

Electrify **Noosa**

JULY 2024



1 Introduction

Australia has an exciting opportunity to lead the world by electrifying everything. This is thanks to our abundant renewable resources, our rooftop solar revolution and our passion for positive action and innovation.

By embracing electrification, we can have houses that are healthier to live in and cheaper to run, communities that are more resilient and connected, thriving local economies and a safer climate.

Electrifying our homes and businesses is the climate solution ready to go now. It involves replacing appliances and vehicles that use polluting fossil fuels with efficient, electric alternatives powered by renewable energy. This will require us to rewire how we do energy, transport, finance and housing. It will bring together consumers

and voters, governments and businesses, towns and cities.

This report outlines how electrification can bring a range of economic, social and environmental benefits to your household, to your local community in Noosa and to the country.

The faster we work together to electrify everything, the faster we can experience these benefits and create a safer, healthier and abundant future for every Australian.



Yearly energy bill savings when electrifying fossil fuel homes and cars

The average local household could save
\$1800
tons CO2e per year

The community could save
133,000
tons CO2e per year

Compares a Noosa household using all gas appliances and petrol vehicles, to a fully electrified home with solar and battery.

Australia could save
\$50bn
tons CO2e per year

Australia could save
60 million
tons CO2e per year

The community could save
133,000
tons CO2e per year

The average local household could save
5,750
tons CO2e per year

Yearly reduction of greenhouse gas emissions when electrifying fossil fuel homes and cars

Electrify Noosa Snapshot

Collectively Noosa could save this much, by 2040, by electrifying fossil fuel homes and vehicles

\$1.0bn



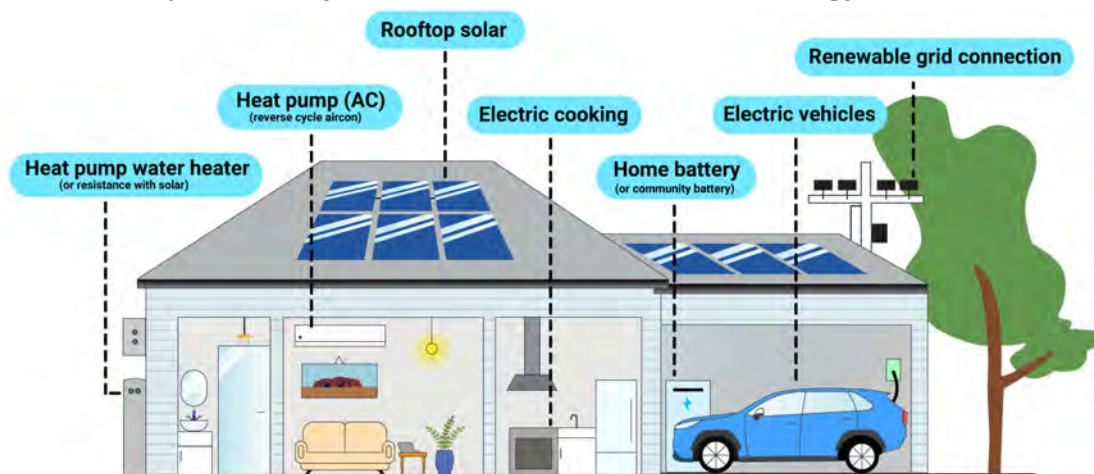
Local jobs that could be created from the savings and trade work of electrifying households



655

2 What is electrification?

Electrifying our homes and businesses means replacing appliances and vehicles that are run on polluting energy sources such as gas and oil with efficient, electric alternatives powered by clean, renewable sources of energy.



It will be enabled by putting more solar on all rooftops, everywhere. This is the 'low hanging fruit' in our energy transition: the technologies are available today and put everyday people in charge of accelerating achievable climate and energy solutions.

In practice, this means switching over gas hot water systems and space heaters to efficient electric heat pumps, replacing gas cooktops with electric induction stoves, retiring petrol and diesel cars for electric vehicles (EVs) and powering it all with rooftop solar everywhere and large-scale renewable energy to replace coal-fired generators. Batteries will play a key role, whether installed 'behind the meter' in our homes, shared 'community batteries' in the street or, most excitingly, the millions of batteries on wheels, inside our EVs.

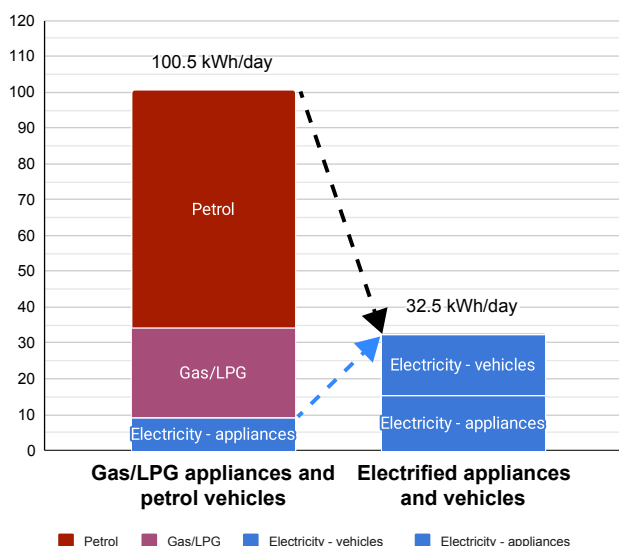
Electrification is efficiency

Electrification not only reduces fossil fuel dependence, it makes our homes more efficient. That is because the technologies of heat pumps, induction stoves and EVs are on average 3-4 times more efficient at using energy than conventional machines. Even without solar, electrifying homes with efficient electric appliances can reduce household and business energy usage by two-thirds, saving money and cutting emissions.

By removing gas appliances from homes and businesses, and petrol and diesel cars from our roads, we can clean up our energy system from the demand side at the same time as wind and solar farms displace coal from the grid. Growing household solar will make the energy transition more affordable, fairer and efficient.

Energy use comparison in Australian homes

Based on average Australian home energy needs and driving. RBS 2021. ABS Motor Vehicle Survey. Rewiring Australia analysis.



3 Benefits for households

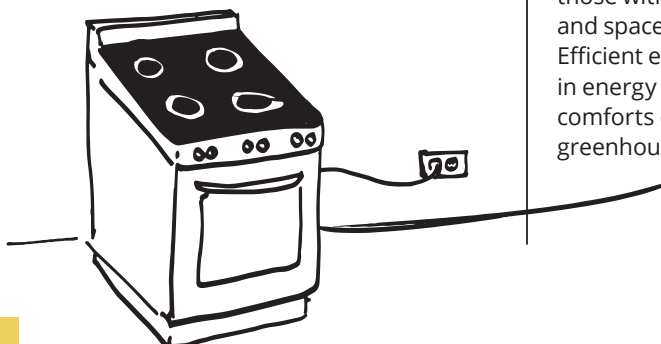
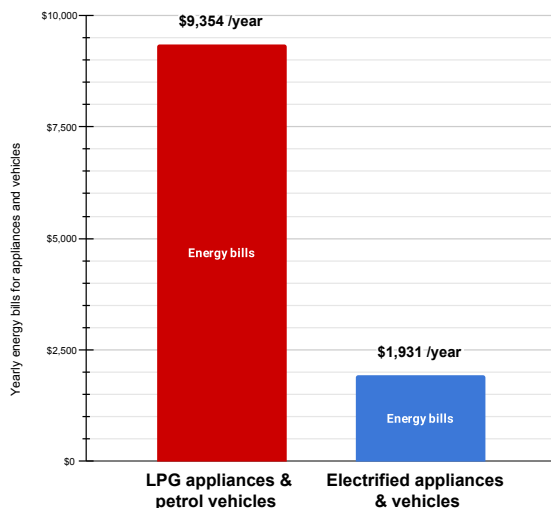
Electrifying your home and vehicles can dramatically reduce your energy bills and household emissions and create a healthier environment to live in.

Transitioning from a gas and petrol powered home to a solar electric home will save the average household around \$7,400 on energy bills every year. If you include the financed upfront costs of purchasing electric vehicles and solar and battery, homes still save around \$1,800 per year.

Yearly energy bill savings

Noosa - energy bill comparison - fossil fuel appliances and vehicles versus electrified appliances and vehicles

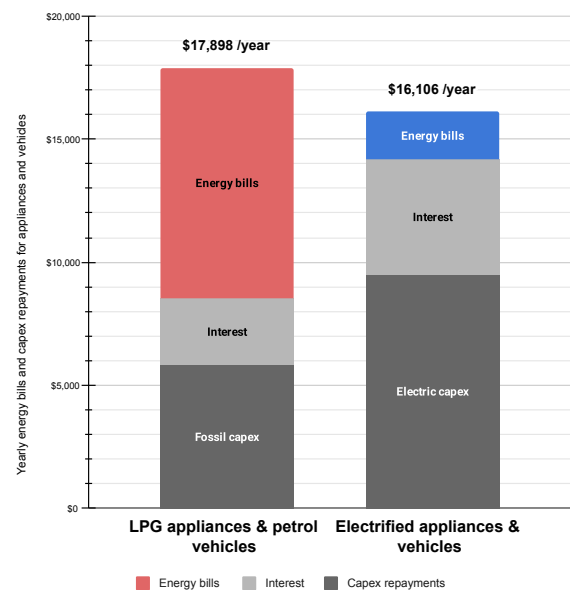
Rewiring Australia analysis. 2024 onwards energy pricing based on CPI. 15 year lifetimes at 5.5% finance, solar at 30 years.



Yearly savings including upfront costs

Noosa - energy bill and upfront cost comparison - fossil fuel appliances and vehicles versus electrified appliances and vehicles

Rewiring Australia analysis. 2024 onwards energy pricing based on CPI. 15 year lifetimes at 5.5% finance, solar at 30 years.



Healthier, comfortable homes

Fossil gas in the home has been found to release harmful gases like formaldehyde, acrolein, nitrogen dioxide (NO₂), and carbon monoxide (CO), which can affect respiratory health, especially in children and those with [asthma or allergies](#). Electrifying cooktops and space heaters can create a healthier home. Efficient electric appliances also bring a reduction in energy use which means we can enjoy the home comforts of hot showers and warm rooms with no greenhouse gas emissions and lower energy costs.

Case study

Howard
Elston

In Melbourne's eastern suburbs, Howard Elston and his wife have realised their dream of sustainable living. Their journey began in 2012 with a desire to downsize into a smaller, electric and efficient home.

After a two-year search, the Elstons developed three sustainable homes on a single block. Working with a forward-thinking designer/builder, they created an all-electric, thermally efficient home that set a new standard for sustainable living.

Challenges arose in 2016 when the concept of an all-electric home was still novel. Initial pushback from contractors tested the Elstons' resolve, but their persistence inspired the team to embrace new skills.

The results are impressive. The Elstons' home uses passive solar design, efficient electrical appliances, rooftop solar panels, and a battery system. Their energy bills have plummeted, averaging just over \$1 per day for electricity in 2023.

Looking ahead, Howard wants to see greater public awareness about the economic benefits of all-electric homes. He calls for targeted government support through rebates and financing options to help more households begin their electrification journey.



Energy control

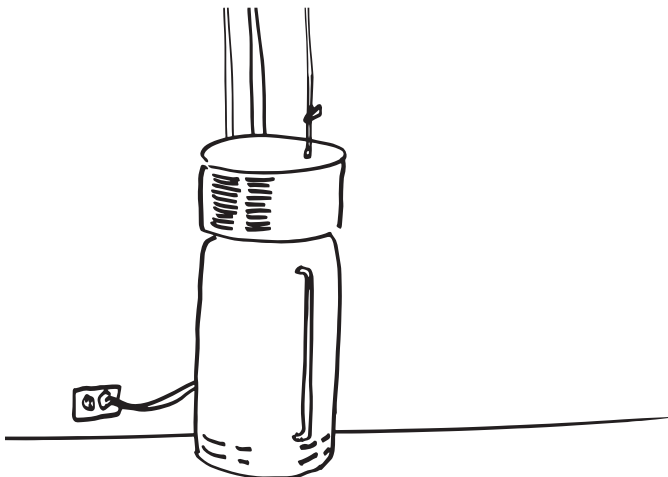
Fully electric homes have the benefit of being more energy independent and resilient to blackouts, with a greater level of control over energy consumption. For instance, when you fill your car up at the petrol station, there is little control over how much you'll pay at the bowser. However, with an electric car, you can time its charging to coincide with daytime solar production or cheaper retailer tariffs. With smart devices and controllable technology, electric households can transition from being simple energy consumers to crucial energy generators and empowered consumers in a more dynamic energy grid.

Bill savings

When we buy things, we mostly think about the upfront costs and forget about running costs. The key to understanding the bill savings from electrification is to realise that the electric alternatives have lower running costs. Once we factor in the lifetime costs of an appliance, it makes sense to spend a little more upfront if it saves even more over the long term. While every household is different, Rewiring Australia's modelling demonstrates what the average household will save over the lifetime of appliances when they go all electric.

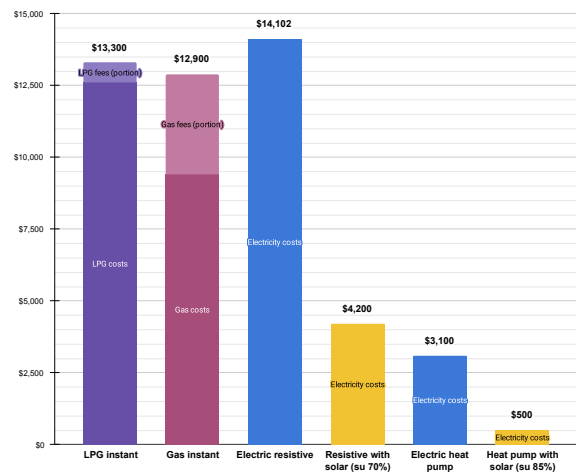
Water heating

Electrifying your hot water system is one of the most important steps you can take to lower your energy costs and emissions. Heating water consumes a lot of energy. It is one of the most flexible energy uses, meaning you can choose to heat your water when it's cheaper to do so. Shifting the electric hot water load in this way lowers the cost of energy for everyone. The benefits are even greater if you have a big solar system and use the excess solar in the middle of the day to heat enough water for the next 24 hours or more.



QLD - Water heating cost comparison over a 15 year appliance lifetime

Sources: Rewiring Australia analysis. Residential Baseline Study 2021. 2024 electricity, gas, LPG, and solar prices adjusted to CPI trends. 15 year operating costs. Prices exclude state subsidies. su = solar utilisation

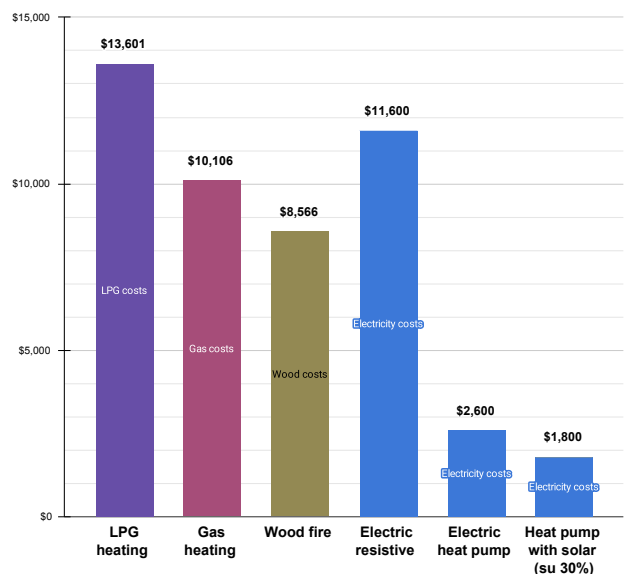


Space heating and cooling

As the planet warms and summers become extremely hot, more of us are installing reverse cycle air conditioners to cool our homes. The great energy bonus is that the heat pumps these air conditioners use to create cool air are the most efficient technology we have for making warm air, to heat your home. Reverse cycle air conditioners (also known as heat pumps or "split systems") use about 60% less energy than conventional electric or gas heating systems.

QLD - Space heating bill comparison over a 15 year lifetime

Sources: Rewiring Australia analysis. Residential Baseline Study 2021. 2024 electricity, gas, LPG, and solar prices adjusted to CPI trends. 15 year operating costs. su = solar



Case study

David Washbrook

David Washbrook of NSW's Northern Beaches has transformed his home from a typical energy consumer to a model of self-sufficiency. Motivated by environmental responsibility, technological efficiency, and cost savings, David and his family embarked on a year-long transition to full electrification.

The family replaced their petrol car with a Tesla Model Y, disconnected from the gas network, and installed an 11 kW solar system with two Tesla Powerwall batteries. They also switched to electric appliances, including a heat pump for hot water and an induction stove for cooking.

The results were significant. The household became energy independent and now exports around 5 MWh of electricity annually. The initial investment of \$47,830 (excluding the electric vehicle) yields an annual benefit of \$11,150, with a 4.29-year payback period and a 366% return on investment. Their carbon emissions dropped from 14 tons per year to a miniscule 0.1 tons!

The Washbrook family now plans to implement more home automation to optimise their energy use and exports. Electrification converts, they documented their journey to make it easier for others, are optimising their energy use and exports and are advocating for increased government support for home battery systems, and policies to make the energy transition accessible to renters and lower-income households.

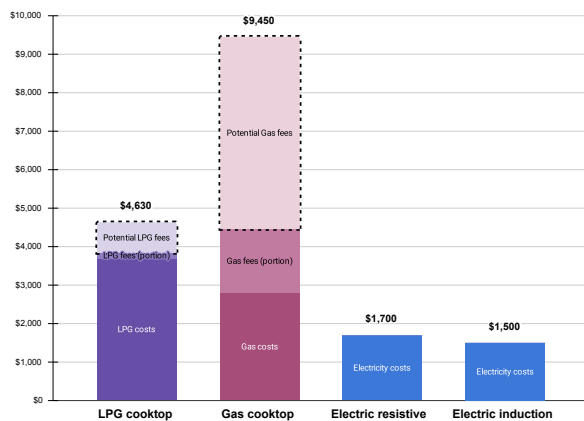


⚡ Cooktops

Stove cooktops are a common gas user in the average home. Unlike a heater or hot water system which vents the fumes outside, a gas stove literally burns a dangerous fossil fuel inside your home. This has the most direct impact on the health of our families in the short term and contributing to chronic illness such as asthma in the long term¹.

QLD - Cooktop bill comparison over a 15 year appliance lifetime

Sources: Rewiring Australia analysis. Residential Baseline Study 2021. 2024 electricity, gas, LPG, and solar prices adjusted to CPI 15 year operating costs.

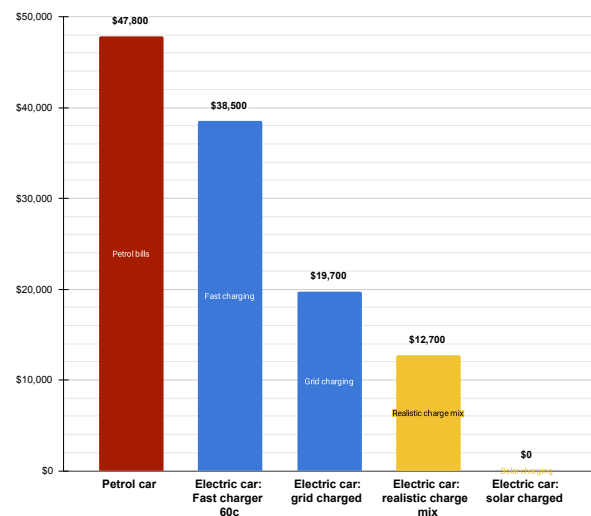


⚡ Electric Vehicles

The single biggest change you can make to your household emissions and energy costs is to replace your petrol or diesel car with an electric vehicle. This is especially powerful if you can charge it off your own rooftop solar which will lock in considerable ongoing savings.

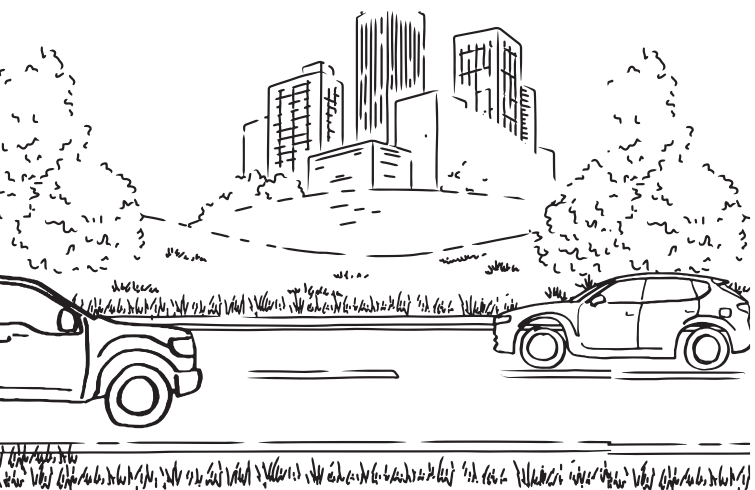
QLD - Vehicle cost comparison over a 15 year vehicle lifetime - average driving

Sources: Rewiring Australia analysis. ABS motor vehicle survey 2018. 2024 electricity, petrol, and solar prices. 2024 new vehicle prices. Charge mix 50% solar, 35% grid, 15% public charging. 15 year operating



⚡ Solar & Battery

Australia's rooftop solar is the cheapest consumer energy in the world. From the day a home installs solar panels, energy bills go down. A unit of energy purchased from the grid (a kilowatt hour) costs over 30 cents, but if generated by a solar system costs around 5 cents. The way to maximise these economic benefits is to shift when a home consumes energy to the daytime and in particular to the afternoon when solar production is highest. This "load shifting" can be done manually, using the timers built into the appliances and with appliance or whole-home management systems and apps such as EV apps. The economic benefits can be even better when a home battery is installed to store solar energy for use in the evening and even trade the energy through a "Virtual Power Plant", when grid prices are high or the local network needs an injection of energy.



¹ <https://asthma.org.au/triggers/gas-appliances/>



Case studies Householders

Renée
and Tim
McLennan

Renée and Tim McLennan are taking sustainable living to new heights - or rather - new distances. This family has not only electrified their home but is currently embarking on an electrified adventure around Australia.

Driven by a desire to transition from fossil fuels, reduce emissions, and save money, the McLennans have successfully electrified everything in their home, including vehicles. They're now touring Australia in an electric vehicle with a solar camper, proving that eco-friendly travel can be both adventurous and family-friendly.

Their cross-country EV journey has had a few bumps, particularly in remote areas lacking charging infrastructure. However, they've embraced this as an opportunity to slow down and savour their travel experiences by doing slow trickle charges when infrastructure was lacking.

The benefits are clear: reduced power and fuel costs, coupled with the satisfaction of contributing to the broader energy transition. The McLennans are not just adopting sustainable practices; they're showcasing what's possible.

They advocate for more government and industry support to help others electrify, suggesting subsidies for electric appliances and assistance in developing individual transition plans. And in the meantime, their advice is simple: replace appliances and vehicles with electric alternatives when due for an upgrade.



4 Benefits for the community

Household savings are important, particularly as cost of living pressures rise and when an entire community electrifies, those savings are magnified and there are shared economic and social benefits.

As more households install solar and electrify their appliances and vehicles, significant sums of money will be retained in local economies rather than financing distant coal and gas plants and pipelines (often owned by foreign corporations). At the community level, electrification will create hundreds of skilled jobs, improve local economic resilience and social connectedness and enhance neighbourhoods with less air and noise pollution.

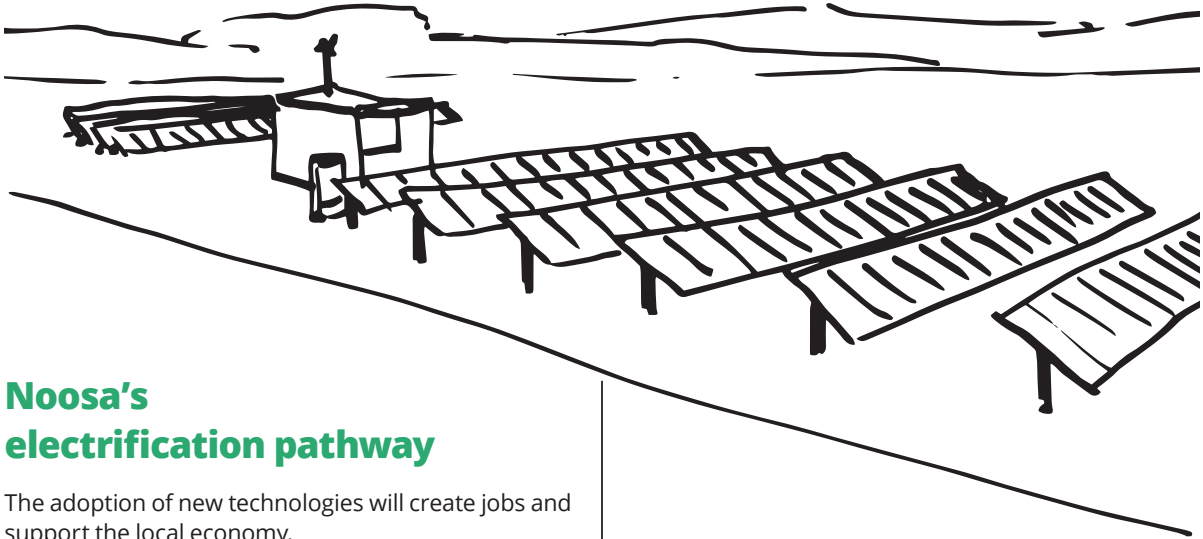
Noosa could save \$108m per year, and a total of \$1.0bn by 2040.

This would create 655 jobs, many of which are likely to be local jobs.

Supporting the local economy, investing in local jobs

The bulk of current household fossil fuel spending is on petrol and diesel imported from overseas. The electrification of homes and businesses will require the upgrading and renovation of thousands of homes, generating local jobs. Plumbers are needed to change over hot water systems, air conditioner installers for new space heaters and plenty of electricians to install solar panels, batteries, EV chargers and cooktops. Not to mention opportunities for home energy advisors, technology startups, transport and town planners, sustainability experts and financial product managers to support successful community-wide electrification.

When we electrify we are spending money paying for tradespeople in our community to install solar and appliances and then paying each other for locally-generated solar power. If we then spend some of the bill savings locally then that brings even more benefits to our communities.



Noosa's electrification pathway

The adoption of new technologies will create jobs and support the local economy.

Localised energy

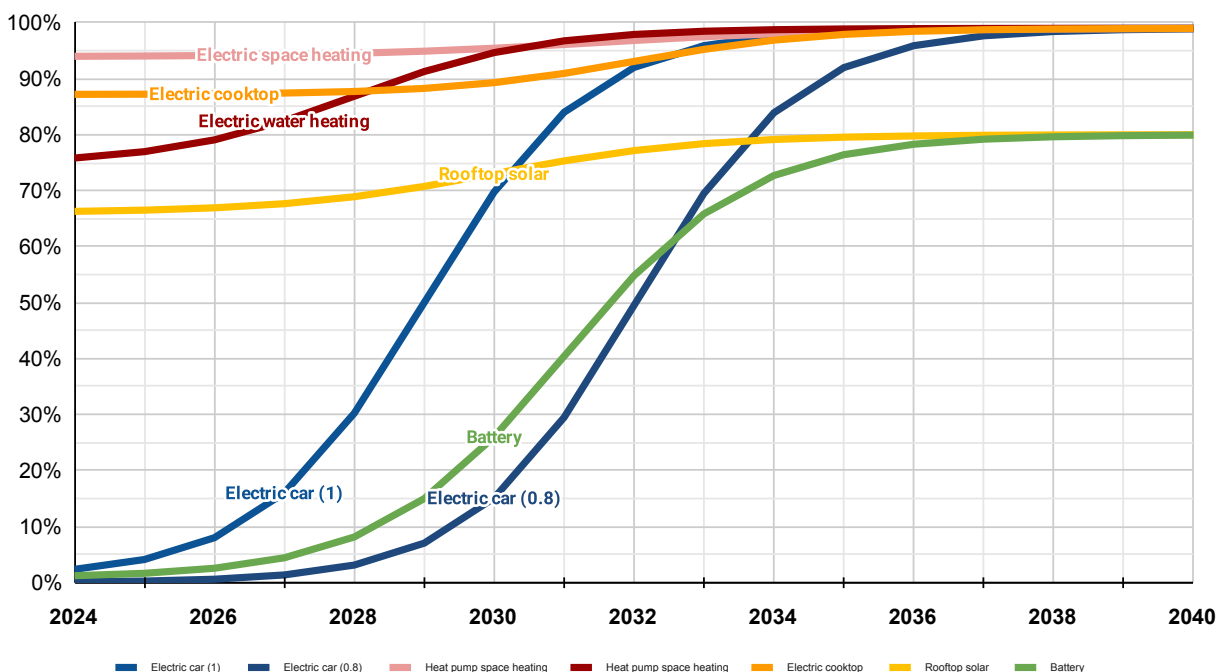
The communities of tomorrow will not just send more power to the grid, they will make it more reliable in the face of natural disasters like storms and unnatural disasters like breakdowns at coal-fired power stations. It is important to make the electricity market rules more fair so that solar households have a big incentive to stay connected to the public electricity network. The more local solar generation and energy sharing between consumers, the lower our energy prices will be.

Cleaner neighbourhoods

An electric community is a community that will enjoy a reduction in the noise and air pollution generated by petrol and diesel cars, burning gas for heating and hot water and small fossil-fueled machines like lawn mowers. Electric bikes and active transport, alongside electric vehicles and electric public transport, powered by renewable sources of energy, will create quieter, zero emissions neighbourhoods.

Noosa's pathway to zero emissions - Electrification adoption curves

Based on current rates of adoption for each technology the region. Electric car curves (1 & 0.8) refer to the average home having 1.8 cars, with the first being replaced at a faster rate



5 Benefits for Australia

Around 42% of Australia's domestic carbon emissions come from everyday decisions made by households, like the food we eat, how we heat our spaces or travel to work.

Most of those emissions are the coal, oil and gas burned to power cars, heat homes and water and generate electricity. This means that supporting households to electrify their household appliances and cars can collectively have a significant positive impact for our whole nation from a climate perspective, and brings a range of other economic, technological and social benefits.

Australia could save around \$50 billion a year and create 300,000 jobs as it transitions to full residential electrification.

Climate and energy solutions

The sooner we quit fossil fuels, the better. The next 5-10 years are critical for our planet and we will only be able to make deep emissions cuts if we electrify and do it fast. A safe climate requires us to clean up the grid with large, renewable energy projects displacing coal and gas. Rewiring Australia's research has demonstrated that it is equally vital to electrify homes and businesses. We can reach Australia's 82% renewable energy by 2030 target more easily by focusing on the demand side and bringing energy savings for households. These millions of consumer investments can be made today, with off the shelf technologies and bill savings from day one. That is the fastest way to clean up Australia's emissions.

Fairer energy system

While global gas and oil prices continue to climb, solar gets cheaper every year, as the cost of solar panels goes down. Around 1 in 3 Australian households already has rooftop solar,² locking in household savings and reducing the cost of wholesale daytime electricity for everyone. More consumer energy resources such as electric heat pumps, batteries and electric vehicles, will form the backbone of an efficient and affordable energy system. Governments should support household investment in energy by writing new energy system rules to deliver a consumer-centred market. This fairer energy system will be cheaper and this "people power" will translate into democratic support for greater climate action in the future.

Rooftop renewable superpower

Australia imports 842 million barrels of oil most of which fuel the 20 million private vehicles in our garages. Yet we have abundant natural renewable energy resources, large enough to power our vehicles, homes and industries and retain that wealth domestically. We have the critical minerals the world is begging for underfoot and an opportunity to ensure Australia moves on from our dig and ship mentality to be a leader in the clean energy economy. We stand at a precipice of technological innovation and domestic manufacturing opportunities if we choose to embrace it, creating new industries, economic revenue and world-class innovation. Electrification can drive the public agenda for Australia to become a clean energy superpower, starting at home.



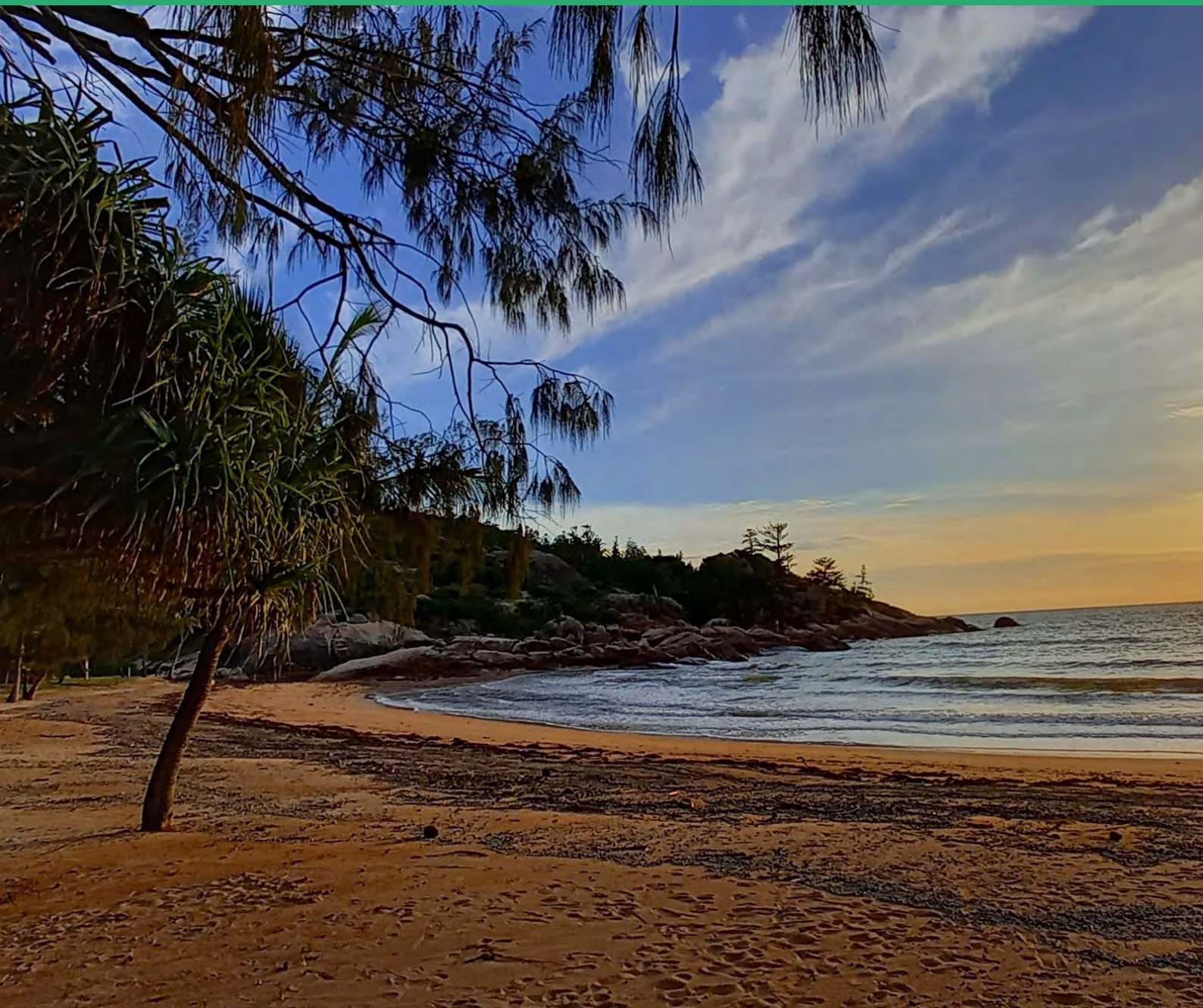
Case study

Magnetic Island, Queensland

On Queensland's Magnetic Island, nestled in the Great Barrier Reef, a dedicated group of volunteers is working to transform the island's electricity system. The current system accounts for about 75% of the island's carbon output, and Totally Renewable Magnetic, a community working group of the Magnetic Island Community Development Association, aims to achieve 100% renewable energy for Magnetic Island by 2030.

Running workshops, advisory services, producing reports and partnering with Council, their approach focuses on increasing solar generation, investigating storage and microgrids, and energy efficiency and demand management. So far, there are 4.2MW of solar panels on the island, increasing by more than 20% per annum since 2019. Solar generation is estimated to save the Magnetic Island community \$1.3 million annually (i.e. \$300k from the feed in tariff and \$1m of estimated self consumption).

Through a grant provided by a partnership of the Australian Government's Reef Trust and the Great Barrier Reef Foundation, Totally Renewable Magnetic is now helping businesses on the Island be more energy efficient. Businesses such as holiday accommodation and hospitality venues currently consume around 50% of the island's electricity. Totally Renewable Magnetic is a fantastic example of community-driven campaigns that create long-lasting change.



Case study

Esperance,
Western
Australia

The entire WA town of Esperance has managed to transition off its reticulated gas network in just 12 months. This transition, involving approximately 400 residents and businesses, was prompted by the gas distribution company's decision to cease offering the gas service due to commercial unviability.

Horizon Power, the state-owned utility, managed the transition with a \$10.5 million government-funded program. The initiative offered financial assistance to customers to replace gas appliances with electric alternatives, including installation costs and electrical work.

The ambitious task of electrifying an entire community in a tight timeframe was set about with the provision of personalised consultations, educational events and targeted resources to build trust and understanding of the community. Local tradespeople also played a crucial role, with 88% of the work going to local trades. This approach not only supported the local economy but also ensured smooth installations and customer satisfaction.

By March 2024, over 300 residential transitions were completed with 75% opting to fully transition to electric appliances (with the remaining using bottled gas for specific industrial needs). The project is expected to result in average household energy savings of 38% and a significant reduction in Esperance's carbon emissions.



6 How does Noosa get there?

There are 11 million homes in Australia with over 30 million fossil-fuel powered appliances and vehicles to replace. It's a big job ahead.

While there is plenty that individual households can do, governments have a responsibility to understand the needs of households and communities as they electrify and to enable it to proceed fairly and rapidly.

For households & communities: make a plan

1. Research and plan

You don't want to wait for your 'cold shower day' to understand the best options for your needs. Prior research can ensure you're prepared when something needs replacing, and creating a household electrification plan can help make a full electric retrofit achievable within your timeframe and budget.

2. Investigate rebates and finance options

Electric homes and cars will ensure households can enjoy yearly bill savings, but the upfront costs can still be prohibitive for many. Many householders afford those costs by taking out a loan with their mortgage or another loan from a green finance provider. There are also a number of local, state and federal government rebates, subsidies and support programs that incentivise electrification and support householders. Visit energy.gov.au/rebates.

3. Collaborate

Talk to your friends and neighbours about your experience, join or start a community group to bulk buy appliances and run education campaigns and meet with your state and federal MPs to call for the big changes needed.

4. Engage Local Council

Local councils can provide a number of electrification incentives including negotiating solar soaker tariffs with retailers, providing access to community solar and batteries, supporting strata processes and mandating electric new builds in development control plans.

For decision makers: rewire the system

1. Access to finance

The biggest barrier for households and communities accessing the benefits of electrification is access to finance to afford the upfront costs. The federal government allocated \$3.5 billion in the 2024-2025 budget to provide a one-off \$300 energy relief payment for every household. Rewiring Australia modelling shows that an investment of \$4 billion to provide universal access to electrification finance will bring permanent cost-of-living relief with consumers saving a whopping \$1.7 trillion by 2050. See rewiringaustralia.org/eels

2. Support the vulnerable

As well as finance, governments and councils can provide more ambitious and fairer rebates, subsidies and support programs especially for vulnerable households including social housing, renters and low income homes.

3. Training opportunities

The job opportunities are an exciting prospect for electrified communities, but we need to be prepared with a skilled workforce ready. Investment in training programs and apprenticeships to build the electric trade workforce is crucial.

4. Regulatory reform

Australia's energy markets and rules were designed for the age of coal and it's time to design a consumer-centred system that is fit for purpose. There are hundreds of outdated laws and regulations holding back electrification in energy markets and other jurisdictions. To support our electric transition we need to see a range of changes from planning regulations at council level to mandatory EV charging infrastructure, to state regulations that ban new gas connections and introduce minimum efficiency standards on rentals, to national electricity market reforms that make it fairer for households to produce, consume and trade energy. It's time we recognise and prioritise the crucial role households are playing in our energy transition and help unlock the benefits for all.



Case study

Boroondara,
Victoria

A dedicated group of volunteers in the eastern suburbs of Melbourne joined together just 18 months ago and have since set about electrifying their LGA of 72,000 dwellings.

Forming partnerships with service organisations, local churches, schools, universities, environmental groups, industry partners and with support from their local council, Electrify Boroondara is increasing the uptake of local rooftop solar, batteries, electric transport and advancing gas disconnections.

Grants have enabled the volunteers to train up home energy advisors to guide low income households on electrification, host electrification expos attended by thousands of people and developing a tradie hub prompting local tradespeople to recommend the efficient, electric option when a customer needs an appliance replacement.

The dedication of the team, which has grown to include 140 volunteers, demonstrates the impact and value of providing trusted, independent support services to community members in order to electrify everything.



5 About Rewiring Australia

Our current energy system was designed for a fossil fuelled economy. Our research and advocacy is helping design an economy that puts planet and consumers at the centre. Rewiring Australia is mobilising people across the country to help us create an energy future that empowers households and communities while driving real climate solutions.

We are a non-profit, independent organisation on a mission to electrify everything, working with governments, industry and communities. We research, advocate and demonstrate how electrification will not only drastically cut Australia's emissions, it will create an energy system that is efficient, cheaper and fairer.

Leading Change

Rewiring Australia's co-founder Dr Saul Griffith is an engineer, inventor, and energy expert. He founded our sister organisation Rewiring America, and helped co-design the US \$1 trillion Inflation Reduction Act, the world's most ambitious climate legislation. Dr Griffith returned to his homeland of Australia in 2021 to set us on a more ambitious path – to electrify every Australian household and community as our nation's cornerstone approach to tackling climate change. Rewiring Australia has grown to become Australia's leading research and advocacy organisation on electrification as a critical climate solution.



JOIN US

Make a tax-deductible donation today to support Rewiring Australia's visionary work.

rewiringaustralia.org/donate



Methodology Notes

Energy use data

Appliance energy use

The [2021 Australian and New Zealand Residential Baseline Study](#) is used to derive energy use by appliance. Energy efficiency factors / coefficient of performance across each appliance type are used to calculate the base energy requirements needed by a home depending on what appliances it uses/chooses, and its location based heating requirements.

Heat pump space heating Coefficient Of Performance (COP) is set for national average numbers at 4.0 (400%) and is set for each individual state and territory for their own individual analysis as outlined below. The COP of appliances will vary by region temperature and individual device performance.

- NSW: 4.0
- ACT: 3.8
- NT: 4.7
- QLD: 4.5
- SA: 3.8
- TAS: 3.0
- VIC: 3.5
- WA: 4.5

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

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

Water heating energy factors are sourced from the [US Department of Energy - Energy Star ratings scheme](#) and set at the following values.

- Electric resistive tank water heating: 90%
- Gas/LPG instant water heating: 95%
- Gas/LPG tank water heating: 86%
- Heat pump water heaters: 360%. This assumption is based on 10% tank losses combined with the 400% heat pump efficiency for space heating. This is also set state by state using the same methodology. Note heat pump hot water heaters are already available with average COPs [stated at 450% & 520%](#)

Cooktop energy factors are sourced from the [2019 Frontier Energy Residential Cooktop Performance and Energy Comparison Study Report](#) and set at the following values.

- Electric resistive/ceramic cooktop: 71.4%
- Induction cooktop: 78.5%
- Gas/LPG cooktop: 30.4%
- Electric oven efficiency is assumed at 95%
- Gas/ LPG oven is assumed at 90%
- Microwave assumed at 65%.

Vehicle energy use

Average vehicle energy use is sourced from the [2018 Australian Bureau of Statistics \(ABS\) Survey Motor Vehicle Survey](#). Data from 2018 is used as the most recent release draws on data collected during Covid-19 lockdowns and is not accurate reflection of current driving patterns.

The number of vehicles per home is sourced from the 2021 ABS Census. The national average is set at 1.83. The breakdown by states and territories is outlined below.

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

Vehicle efficiency data is used for comparative energy use from the [US Department of Energy EPA Fuel Economy Database](#) to calculate the different energy requirements across vehicle types. This dataset is used because it is a detailed comparison of driving efficiency differences between vehicles. Individual vehicle efficiencies across a range of vehicles that are popular in Australia are used in modelling to determine an average difference in efficiency between a petrol vehicle and an electric vehicle of similar size. For electric vehicles this includes charging losses.

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

vehicle's efficiency. The average miles per gallon for an internal combustion engine (ICE) vehicle used is 27.4, the average miles per gallon for an electric vehicle used is 116.8. Therefore an electric vehicle using an average of 25.9% of the energy to drive the same distance as a similarly sized ICE vehicle. Hybrid vehicle petrol use is derived from a comparison of modern hybrid vehicles compared to the same non-hybrid variant of the same vehicle, and is set at 70% petrol use of the equivalent nonhybrid vehicle.

Energy Prices Data

Electricity pricing

Electricity pricing varies between locations, retail plans, times of the year and a range of other factors. Assumption on average electricity prices are set for each state and territory and nationally. These assumptions are set through a comparison of current electricity prices in each region. This includes a comparison of Australian Energy Market Operator National Electricity Market wholesale prices, Australian Energy Market Commission price breakdown estimates, network pricing structures, and retail plan comparisons from both online and through analysis provided by Solar Analytics plan comparisons. Data was drawn from the following sources: [Australian Energy Market Operator](#), [Australian Energy Market Commission](#), [Australian Energy Regulator](#), [Utilities Commission of the Northern Territory](#), [Western Power](#), [Western Australian Government](#), [Canstar Blue](#)

Electricity pricing for 2024 is set at the following:

- AUS: volume rate: \$0.33/kWh, fixed rate: \$429 per year.
- NSW: volume rate: \$0.36/kWh, fixed rate: \$459 per year.
- ACT: volume rate: \$0.26/kWh, fixed rate: \$394 per year.
- NT: volume rate: \$0.28/kWh, fixed rate: \$202 per year.
- QLD: volume rate: \$0.31/kWh, fixed rate: \$443 per year.
- SA: volume rate: \$0.44/kWh, fixed rate: \$418 per year.
- TAS: volume rate: \$0.29/kWh, fixed rate: \$397 per year.
- VIC: volume rate: \$0.30/kWh, fixed rate: \$411 per year.
- WA: volume rate: \$0.31/kWh, fixed rate: \$403 per year.

Gas pricing

Gas pricing is determined from a comparison of sources for 2024 residential gas pricing. This includes [online gas price comparisons](#) of individual state/territory and retailer specific gas rates and [AER wholesale gas price data](#). Gas pricing for 2024 is set at the following.

- AUS: volume rate: \$0.142/kWh, fixed rate: \$256 per year.
- NSW: volume rate: \$0.15/kWh, fixed rate: \$234 per year.
- ACT: volume rate: \$0.16/kWh, fixed rate: \$271 per year.
- NT: N/A
- QLD: volume rate: \$0.22/kWh, fixed rate: \$282 per year.
- SA: volume rate: \$0.19/kWh, fixed rate: \$299 per year.
- TAS: volume rate: \$0.18/kWh, fixed rate: \$230 per year.
- VIC: volume rate: \$0.13/kWh, fixed rate: \$311 per year.
- WA: volume rate: \$0.11/kWh, fixed rate: \$104 per year.

LPG pricing

LPG pricing is determined from a comparison of sources for current (2024) residential LPG bottle prices. This includes [Origin Energy](#), [Plus Gas](#), [Horizon Power](#). LPG pricing for 2024 is set at the following:

- AUS: volume rate: \$0.29/kWh, fixed rate: \$45.28 per year.
- NSW: volume rate: \$0.31/kWh, fixed rate: \$44.50 per year.
- ACT: volume rate: \$0.24/kWh, fixed rate: \$44.50 per year.
- NT: volume rate: \$0.37/kWh, fixed rate: \$48.50 per year.
- QLD: volume rate: \$0.30/kWh, fixed rate: \$46.50 per year.
- SA: volume rate: \$0.25/kWh, fixed rate: \$48.50 per year.
- TAS: volume rate: \$0.22/kWh, fixed rate: \$44.50 per year.
- VIC: volume rate: \$0.29/kWh, fixed rate: \$44.50 per year.
- WA: volume rate: \$0.22/kWh, fixed rate: \$45.00 per year.

Wood pricing

Wood pricing is determined from a comparison of multiple online wood prices across each state and territory. The wood pricing for 2024 is set at the following:

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

Petrol and Diesel pricing

Petrol and diesel pricing is derived from the [Australian Institute of Petroleum data tables](#) on pump prices for the most recent year. For conversion to kWh pricing, 9.5 kWh/Litre is used for petrol, and 10.7 kWh/Litre for diesel. The petrol and diesel prices used for 2024 are:

- AUS: Petrol \$1.90/L, Diesel \$2.02/L.
- NSW: Petrol \$1.90/L, Diesel \$2.02/L.
- ACT: Petrol \$1.90/L, Diesel \$2.02/L.
- NT: Petrol \$2.01/L, Diesel \$2.25/L.
- QLD: Petrol \$1.91/L, Diesel \$2.03/L.
- SA: Petrol \$1.86/L, Diesel \$1.99/L.
- TAS: Petrol \$1.93/L, Diesel \$2.08/L.
- VIC: Petrol \$1.90/L, Diesel \$2.02/L.
- WA: Petrol \$1.85/L, Diesel \$1.97/L.

Solar pricing

Solar pricing is derived from the state and territory pricing from [Solar Choice](#). Per kWh pricing is determined by calculating the lifetime generation of the solar panels over 30 years, solar panels now come [warranted at lifetimes up to 40 years](#), with others at 25 years and 30 years. One replacement inverter is included at \$2,000. Degradation is assumed at 0.5% per year.

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

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

The solar pricing used by location is:

- AUS: \$901/kW, \$0.027/kWh + financing costs (weighted average of regions)
- NSW: \$831/kW, \$0.026/kWh + financing costs
- ACT: \$892/kW, \$0.028/kWh + financing costs
- NT: \$1,406/kW, \$0.035/kWh + financing costs
- QLD: \$942/kW, \$0.025/kWh + financing costs
- SA: \$937/kW, \$0.027/kWh + financing costs
- TAS: \$1,239/kW, \$0.038/kWh + financing costs
- VIC: \$867/kW, \$0.029/kWh + financing costs
- WA: \$978/kW, \$0.023/kWh + financing costs

Battery pricing

Battery pricing is determined from a comparison of online battery prices from [Solar Choice](#) and [Solar Quotes](#). Installed battery pricing is assumed at \$1,200 per kWh. Battery operational lifetime is assumed at 15 years, with degradation down to 60%. Batteries often come warranted for at least 10 years of operation, and some already have 15 year warranties.

Appliance pricing

Appliance pricing is derived from a detailed online pricing comparison of available products in Australia. A comparison of 10-20 different available products were made to develop pricing estimates, including from different stores. Installation pricing is less openly available for comparison, the installation costs used are derived from online installation cost estimates in addition to on the ground pricing estimates from installers reported directly.

Appliance lifetimes are assumed at 15 years per device.

Space heaters

- Heat pump (7kW) pricing per heater: \$1,700 per device; \$800 per install.
- Gas/LPG pricing per heater: \$2,290 per device; \$480 per install.
- Resistance heaters per device: \$190 per device; install n/a
- Wood fire per device: \$1,900 per device; \$1,000 per install.

For household comparison scenarios, the power output of different devices is compared to determine how many of each device can be replaced with

another. Resistance/ bar heaters are often around 1-2kW, so it is assumed that one 7kW heat pump replaces three resistance heaters. Wood fires can be 15kW individually, so it is assumed that two heat pumps are needed to replace one wood fire. One heat pump is assumed to replace a gas/LPG heater one for one. A different number of necessary heating devices is assumed for an average size home in each region. For Australia nationally, this is two heat pumps. NSW: 2, ACT: 3, NT: 0, QLD: 1, SA: 2, TAS: 3, VIC: 3, WA: 2.

Water heaters

- Heat pump water heater: \$3,500 per device; \$1,600 per install.
- Resistance tank water heater: \$1,200 per device; \$600 per install.
- Gas/LPG instant water heater: \$1,300 per device; \$700 per install.

Cooktops

- Resistance/ceramic cooktop: \$500 per device; \$390 per install.
- Induction cooktop: \$1,200 per device; \$540 per install.
- Gas/LPG cooktop: \$500 per device; \$430 per install.

Vehicle pricing

Vehicle pricing is determined from a detailed comparison of over 25 popular vehicles in the Australian market, compared to similar sized and specified electric vehicles available in Australia. The average price of a new petrol vehicle used is \$40,700 and the average price of a new electric

vehicle used is \$57,500. One electric vehicle charger is assumed per home at \$1,000 per device and \$1,000 per install. Vehicle lifetimes are assumed at 15 years.

Historic pricing and forecast pricing

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

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

Solar

Historic solar pricing in Australia is sourced from the solar pricing indexes provided by [SolarChoice](#). Where data is not available further back in time, the global module price for solar is used as an index for the [Australian price of the closest year](#). Solar forecast pricing includes the sunseting of the Australia STC rebate for solar, and solar pricing forecasts are indexed by the [National Renewable Energy Laboratory Residential PV ATB Advanced forecast](#) with acknowledgement that forecasts for renewable energy have consistently underestimate the pace at which renewable energy falls in price with economies of [scale](#).

Battery

Battery price history is based on a study by [Ziegler, M. S.; Trancik, J. E.](#) adjusted to current Australian battery prices.

Forecast battery prices are based on the [National Renewable Energy Laboratory Residential Battery Storage Advanced cost forecast](#) which is used as an index and adjusted to Australian battery prices.

Heat pumps

Heat pump price forecasts are based on the [International Energy Agency Sustainable Development Scenario heat pump price trajectory](#).

Electric vehicles

Electric vehicle price forecasts are based on an index derived from [Bloomberg NEF](#) adjusted to Australian EV prices today.

Financing and interest rates

The primary financing rate used for purchases is 5.5%pa. The finance terms used are 15 years for appliances, batteries, and vehicles, representative of their expected or warranted lifetimes, and the finance term used for solar is 30 years with solar panels now available with warranties covering this time period.

Macroeconomic numbers and job numbers

This paper uses household and vehicle energy use data at a per machine level (e.g. energy use per gas water heater, or per petrol car), combined with up to date energy pricing and product pricing, to understand the individual machine economics of electrification in Australia's housing stock. This includes the operating costs (e.g. the gas, electricity, or petrol bills paid to operate that machine), the product replacement costs (the costs to replace like for like, or to replace a fossil fuel option with an electrified option including installation costs), and the finance costs associated with paying off the product over its finance term. Fixed connection costs are included for gas, LPG, and electricity, including a cost to disconnect from gas or LPG and the associated savings each year.

These individual machine energy economics are then combined with an estimate of the current machine adoption rates across the housing stock of Australia including of specific regions where applicable (e.g. postcodes, LGAs, states and territories). For example, how many homes are predicted to currently have gas water heaters, and how many homes have petrol vehicles. This creates a snapshot of current energy economics for homes, which is reconciled against petrol and diesel imports and energy flows across the economy.

S-curve adoption rates to reach a fully electrified economy are then modelled, and for each machine two scenarios are compared. A scenario where the machine is replaced with another one of the same type, for example a petrol car is replaced with another petrol car, and the electrified scenario where the petrol car is replaced with an electric car.

The same for all fossil fuel machine types. Solar and battery installations, though not "machine replacements" also have an adoption curve calculated. These curves determine how many of each machine are replaced/installed each year across the economy.

For solar, batteries, electric vehicles and heat pumps, we then model the predicted costs with economies of scale based on international learning rate forecasts adjusted to Australian pricing for each item. The cost differences for each machine decision are then determined for each year going forward, both opex/operational and upfront cost differences. These then determine a baseline savings per year for each electrification choice, which is applied to the adoption curves. We base the rate of inflation of product prices on the Australian CPI history from 2000 to 2024. Energy inflation rates are determined by the respective category rate of inflation. The numbers presented are "real" 2024 dollars and not "nominal" for the year 2040 and for cumulative savings.

Combined, these create national capex and opex curves mapped to the adoption rates, Showing the net saving from avoiding fossil fuel costs and saving on grid electricity costs both yearly and cumulatively over time. This creates the final macroeconomic charts and numbers. Job creation numbers are estimated at 5.90 jobs per million dollars saved annually, 2.3 direct and 3.6 indirect. In addition to 3.70 jobs created per million dollars of additional spending on installation work (e.g. installing solar and installing electric vehicle chargers), with 1.5 being direct and 2.2 being indirect.

Subsidies

The macroeconomic numbers used in this model include the sunset/conclusion of the STC rebate scheme after 2030. The STC price is set at \$39.85. State or LGA based subsidies are not included in the calculations.