourage investment in electrification and renewable energy and ensure related industries remain in Australia.

Adding equal focus on the 'demand-side' will accelerate the energy transition

Until now, Australia, like other countries, has focused on changing the supply-side of energy: replacing big coal and gas power stations with big solar, wind and hydro. Adding an equal focus on the demand side of the energy system equation presents a significant opportunity to accelerate the energy transition and deliver household economic benefits. Energy consumers (big and small) can and must play a key role in the transition by generating their own solar electricity and replacing gas appliances and internal combustion engine (ICE) vehicles with EVs.

The electricity market was designed for the age of coal, and the rules are a huge barrier and cost for households and large-scale renewable projects. A reboot of energy market governance is required to allow us to take full advantage of the opportunity of electrification.

³ Centre for Research on the Epidemiology of Disasters CRED and UN Office for Disaster Risk Reduction (2020), *Human Cost of disasters: An overview of the last 20 years 2000-2019*,

⁴ Commonwealth Scientific and Industrial Research Organisation, (2022) *State of the Climate 2022*.

⁵ IEA, (2022). *World Energy Outlook 2022*. International Energy Agency. Retrieved from www.iea.org

Australia must choose between two pathways to low-emissions energy:

- The current default pathway: laissez-faire policies that leave vested interests to deliver a high-cost energy system to consumers with gradual (and insufficient) emissions reduction progress (with an occasional crisis), or;
- The electrification alternative: substantial investment in maximising rooftop solar and residential electrification, resulting in low-cost energy abundance with accelerated emissions reduction.

Australia has led the world with the uptake of rooftop solar. In 2022, one in every three Australian houses had solar on the roof, generating energy for their own use and sending energy into the grid⁶. Australia can and should leverage our rooftop solar success to become the world leader in electrification. The low cost of rooftop solar energy means the economic tipping points and benefits of home electrification arrive here first. Australia should innovate electrification technologies and business models for export to the world. Household electrification should form a central role in Australia's next major cost-of-living and climate policy, just as it does in the US *Inflation Reduction Act*.

In 2023, the Australian Government recognised the importance of electrification and the demand side. The 2023-24 Federal Budget included \$1.3 billion in electrification and energy performance funding for households, \$310 million for small businesses and another \$100 million to support local government projects.

Electrification costs will continue to decline

The economic savings associated with electrification will improve into the future as the cost of the electric machines, particularly batteries, solar and EVs continue to decline. Solar already makes medium to long-term economic sense for almost every Australian household. The deployment question is one of the commercial models, finance offers, product offerings and ownership structures of housing (e.g., renters). The cost of financing solar in Australia already delivers electricity to homes at less than the cost of distribution and transmission.

⁶ AEMO (2022). *Integrated System Plan 2022*. Australian Energy Market Operator Retrieved from AEMO ISP 2022.

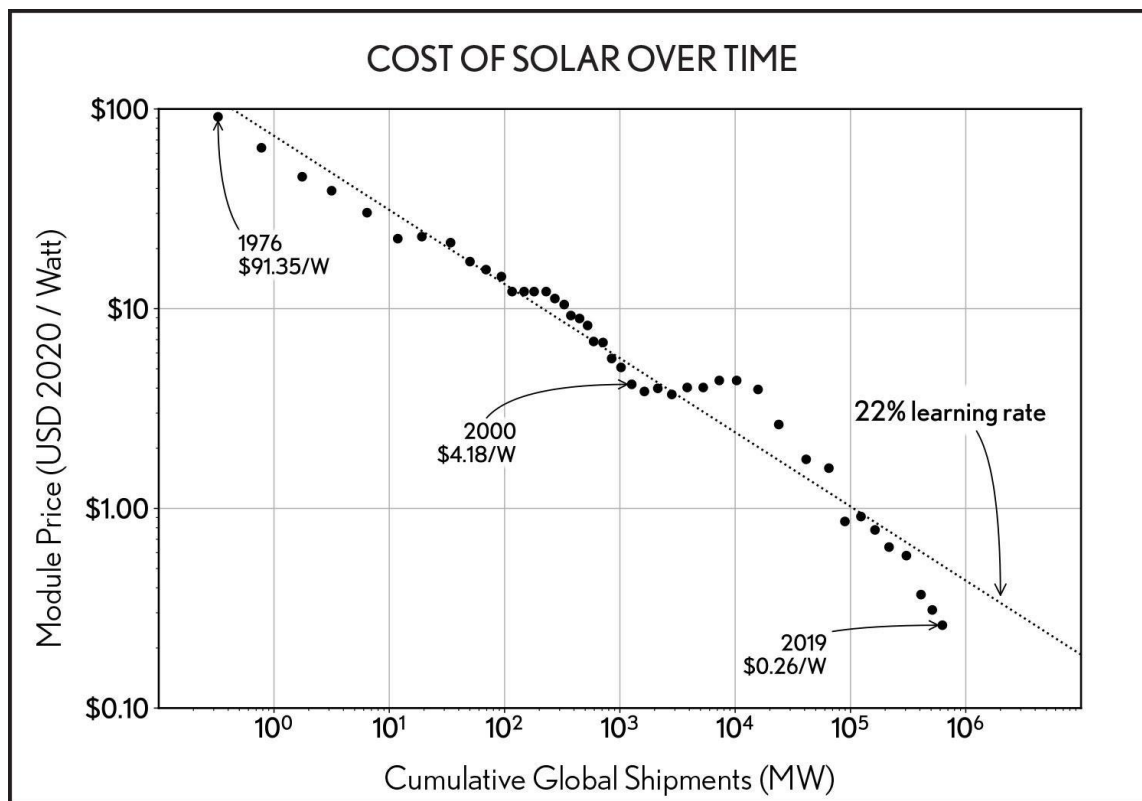


Figure 2-1 Cost curves of PV modules⁷

Australians are well acquainted with the solar cost curve (Figure 2-1). We are now seeing those same curves for batteries and this in turn is driving cost reductions in EVs since the battery is a major component of their cost. The speed at which these manufacturing cost curves lower the price of renewable energy has been consistently underestimated⁸ and should be taken into detailed account when planning the energy system.

While residential batteries are only just reaching economic tipping points, they are forecast to continue to drop in price and increase in efficiency. For example, while residential batteries are installed at \$1300/kWh, a Tesla with a 60kWh battery can be purchased for \$60,000, functionally a \$1000/kWh battery with a free car. Wholesale battery prices in Australia are already about 5 times lower than in the USA. This is important to consider for demand side saturation, and avoiding sunk costs in infrastructure build-out focussed on large-scale generation.

Electrification benefits households

Electricity consumption in our homes and small businesses represents about 70% of our domestic emissions⁹. Decarbonisation will occur in domestic economies worldwide, which will mean the end of Australia's fossil fuel exports and their associated production emissions - leaving our domestic emissions as the central decarbonisation challenge. It's the emissions from our communities that

⁷ Griffith, S., (2021) *Electrify. An Optimist's Playbook for Our Clean Energy Future*. MIT Press. Retrieved from [MIT Press](#)

⁸ Way, R., Ives, M.C., Mealy, P., Farmer, D. (2022). *Empirically grounded technology forecasts and the energy transition*. Retrieved from [Joule](#)

⁹ Australian Government (2023), *National Greenhouse Gas Inventory*. Retrieved from [National Greenhouse Gas Inventory](#)

must be addressed, and it's our communities who win if we get this right as a nation.

In 2021, Rewiring Australia's research highlighted that full residential electrification could save households tens of billions of dollars annually by the early 2030s¹⁰. Since 2021, a number of additional studies have confirmed these findings¹¹.

EV's have an important role to play

Electrification policy must include EV and transport policy to be effective. The replacement of ICEs with EVs accounts for a large portion of the emission reduction from electrification. Household solar will play a large role in decarbonising our vehicle fleet as it will be the cheapest charging option for vehicles. Home appliance electrification will both support and be accelerated by electric vehicle adoption. It is estimated that by around 2026, EVs will cost around the same as ICEs for most classes of light vehicles¹². For some homes today, EVs are already at parity if they drive more than 40km a day and are in the market for a new (not second-hand) car. This price parity could happen even sooner for many Australian homes, given increasing petrol costs and the fact that wholesale battery costs are falling faster than forecast.

Barriers to household electrification

Every household will have a different electrification journey, and some households will face more barriers than others. There are five key barriers to household electrification:

- **Upfront costs.** This is both a real and perceived barrier and will be felt most acutely by households on low, fixed or precarious incomes. For many households, they will be unable to access the capital or finance to upgrade from fossil fuel machines to electric ones. For others, they may be unwilling or unsure about investing money in upgrading their homes to be all-electric.
- **Ownership structures.** This is made up of three groups:
 - Private renters, who make up 31%¹³ of the housing market and don't have control over the decisions on fixed appliances within their home or how their home is powered;
 - Residents of social housing properties who are in a similar situation to renters; and
 - Strata properties which include apartments, townhouses and retirement villages where strata bodies may place restrictions on shared facilities including roof spaces and car parking.
- **Physical or logistical considerations.** These include both the actual building as well as their location. Apartments, particularly high-rise apartments, face additional barriers, including

¹⁰ Griffith, S., (2021). *Castle and Cars. Savings in the Suburbs through Electrifying Everything*. Rewiring Australia. Retrieved from [Castles and Cars Rewiring Australia Discussion Paper](#)

¹¹ Tidemann, C., Raynor, J., Cheung, H., (2022) *Switch and save: how gas is costing households, 2022*; Climate Council. Retrieved [Switch and save: how gas is costing households](#)

Wood, T., Reeve, A., Suckling, E., (2023). *Getting off gas: why, how and who should pay*. The Grattan Institute. Retrieved from [Getting off gas: why, how, and who should pay?](#)

¹² Bloomberg NEF (2021). Hitting the EV Inflection Point. Electric Vehicle Price Parity and Phasing Out Combustion Vehicle Sales in Europe. Bloomberg NEF. Retrieved from [Hitting the EV Inflection Point](#)

¹³ ABS (2022). *Housing Occupancy and Costs*. Australian Bureau of Statistics. Retrieved from [Housing Occupancy and Costs, 2019-20 financial year | Australian Bureau of Statistics](#)

around solar installation. Homes in regional and rural areas may face barriers to accessing timely installation of electric machines.

- **Regulatory.** The National Electricity Market (NEM) that serves the eastern states and Western Australia's Wholesale Electricity Market (WEM) were designed in the age of coal. Electricity and gas laws are out of date and are a barrier to household electrification and large-scale renewable energy.
- **Legal.** These vary across the country, however, within some state and local governments, planning laws inhibit the placement of rooftop solar, EV chargers and community batteries.

Many of these barriers overlap with each other; people living in social housing may also have fixed incomes, and people living in apartments are often also renters.

In seeking ways to address these barriers, Rewiring Australia is currently working with economists and actuaries at the Australian National University on designing policy options to deploy electrification at a large scale. The focus of this work is exploring how government-supported finance can be deployed to assist in removing some of the barriers associated with upfront costs and ownership structures.

In positioning Australia to benefit economically from the clean energy transition, the Australian Government will need coordinated policies across portfolios. Not least, rapid household electrification will require an expanded skilled workforce. Jobs & Skills Australia has estimated an additional 32,000 electricians are needed by the end of the decade¹⁴.

Positioning our manufacturing capacity and supply chain also needs consideration. If Australians are going to purchase millions of heat pumps, EVs or induction stoves and tens of millions of solar modules, we may want to establish trade agreements with China and other supplier countries.

Electrification investment in the United States

The US Inflation Reduction Act (IRA) of 2022¹⁵ has catalysed governments around the world to make significant investments in electrification. Of the IRA's initial investment outlay of US \$369 billion, 80% is focused on household electrification and increasing the supply of renewable energy. As the world's largest climate policy to date, the IRA will deliver extensive electrification benefits, including lowering household energy bills, creating jobs and reducing America's carbon emissions by approximately 42% below 2005 levels by 2030¹⁶.

At a household level, the IRA means the Australian government will subsidise every American home at likely an average of US \$14,000 to electrify and underwrite the provision of clean electricity to all of those homes. A breakdown of the IRA spending it outlined in Figure 2-2 demonstrating the sale of

¹⁴ Jobs and Skills Australia (2023) *The Clean Energy Generation. Workforce needs for a net zero economy. Clean Energy Capacity Study*, Australian Government, Retrieved from [The Clean Energy Generation | Jobs and Skills Australia](#)

¹⁵ Former Whitehouse Climate Advisor, Sonia Aggarwal, Electrification expert Dr Saul Griffith and Princeton's Net Zero lab director, Dr Jesse Jenkins share their first-hand insights into the design, passage and implementation of the IRA (2023). [Webinar: IRA Insights from three that were there](#)

¹⁶ Jenkins, J.D., Mayfield, E.N., Farbes, J., Jones, R., Patankar, N., Xu, Q., Schivley, G. (2022), "[Preliminary Report: The Climate and Energy Impacts of the Inflation Reduction Act of 2022](#)," REPEAT Project, Princeton, NJ. DOI: 10.5281/zenodo.6992940

investment in electrification. Government investment because of the IRA will also unlock substantial spending across the economy, as demonstrated in Figure 2-3. Australia can leverage America's IRA experience to further our own national electrification strategy. Using the IRA as a guide for bold, nation-building investment would see Australia invest \$35 to \$40bn over the next five years as shown in Table 2-2.

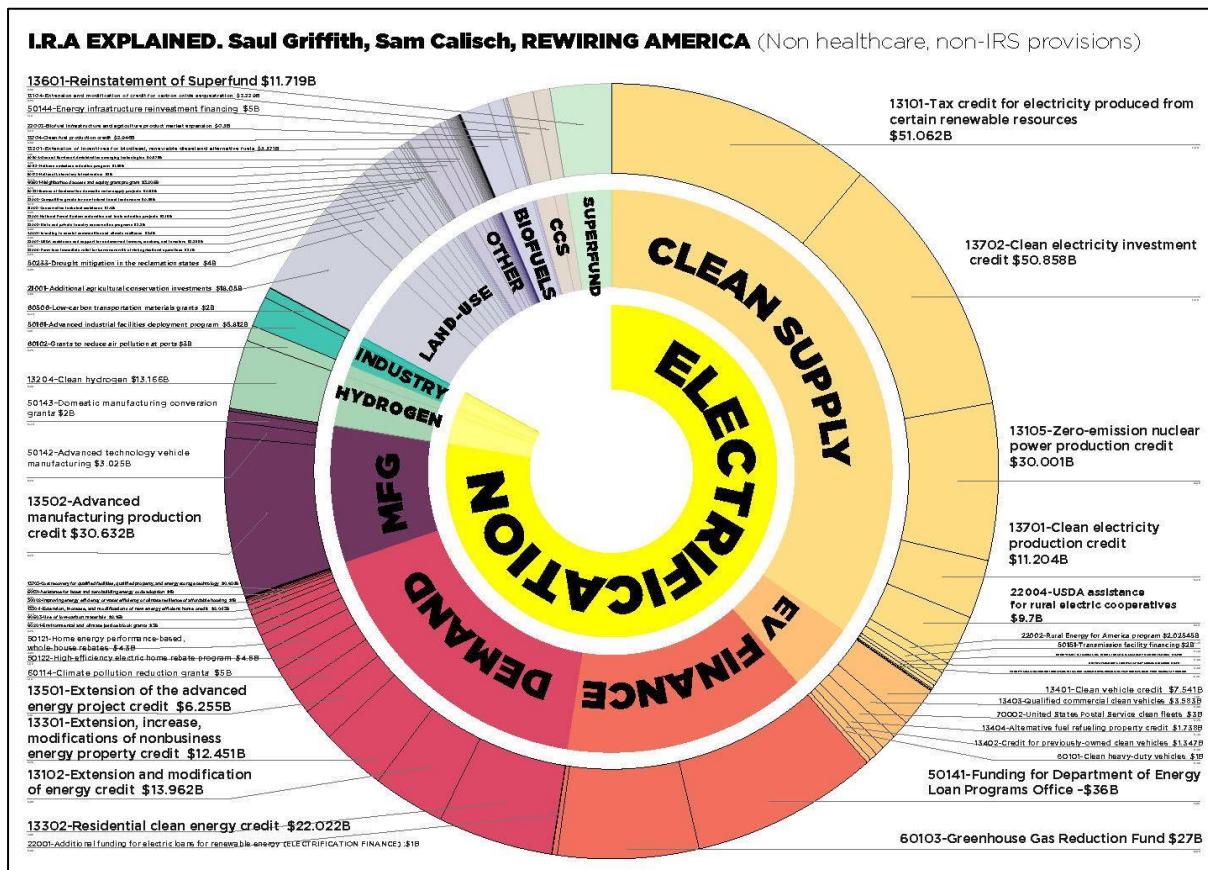


Figure 2-2 Breakdown of spending in the Inflation Reduction Act

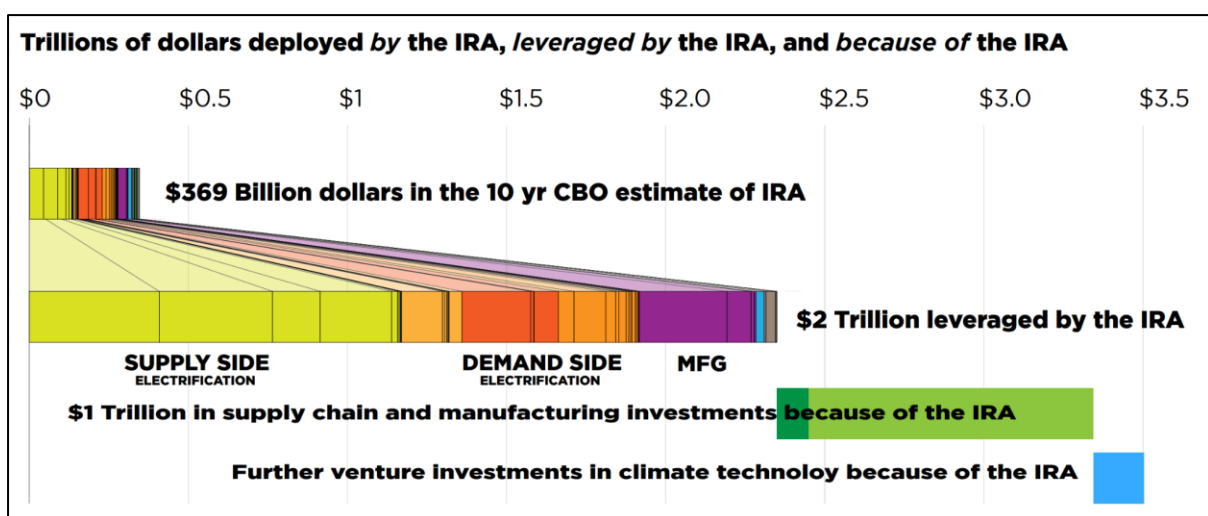


Figure 2-3 Investment deployed by the Inflation Reduction Act

Government investment initiatives	IRA equivalent spend A\$ billion
Clean energy production subsidies	18.6
Electric vehicle subsidies	2.1
Cost of electrification finance to government	3.7
Electrification subsidies for homes and businesses	9.3
Support for manufacturing to electrify processes	4.6
TOTAL	38.3

Table 2-2 An Australian equivalent IRA climate policy. Equivalency takes into account population size and foreign exchange rates

Setting electrification targets

National energy performance and electrification targets are required for all sectors as part of the economy-wide goal of reducing emissions in line with a 1.5-degree scenario. Such targets would take into account the specific barriers and opportunities faced by those energy consumers. These targets would flow from a top-down carbon budget for sectors designed around the proportional efficient abatement they can deliver on the timeline to meet the Paris Agreement commitments. Progress towards targets could be measured with mandatory self-reporting for large consumers through existing mechanisms such as the National Greenhouse and Energy Reporting (NGER).

Rewiring Australia's electrification modelling demonstrates that electrification can drive rapid emissions elimination that is economically viable. It is reasonable to set a target of net zero emissions within ten years across from the household sector, commercial buildings with similar demand profiles (space heating and cooling, hot water heating, lighting) and light vehicles. Hitting a radical ten-year target would have significant anti-inflationary benefits. It would also have positive impacts on the electricity sector.

3. Benefits of household electrification

Electrification offers economic benefits to householders, reduces the cost of energy and accelerates the clean energy transition. This acceleration of emissions reduction is critical because climate action has not kept pace with the Paris Agreement goal of keeping within a carbon budget that would deliver no more than 1.5 degrees of global heating.

Every household that electrifies its energy use cuts the cost of energy immediately. The combination of consumer and environmental benefits makes electrification popular with Australian communities and increases the social licence of climate action.

Electrifying households heating, cooking and transport

Household electrification refers to the substitution of machines powered by fossil gas and petroleum with electric ones and the addition, where possible, of rooftop solar and the installation of batteries. Gas water heaters are replaced by electric hot water heaters, gas space heaters are replaced with heat pumps (which are commonly called 'split systems'), and gas stoves and ovens are replaced with electric cooktops and electric ovens. Figure 3-1 and Figure 3-2, below depicts a house before and after electrification. Critically, electrification includes replacing an internal combustion engine (ICE) vehicle with an electric vehicle (EV). These batteries on wheels will become critical to the storage required by renewable energy.

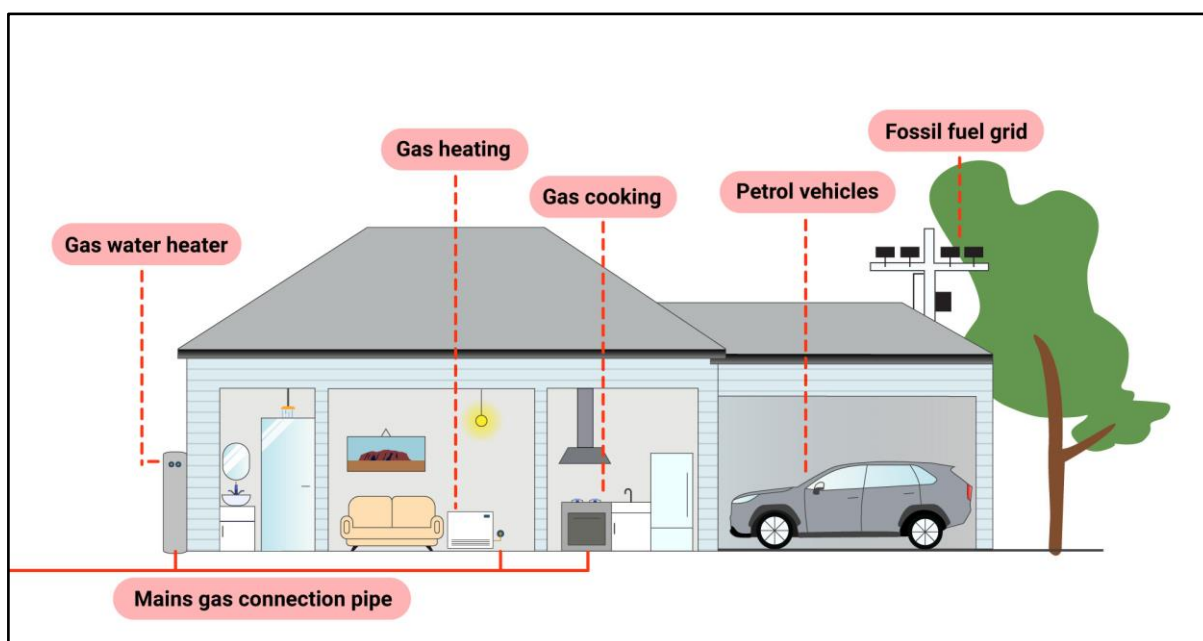


Figure 3-1 Non-electrified home example

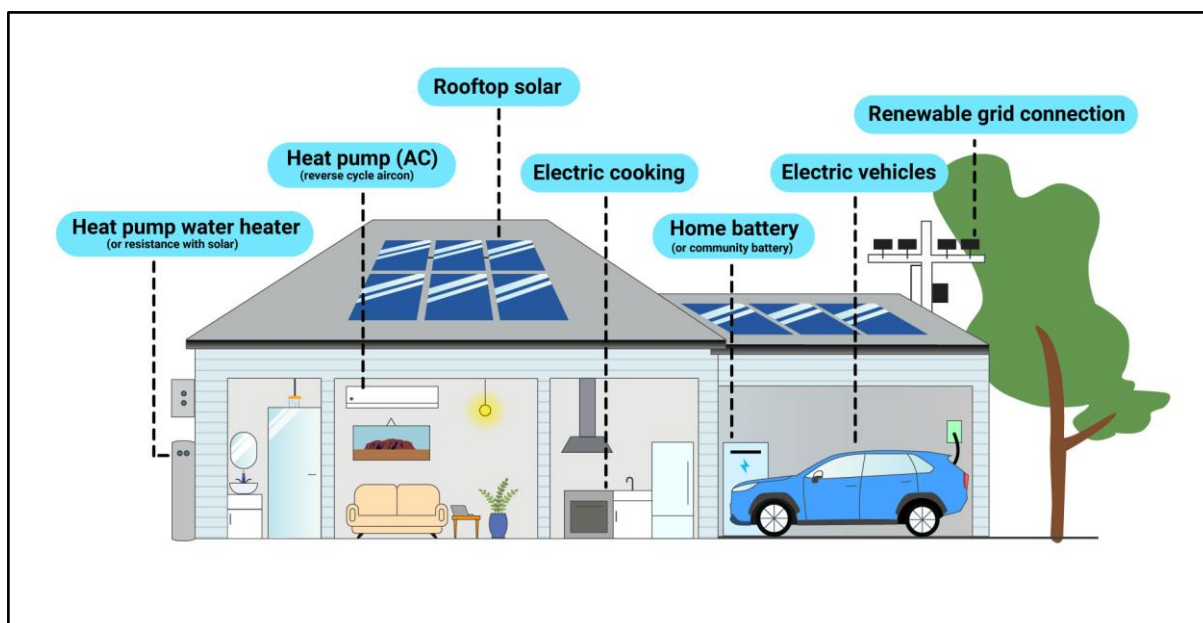


Figure 3-2 Electrified home example

Most of the benefits of electrification are due to the combination of rooftop solar generation and replacing a petrol or diesel car with an electric vehicle. Australia's rooftop solar electricity is the world's cheapest delivered energy, at approximately 5 cents per kWh financed.¹⁷ By about 2030, the annual benefits of electrification to an average Australian household are in the realm of \$4,000 - \$5,000 per year. Approximately two-thirds of those savings are due to replacing the 1.8 ICE vehicles in driveways with electric vehicles.

Electrification is anti-inflationary

Rewiring Australia's modelling has demonstrated that the economic opportunities of household electrification are significant¹⁸. Electrification powered by rooftop solar and supported by batteries is anti-inflationary.

Figure 3-3 captures the trajectory of household spending on energy by comparing households drawing on fossil fuels and the grid with fully electric homes powered by solar, batteries and the grid. This chart tells a story of possibility, especially during a cost-of-living crisis such as Australians are experiencing in 2022 and 2023. The black line tracing upwards from 1990 is the total cost of energy for an average Australian household. This is the total sum of money spent on petrol, diesel, LPG, electricity and natural gas in the course of a year. It travels upwards and to the right, increasing year on year at roughly the rate of inflation. This is what we call "fossil-flation."

¹⁷ Griffith, S., (2021) *Castles and Cars. Savings in the Suburbs through Electrifying Everything*. Rewiring Australia. Retrieved from [Castles and Cars Rewiring Australia Discussion Paper](#)

¹⁸ Griffith, S., (2021) *Castles and Cars. Savings in the Suburbs through Electrifying Everything*. Rewiring Australia. Retrieved from [Castles and Cars Rewiring Australia Discussion Paper](#)

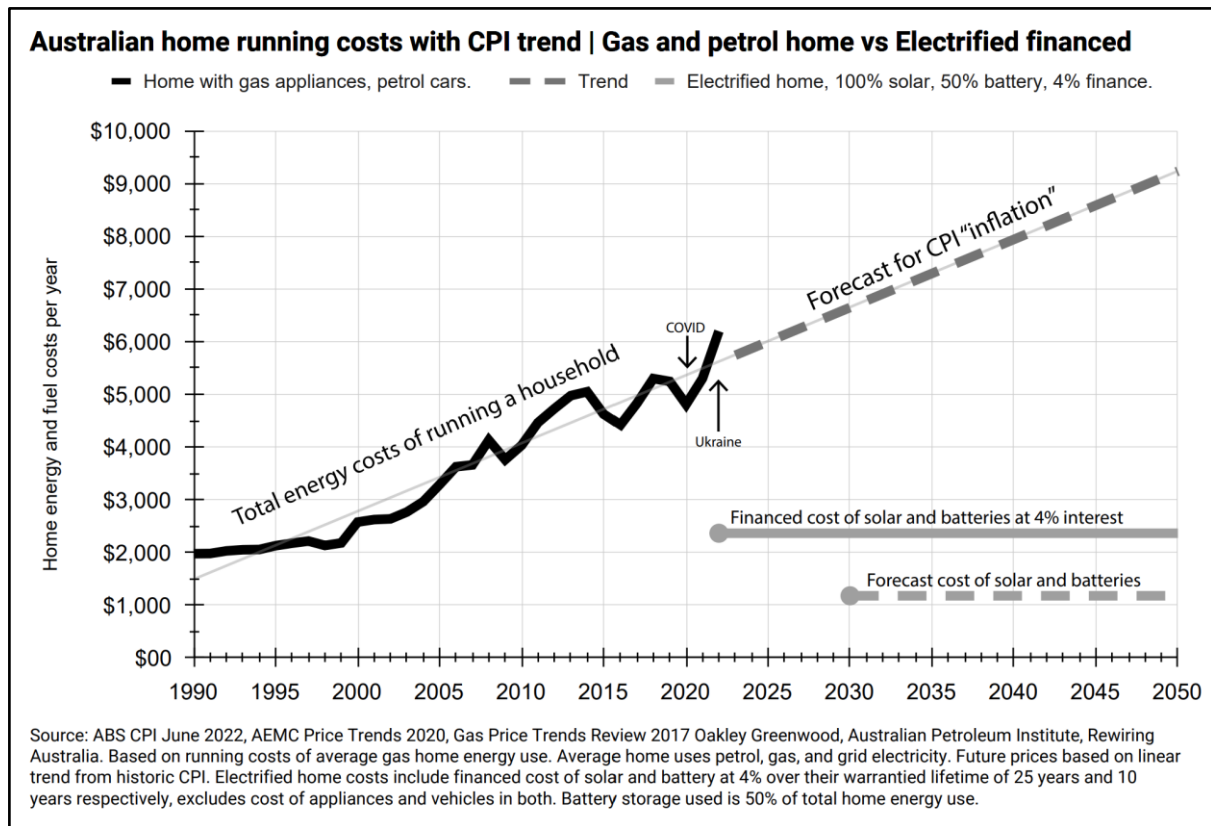


Figure 3-3 trajectory of household spending on energy

It is unsurprising that the cost of fossil fuel powered energy is increasing. The marginal cost of extracting fossil fuels is increasing over time as the resources become scarcer and at lower concentration and quality. From around \$2,000 a year in 1990, it is now up to \$5,000 to \$6,000 a year. The cost of energy is not just inflationary, but it's also volatile and sensitive to international and geo-political change. Supply chain disruption, COVID-19 and the war in Ukraine among other things in the last several years have seen the cost of energy tipping to \$7,000 a year in 2022/23. Based on the trend of the last thirty years, by 2050 homes are forecast to be paying over \$9,500 a year in energy bills (dotted line).

The horizontal lines depict the total cost of financing the solar and batteries required to replace those fossil fuels, with the home using all electric appliances and vehicles. The cost of energy in this scenario is shielded from the impact of inflation and remains steady as it draws on the energy generated and stored at the home with limited reliance on the grid. The installation of electric appliances and use of electric vehicles means there is no reliance on petrol, diesel or gas. The capital cost of purchasing solar and a battery are taken into account in this scenario and are financed over their lifetime at 4% interest. With the cost of solar and battery technology falling, the forecast for 2030 is even lower.

Electrification lowers household energy bills

Every household will have a different pathway for becoming all-electric. Almost all Australian homes already have some combination of electric machines, and 3.5 million have solar on the roof. For some homes, they will replace fossil fuel machines at the end of the machine's life with an electric version. Some people may fully electrify after the purchase of a home or during a renovation. Other

homes, particularly where gas is less available, are already mostly electric except for their car.

Economics will be the primary determinant of the pace of household electrification. Some high-income households are fully electrifying their lives because they wish to reduce their emissions. However, for most households, while climate and health concerns will encourage electrification, the decisions to switch to solar, EVs, and electric machines will be determined by a combination of finance and personal circumstances.

The economics of electrification will also vary for every household depending on various factors. These factors include the number of people and floor size of the home, geographic location (solar potential, requirement for heating/cooling), efficiency of all appliances in the home, current energy use and lifestyles. Despite these variations, looking at the average home and average appliance use, the economic savings of electrification, when paired with rooftop solar, are compelling and broadly applicable.

Electric machines are more energy efficient

The thermodynamic efficiency advantage of electric machines is clear. Electric heat pump space heaters and water heaters are both 3-4 times more efficient than gas water heaters. Electric vehicles are about 3 times more efficient at converting energy into motion. Induction stoves are 2-3 times more efficient than gas stoves.¹⁹ This efficiency advantage becomes even more beneficial when Australia's world-leading rooftop solar is considered. Combining the lowest cost delivered energy on earth with the most efficient electric machines to provide the lowest cost energy bills.

Vehicles

Due to the technology of internal combustion engines, the majority of energy contained in petrol or diesel is lost as heat or vibration. The efficiency of ICE vehicles is only in the range of 12% to 30% of the energy able to be converted into motion. This compares to electric motors which have an efficiency in the range of 77% of electrical energy converted into motion.²⁰

This significant efficiency win transforms into a significant cost of living win, and when combined with rooftop solar, the cost of living benefits increase further. Filling the "tank" of an average car of about 50 litres to drive 500km, costs about \$100 with today's petrol costs of about \$2 per litre. In comparison, charging an electric car to drive the equivalent kilometres is about \$43 with grid prices at 29 cents / kWh (see Figure 3-4). With rooftop solar, filling the "tank" of an electric vehicle can be as low as about \$5²¹.

While electric vehicles are about 3.5 times as efficient as gasoline vehicles at performing the same task, substantial amounts of additional electricity will need to be found as the national fleet becomes electrified. The anticipated future energy needs for EVs will be tempered by increased energy conversion efficiency.

¹⁹ Griffith, S., (2021) *Castles and Cars. Savings in the Suburbs through Electrifying Everything. Technical Study*. Rewiring Australia. Retrieved from [Rewiring Australia Castles and Cars Technical Study October 2021](#)

²⁰ Official US Govt source of fuel economy information. US Dept of Energy. Retrieved from [fueleconomy.gov](#)

²¹ Solar and petrol prices sourced October 2023, grid prices are taken from 2022 data.

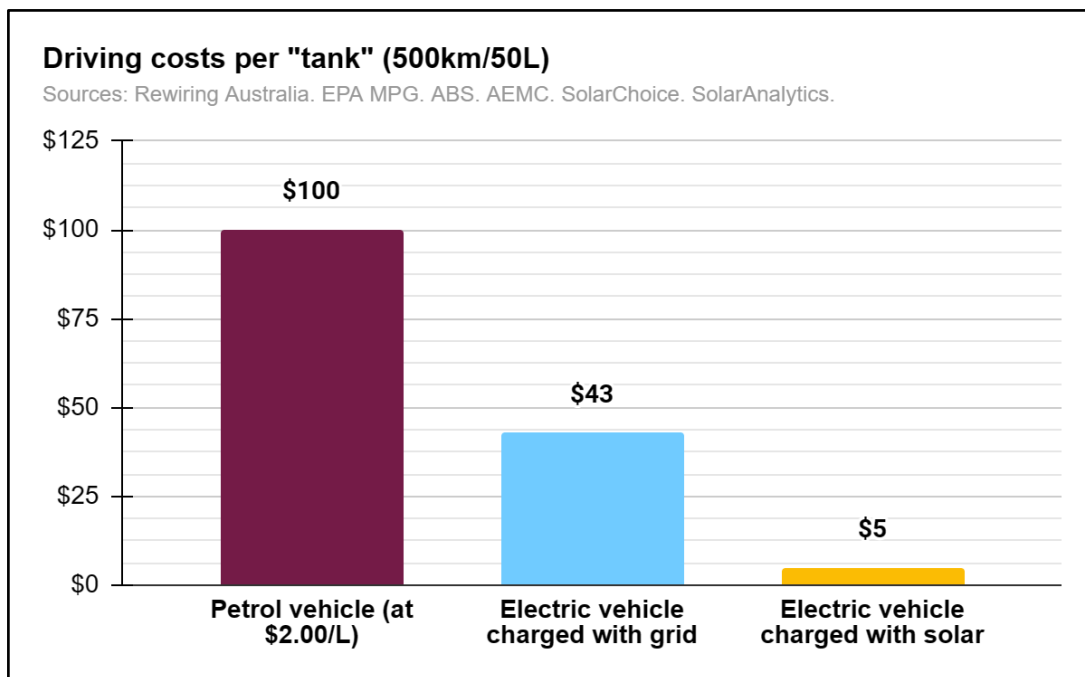


Figure 3-4 Driving costs per tank

Space heating

Energy used for space heating varies across Australia's vast landscape, from being near zero in the Northern Territory to being the most dominant energy-using appliance in southern states (refer to Figure 3-5). On average, a heat pump (mini-split or reverse cycle air conditioner) is 3-4 times more efficient than heating with natural gas or LPG. For the average Australian home, heat pumps cost about half the price of heating with natural gas and about a third of that of heating with LPG.

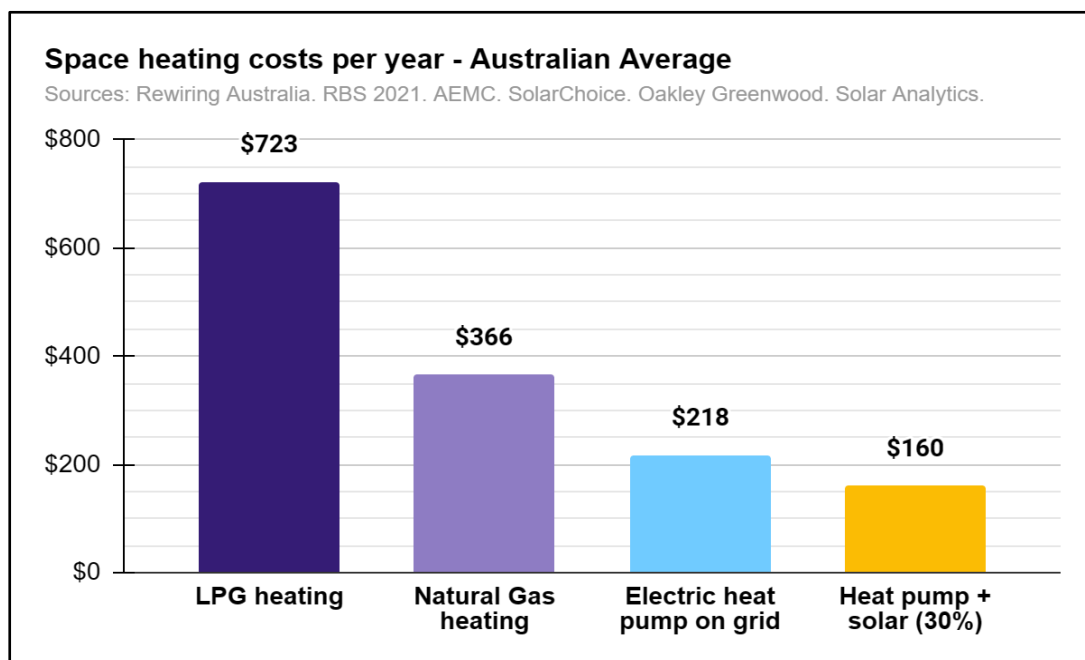


Figure 3-5 Space heating costs per year – Australian average

Water heating

Water heating costs almost as much as space heating in many Australian homes as it is typically the second largest energy-using appliance. In warmer climates, it can be the most significant energy cost. Heat pump hot water heaters, an Australian invention are the most energy efficient water heater. Combining the efficiency gains of heat pump water heating with solar lowers costs even further.

A solar-powered heat pump water can provide hot water services at 20% of the cost of natural gas or 10% of the cost of LPG water heating.

Cost savings can be further optimised by using a heat pump as a “thermal battery”, that is, water is heated when solar power is plentiful and low cost. The heat pump then draws on the thermal store of hot water at night. This translates to a considerable cost-of-living saving and an opportunity to reduce energy demand on the electricity grid, as shown in Figure 3-6.

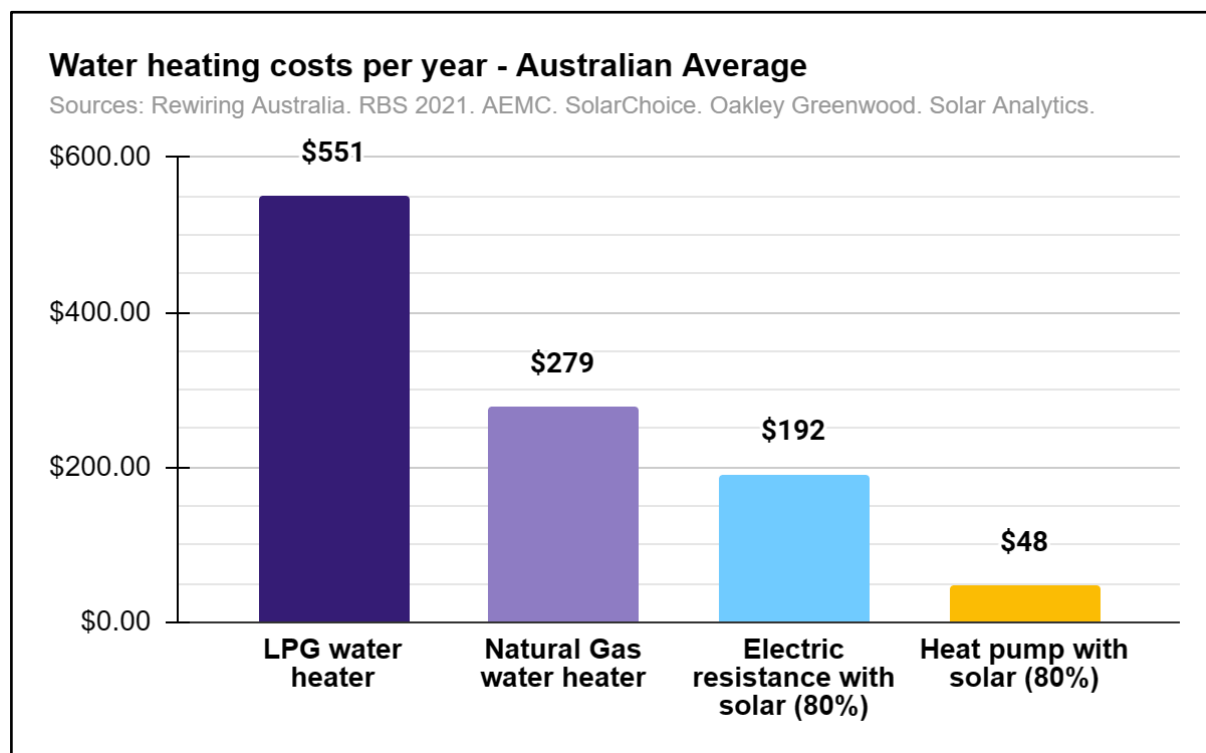


Figure 3-6 Water heating costs per year – Australian average

Cooking

Electric cooktops (induction or resistance/ceramic) are approximately twice as efficient as gas cooktops at turning energy into cooking heat. Cooking with electric induction is the lowest-cost option, as shown in Figure 3-7. In addition to the efficiency and cost benefits, electric induction cooking avoids negative health risks associated with burning natural gas in homes.

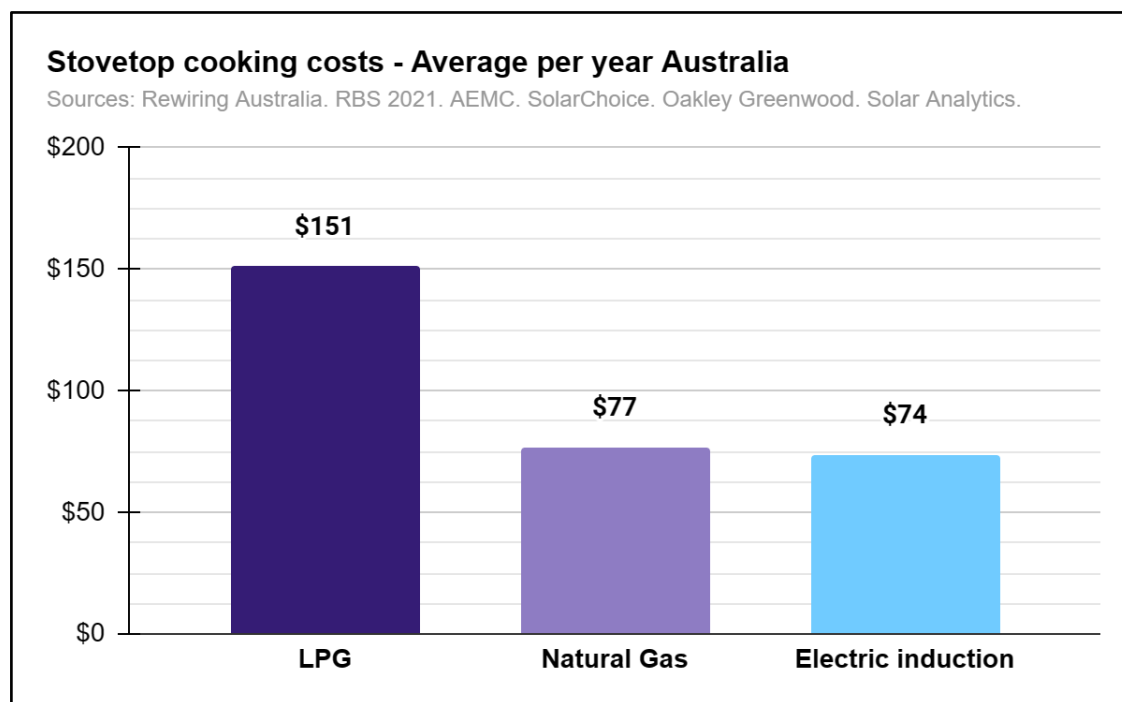


Figure 3-7 Stovetop cooking costs per year – Australian average

Rooftop solar and batteries

Maximising rooftop solar potential in communities is the lowest-cost energy source. Australia's success in rooftop solar has been recognised worldwide, and we have been rewarded with the cheapest delivered energy in the world.

Figure 3-8 compares average electricity costs between the grid, solar, and battery installations. The cost of distribution (poles and wires) alone is three times that of solar. While seasonal variations and fluctuating wholesale prices will influence the cost of grid electricity, even if households did not have to pay the wholesale energy price, grid electricity would still arrive at Australian homes at a higher cost than solar.

Batteries have just passed the cost tipping point for Australian homes, and the prices of both batteries and solar are predicted to continue dropping. Further to this, the availability of batteries to homes will only grow when they have two EVs parked in their garage.

Notably, households should not disconnect from the grid. Managing the inherently variable nature of renewable energy means these homes will have lower-cost energy if they are grid-connected. The strength of the grid will also be crucial throughout the energy transition.

Transitioning to a zero-emission energy system requires about 2-3 times more energy to be delivered

to households, including their electric vehicles. Rooftop PV is the lowest-cost option for most of that energy. It will need to be supported by storage and grid-scale renewables that counter-correlate with our communities' natural solar windows. Further, it will need to be smartly integrated into networks of homes that can shift their energy demand.

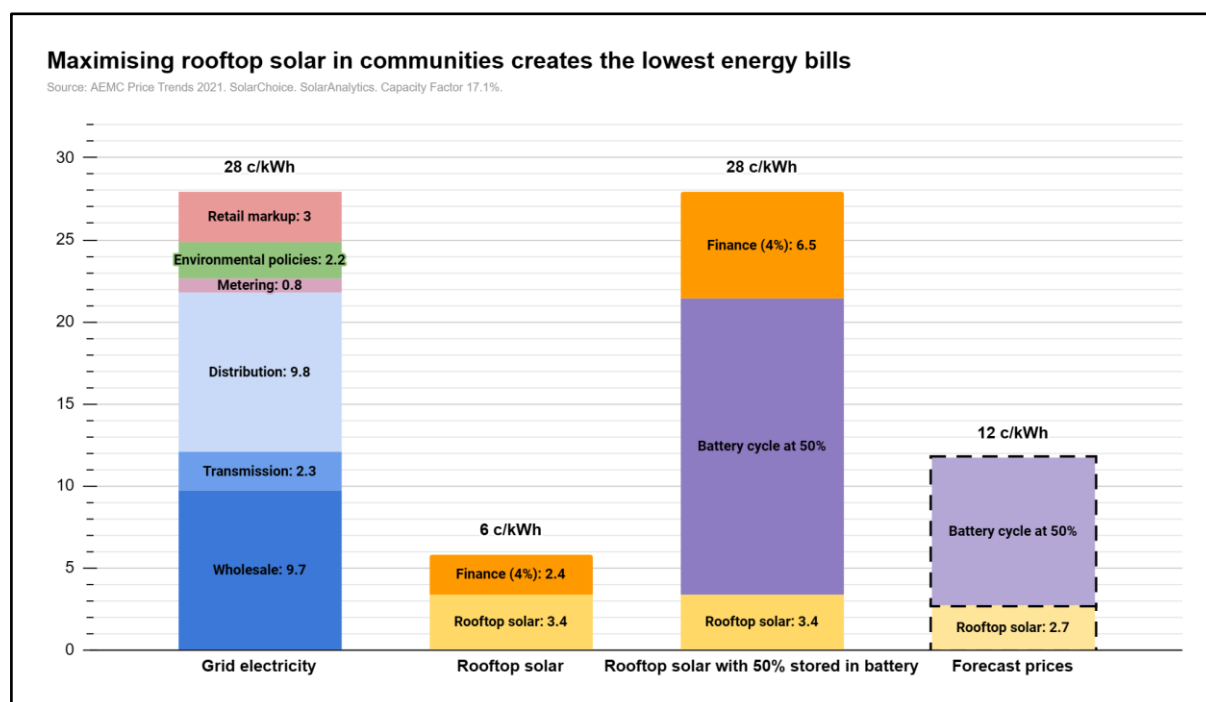


Figure 3-8 Average electricity costs between the grid, solar, and battery installations comparison

Electrification generates community economic benefits

In the community

Many of the economic and other benefits of household electrification will sit at the level of local communities. Once local communities are fully electrified, they will be generating a large amount of their own electricity. Much of this electricity will be stored in EVs and community batteries. With the right structures and incentives, this electrification will then be shared efficiently. In the ideal scenario, distribution network tariffs will have been reformed to reflect the costs and benefits of this community-level energy fairly which will maximise the economic benefits of household electrification.

Electrification will replace the centralised electricity system based around coal with a decentralised system, where consumers become generators and traders of energy. This transition will still require large-scale transmission, interconnection, generation and storage assets, but policy will address this “supply side” of the system and also the “demand side” (or electrification).

To meet our demand-side electricity generation (plus storage potential), a reorganisation of the electricity system and market is required. The critical organising unit for electricity transition, climate policy and economic renewal requires a refocus on the thousands of homes connected as a community and within a substation catchment. As a result, community-based electricity and transport policy will maximise investment efficiency in the energy transition and the allocative

efficiency by which we utilise energy assets (transmission, distribution, generation, storage and consumer energy resources).

A further localised economic benefit is the reinvestment of household savings within the community. The majority of current fossil fuel spending goes towards petrol, an imported fuel with most profits being offshored. Less money spent on imported fuel, provides an opportunity for more money to be spend within local communities.

We can predict with confidence that rapid electrification will lead to job opportunities in local communities around the country because that is where the work will be. These are jobs that can not be sent overseas. Beyond just the home, our growing renewable energy system will also require engineers, energy experts and more electricians to build generation, transmission and distribution infrastructure to support electrification

For Australia

The extensive benefits of electrification accrue beyond households and the environment to include wide-ranging benefits to the economy. These economic benefits relate to employment, domestic capacity, international trade and the domestic energy sector.

An ambitious national policy to enable the electrification of millions of households would obviously have macroeconomic impacts, including tens of thousands of new jobs. Combined with manufacturing policies, it may stimulate industry – such as heat pump hot water systems, cooktops and solar PV – which would reduce Australia’s reliance on imports.

A transition from imported petroleum would also improve Australia’s energy security and balance of payments. Decoupling our economy from the geopolitical volatility around the petrostates may benefit our foreign policy. It should be possible to eliminate fossil gas in households and vastly reduce petroleum consumption in vehicles within a decade. This shift would have significant health and local environmental benefits for the Australian community.

Nation-building infrastructure

If household electrification is to reach its potential as a supply of energy and a source of emissions reduction, understanding it as a new form of nation-building infrastructure is critical. This will require a shift in government thinking around infrastructure and the private sector’s thinking around finance.

In early 2023, Australian Treasurer Jim Chalmers published an essay outlining a new economic vision where government and private capital are mobilised jointly. He put the energy transition at the front and centre of this new, national economic policy approach. He said that governments should actively shape the economy to increase resilience, equity, the quality of life and the health of the environment.²²

Household electrification is a prime candidate for this new paradigm of public-private ownership and

²² Chalmers (2023) *Capitalism after the crises*. BlackInc. Retrieved from [The Monthly](#)

takes the concept one step further. The finance of hundreds of billions of dollars of assets operated in households – including their EVs – could involve the government, millions of households and private equity and debt providers.

In the 2020s and 2030s, the Australian government should invest tens of billions of dollars in household electrification infrastructure. Some of this will be on-budget expenditure to guide and deliver the electrification transition. Most of this will be off-budget debt that is then loaned out to accelerate electrification and ensure it is economically progressive, not regressive. Low and middle-income households and renters – including welfare recipients – all deserve support to enjoy the economic and health benefits of quitting fossil fuels. In this submissions, we outline finance models to support broad, rapid and equitable household electrification.

Government investment in household electrification will leverage considerable private investment. In the United States, the Inflation Reduction Act (IRA) was focused on leveraging private capital in order to accelerate electrification. This was achieved through tax incentives and direct rebates for producing clean energy and purchasing electric machines. Modelling from Rewiring America estimates US\$100 billion in government spending will translate to households collectively spending up to US\$858 billion. A key policy outcome of the IRA is the spending of money because of the IRA, not just spending by the IRA.

Electrification eliminates emissions

Household electrification can reduce up to 40% of our domestic emissions.

Sector coupling and decarbonisation

The widely accepted categorisation of emissions doesn't show the full picture. The prevailing nomenclature uses categories from the US's response to the 1970s oil crisis, where existing economic sector definitions were used to map energy flows²³.

Traditionally, energy sectors were broken into artificial economic sectors. These sectors are:

- Residential. Homes and home heating, cooling, and electrical systems.
- Commercial. Non-residential built environment including retail, education, healthcare and non-profit sector including schools and clubs.
- Transportation. Public transport, freight, as well as household cars and small business vehicles.
- Industrial. Mining, manufacturing, and agriculture.
- Electrical sector. This was added in the wake of the 1970s energy crisis in the US and further complicating our understanding of how energy flows in an economy.

This categorisation approach has constrained our understanding and thinking about transforming our energy economy and therefore, emissions. The energy use and emissions across these sectors are intrinsically linked, especially with electrification, and mapping the actual decarbonisation

²³ US Congress. Joint Committee on Atomic Energy. (1973). *Understanding the national energy dilemma*. Retrieved from [Google Books](#)

decision points provides a clearer view of emissions reduction opportunities. This is best outlined in the examples below.

Example one: Gas heating in homes

Emissions generated by a single gas heater include:

- the distribution pipeline emissions required to get that gas to the home,
- the fugitive emissions in extracting that natural gas that is burnt in the home
- the diesel truck transport emissions used to deliver either large gas amounts or many LPG bottles
- the emissions from the heater when in use

All of these emissions are eliminated if we electrify that one household machine and power it with renewable energy. Currently, these four sets of emissions are all accounted for under different sectors, and all looked at as separate problems to solve rather than one.

Example two: transport emissions, grid reliability and security

In the national carbon accounts, transport sector energy emissions are categorised separately from residential emissions. However, as the EV fleet is electrified, the emissions are categorised as residential emissions.

In the electrified scenario, EVs are charged from additional rooftop solar at the community level, which is colocated where the EVs are parked at home, work, or public spaces like shopping centres and integrated into the grid.

Grid integration is defined as the EV charging infrastructure being demand flexibility trading ready through V2G technology, supportive tariffs and price signals. In that case, the negative impacts on the electricity grid will be minimised and the benefits maximised.

Not only is it possible to eliminate emissions from the transport sector, but EVs have an important role in improving the reliability and security of the electrical grid. EVs can be used as a power source, providing generation and electrical services to the grid when required, including in an emergency. The latest EV models are being manufactured with vehicle-to-grid (V2G) capacity and can power three times the demand of average households.

Analysis conducted by Rewiring Australia has represented Australia's domestic emissions data in a way that enables us to think about domestic economy decarbonization separately from export economy decarbonisation (Figure 3-9 refers).

We separate out 2 categories, (1) the domestic emissions that support our domestic economy from (2) the trade emissions that count on Australia's emissions budget but are in fact emissions that are associated with creating our exports.

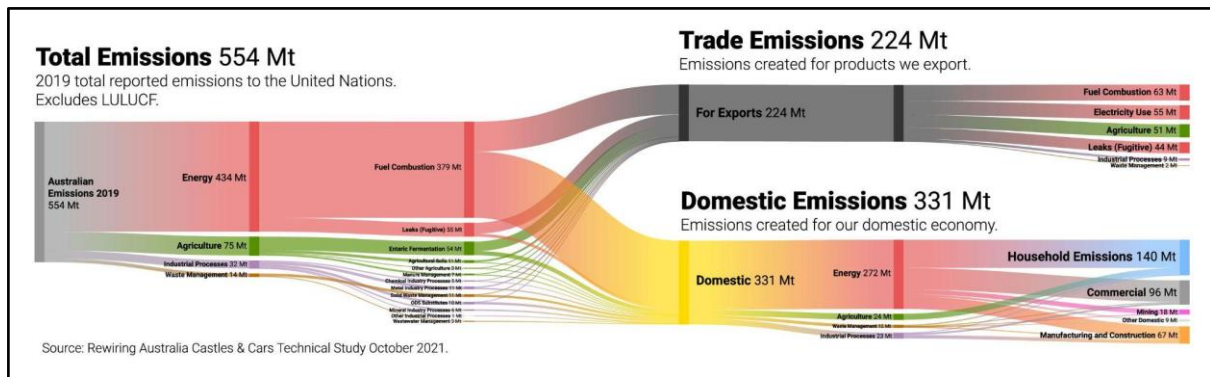


Figure 3-9 Emission flows in the Australian economy

This categorisation quickly demonstrates that our household decisions are responsible for a significant amount of our emissions reduction opportunity. Decisions made around the dinner table impact about 42% of Australia's domestic emissions (Figure 3-10). Simultaneously because of technology cost curves, these are the lowest cost emissions reductions available today. They are the spearhead of our climate response, and Australia can and should move faster to give time for the harder-to-mitigate areas.

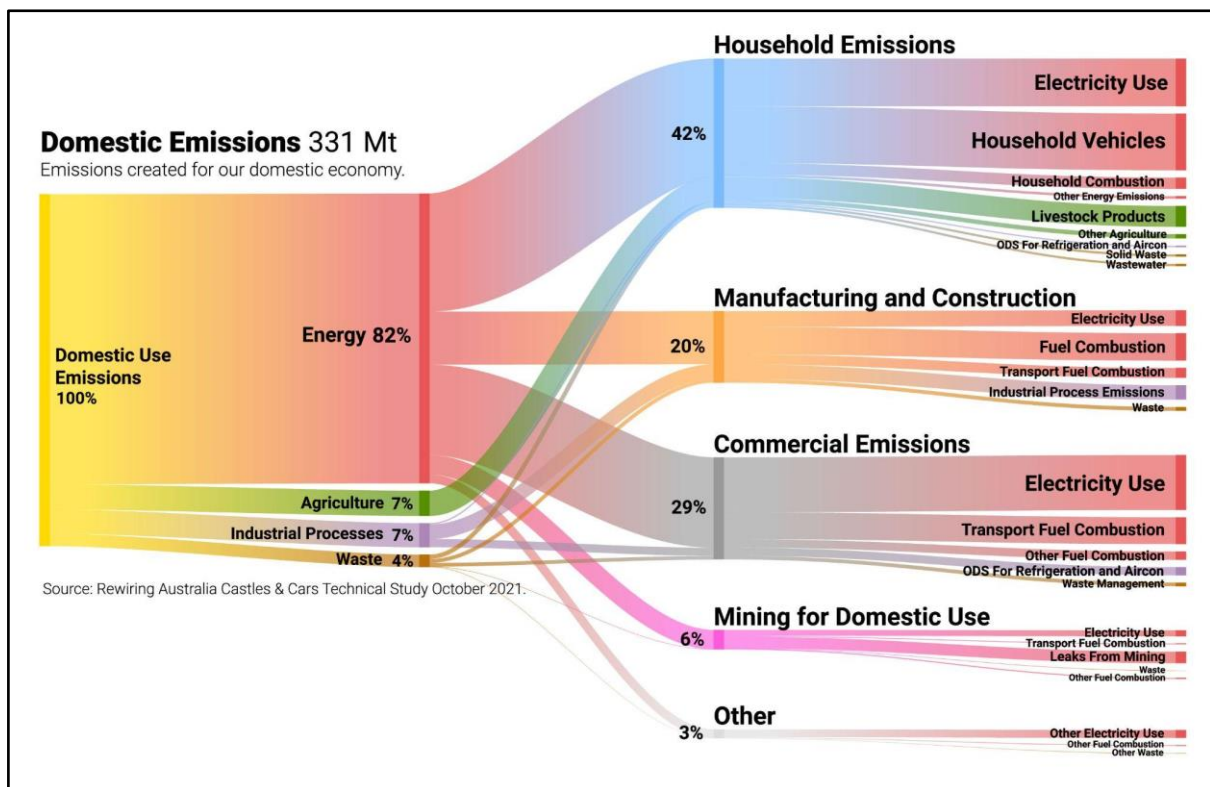


Figure 3-10 Domestic emission flows in the Australian economy

Commercial emissions refer to Australian businesses and contribute about 29% of domestic emissions. These emissions are largely derived from similar decisions to households; decisions about what appliances are used in those businesses, where their electricity and heat comes from, and the vehicles and transport used (refer to Figure 3-11).

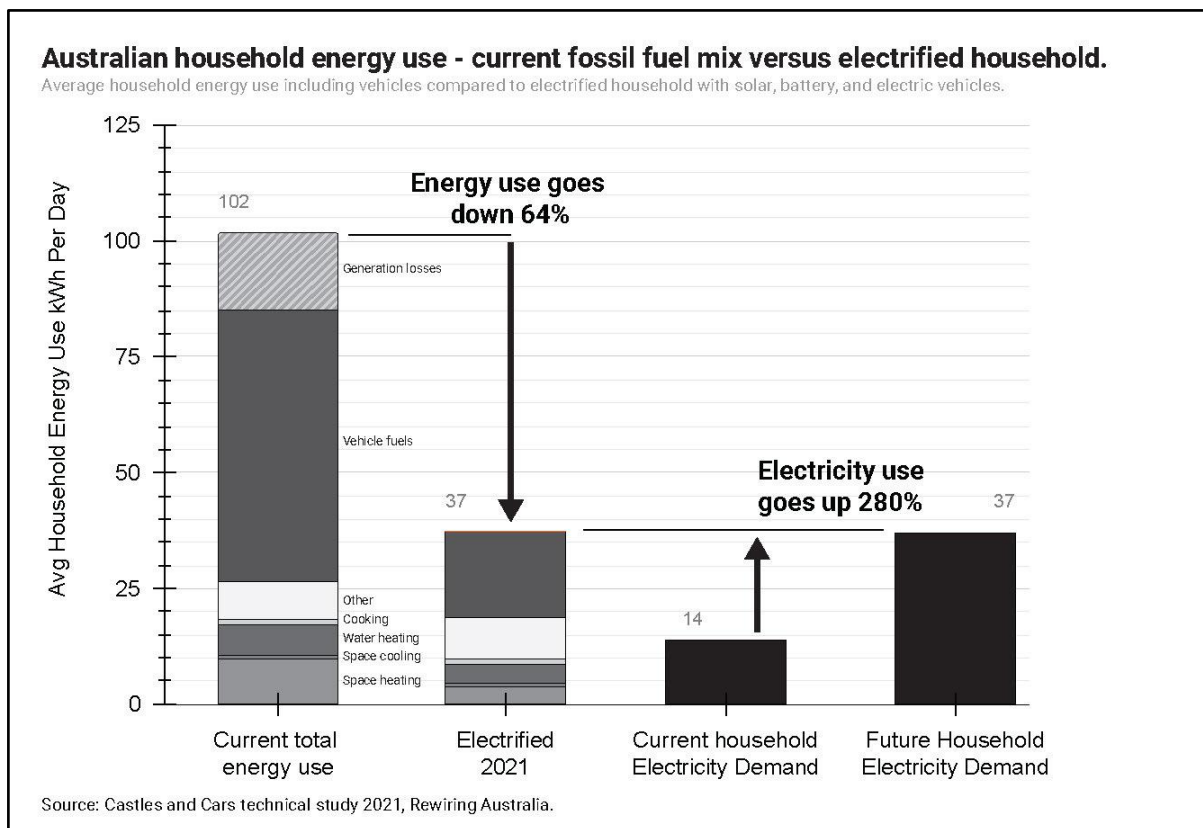


Figure 3-11 Average Australian household energy use before and after electrification

Electrification generates dividends at scale

Battery and electric vehicle storage optimisation

As the passenger vehicle fleet moves towards fully electric vehicles, their combined storage capacity will be about five times the storage capacity of Snowy Hydro 2.0. As battery technology approaches a tipping point, where the levelised cost of electricity (LCOE) as a battery cost per cycle is lower than peak feed-in tariffs, the large amount of storage that will come into the system at near-zero cost through vehicle-to-grid (V2G) needs to be considered. EVs that are technology-enabled as V2G have the potential to participate in the energy system more cheaply than to build other storage.

Community generation

Recent Rewiring Australia research (yet to be published) suggests our community car parks and train lines could provide another 7kW of solar generation per home in the community. This is roughly double the solar potential we currently see on household rooftops and will go a substantial way in meeting growing demand needs. The generation of solar throughout the community would allow the delivery of lower-cost solar as it is generated under the substation level and avoid the costs (and loss of efficiency) of long-distance transmission. Maximising the generation of solar on community assets and transit corridors will likely be the second lowest-cost energy source after behind-the-meter solar (household rooftop), especially if operating in a tariff environment that is more reflective of network capacity (e.g. solar soaker tariffs).

Businesses sit in a similar scenario to renters, where solar makes complete financial sense but is yet to be adequately supported by the business models and products that can deliver on the non-permanent residencies they both have. Increasing small business rooftop PV generation with emerging business models will even further expand this generation potential.

Electrification and dominance of the demand-side

The previous sections discuss the measurable cost differences of the electrification option compared to business as usual. Implementing government policies that address the barriers to electrification will lead to energy users rationally maximising their solar deployment over time to save money.

Australia could continue at the current rate of rooftop solar adoption of 30% until the market is saturated. Demand-side saturation of solar and electric machines, as orchestrated as flexible demand, is the cost-effective pathway to a zero-emissions energy system.

4. Addressing barriers to electrification at the household level

Mass electrification requires millions of homeowners, landlords and owners' corporations to make an investment decision to replace fossil fuel machines with electric versions. Every household will have a different electrification journey and it will be easier for some homes to afford than others.

The Government must coordinate household electrification using the full set of policy levers, from reforms of the energy market to support for training electricians. In addition, it has the largest role to play in incentivising and enabling owner-occupiers, tenants and landlords to grab the opportunity of household electrification through policy that can influence millions of investment decisions made over the next two decades. It will require significant government financial support targeted to low-income households and a range of regulatory measures to nudge households across all income deciles to make clean energy choices.

There are a range of barriers to household electrification, and it is likely many households will face multiple barriers (ie. being both a renter and apartment dweller) which should be taken into account in policy design.

Make finance accessible for all homes

Recommendations:

1. Issue a new Clean Energy Finance Corporation Investment Mandate Direction to enable the HEUF to reach lower income households.
2. Deploy some HEUF loans via pilots of innovative funding models including on-bill financing and income contingent loans and use this to design options for a large-scale finance package to significantly accelerate electrification over 10 years, particularly among low and medium income households.

Well-designed finance is critical to helping Australians access the cost savings offered by household electrification. The Grattan Institute has analysed wealth and income barriers to electrification and proposes that these are material for around 20% of Australian owner-occupier households²⁴ who have either low savings or low incomes. The upfront and perceived cost of electrification is also a barrier for the remaining 80% of homeowners, landlords and owners corporations even if they have savings and higher incomes. Over the next several years, declining technology costs and the development of the electrification market will gradually make the transition accessible for more households. However, both the urgency of climate action and the potential spiralling costs for remaining gas network customers means that policy should be established now that clears the way for electrification for households at all income levels.

The use of finance to help bridge the gap between higher capital costs and lower operating costs of electrification has been recognised by State and Federal governments as a key tool in driving electrification. To date, these policy interventions have focussed on providing low-interest rates as an incentive to electrify and improve efficiency. However, this does not necessarily remove the

²⁴ Wood, T., Reeve, A., Suckling, E., (2023). *Getting off gas: why, how and who should pay*. The Grattan Institute. Retrieved from [Grattan Institute](#)

substantial barriers faced by households on low, fixed and precarious incomes who may not be eligible for finance or who may not be able to afford long-term repayments. In this section, we recommend the development of policies that more creatively deploy finance with the aim of making it more accessible.

Home Energy Upgrade Fund

The 2023-24 Federal Budget included a \$1 billion reallocation to the Clean Energy Finance Corporation (CEFC) to create a Households Energy Upgrade Fund (HEUF), drawing funds from the Rewiring the Nation fund. The purpose of the fund is to deliver on an agreement reached between the Government and cross bench parties on 14 December 2022, for a Household and Business Electrification Package. This package planned to “focus on households that most need support, such as low-income households, renters, public and community housing residents and apartment dwellers”.²⁵

In August 2023 the Minister for Finance and Minister for Climate Change and Energy issued an Investment Mandate (IM) for the CEFC that defined the terms of the HEUF finance: 5-year Australian Government bond rate +0.5 per cent before overheads and concessions, repayment within 10 years, risk undefined but higher than for General Portfolio, no guarantees. The fund is available for homes with a value up to \$2.5 million. The median house price is around \$912,000²⁶ so it is questionable whether the current HEUF package is appropriately designed.

Rewiring Australia applauds this significant investment in electrification, but believes that the design of the HEUF program could be improved to target low and medium income households and this would require a new CEFC IM.

If the HEUF was expanded to become the primary vehicle for financing household electrification, the fund would need to target a broader range of homes and offer more innovative and compelling products to drive electrification (eg the ACT Sustainable Household Scheme 0% loans).

Income contingent loans

Conventional loans, with low or no-interest won't necessarily be attractive or accessible to all homes, particularly those on low, fixed or precarious incomes. In order to address this gap, Rewiring Australia has been working with the Australian National University to explore the application of income contingent loans (ICLs) to electrification.

Under this policy option, government-supported household electrification loans would be repaid by income tax withholding with repayments required only after a certain income threshold has been met, with the loans secured against the upgraded property. By requiring the upgraded home as security, the loan can be repaid out of settlement funds on the transfer of title, minimising unpaid debts while ensuring access for all homeowners in Australia.

²⁵ Australian Government (2022) *Household and Business Electrification Package (14 December)*

²⁶ ABS (2023). *Total Value of Dwellings*. Australian Bureau of Statistics. Retrieved from www.abs.gov.au

The best-known ICL is the HECS-HELP student loans scheme. HECS-HELP is a world-renowned success story in making higher education universally accessible, at a low cost to the government, without imposing the risks of conventional debt on recipients.

Income-contingent loans mitigate some of the most important barriers to home electrification. For example, low-income pensioners who are homeowners could access this scheme and reduce ongoing bills. Although they are unlikely to repay the loan via income withholding, the security on the property means the loan is eventually recovered from the property sale and cost to the government is minimised.

ICLs are an appealing model for many reasons:

- Repayments are not due when they can't be made and thus avoid the risk of default in most situations. This removes the risk of uncertainty about future earnings, a key issue for almost every consumer considering conventional finance, and a large barrier to credit access for those on fixed, low or precarious incomes.
- ICLs withheld from income tax require no administration or cash flow management from the consumer
- ICLs (like other potential government-provided loans) are generally accessible to people with poor or no credit history - an important feature in providing universal access
- Repayments made through the tax withholding system incur very low administrative overheads
- The low overheads of collection and administration make the loans lower cost and can be issued at close to bond rates without subsidy
- The government could choose to apply below-market interest rates, zero real indexation rates (adjusting debts for inflation like the existing HECS scheme), or even nominal zero interest rates (like the ACT scheme) depending on appetite to incentivise uptake.

Rewiring Australia and the Australian National University are currently developing a proposed income contingent loan scheme that could be adopted by the Federal Government. The proposal will include full modelling of different scenarios and costs including indexation, repayment structures, security and eligibility requirements. Based on initial work, a universal scheme with an aim of electrifying one million homes including appliances, solar PV and battery would require a maximum \$35 billion in loan capital, but at a very low cost (<\$1bn total over 10 years) to budget²⁷.

Lower income households are also more likely to be in social housing or private renters, as well as strata residents, and these separate barriers are discussed below. Rewiring Australia would recommend this ICL scheme is universally accessible across incomes and including landlords. However, further incentives and complementary reforms would be required to overcome strata challenges and split incentives for renters which is discussed below.

²⁷ Based on CPI indexation (avg 0.5% below cash rate), 99.5% collection on home sale

Alternative approach: on-bill financing

Although Rewiring Australia believes that an ICL scheme represents the best and most inclusive approach to electrification finance, there are significant setup and administrative costs associated with a nationwide program delivered using the tax system. An interim alternative approach using conventional finance mechanisms may also unlock immediate opportunities.

On-bill financing refers to schemes where loans for the purchase of electric machines are paid back via electricity bills. One benefit of this approach is it co-locates the capital costs (loan repayments) and operating savings (reduced electricity usage fees).

On-bill financing could be applied to any housing ownership category. However, it is a particularly attractive option for renters to fund solar installations and possibly home batteries. These investments will immediately bring down the cost of energy bills that are paid for by tenants. Ideally repayment terms would utilise concessional finance and be set up for the life of the asset (which may cover multiple tenants) which would minimise the capital repayments and allow for some immediate energy bills savings to be realised by tenants.

The case is easiest to make for solar panels, which can generally offer savings even at commercial interest rates. For example: a 6kw solar panel installation costs approximately \$7,000 upfront. If financed at 9% over 10 years, finance repayments would be \$100 a month. However, the expected savings in energy bills is \$160 a month. This would leave the bill payer \$60 a month better off on average (though subject to seasonal variation).

Although the case for solar may be commercially viable in most settings, appliance retrofits will have a much higher variance with different product price points and installation costs. For renters, it may not be appropriate for appliances to be included in this scheme. Replacement of broken appliances is squarely the responsibility of landlords to fund. However, for homeowners, on-bill financing may provide an option to purchase a slightly more expensive but more efficient appliance.

Concessional (government supported) finance offers may be key to making this economic in most homes. Rewiring Australia recommends the Australian Government's HEUF and other future finance programs look for partnership with energy retailers to apply concessional finance to on-bill financing arrangements.

On-bill financing should also be deployed carefully, taking into account the following:

- Energy bills are an existing point of financial distress for many households. There are existing protections and procedures for managing defaults on energy bills, however, responsible lending practices would be critical in ensuring households aren't placed further into energy stress or poverty.
- Energy retailer portability is a valued feature of the current electricity market and builds in competition. A repayment obligation must be portable across retailers. It's possible this could be achieved by including the repayment in the underlying daily fees from the energy distributor (DNSP) that are passed on by the retailer.
- For renters, tenants must have transparency around repayment obligations upfront and including when new tenants sign a lease.

Some current examples of on-bill financing programs include Sydney Water funding strata efficiency upgrades²⁸ and a large number of programs in California²⁹.

An alternative to collection via energy bills would be to add repayments to council rates notices. Environmental Upgrade Finance is already being used in several local government areas to finance upgrades that are repaid via rates collection. This leverages existing collection methods and has many of the same benefits as on-bill financing to keep assets tied to repayment. This approach does not automatically avoid the split incentive between landlord and tenant because the landlord pays rates, but it could be transparently passed through from landlords.

Reduce the upfront costs of electrification

Recommendations:

3. Amplify, boost, support, coordinate and broaden state based rebates, incentives, and Energy Efficiency Obligation schemes. Broader rebates for electrification appliances
4. Broaden the rebates and price incentives beyond solar PV and heat pumps to electrification equipment such as battery storage, induction cooking appliances that replace gas cooking, demand flexibility enabled space heating that replaces gas heating and smart EV charging equipment.

Policy options that bring down the upfront costs of the machines are important in incentivising electrification. The Commonwealth has administered an incentive for rooftop solar (and heat pump hot water) via the Small-scale Renewable Energy Scheme (part of the RET) for over 20 years. These incentives reduce upfront costs by thousands of dollars and have been a critical part of Australia's world-leading success story in solar renewable energy.

The government should introduce similar incentives, either by extending existing schemes or developing new ones, that reduce the upfront cost of home batteries, induction cooking, air conditioning, smart EV charging equipment that can help EVs use renewable energy, and related home electrification upgrades. These incentives should recognise the value of electrification to the grid through the renewable transition.

Home Electrification rebates and subsidies at the state level

Rewiring Australia recommends the Australian government align, support, and strengthen state government schemes and rebates including the energy efficiency obligation initiatives.

The Victorian government administers a \$1.3 billion Solar Homes Package³⁰. The package combines education materials, information, rebates and loans for households to install solar, battery, electric machines and vehicles. The package is offered through limited funding rounds, and each round is

²⁸ Sydney Water (2023), *How to save on water costs in strata buildings. Free desktop assessment*. Sydney Water. [WaterFix Strata \(sydneywater.com.au\)](https://www.sydneywater.com.au)

²⁹ On-Bill Financing (OBF) Project (2023), *An Access Clean Energy Savings Program*. Environmental and Energy Studies Institute. USA. [On-Bill Financing \(OBF\) Project](#)

³⁰ Victorian Government (2023), *Welcome to the Solar Homes Program*. Victorian Government. Retrieved from [Welcome to the Solar Homes Program | Solar Victoria](#)

adapted to extend the scope of technologies and improve targeting over time. In NSW concession cardholders are eligible for the low-income Household Rebate of \$285 a year, and once they are eligible, they can choose to swap 10 years of this subsidy and receive a 3-kilowatt solar system on their home.

These schemes are a good start for incentivising electrification. The Federal Government should continue working with States and Territories on how they can best coordinate with Federal schemes and how all states can be encouraged to implement further incentives and electrification plans.

Energy Efficiency Obligation Schemes

Victoria, New South Wales, and South Australia most notably have long-standing energy upgrade schemes, also referred to as Energy Efficiency Obligation Schemes. These state-based measures are designed to address the traditional barriers to consumers in retrofitting their households with energy-efficient appliances. The barriers are access to information, the time and effort to search for this information, the upfront capital cost of appliances, and split incentives, particularly in the case of renters and apartments where the costs and benefits accrue to different parties.

In 2009, NSW created a certificate trading scheme, the Energy Savings Scheme (ESS) which supports households and small businesses with energy-efficient upgrades which can include HVACs, draft proofing or sealing windows, doors, chimneys and exhaust fans, installing solar hot water systems, heat pump water heaters or efficient lighting. The subsidy is available for replacing a gas hot water service or a resistive electric hot water service.

In 2009, Victoria introduced the Victorian Energy Upgrades (VEU) scheme, which is similar to the NSW ESS scheme. It was designed to address the barriers to retrofitting energy-efficient appliances. The aims were to unlock the private affordability benefits to householders and businesses and the public benefits of energy security and carbon abatement. Victorian households and businesses that participated in the program in 2022 are expected to save between \$100 and \$2,117 annually on average.

Support renters to electrification

Recommendations

5. Encourage states and territories to incorporate minimum energy performance standards into rental standards³¹
6. Introduce an instant tax write-off for landlords electrifying rental properties.
7. Support measures that increase transparency for renters around energy costs.
8. Work with states and territories to expand the Victorian scheme that incentives electrification of rental properties

Renters make up 31% of households³² and are locked out of energy choices. Landlords make

³¹ Australian Government (2021) National Framework for Disclosure of Residential Energy Efficiency Information. A collaborative project of the Commonwealth, state and territory governments. Australian Government. Retrieved from [National Framework for Disclosure of Residential Energy Efficiency Information](#)

³² ABS, (2022). *Housing Occupancy and Costs*. Australian Bureau of Statistics. Retrieved from [Housing Occupancy and Costs](#).

appliances and energy investments, but tenants pay for operational costs, providing a perverse incentive for landlords to under-invest in energy efficiency. This split incentive is economically inefficient and unfair. A third of Australian households that rent often miss out on energy bill savings of electrification. At the same time, this barrier is slowing the transition to renewable energy.

About 30% of Australian homes have solar panels, however, less than 5% of rentals have solar³³. Solar panels have a strong return on investment. When an owner-occupier installs solar, they benefit from lower bills and might typically recover the whole investment within 5 years. The incentives to make these kinds of cost-saving investments don't necessarily translate for renters because running costs are not borne by the landlord. Further, savings are almost entirely hidden from renters until they occupy a house, which prevents landlords from recouping the benefits of cheaper energy through higher rents.

Similarly, despite the extra running costs of two energy connections, landlords may rationally choose to have gas-connected homes and gas appliances, as the appliances are often cheaper and the cost of changing machines from gas to electric is seen as an unnecessary expense.

Unlocking home upgrades like solar panels, appliance electrification, and efficiency can save everyone money. The challenge has been finding the best way to align the split incentives of tenants and landlords.

Minimum standards for rental properties

Currently, only two states include energy in their minimum rental standards: the ACT and the Victorian Government. The Australian Government should encourage states and territories to include energy standards, including the phase out of fossil fuels, in their rental standards. This could include making funding opportunities contingent on including energy performance in rental standards.

Tax deductibility for electric upgrades on rentals

A clear way to incentivise landlords to upgrade to electric appliances is by providing an instant write-off for any new appliances that replace gas. This would allow landlords could claim a tax deduction for the full cost of the new appliance. The Grattan Institute published modelling that found an instant asset write-off would substantially close the cost gap for water heaters and cooktops and cost a maximum of \$384 million over five years³⁴.

Transparency around energy costs

Prospective renters should have more information on the actual cost of occupying a house before they agree to rent it. Rental listings showing actual historical energy costs will make older, un-

[2019-20 financial year | Australian Bureau of Statistics \(abs.gov.au\)](#)

³³ ABS, (2020) Media Release. Solar Heats Up. Australian Bureau of Statistics. Retrieved from [Solar Heats Up | Australian Bureau of Statistics](#)

³⁴ Wood, T., Reeve, A., Suckling, E., (2023). *Getting off gas: why, how and who should pay*. The Grattan Institute. Retrieved from [Getting off gas: why, how, and who should pay?](#)

upgraded homes less competitive in the rental market, help renters more accurately understand real costs for a home, and incentivise landlords to upgrade inefficient homes.

Collecting running cost information from historical data has recently become feasible with the Consumer Data Right (CDR) system, including energy billing information. A realistic weekly energy bill based on the previous 12 months could be automatically calculated for a rental and included in rental listings.

There are, of course, limitations in the usefulness of averaged historical data. Energy usage can vary significantly between households. In any situation, advertisers will have the opportunity to explain past and potential energy costs to prospective renters. Although there are limitations to historical averages, this information, with caveats, is better than the lack of information currently provided to households. A mock-up of how energy prices could be incorporated into rental advertisements is presented at figure 4-1.

Access to Consumer Data Right energy data is highly regulated, and careful consideration would be required around disclosing a household's average energy usage in public documents. However, balanced policy consideration should be given to the benefits of improving transparency and economics for rentals overall. The Australian Government should engage with tenancy advocates and real estate agent platforms, as well as consider any necessary CDR regulations, to introduce transparency around rental energy costs.

 NEW	\$675 ☆ Energy bill estimate: \$4 / week ⓘ 1 Smith St, SUNNYTOWN NSW 2000 🛏 2 🚿 1 🚗 - • House
 UPDATED	\$930 ☆ Energy bill estimate: \$52 / week ⓘ 3 Smith St, DRAUGHTSVILLE NSW 2001 🛏 3 🚿 2 🚗 1 • House
	\$950 pw ☆ Energy bill estimate: \$17 / week ⓘ 3/5 Smith St, WARMVALE NSW 2002 🛏 3 🚿 3 🚗 2 🏠 780m²

Figure 4-2 Example of information at point of sale or lease

Victorian example

Victoria's solar subsidy is targeted at householders in rental properties, which is a sector more often deprived of choice around the upgrade of their appliances. It consists of a \$1,400 grant and a \$1,400 loan, which is repaid over 4 years.

It has a means-testing component, and eligible householders must have a taxable income under \$210,000 and property less than \$3,000,000, which also applies to the hot water rebate. Owners of rental properties in Victoria can apply for the solar subsidy on a maximum of two rental properties. The same property and household income limits apply. A hot water rebate provides \$1,000 for solar hot water and heat pump hot water systems. The landlord can negotiate with the tenants for them to pay up to 50% of the repayments. At this level, the repayment over 4 years is \$14.58 monthly. A solar battery loan is also available. This provides \$8,800 repaid over 4 years for batteries with capacity equal to or greater than 6kWh and a solar system equal to or greater than 5kW.

The Federal Government should work with the Victorian government to encourage other jurisdictions to adopt similar programs that provide pathways for renters to install solar and electrify.

Invest in electrifying social housing**Recommendation**

9. Work with states and territories to electrify all community housing by 2030.

The electrification of public and community housing would deliver meaningful financial benefits to people living on low-income, as they spend disproportionately and significantly more of their income on electricity bills (6.4%) compared to high-income households (1.4%)³⁵. In addition, electrifying homes will reduce the number of people in energy hardship and energy hardship retail programs, as well as reducing poverty and inequality. Social housing residents in both community and public housing face similar energy and appliance choice barriers to renters.

Direct Government investment is needed to drive electrification of social housing. Through investing in public and community housing stock, electrification upgrades would drive demand and expansion of the supply chain, creating jobs and demand for skilled tradespeople, in addition to delivering economic and health benefits.

Rewiring Australia welcomed the government's investment of \$300 million in the 2023-24 Federal budget in partnership with states and territories to electrify social housing. Funding of this scope needs to be continued into future budgets and a target should be set to electrify all social housing by 2030.

³⁵ ACOSS and BSL (2019), *Energy Stressed in Australia*. <https://www.acoss.org.au/wp-content/uploads/2018/10/Energy-Stressed-in-Australia.pdf>

New builds should prioritise the long-term benefits to future occupants

Recommendations:

10. Update the National Construction Code standards for new builds to require electric appliances and no reticulated gas connections.
11. Move to a 7-Star Standard for new home construction, to take into account home energy appliances and drive greater energy efficiency from the point of design.
12. Introduce gas disconnection bonds to offset the cost of disconnecting from gas.

The first decision to electrify is made by the person who builds the home. This initial decision has more economic consequences for electrification than any other moment. Electrification at build time is the cheapest and most efficient time to electrify. Non-electrification at build time adds depreciation and retrofit costs to electrification. These costs are even higher for strata buildings due to the technical difficulty and coordination costs of strata retrofits.

Australia currently builds roughly 100,000 houses and 70,000 new strata units every year³⁶ (with lots of current public discussion about the need to build more). It should be the goal of government electrification policy to push towards all new builds having all-electric appliances and the wiring and capacity to support EVs as soon as possible. Barriers and counter-incentives should be removed where possible.

Analysis shows that owners are much better off financially building all-electric, with lower build costs from avoiding new gas connections and lower running costs³⁷.

The basic factors and barriers shaping electrification decisions at build time are:

- compliance with laws and building standards: the extent to which regulation directly requires electric-only appliances (ACT and Victoria) or requires thermal and energy efficiency in ways that improve the financial benefits of electrification (National Construction Code)
- up-front connection costs that hide future disconnection costs: removing an unwanted gas connection costs the customer \$1,200
- up-front appliance costs that hide future running costs: gas appliances generally are cheaper up front but more expensive to run, which incentivises developers and landlords to choose the lower upfront cost

Building standards and laws

Regulatory updates (like the update to the National Construction Code to require new builds to have a 7-star rating) are gradually requiring builders to improve the thermal qualities of homes and to reduce net energy usage. These changes improve the economic benefits of electrification, especially

³⁶ Australian Bureau of Statistics (2023) Building Activity, Australia. <https://www.abs.gov.au/statistics/industry/building-and-construction/building-activity-australia/mar-2023>

³⁷ Renew (2021) Submission to Victorian Government Inquiry into Renewable Energy <https://renew.org.au/wp-content/uploads/2021/11/Nov-21-Inquiry-into-Renewable-Energy-in-Victoria-Renew-submission.pdf>

solar PV. However, they do not (outside of ACT and Victoria) explicitly require electrification.

Updating these standards for new builds to require electric appliances and no reticulated gas connections would be a simple way to avoid the costs of electrification retrofits. Consumers with a specific need or preference for gas could continue to choose to use non-reticulated gas supply as they do in much of Australia.

Gas disconnection bonds

New connections to the gas network have a significant cost of around \$1,500. This is generally buried in a building contract as a standard inclusion. Abolition of the gas connection costs a similar amount, around \$1,200. This is a cost faced by any current or future homeowner who wants to upgrade their appliances to the already-cheaper electric equivalents and avoid the ongoing cost of gas connection.

As for-profit companies, gas networks are motivated to find ways to reduce the initial connection cost and acquire customers - offering large rebates³⁸ and subsidies to new customer connections in ways that distort the true cost of the connection. They are, for the same reasons, highly unmotivated to find more cost-efficient ways to disconnect customers.

Over the next 25 years, most gas connections will need to be abolished to meet a net zero target. If gas connections are still to be permitted, the abolition cost should be charged up front alongside the connection cost and held by the distributor as a type of remediation bond. This approach would reflect the true cost of making the connection so that a future owner can elect to disconnect and draw on the bond to pay the abolition cost. This would:

- retain choice while placing the true costs of the decision on the decision-maker, better aligning the incentive to avoid the dual energy connection where not required,
- incentivise gas network operators to deliver more efficient abolishment services (to reduce this upfront bond required), and
- remove the “lock-in” cost for future home occupants to make more efficient energy choices.

The Australian government should work with market and regulatory bodies, such as the Australian Energy Regulator and Australian Consumer Competition Commission, on reforming gas disconnection fees. It is recommended that a bond reflecting the total cost of connection and disconnection be introduced for new connections.

³⁸ Australian Gas Networks (2023) \$500 first-time connection bonus. Retrieved Oct 2023.
<https://www.australiangasnetworks.com.au/rebates/current/new-connection-bonus-for-existing-homes>

Address the specific challenges of strata buildings

Recommendations:

13. Update the National Construction Code to ban gas connections to new apartment developments.
14. Provide targeted grants and tailored finance products to support the electrification of apartment buildings.

As of June 2022, apartments accounted for 16 per cent of Australia's housing stock³⁹. While there are emerging technologies that allow apartments to share a common solar and storage system, apartment dwellers cannot rely on rooftop solar to the same extent as people living in houses. Designing solutions that maximise community-level benefits are the answer to this and many of the other challenges facing the clean energy transition.

The electrification of apartments requires a separate approach to the electrification of stand-alone housing due to the realities of each dwelling being physically and legally interconnected. In addition, large residential and commercial buildings are usually occupied by tenants rather than owners - 59% of residential apartments are rented⁴⁰ which means these households have very limited choice around their energy supply or the machines within their homes.

New strata builds

An urgent update to the National Construction Code to ban new gas connections is required, and this applies even more so to strata construction. Such regulation is necessary to ensure time-of-building decisions about energy sources are durable and avoid locking owners into expensive and unsuitable gas connections for decades into the future. This would address the lack of economic choice for strata owners over the energy connections to the building and avoids the significant expense and challenges of retrofits. Again, consumers and businesses can retain the choice to use non-reticulated gas if they have a preference or need for gas loads.

Existing apartment buildings

In the instance of existing apartment buildings, owners and renters alike need to be able to access the financial and health benefits of electrification, especially in lower socio-economic households. Given the necessary investment of time and money required to retrofit apartment buildings, government policy and incentives are required to support their electrification including targeted funding grants and tailored finance products for apartment buildings.

³⁹ ABS, (2022). Housing Occupancy and Costs. Australian Bureau of Statistics Retrieved from [Housing Occupancy and Costs, 2019-20](#)

⁴⁰ Australian Bureau of Statistics (2017) 2071.0 - Census of Population and Housing: Reflecting Australia - Stories from the Census, 2016 [2071.0 - Census of Population and Housing: Reflecting Australia - Stories from the Census, 2016](#)

Accelerate the adoption of Electric Vehicles

Recommendations

15. Introduce vehicle emissions standards to drive EV supply and adoption.
16. Set a medium-term target for no new ICEs sold by 2027 for petrol and 2030 for diesel engines, with defined exceptions for emergency and remote applications including national parks management, fire services etc. with encouragement of qualified bio-diesel.
17. Provide concessional finance support to incentivise low and middle income consumers to choose EVs.
18. Accelerate vehicle-to-grid (V2G) development and deployment.
19. Plan and fund for community generation infrastructure and community charging infrastructure.

Vehicle fuels account for almost 70% of the total energy consumed by an average household. Electric vehicles, acting as home batteries on wheels, will play a huge role in our energy future. Household policies and programs need to be broad and include private vehicle use. Light vehicles dominate energy use and, thus cost of energy for households and much of the commercial sector.

Vehicles last about 20 years before they are replaced. This makes the net zero calculation simple: all new vehicle purchases will need to be zero emission by 2030 if we are to meet our 2050 zero emission commitments. Addressing vehicle energy must be a priority in any residential electrification strategy.

Supply

Australia should urgently catch up with its developed peers internationally and enact a vehicle emissions standard that requires car manufacturers to supply Australia with EVs. This is a crucial step towards meeting emissions targets and will also support efforts to increase the supply of EVs in Australia.

Finance

The main barrier to electric vehicle adoption today is the upfront cost. While the running costs of electric vehicles are significantly lower than ICEVs, awareness of the lower running costs is poorly understood and valued, and the benefits of EVs to the broader grid are not considered. Improving access to electric vehicle finance can help all Australians access the cost savings benefits of EVs.

Rewiring Australia recommends the consideration of a Car Energy Upgrades Fund for the CEFC to supply concessional finance (through established lenders) for buyers of new and used EVs. Such loans could help incentivise buyers to consider EV options over ICE models. A 7-year \$15,000 loan at 4.10% (the current cash rate) would cost around \$55 per week to service, which closely matches the average savings on petrol and running costs.

As mentioned earlier, Rewiring Australia is currently participating in research and modelling on the potential for income contingent loans (ICLs) to play a core role in electrification, and will consider the potential for ICLs to play a role in car finance.

Vehicle to Grid (V2G)

Household electrification joins two traditionally separated sectors of transport and residential energy. We will derive significant benefits from thinking about these sectors together, as they will support each other in the energy transition and no longer be separated in an electrified world. Our rooftop solar will be the lowest-cost charging option for our electric vehicles, and our electric vehicles will be the lowest-cost storage asset in our communities.

The 1.8 electric vehicles that will be parked in Australia's driveways will represent an energy storage asset 5 times larger than Snowy Hydro 2.0. Maximising the utilisation of this asset is vital to delivering a low-cost and resilient energy system. Home batteries are installed today at around \$1,200 / kWh. For comparison, \$60,000 electric vehicles can be purchased containing 60kWh batteries, effectively a battery cost of \$1,000/kWh with a free car attached. Enabling the participation of these batteries on wheels has significant potential. Current vehicle-to-grid development and deployment has been slow-moving, and the nation could benefit greatly from a focus on rapidly accelerating this as a priority across sectors. The enablement of V2G on time could save billions in infrastructure costs and would lower the barrier to entry of purchasing an electric vehicle because purchasers could also be financially rewarded for their car's ability to contribute to the energy system.

Community EV charging with community generation

EVs will support a renewable grid best by helping shift demand into the middle of the day . EVs will achieve this most effectively by:

- charging using the cheapest available energy in Australia, solar PV, during the daylight hours, when cars are often away from home and at workplace and community locations
- being sufficiently charged by late afternoon to be able to power homes through the evening peak and support the grid around 6pm when renewables are least able to supply

As Australians update their vehicle usage habits and adopt the continuous small refuelling approach that suits EVs, we should ensure that our infrastructure supports this optimised usage and makes it easy for people to charge throughout the day while their cars are away from home.

The government should develop a plan and fund for abundant, low-cost EV charging available throughout community locations including workplaces, street poles and carparks that delivers recharging while wholesale power is cheapest. This should be paired with increased local solar generation to best utilise local distribution infrastructure and minimise the need for additional transmission.

Provide clear information for consumers about electrification

Recommendations:

20. Partner with state, territory and local governments to deliver national education and awareness campaigns and provide accurate information on relative full ownership costs (purchase and operation) of electric appliances, compared to fossil fuel machines.
21. Work with appliance retailers, property managers, retail outlets, local governments and energy retailers to provide information at the point of sale and lease.

For many households, the greatest opportunity for electrification will be when an existing fossil fuel machine breaks or needs replacing. At this point in time, it is critical that consumers receive the right information and that the process is easy to understand.

While there is the opportunity for innovation to emerge from the platform economy, householders will usually rely on advice from trades and salespeople. In receiving this advice, there is no certainty or guarantee that what they are being told is correct or free from bias. Builders, trades and salespeople should have the skills and knowledge to deliver electrification and provide reliable advice, including information about rebates and incentives. There is a role for the government in protecting the consumers' interests when and where the decisions are made - at the point of sale.

Improve regulation of appliance standards

Recommendation:

22. Harmonise and update regulatory standards for appliances including GEMS Act, and Australian Standards technical standards to encourage electrification, DER integration and demand flexibility trading readiness.

The Greenhouse and Energy Minimum Standards (GEMS) Act 2012 outlines minimum efficiency standards for appliances and equipment. Many Australian technical and international standards relating to solar inverters, vehicle-to-grid, battery systems, and demand response capabilities could be updated and broadened.

These standards will act as a point of sale consumer protection, as only efficient appliances that can be integrated onto the grid and be demand flexibility trading ready will be available for purchase. The benefits accrue to the consumer, the electricity system, and the industry.

With these standards updated, there is an opportunity to partner with appliance manufacturers and retailers to provide information at the point of sale. It would provide the consumer with unbiased information on appliances, reduce operating costs, and build trust and energy literacy.

5. Addressing barriers to electrification at a systems level

Rewiring Australia has demonstrated through our modelling that electrification is the fastest way to decarbonise our economy whilst locking in a huge range of benefits for Australian households and businesses. An electrification strategy approach is about optimising householders' behind-the-meter solar generation by the retrofit of inefficient and gas-fuelled appliances with efficient appliances. Therefore, we advocate for a coordinated electrification and efficiency strategy as the most cost-effective clean energy transition. Or, as we prefer, the opportunity to electrify everything.

The key to delivering such ambitious goals is a paradigm shift that combines electrification and energy efficiency and gives equal weight to both the supply and demand-side aspects of the energy equation. Also critical to the success of an electrify everything strategy is to align and mobilise the private sector finance and leverage private sector investment.

However, Australia's climate and energy performance goals cannot be achieved without simultaneously tackling governance, aligning government budgets, mobilising finance and creating investment environments for technology and business model innovation.

Develop and coordinate a national electrification plan

Recommendation:

23. Implement a National Electrification Plan and supporting governance arrangements.

Electrification of Australia's residential sector brings both challenges and opportunities for all the key players in the electricity system - consumers (residential, commercial and industrial), energy retailers, Network Service Providers, trades, appliance retailers, market bodies, federal, state and local governments. As well as organisations adjacent to the system, such as financial institutions. The most efficient, cost-effective and streamlined approach to electrification will require the input and cooperation of all these bodies and organisations.

Our national energy system transcends every layer of government. Therefore, leadership from the Australian Government in the area of energy market governance, policy direction setting, targets and coordination across local, state and federal governments is required.

The Australian, State and Territory government jurisdictions are to be congratulated on committing to net zero emissions by 2050 or earlier. With the election of the Albanese government, this target is now enshrined in law (Climate Change Act, 2022) and supported by the National Energy Transformation Partnership (NETP). The Agreement commits Australian and state and territory governments to a zero net carbon emissions target by 2050 and recognises:

"the needs of consumers are central to the transformation, and that affordable, clean, reliable and secure energy is fundamental to a strong economy".

In effect, the NETP delivers a nationally consistent policy direction and recognises that each jurisdiction will pursue its own policies on energy transformation but will work collaboratively to deliver on national energy and climate change outcomes.

However, no Australian state, territory or local government has a comprehensive plan for household

electrification, but they do have the foundations. All state and territory governments have now set targets of net-zero emissions by 2050 and renewable energy targets. All State and Territory governments have policies and rebates to support elements of residential electrification (solar PV, EVs, batteries, heat pumps).

With leadership from the Australian government, an electrify everything strategy could be achieved by extending current state-based policy initiatives to unlock the benefits of rapid electrification. We recommend establishing a coordinating Office within the Australian Government Department of Climate Change, Energy Efficiency and Water that can provide interdepartmental and intergovernmental coordination. Such a coordinating office, could be referred to as the Office of Electrification and Efficiency and would be tasked to address sectoral linkages between transport, gas, electricity, exports, energy performance and housing. It would coordinate the Australian Government's response to the US IRA in relation to international competitiveness.

State and Local governments can support electrification through coordination and planning, rebates and community engagement around electrification, as well as supporting trials and pilots. State governments also have an important role to play in the planning of the gas network and consumer protections relating to connection and disconnection from the gas network. Local governments are important in planning and community engagement at the neighbourhood level.

Reform the electricity market design and regulation

Recommendations:

24. Undertake electricity market reform and redesign.
25. Create a new market structure that is fit for purpose for the climate emergency.
26. Develop market design principles that support rapid decarbonisation.
27. Create an Office of Electrification and Efficiency.
28. Fix the Wholesale Demand Response Mechanism to encourage commercial and industrial demand response and extend the Mechanism to DER

Energy market reforms are overseen by jurisdictional Ministers of Energy acting as the Energy National Cabinet Reform Committee (ENCRC). However, given Australia's federated system, there is a divergence of interests, political positions, and perceptions of political risks at any given time. As each state government jurisdiction has responsibility for energy matters, there is a divergence in the policy responses that have implications for energy market reform positions.

In recognising the unique position of Western Australia with an electricity system comprising of a number of isolated grids. It is notable that the WA government has progressed with significant electrification and DER integration strategies and as part of the Energy Transformation Strategy⁴¹, Distribution Energy Resources Roadmap⁴² and microgrid strategy.

There is a need for the Australian government to provide leadership on electrification and DER

⁴¹ Western Australian Government (2021) *Energy Transformation Strategy*. Western Australian Government. Retrieved from [WA Govt](#)

⁴² Western Australian Government (2020) *Distributed Energy Resources Roadmap*. Western Australian Government. Retrieved from [WA Govt](#)

integration and coordinate with the states on energy market reform matters. The regulatory framework for the National Electricity Market (NEM) was formulated in the 1990s to promote competition between the 30 plus large coal-fired power generators. Australia's clean energy transition is characterised by the rapid uptake of rooftop Solar PV by householders, the connection of renewable energy generation at the large scale, and the exit of coal-fired power plants as they reach end-of-technical and economic life.

However, the current NEM design favours incumbent fossil fuel generators from competition from large-scale renewables and also from energy consumers who want to be able to generate, store and be rewarded for services to the electricity system from their homes and EVs.

The NEM market design, the architecture and even the culture of the market bodies were formed in the age of coal. Hundreds of pages of outdated electricity laws, rules, procedures and standards need to be discarded and replaced with a market framework engineered to deliver the clean energy transition rapidly, equitably and safely. In practical terms, this means that the governance framework also requires revisiting and for Energy and Climate Ministers to provide greater leadership.

The Energy Security Board and the market bodies in managing the Post 2025 Energy Market project were expected to deliver a new market design that would deliver the benefits of the clean transition.

Theoretically, we could reform the NEM by proposing rule changes to the Australian Energy Market Commission (AEMC). However, each rule change takes around 2 years to progress, and each rule can only change one small part of the market. With no disrespect intended to the professional staff employed at AEMC, AEMO and AER, it is inconceivable that reform to the NEM will be anything other than an incremental and rule-by-rule manner. These small regulatory changes and barriers to the clean energy transition are better conceived not as dozens or hundreds of small rule change issues but as one big national issue of governance and reform.

What to keep, leave behind and add

The challenge for governments is to imagine how the market bodies will redesign the market for the clean energy transition within a timeframe that reflects the urgency. Governments must question the purpose of the energy market governing institutions and how they are constituted to deliver this purpose in an environment of rapid transition.

No government has ever written a plan to transition the NEM from fossil fuels to clean energy. The closest to a plan for the transition is the Australian Energy Market Operator (AEMO) Integrated System Plan (ISP), but this is merely a schematic for the evolution of the transmission grid, not an implementation plan.

AEMO has no power to deliver the ISP, and the regulator that approves network expenditure - but still doesn't deliver networks - the Australian Energy Regulator (AER), has slowed down the ISP and forced NSW and Victoria to legislate their own powers to implement the ISP. The NEM was not designed to deliver infrastructure, let alone urgent infrastructure transformation and delivery in a climate emergency.

Just as no government has written a plan for the clean energy transition, no government has

inquired into how to deliver the transition. The closest was the Finkel Review in 2017⁴³, which inquired narrowly into how to “maintain the security, reliability and affordability of the NEM in light of the transition taking place”. However, the Finkel Review was not directed to accelerate the transition, nor even to deliver it, but simply to ensure that, to the extent that a transition occurs, the lights would stay on.

The legal and regulatory challenge is that it is very hard to reform the market bodies because they sit within an intergovernmental framework in which the Australian government is the most important player but needs a consensus of all governments to make these decisions. State governments have a legal work-around to fix the large-scale transition. They have taken control of transmission planning and other factors that present barriers to large-scale renewable energy. The Capacity Investment Scheme will further support large-scale transition.

To act in the timeframe that the climate emergency requires, the necessary action is for the Australia and state governments to create a new market structure that is fit for purpose. Energy ministers could then delegate the rule-making and regulation, standards-setting and market and system operations to the new transition-focused market bodies. With focussed consideration of what is currently working, what doesn’t work and what needs to be added.

Market design principles

In embarking on the process of creating a new market structure, it is recommended that market design principles are agreed. Policymakers across the world are in agreement on the need for high-level principles that support a rapid transformation of the energy sector. Without the definition of and a commitment to principles of what success constitutes, any transformation strategy would likely fail. Some principles that Rewiring Australia have identified are:

- Energy market and regulatory reform that is fit for a clean energy future.
- The need for adaptive governance, guiding principles, and transparency of policy-making and decision-making.
- Trends in consumer appliance and vehicle purchase preferences with uptake measured and used to inform energy system planning and policy.
- Updated ISP that models a rapid electrification scenario.
- Balancing large-scale and long-distance transmission grid investments with medium, small and behind-the-meter distribution grid-connected generation.
- Strengthened social licence and consumer protections. An electrification strategy focussed on the end consumer-owned Distributed Energy Resources (DER), enabling consumer choice while ensuring consumer protections.
- Additional sources of power system flexibility from both the supply and demand side of the market.
- Develop a Roadmap for Household Orchestration and a Demand Flexibility Strategy.
- Revised network regulation, including performance-based elements and an integrated sector-regulation approach.

⁴³ Finkel, A. Moses, K., Munro, C., Effeney, F., O’Kane, M., (2017), Independent Review into the Future Security of the National Electricity Market - Blueprint for the Future, Australian Government.

- Transparency and publication of data to the market, including data on network congestion and opportunity for avoided network investment through orchestrated demand flexibility responses.
- Local energy system coordination and decentralised micro-grids in coexistence of the central grid.

Rule changes

The NEM does not have a coherent strategy for integrating consumer-owned Distributed Energy Resources (DERs). Properly integrated, commercial buildings, homes and private and commercial light vehicles have the potential to become a vast resource for the electricity system.

Energy Ministers could make simple rules to quickly open up the wholesale market to competition from DER through reforms to tariffs, technical standards and extension of the Wholesale Demand Response Mechanism to small consumers, including EVs.

This could be achieved through stronger direction from the Australian Government on the reforms of the National Energy Market and the establishment of an Office of Electrification and Efficiency to provide overall coordination. An Office would coordinate policy and drive market reforms to encourage households, small businesses, and large consumers to use distributed energy resources (DER) to reduce their bills and emissions.

Design and implement a national gas substitution roadmap

Recommendation:

29. Design and implement a national gas substitution roadmap

The Victorian government, looking at both the household economics and realities of meeting net zero, has recognised that gas no longer has a long term role in household energy, and that by going all-electric householders can expand their options, save money, and reduce emissions.

The Victorian Gas Substitution Roadmap⁴⁴ was developed through public consultation and outlines a plan to:

- Phase out historical incentives for gas appliances.
- Expand the VEU scheme, with new incentives for switching to efficient electric appliances.
- Change the Victoria Planning Provisions in 2022 to remove the requirement for new housing developments to be connected to gas.
- Retire Victoria's 6-Star National Construction Code variation to allow for more efficient hot water systems as part of new construction and major renovations.
- Move to a 7 Star Standard for new home construction, this standard takes account of home energy appliances and not just the thermal shell of the building, driving greater energy efficiency from the point of design.

⁴⁴ Victorian Government, (2023) Victoria's Gas Substitution Roadmap. The Roadmap is the start of the journey to net zero emissions for the gas sector. Victorian Government. Retrieved from [Victoria's Gas Substitution Roadmap](#)

It is vital that we face up to the end of the domestic gas network at a national scale and start acting in similar fashion to Victoria to enable paths forward to electrification. If the move towards electrification happens in an unplanned way and is left to the market, the impacts will be felt worst by renters and low income homes facing spiralling prices and left stranded on gas connections without the ability to electrify. The need to co-ordinate the end of residential gas has been explored in depth in recent publications, including from the Grattan Institute⁴⁵.

A national gas substitution road map should be developed which:

- Provides finance support to homes to switch to electric appliances (discussed above).
- Coordinates and requires states to
 - end new residential and commercial connections
 - ensure gas appliances are excluded from incentive programs or building requirements
 - set dates for elimination of emissions from residential and commercial gas
 - introduce minimum rental standards that require electrification.
- Co-funds electrification of all community housing, and directs Housing Australia to avoid investing in housing using gas.
- Supports reskilling of mature-age plumbers and gas-fitters.
- Works with high-value gas users in the manufacturing and industrial sectors on a gas equipment replacement strategy.
- Require gas network businesses to include plans for the efficient and safe decommissioning of the networks in the five-year reviews with the Australian Energy Regulator.

Develop Pilot Suburbs and Community Energy Zones

Recommendations:

30. Establish lighthouse electrified pilot suburbs.
31. Invest in the development of Community Energy Zones

Current electricity planning focuses on the supply side, large-scale renewable energy zones (REZ) and transmission line augmentation, and an absence of focus on the demand side will result in a compounding of energy affordability problems. As DERs become a dominant player, inefficient investment and stranded assets at the transmission and large-scale level becomes the primary risk.

The fastest and lowest-risk pathway to deliver the Australian Government's 2030 targets for energy and emissions is to accelerate household and commercial electrification. This could be achieved through the development of smaller lighthouse suburb pilots and scale to 'Community Energy Zones' (CEZ).

⁴⁵ Wood, T., Reeve, A., Suckling, E., (2023). *Getting off gas: why, how and who should pay*. The Grattan Institute. Retrieved from [Getting off gas: why, how, and who should pay?](#); Energy Consumers Australia (2023). *Stepping up; A smoother pathway to decarbonising homes*. Retrieved from: [Stepping up](#)

Solar electric suburb lighthouse projects

Rewiring Australia hopes to commence a two-year Solar Electric Suburb lighthouse project in 2024. This would involve a multi-phase process starting with a small sample of households to test methodology and understand installation challenges and soft costs. It would quickly expand to at least 500 homes per suburb in the full electrification deployments. This would provide a living laboratory for household electrification and efficiency policies and programs. It will provide a granular understanding of the interaction between technologies, demographics, and behaviour. Pilot suburbs for electrification will develop the experience and knowledge of the social, economic and technology barriers that can be avoided at scale.

Community Energy Zones

With learnings in hand from pilot suburbs, this model can scale quickly to Community Energy Zones (CEZ). The CEZ approach is a geographical-based and logistic approach to roll out smart grid technology to maximise medium to small-scale generation, including consumer-owned DERS. The concept behind a CEZ is to unlock the benefits of electrification and the participation of the demand side at scale. It is argued the CEZ could enhance social licence in the REZ regions. With a coordinated approach, CEZs would saturate solar and storage in suburbs and regional centres over a period of 5-10 years, thereby derisking the current ISP approach. The CEZ approach is an opportunity to accelerate the achievement of Rewiring the Nation aims and align ARENA's strategic direction in accelerating CEZs and demonstrations of community-scale electrification.

Develop and implement an orchestration roadmap**Recommendation:****32. Design and implement an orchestration roadmap.**

As the coal-fired power stations begin to exit and the level of renewable energy generation increases, the electricity system will require additional sources of power system flexibility, including demand flexibility. Demand flexibility, referred to as orchestration, results from switching DERs on and off and in response to market signals.

Electrification will allow unprecedented coordination of energy demand and demand flexibility, and this will increasingly become a key resource for the reliability and security of the grid. A comprehensive demand flexibility strategy for all sectors (industrial, commercial and residential) is therefore required.

An orchestration roadmap would need to consider NEM market design and the broader economic, and regulatory framework with the aim of enabling DERs to meet their potential. An important component of such a roadmap is the creation of investment environments for technology and business model innovation. Technology innovation is required to support DER integration and demand flexibility readiness, such as Building Management Systems, Home Energy Management Systems (HEMS) and other technologies that enable appliances, equipment and processes to respond to market signals. Supportive technology standards and regulations are required to ensure appliances are deployed with smart technologies that are integration-ready at the time of

installation.

Business model innovation is needed in the form of creating better value propositions for the consumer and beyond current programs for virtual power plants or community batteries.

Publication of data to the market would support business model innovation. Data such as grid emission intensity, network constraint and congestion data.

It is also recommended that tariff design and economic regulation of Network Service Providers are aligned. Great Britain's performance-based network regulation framework, combined with incentives and large-scale investment in innovation, is a successful example of how to kick-start demand flexibility trading to unlock and further enhance the benefits of electrification.

The opportunity is for the Australian government departments to collaborate with ARENA, CSIRO, CEFC, and relevant CRCs to work on an innovation strategy for household electrification to unlock the benefits at scale.

Build an electrification workforce

Recommendations:

33. Provide direct funding for energy transition Registered Training Organisations.
34. Require government-funded projects and companies who receive government funding to deliver on training mandates.
35. Fund mentoring and support for apprentices to improve completed rates.
36. Improve the attraction and retention of apprentices and trainees; including those not traditionally represented in the industry (women, First Nations and CALD workers).

Decarbonising energy will create and sustain tens of thousands of jobs across generation, transmission, distribution, manufacturing, installation and maintenance. American modelling produced by Rewiring America estimated that in the US, decarbonisation would produce around 25 million peak new jobs and 5 million sustained jobs⁴⁶. In the Australian context, modelling suggests an additional 63,000 direct and 604,000 indirect jobs will be created across the economy to support the transition⁴⁷.

Jobs and Skills Australia warn we will need to attract an additional 32,000 electricians by the end of the decade, which will increase to 85,00 by the end of 2050⁴⁸. Electrification faces a key workforce challenge. Australia will need thousands of electricians, builders and plumbers to upgrade and maintain electric homes. At the same time, an increasing number of electricians and engineers are required across the energy sector to support the transition. Australia already faces a shortage of skilled trades people in the energy sector. Government action is needed to boost our training

⁴⁶ Griffith, S., Calisch, S., Laskey, A. (2020), [Mobilizing for a zero carbon America: Jobs, jobs, jobs, and more jobs A Jobs and Employment Study Report](#), Rewiring America.

⁴⁷ Electrical Trades Unions (2022) Tomorrow's Trades to Power Australia's Future. Jobs Summit Position Paper. CEC, NECA, SEC, ETU, MEA, Rewiring Australia. Retrieved from www.etunational.asn.au

⁴⁸ Jobs and Skills Australia, (2023) *The Clean Energy Generation. Workforce needs for a net zero economy. Clean Energy Capacity Study*, Australian Government. [The Clean Energy Generation | Jobs and Skills Australia](#)

pipeline and skilled workforce.

Drawing on the international labour market, as Australia has done in the past, will not be sufficient to meet our electrification workforce needs. Migration will certainly play a role, however, the shortage of skilled energy sector workers is a global challenge. Substantial government investment in training is key to meeting workforce needs, and it needs to begin immediately. The Electrical Trade Union predicts the energy transition will require an extra 20,000 electrical apprentices to start an apprenticeship each year for the next three years.

Rewiring Australia supports collective calls from unions, employers and industry bodies for investment in quality, responsive and supportive training for the future energy workforce⁴⁹. This investment must include attracting and retaining skilled workers in electrical trades with a focus on increasing retention rates of apprenticeships.

⁴⁹ Electrical Trades Union (2022) *Tomorrow's Trades to Power Australia's Future*, ETU, MEA, NECA, SEC, Rewiring Au, CEC. Retrieved from [Trade-Summit](#)

6. Conclusion

In this submission, we have outlined the extraordinary benefits of electrification for households, communities and the broader Australian economy. Unlocking the benefits of energy affordability and emission abatement however, requires a complex and comprehensive suite of policies at all levels of government. Addressing barriers at both the household and system level requires clear planning and large scale investment from the Federal government. It is also critically important that all households have access to electrification. The benefits of electrification will be best realised if all households can share in them.

We should look to the United State's Inflation Reduction Act for the scale of spending required to drive electrification and keep to a 1.5 degrees warming budget. Large scale investment would unlock hundreds of billions of dollars in private investment in household electric machines and would reduce energy price inflation and eliminate energy emissions.