

CASTLES & CARS

SAVINGS IN THE SUBURBS THROUGH
ELECTRIFYING EVERYTHING

D I S C U S S I O N P A P E R



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ACKNOWLEDGEMENT OF COUNTRY

In the spirit of reconciliation
Rewiring Australia acknowledges
the Traditional Custodians of
country throughout Australia and
their connections to land, sea and
community. We pay our respect to
their Elders past and present and
extend that respect to all
Aboriginal and Torres Strait
Islander peoples today.



ABOUT REWIRING AUSTRALIA

In 2019 Saul Griffith and Alex Laskey founded Rewiring America [www.rewiringamerica.org] to increase the U.S. climate policy ambition. Their strategy is to shift the climate narrative from one of sacrifice to one of practical solutions and savings. Rewiring America works alongside the Whitehouse and the U.S Senate to achieve Biden's ambitious climate agenda including the "Electrify America's future resolution" and the Zero Emissions Homes Act of Senator Martin Heinrich. In late 2020, Saul used tools initially developed with the U.S. Department of Energy to model US energy flows and futures, and applied these to the Australian market.

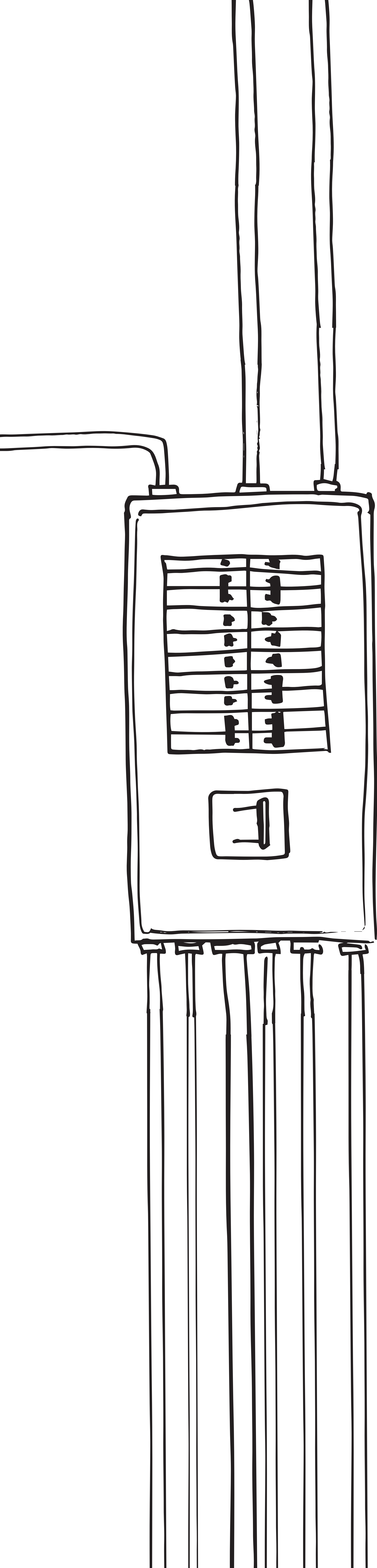
In 2021 The Australia Institute partnered with Saul and analyst Josh Ellison to complete the work of articulating and communicating the abundant commercial and environmental opportunities a rapid transition to clean electrification presents in Australia.

Rewiring Australia is launching in September 2021 and will align with the Glasgow climate conference. It is supported by an optimistic group of non-partisan Australians to collectively narrate and illustrate the positive outcomes possible for Australia, and the world, in transitioning to rapid decarbonization using an "Electrify Everything" strategy.

ABOUT DR. SAUL GRIFFITH

Born in Australia, Saul is an author, inventor and entrepreneur. Saul has a Ph.D. from Massachusetts Institute of Technology and degrees from UNSW and University of Sydney. His first two industrial jobs were in a steel mill and an Aluminum smelter. Saul has founded numerous technology companies based in San Francisco in Renewable Energy and Robotics. Saul has been the principal investigator on over \$65 million dollars in DOD and DOE research projects. In 2007 Saul was awarded a Macarthur Fellowship, the so-called 'Genius Grant', for inventions in the service of humanity.





CASTLES AND CARS:

SAVINGS IN THE SUBURBS THROUGH ELECTRIFYING EVERYTHING

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SUMMARY

CASTLES AND CARS : SAVINGS IN THE SUBURBS THROUGH ELECTRIFYING EVERYTHING



The technical study summarised in this paper modeled the energy, financial and emissions impacts of whole-household electrification in Australia. Led by Dr Saul Griffith, this research builds on the leading work by Rewiring America which is used in designing climate policy with U.S. Senators and the Biden administration.

All of Australia's reported emissions were summarised in a Sankey diagram that shows that Australia's 10 million households are responsible for the largest portion (~42%) of our domestic emissions, with 33.5% attributed to home energy and personal vehicle usage.

The model considers detailed household energy and vehicle use data (by state) and projects the capital and operating costs of the electrified substitution technologies each year through to 2035. Price and performance improvements of rooftop solar-PV, batteries, EVs and 8 key household appliances are modeled through the same period with known cost-reduction learning curves. A financing model is used to compare existing household energy costs with future costs that include the financed replacement items and ongoing fees.

This report shows that with appropriate financing of the purchase cost, these technologies will provide lower annual expenses than conventional technologies for virtually all households by 2024. By 2030, Australia's households could be saving over \$40 billion a year, which is close to - and in future could overtake - our export earnings from coal.

The most economical path to powering our everyday lives is to significantly increase rooftop solar take-up and fully engage the associated storage capacity in vehicles, house-batteries, and thermal systems,

including hot water. Roughly 3 million Aussie homes already have solar power infrastructure on their roofs and are receiving some of the lowest costs of delivered electricity in the world.

The Average Australian household currently uses just over 100kWh of energy, including the energy lost in thermoelectric power generation and the energy required to power personal vehicles. If all users switched to electric solutions, this drops to only 37kWh and can be nearly completely satisfied with a 10-12 kW capacity solar installation and a compatible battery.

The technical potential of Australian rooftop solar is 179GW(DC) or 245 TWh per year. Residential alone is 96GW, or 130 TWh, which is very close to the 135 TWh of yearly electricity required for 10 million 37kWh Aussie homes.

Cars are the largest contributor to household emissions and energy cost, accounting for 38% of household emissions and averaging ~\$3,000 per household in annual fuel expenses.

By 2030 Australian families could be saving \$5,000 per year by replacing their current cars with electric vehicles, switching their natural gas heating systems (water heating, space heating, or kitchen) to electric heat pumps, and furnishing their electricity with solar from their rooftops. Economics can be improved further with weatherization, LED lighting, and other efficiencies.

If this shift is embraced right now and we replace current machines with zero-emission alternatives (from heaters, to cars, to power plants), we can win the global race for decarbonisation and keep track with emissions trajectories commensurate with a 1.5 degree world.

1. <https://www.rewiringamerica.org/policy/household-report>

2. All non-export related emissions.

3. <http://cleanenergyregulator.gov.au/RET/Forms-and-resources/Postcode-data-for-small-scale-installations#Small-generation-unit-SGU-installations>

4. https://www.cefc.com.au/media/402125/isf-rooftop-solar-potential-report-final_.pdf



WE MUST ACT NOW (AND WE CAN)

Australia signed up to the 2016 Paris Agreement which commits us to help limit global warming to 2°C/3.6°F, and aims for 1.5°C/2.7°F. Our lived experience of bushfires and extreme weather events shows how fast the climate is already changing. To save iconic landmarks like the World Heritage-listed Great Barrier Reef, we need to target as close to 1.5 degrees of climate warming as possible. This target is necessary and meeting it will require leadership, optimism and a clear plan.

Australia must halve its emissions by 2030 (IPCC 2018). New technologies are not the answer, nor is hoping the issue will go away. We need to embrace solutions that are already on the table, which fortunately are sound and effective.

Encouragingly, this report confirms that many of the technologies that we need to hit zero emissions are becoming increasingly affordable. Even better, the proposed solutions will save households money on their energy and fuel costs. If we treat the 2020s as a race to electrify the household and personal vehicle sector, Australia could reach zero emissions for transport and appliances by 2030. This will certainly set us up for a safer and more sustainable climate.

There is no denying there has been much talk of waiting for breakthrough technologies. For example, the IPCC AR6 report relies heavily on enormous, and unproven, amounts of negative emissions later this century in its two best-case scenarios (SSP1-1.9 and SSP1-2.6). Negative emissions technologies are not

yet proven to reliably remove carbon from the atmosphere at scale and it may be unrealistic to think they will in the coming decades. Even if they can, their deployment may cause conflicts with other critical land-uses including food production.

We know from studies of committed emissions that existing fossil fuel-powered machines will consume enough fossil fuels in their lifetimes to take us well beyond 1.5 degrees. This includes our coal and natural gas power plants, personal vehicles as well as household and commercial heating systems. Using existing solutions to reduce climate change should be the priority, not inventing new “future” technologies.

The electrification of our appliances, heating systems, and vehicles, paired with the provision of cleanly produced electricity to power them, provides much of the roadmap to a safe climate. In the best-case scenario, starting today, every time we retire a machine (from a heater, to a car, to a power plant) we replace it with a zero-emissions alternative. This practice is known as a 100% clean replacement rate. Renewable energy technologies are ready, and will do the job, if we employ them right away.

The sector of our economy that is poised to decarbonize first and fastest are our own households: our castles and our cars. It presents a perfect opportunity for a classic Australian public-private partnership between government, labor, business and finance.

AUSTRALIA: THE LUCKIEST COUNTRY

Australians love their country and their castles. Government policies that are sympathetic to this sentiment are part of the reason we measure very highly in global quality-of-life comparisons. We can, and should, lead the world with residential electrification because we will save more money from it than other countries, and we will realise those savings sooner and it will benefit our castles.

Our abundant solar energy and favorable regulatory environment has us leading the world in rooftop PV in both costs and penetration. The majority of households are already familiar with heat pumps for water and space heating and cooling. With each year the variety, cost, and range of electric vehicles only becomes more attractive and the notion more socially acceptable.

For some Aussie households total electrification is an economic slam-dunk today. For others only some components work economically in 2021. This study looks forward to analyse the falling costs and rising performance of all of these zero-emission technologies, especially batteries, EVs and heat pumps, and can predict that in around 2024-25 the zero carbon transition will be not only be affordable to all, but save money for every household, provided we enable appropriate financing methods and build supply chain and installation capacity.

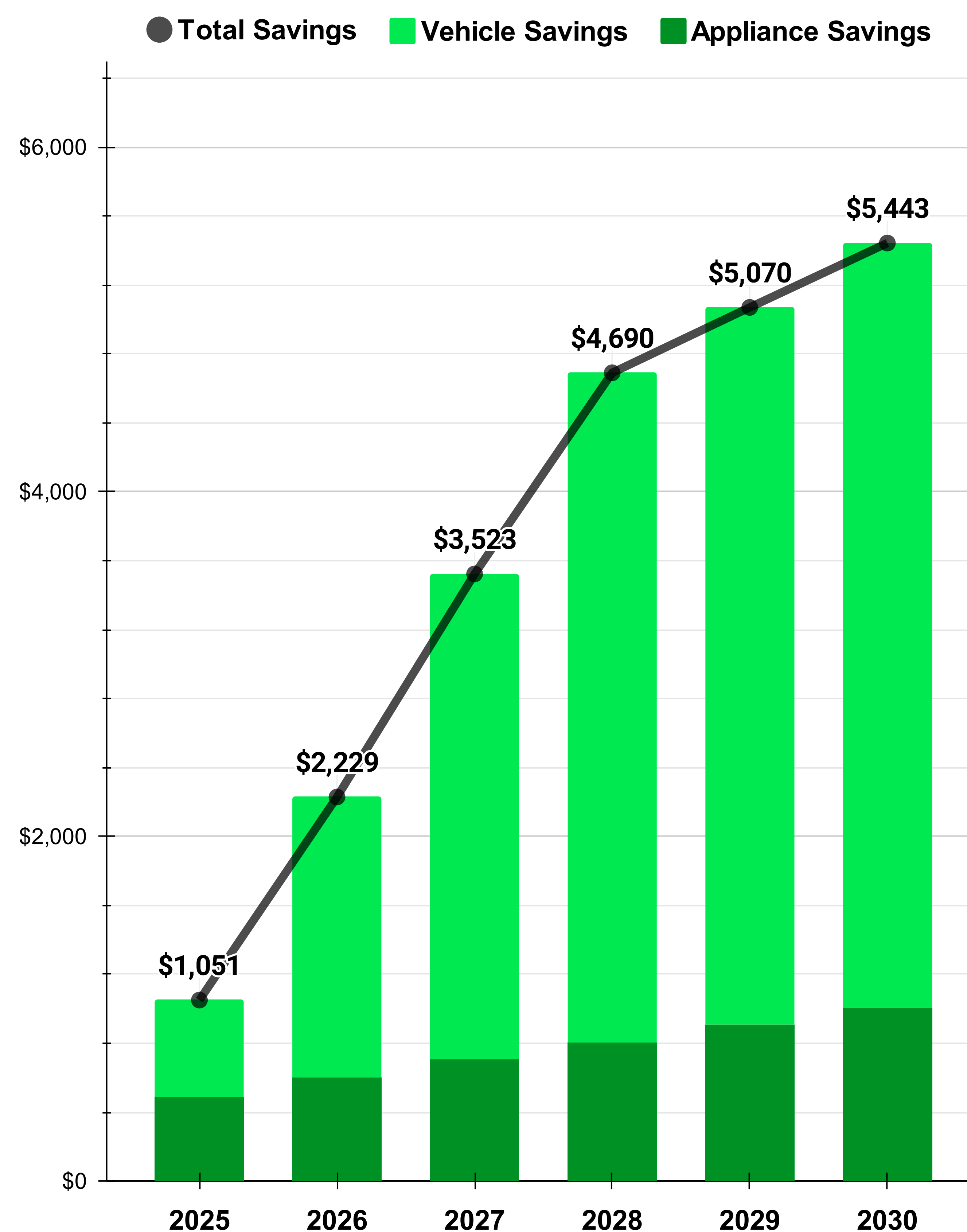
Electrified end use machines – cars, kitchen ranges, water heaters, and heating systems – are typically cheaper to operate, but more expensive to purchase. Finance is clearly a piece of the puzzle that needs to be considered and, pleasingly, major banks are now providing consumer financing for these goods. The banks aren't stupid. They know that by 2030 the average Australian household could save \$5-6,000 per year on energy and vehicle fuel costs relative to 2021.



Investing further in solar and connecting it to our everyday lifestyle items is the simple recipe for decarbonising our domestic economy. Technological solutions are now ready and falling in cost so fast that we'd be crazy not to capitalize on this national opportunity. Indeed, by leading the world in this grand integration project we will raise the rest of the world's ambition on climate goals, redeem our own climate reputation, and generate the technology companies of tomorrow.

Household Savings from 2025 with Electrification of Average Australian Household

Forecast yearly savings from replacement of conventional technology with solar, battery, appliances, and electric vehicles.



8. https://en.wikipedia.org/wiki/Where-to-be-born_Index#2013_rankings

9. Assuming a ~8kw system, 25 year lifetime, \$1.00/installed W, and 4% financing cost, delivered cost of electricity is ~6-7c/kWh.

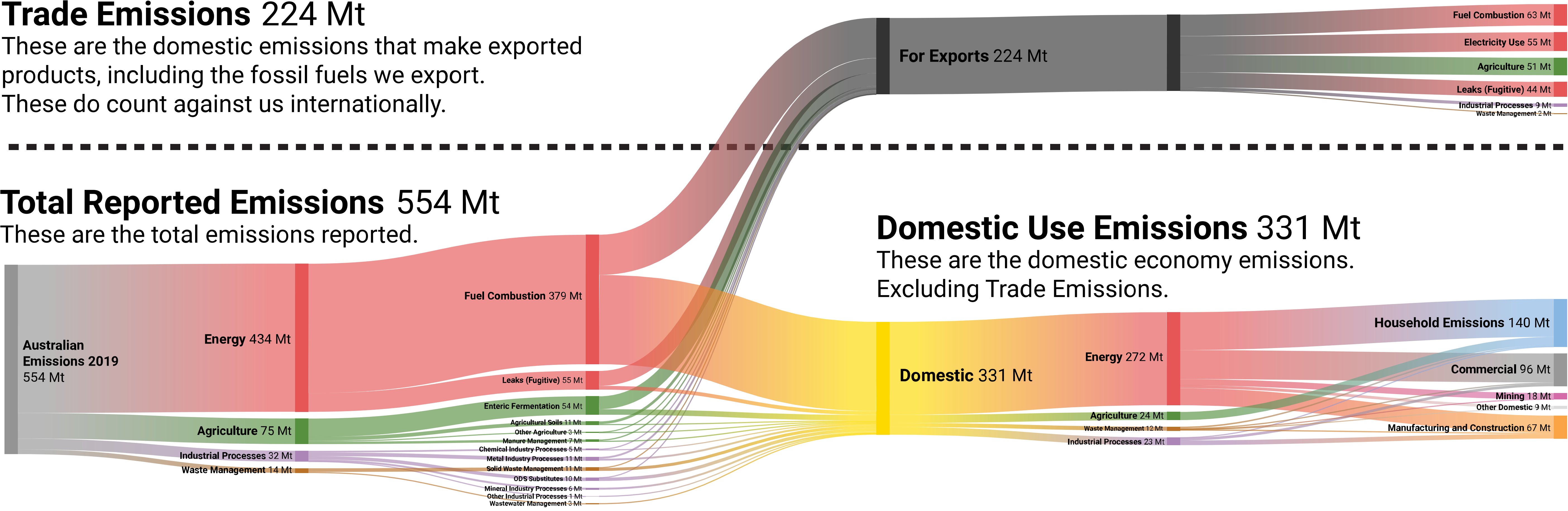
ELECTRIFYING AUSSIE HOUSEHOLDS IS THE KEY

Trade Emissions 224 Mt

These are the domestic emissions that make exported products, including the fossil fuels we export. These do count against us internationally.

Total Reported Emissions 554 Mt

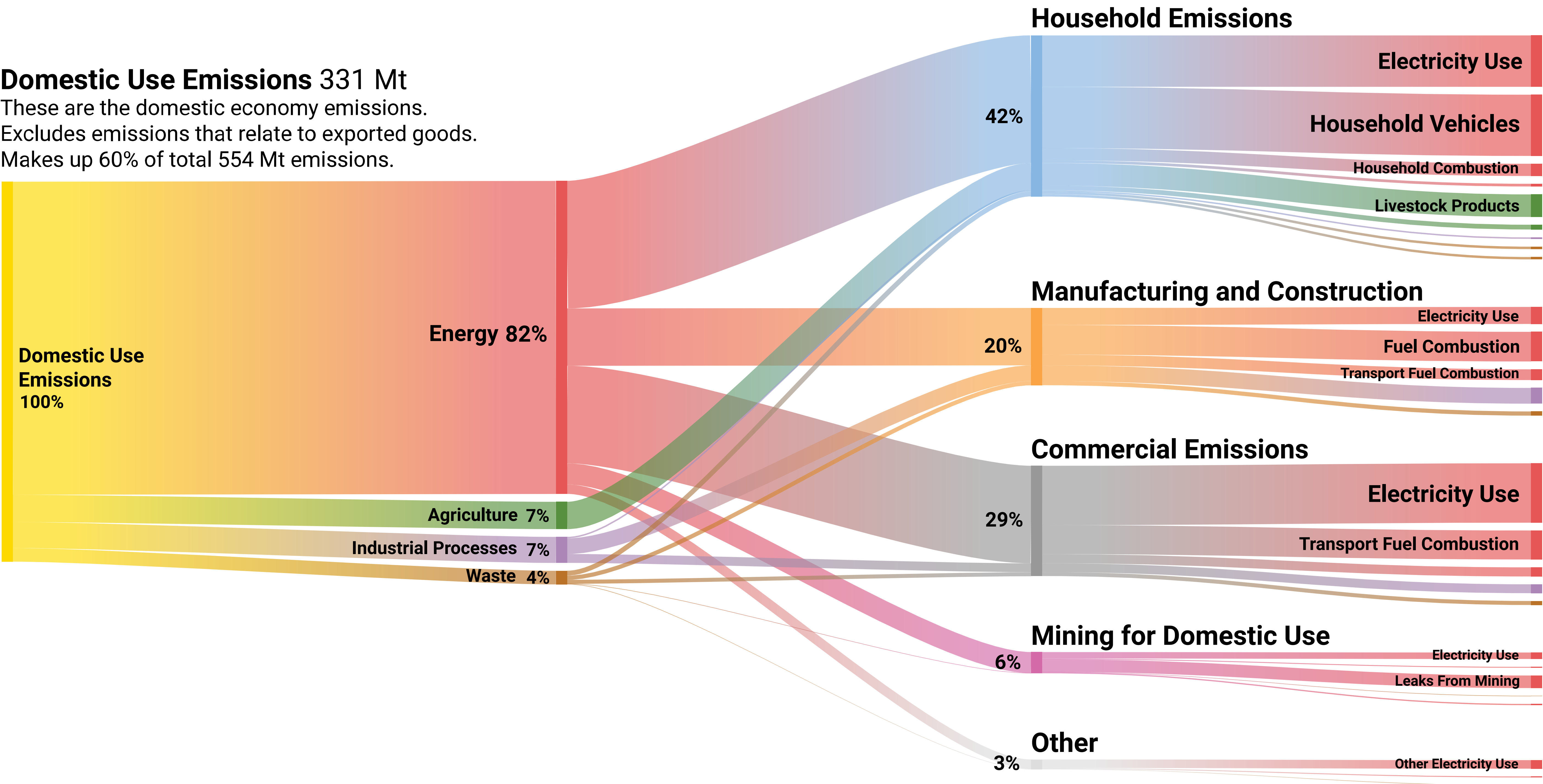
These are the total emissions reported.



We have represented Australia's domestic emissions data in a way that enables us to think about domestic economy decarbonization separately from export economy decarbonization. We separate out 3 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, and (3) the emissions associated with our fossil fuels being burned in other countries that do not count as Australian emissions under agreed international carbon accounting rules.

Domestic Use Emissions 331 Mt

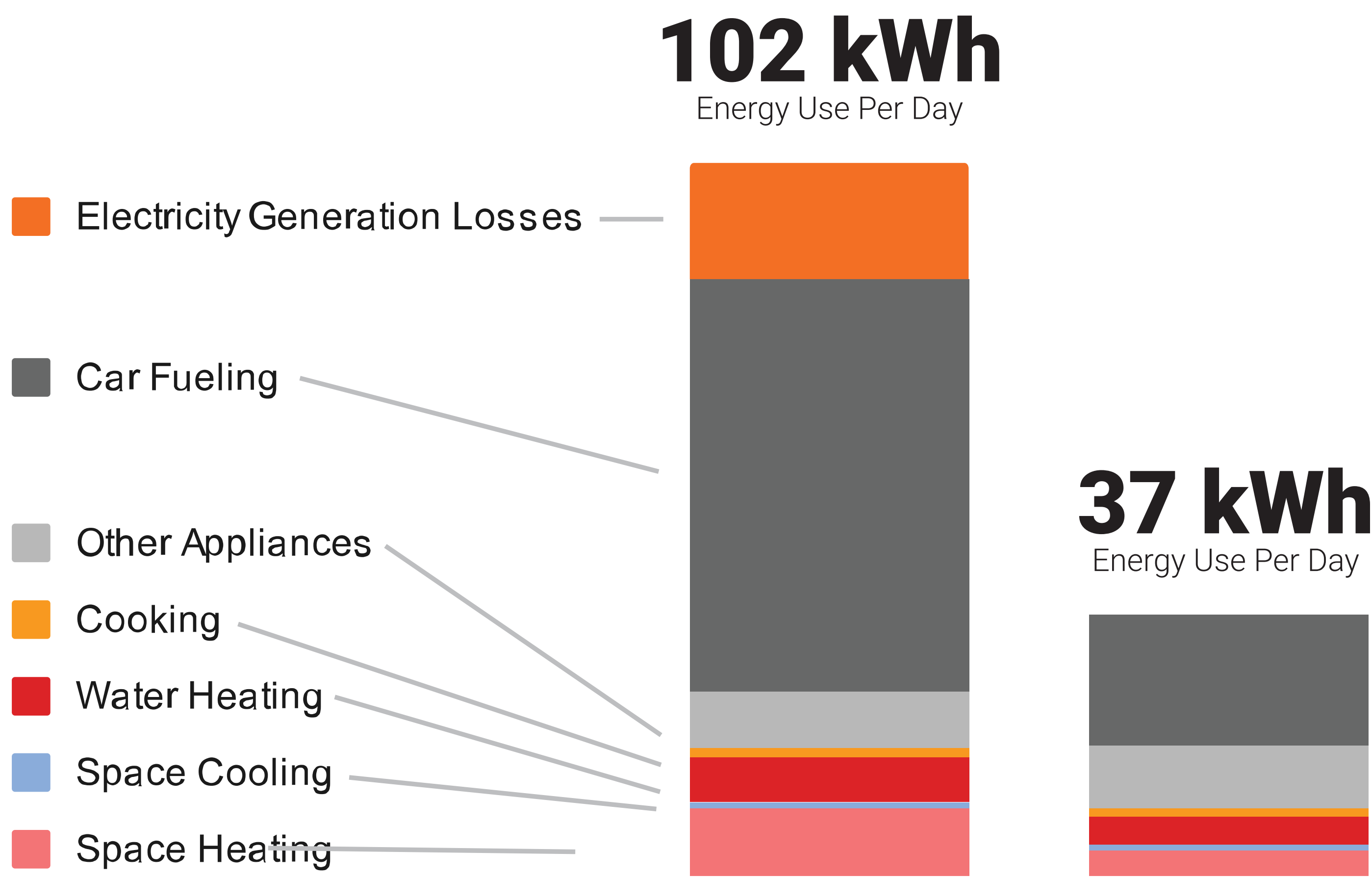
These are the domestic economy emissions. Excludes emissions that relate to exported goods. Makes up 60% of total 554 Mt emissions.



This categorization is useful for a few reasons, principally that the stakeholders and decision makers are very different, also that the solution set and technological readiness are quite different. The majority of emissions in our domestic economy are a result of decisions and purchases made by our individual households and small businesses. It represents a huge number of stakeholders (10,000,000 households) and physically represents a very large number (approximately 100,000,000) of small machines (cars, water heaters, space heaters, kitchen appliances) that are significant capital expenditures to the individual households. These emissions are broken down in the second Sankey diagram in further detail and are the focal point of this study as they can be addressed with technologies that exist today.

The emissions associated with creating our export economy have a smaller number of larger stakeholders, namely the government and corporations. These emissions come from a small number of high-capital, large “machines”— things like smelters, freight rail systems, mining equipment and export terminals. These are also critical to decarbonize and find zero-emission substitutions for, but are not yet ready to go to scale nor as close to economic parity solutions for our households.

AN ELECTRIFIED HOUSEHOLD IS A CHEAPER AND LESS WASTEFUL FUTURE FOR US ALL



AVERAGE HOUSEHOLD

CURRENT “AVERAGE” AUSTRALIAN HOUSEHOLD

The “average” Australian household currently uses ~102kWh of energy per day, and spends \$5,248 per year on energy related costs. Much of this energy use is due to the inefficiency of conventional fuels like natural gas and petrol for cars, which also create a large amount of emissions.

These fuels are both expensive and highly polluting. The average household annually releases 11 tonnes of CO2-e into the atmosphere from its energy use activities.

ENERGY EMISSIONS

11,000 Kg
CO2-E GREENHOUSE GASES PER YEAR

ELECTRIFIED HOUSEHOLD

ELECTRIFIED “AVERAGE” AUSTRALIAN HOUSEHOLD

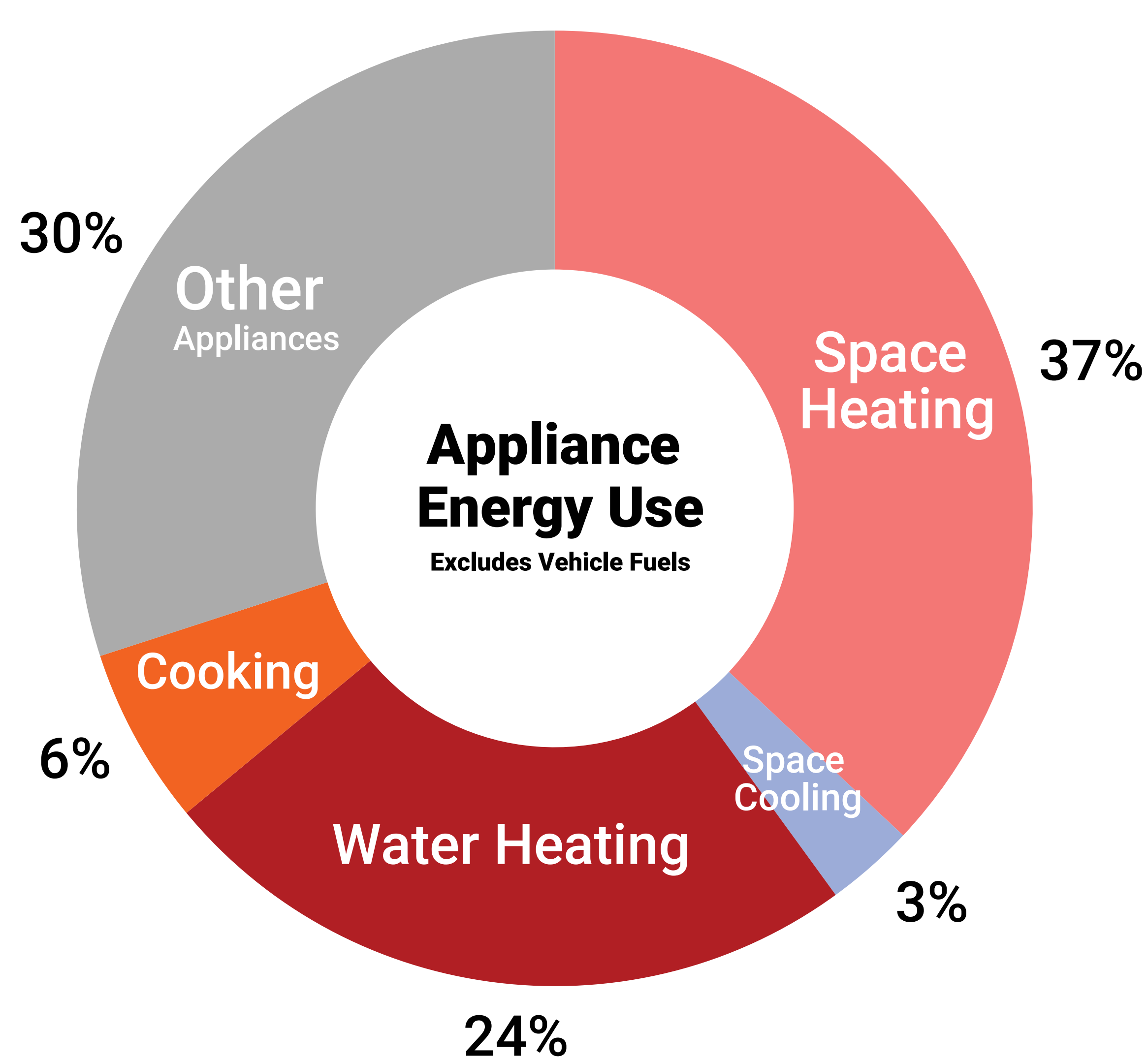
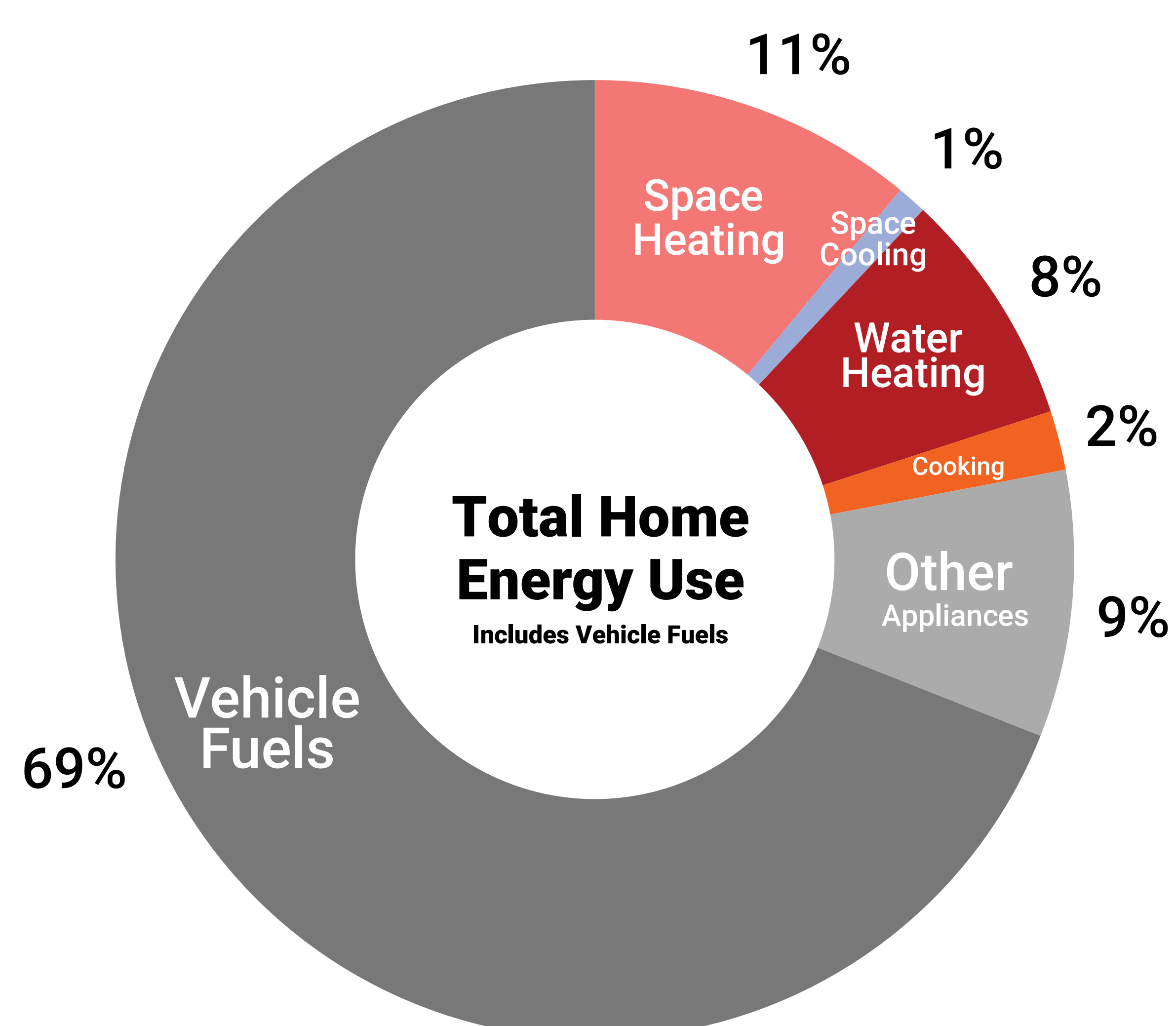
If we electrify the “average” Australian household, with solar panels on the roof, a home battery, electric vehicles in the garage, and replacement of gas appliances with efficient electric ones, we can save thousands per year in household costs for the average home by 2030.

The efficiency gains from new appliances and vehicles drops energy use significantly to ~37 kWh, and Australia’s world leading solar is cheap enough to power the house while saving money.

ENERGY EMISSIONS

ZERO

SAVINGS (2030)
\$5,433/YEAR



THE HOUSEHOLD ENERGY STORY

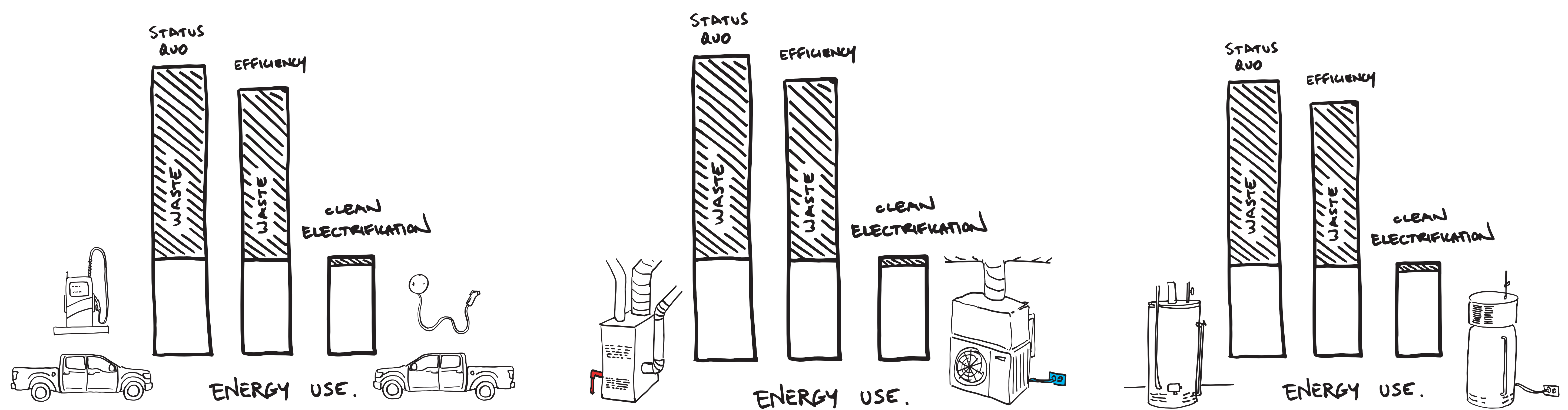
Energy use in an average Australian household can be simplified into a few different categories: space heating and cooling, water heating, cooking, vehicles, and “other” appliances (which are predominantly electric already). These “other” appliances include things like fridges, dishwashers, washing machines, dryers, computers and phone chargers.

In this report we describe the mythical “average” household. Of course in the real world every household is different, with varying numbers of occupants and vehicles and different heating needs. The “average” therefore is a base representation of households in Australia, and the money and energy savings may be more or less than the average depending on the individual real household in focus.

For reference, the “average” household has 2.6 people, and 1.8 vehicles.

When thinking about households it’s useful to think about the “appliance energy use,” which is everything in the house excluding vehicles, and also the “total energy use,” which includes both the appliances and the vehicle fuels used by the household. In the next section we break down the energy use in each of these major categories, and what benefits can be gained from the clean electrification of each.

ELECTRIFICATION EQUALS EFFICIENCY



Our domestic economy can be just as vibrant while using less than half of the energy we do now – without sacrificing anything. The efficiency is in the electrification of everyday items and in providing power via renewable energy.

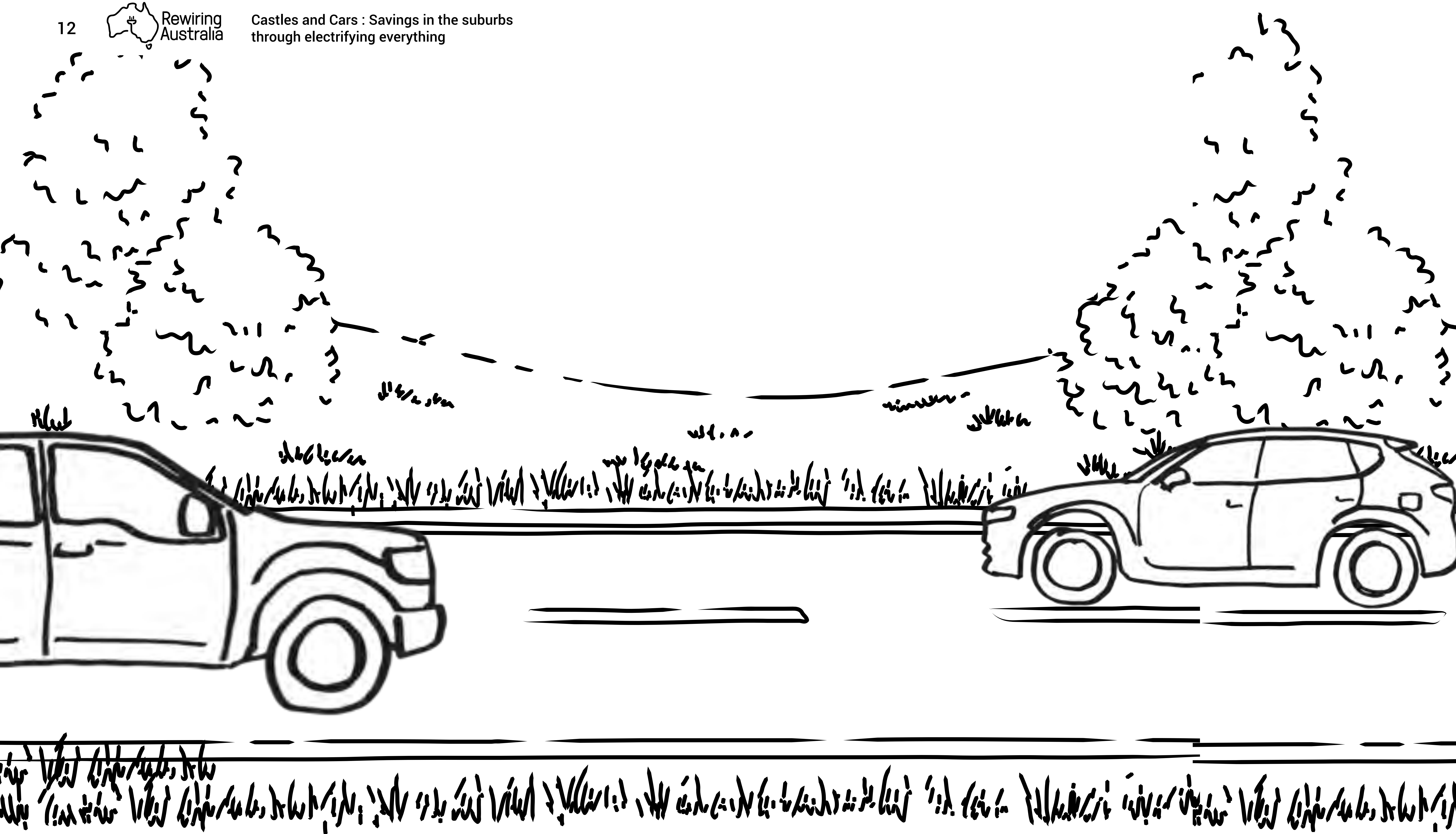
Electric vehicles running on solar or other renewable energy sources consume only 25-35% of the primary energy of their internal combustion engine alternatives. This is because engines are only about 30% efficient in burning petrol or diesel.

Water heaters or space heaters burning natural gas use about 3 times as much energy as a heat pump for the same result. A heat pump is the technology that makes your refrigerator and your air conditioning work, and can be run in a reversible or mini-split

system to also heat your home or water. Heat pumps use electricity to separate out the heat and the cold from air. They typically need only 1 unit of electricity to make 3-4 units of heat.

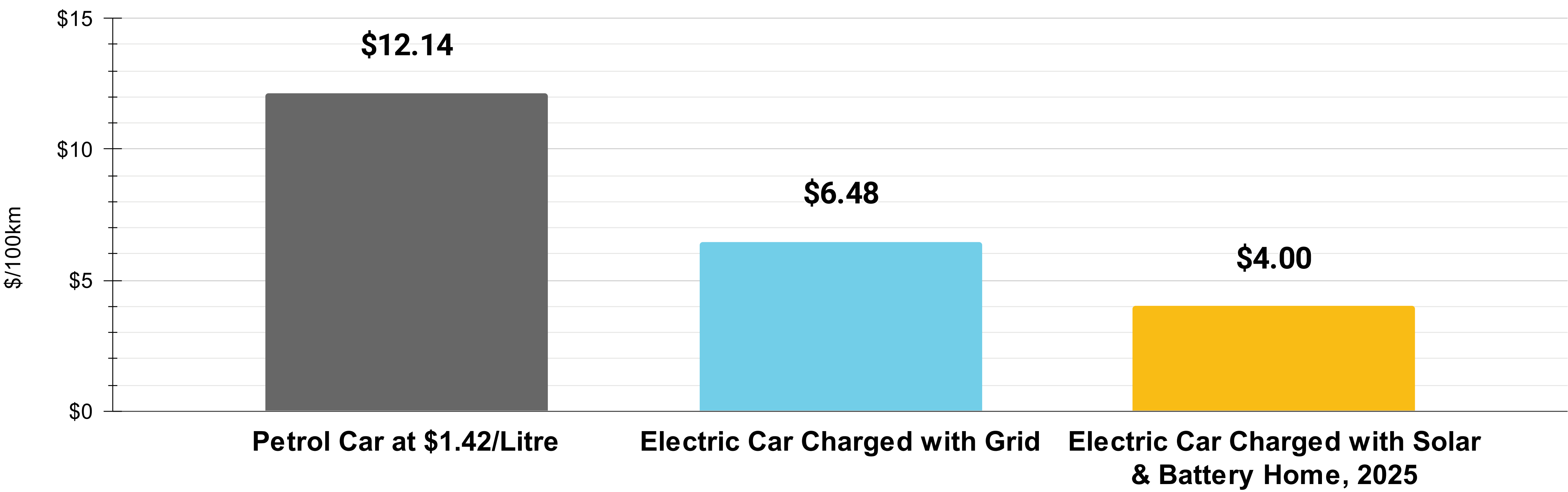
Electricity produced using coal or natural gas power plants wastes a huge amount of energy. Many coal plants are only 25-30% efficient and natural gas plants 40-45%. Producing our electricity with renewables reduces these thermo-electric losses.

A fully electrified home powered by renewables will need less than 40% of the energy of its fossil-fueled counterpart. The Australian economy can run on far less energy when we embrace the electrification of everything.



ELECTRIC VEHICLES

Cost Per 100km - Electric Vehicle versus Petrol Vehicle - Mid-Size Car



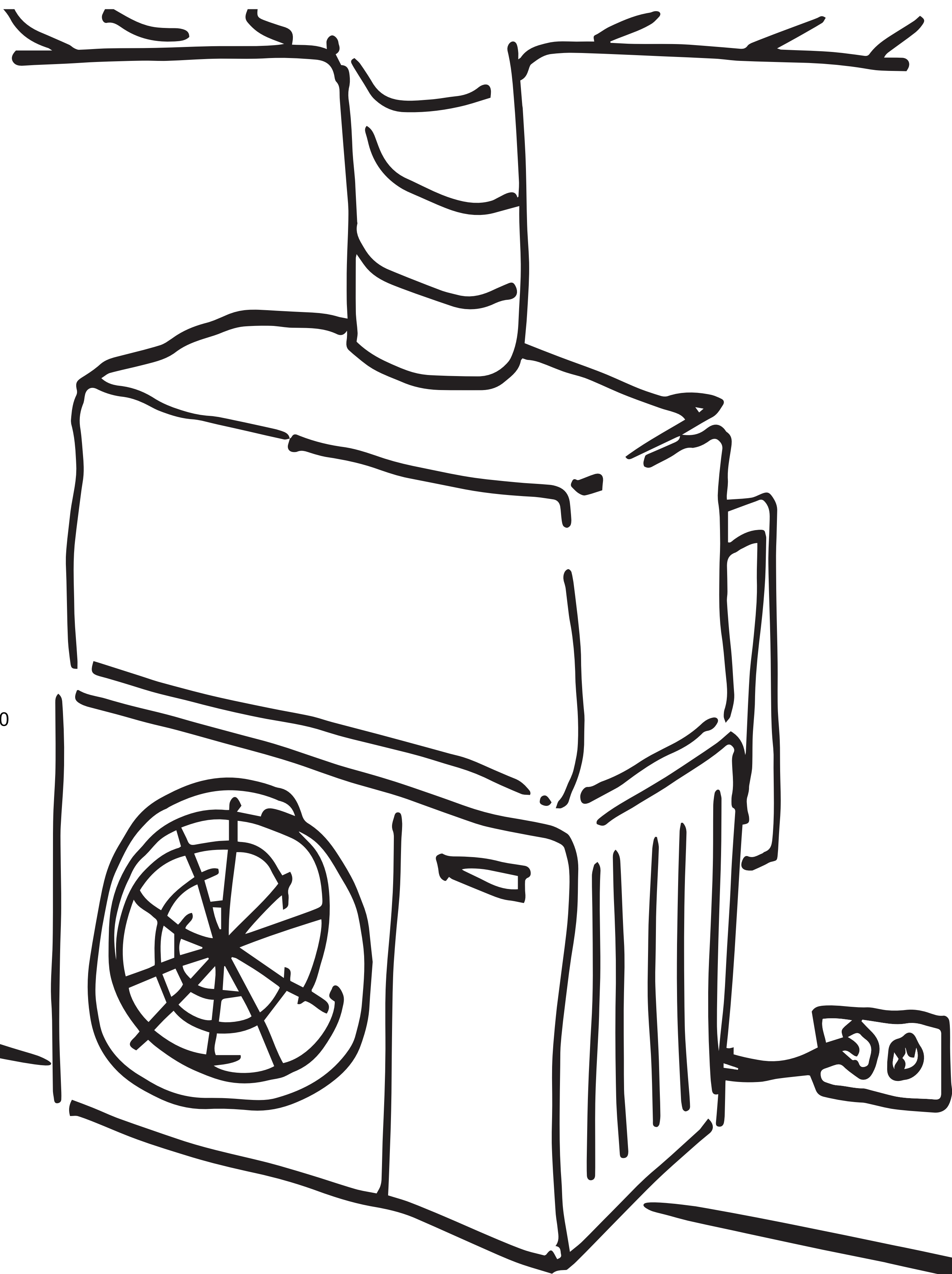
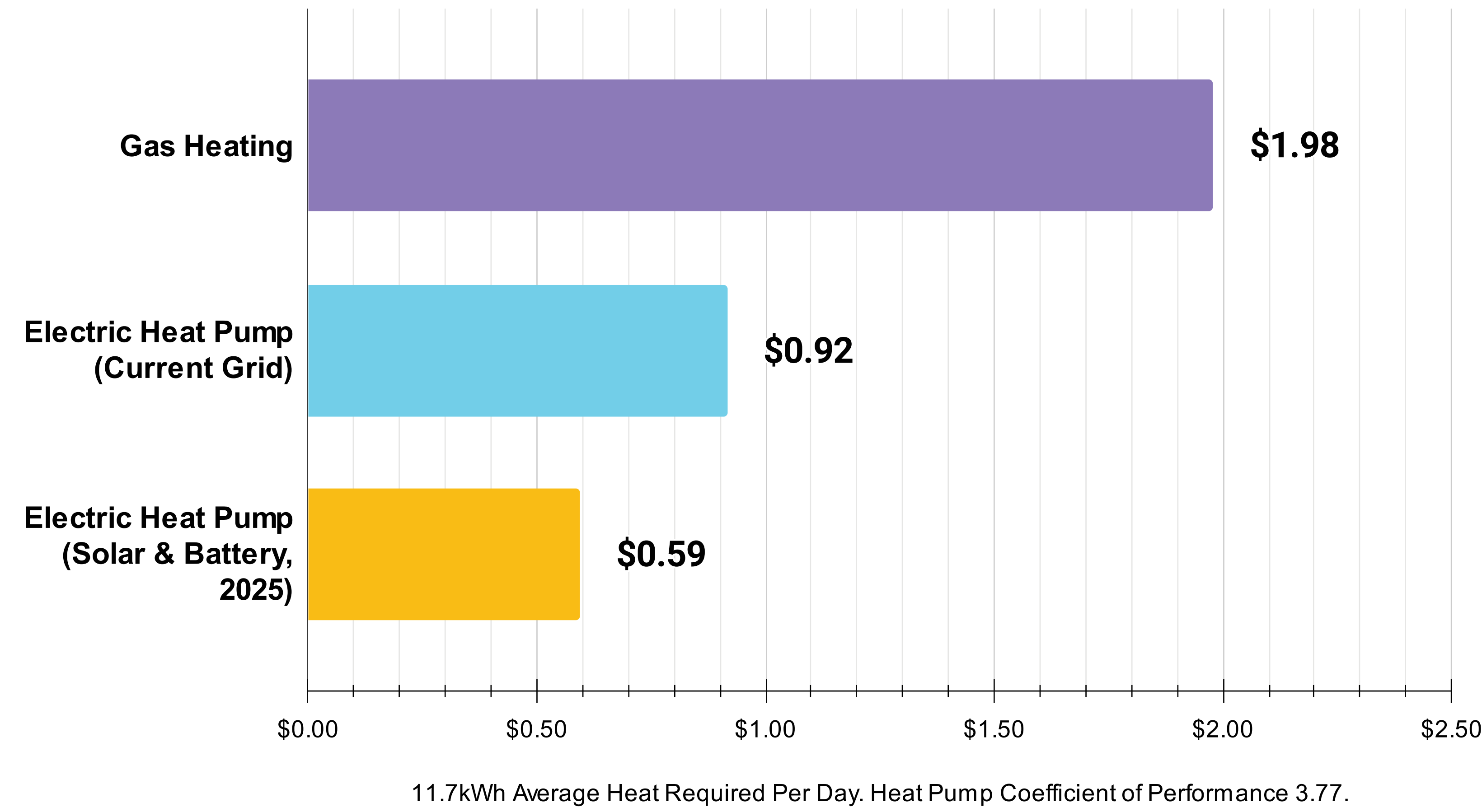
Vehicle fuel use currently dominates the average household's energy use, responsible for 69% of the total household energy use (when including both appliances and vehicle fuels.)

The average car drives approximately 12,500 kilometres per year, using a significant amount of fuel to do so. As shown in the emissions section earlier, vehicle use is the largest area of emissions in the households category, closely followed by electricity use, primarily because the current electricity is provided by a fossil fuel-powered grid. This

demonstrates how vital it is that we not only electrify our household appliances, but also our vehicles.

Electric vehicles are approximately 3.5 times more efficient at converting energy into motion, and therefore unlock significant energy savings per household, and significant long-term cost savings when fueled by (or charged with) cheap renewable electricity. Even charging an electric vehicle with the existing electricity grid will approximately halve fueling costs, and if we charge our electric vehicles with our rooftop solar and home battery, we are looking at around ~67% savings in our fueling costs.

Space Heating Average Cost Per Day, Australia.



SPACE HEATING AND COOLING

Space heating is one of the largest energy uses in the average Australian household, accounting for 37% of the average appliance load, and 11% of the total energy load when cars are included. Heating requirements differ between warm and cold states, with space heating in Victoria accounting for 58% of the appliance load, and space heating in Queensland accounting for only 8% of the appliance load.

Households stand to gain significant energy use and cost benefits from the electrification of space heating. Current space heating is done primarily with a mix of natural gas, electric reverse cycle air conditioners (heat pumps), electric resistance heating, and wood fires. If we take each of these heating methods and look at how efficiently they heat a room, it becomes abundantly clear how we can save the most energy for Australian homes.

Natural gas heating has an efficiency of approximately 0.9. In other words, every 1 energy unit of natural gas is converted to 0.9 units of heat in a room. Electric resistance heating has an efficiency of

approximately 0.95. Wood fires have an approximate efficiency of 0.75, converting 1 unit of energy in a log to 0.75 units of heat in a room.

By comparison, reverse-cycle air conditioners (heat pumps), have an approximate efficiency of a whopping 3.8 in the average Australian household. This means for every 1 unit of electricity, 3.8 units of heat in a room are created. Upgrading to an electrified home with heat pumps saves energy and money with no sacrifice in comfort.

On average, space cooling in Australia requires significantly less energy than space heating. This means Queensland and Northern Territory homes use significantly less energy on average. Our current methods of space cooling are relatively efficient, and are already practically all electric. For these reasons we can leave them as they are and will still get the cost benefits from cheaper solar electricity available in an electrified home. With rising average temperatures there will be a rise in air conditioning.

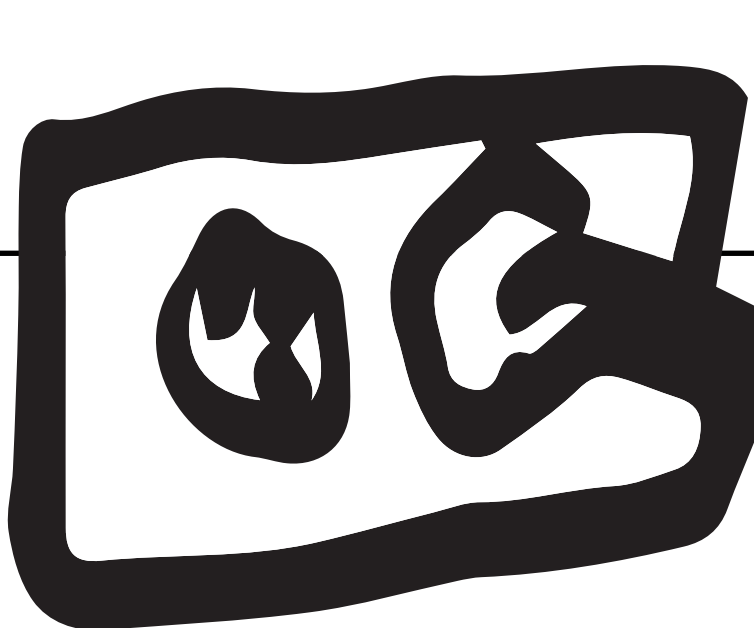
5. <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>
6. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGL_Full_Report.pdf
7. <https://www.nature.com/articles/s41586-019-1364-3>

WATER HEATING

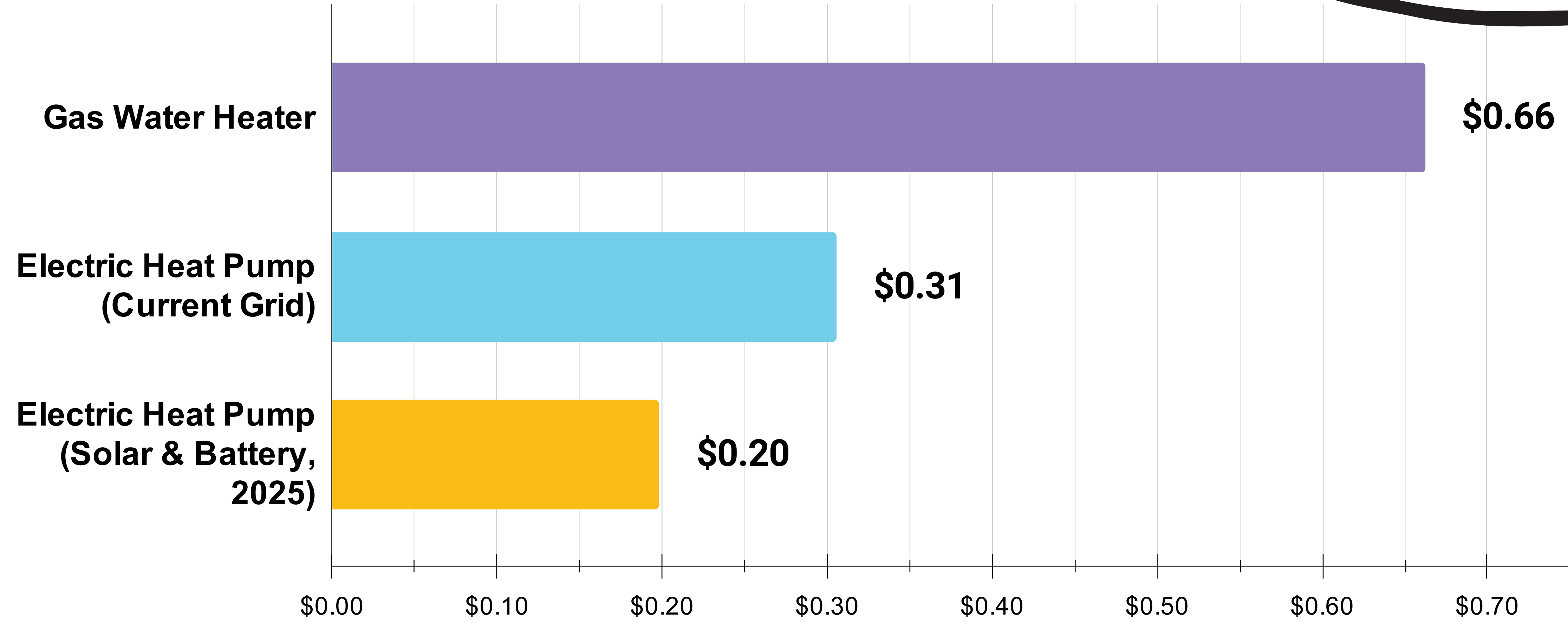
Water heating electrification, like space heating, can also save households money, energy, and emissions. Water heating is the second largest energy use of appliances in the average Australian household. It makes up 24% of the average appliance load, and 8% of the total energy use if vehicle fuels are included.

There are a significant number of gas water heaters in use in Australia. Approximately 45% of water heaters are gas, 45% are electric resistive, and the remaining 10% are a combination of solar water heaters and heat pump water heaters.

Using a heat pump water heater provides significant efficiency gains. On the existing electricity grid, the cost of water heating is roughly halved when using a heat pump compared to a natural gas water heater. With financed solar panels and a home battery providing the energy, the costs fall even lower to around 3 times less than gas heating costs.



Water Heating Cost for One Luxurious Shower, Australian Average.



Assumes 3.93 kWh of heating required, 8 minute shower at 19L a minute. Heat Pump Coefficient Of Performance 3.77

COOKING

Energy for cooking makes up approximately 6% of appliance energy use in the average Australian household, and 2% of the total energy use including vehicle fuels.

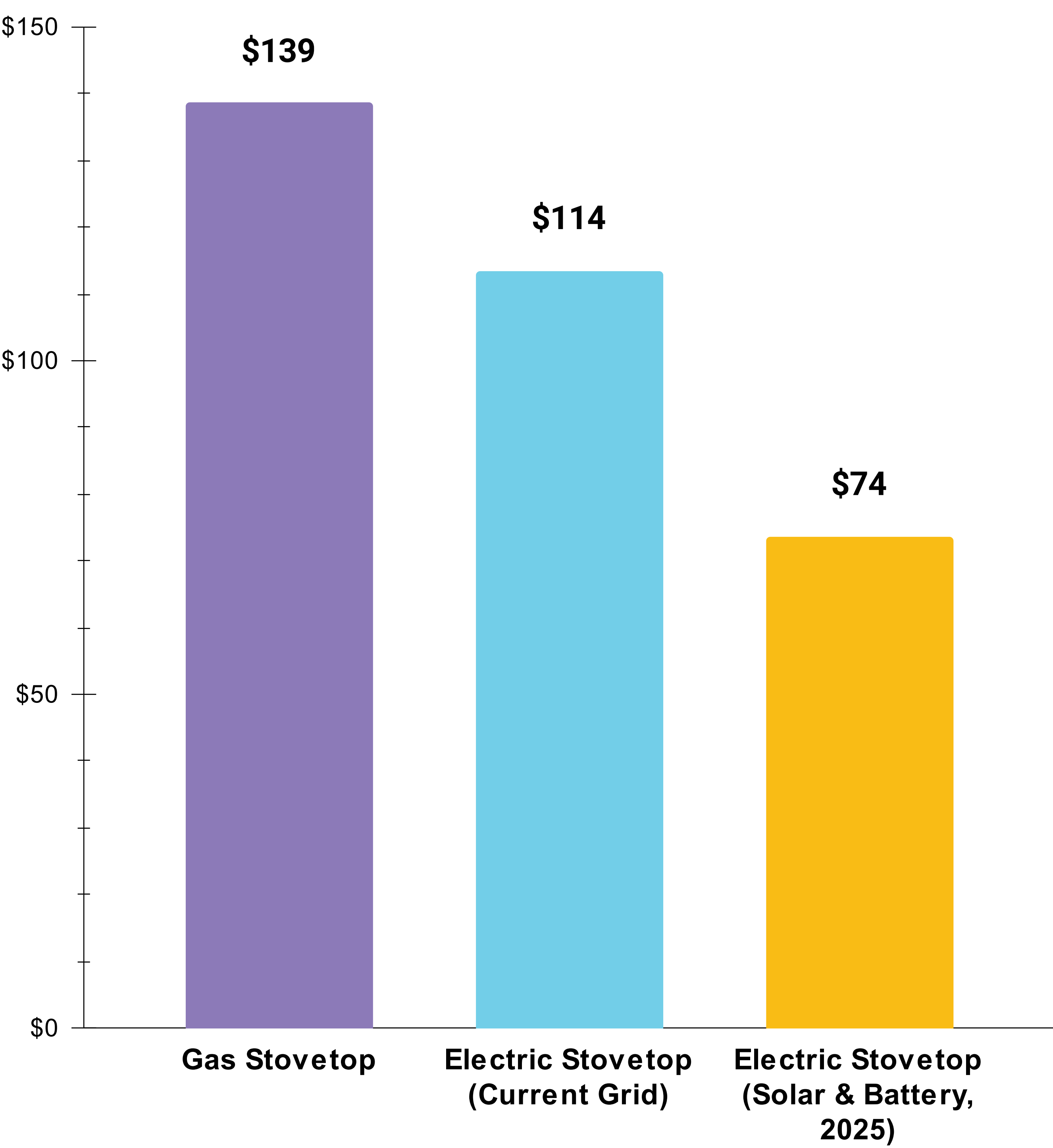
Cooking still stands to benefit from significant efficiency improvements with electrification. A gas stovetop has an approximate efficiency of 0.3, and an electric resistive stovetop has an efficiency of 0.7, or even higher for electric induction stovetops.

Many homes use gas stovetops, which can be replaced with more efficient electric stovetops.

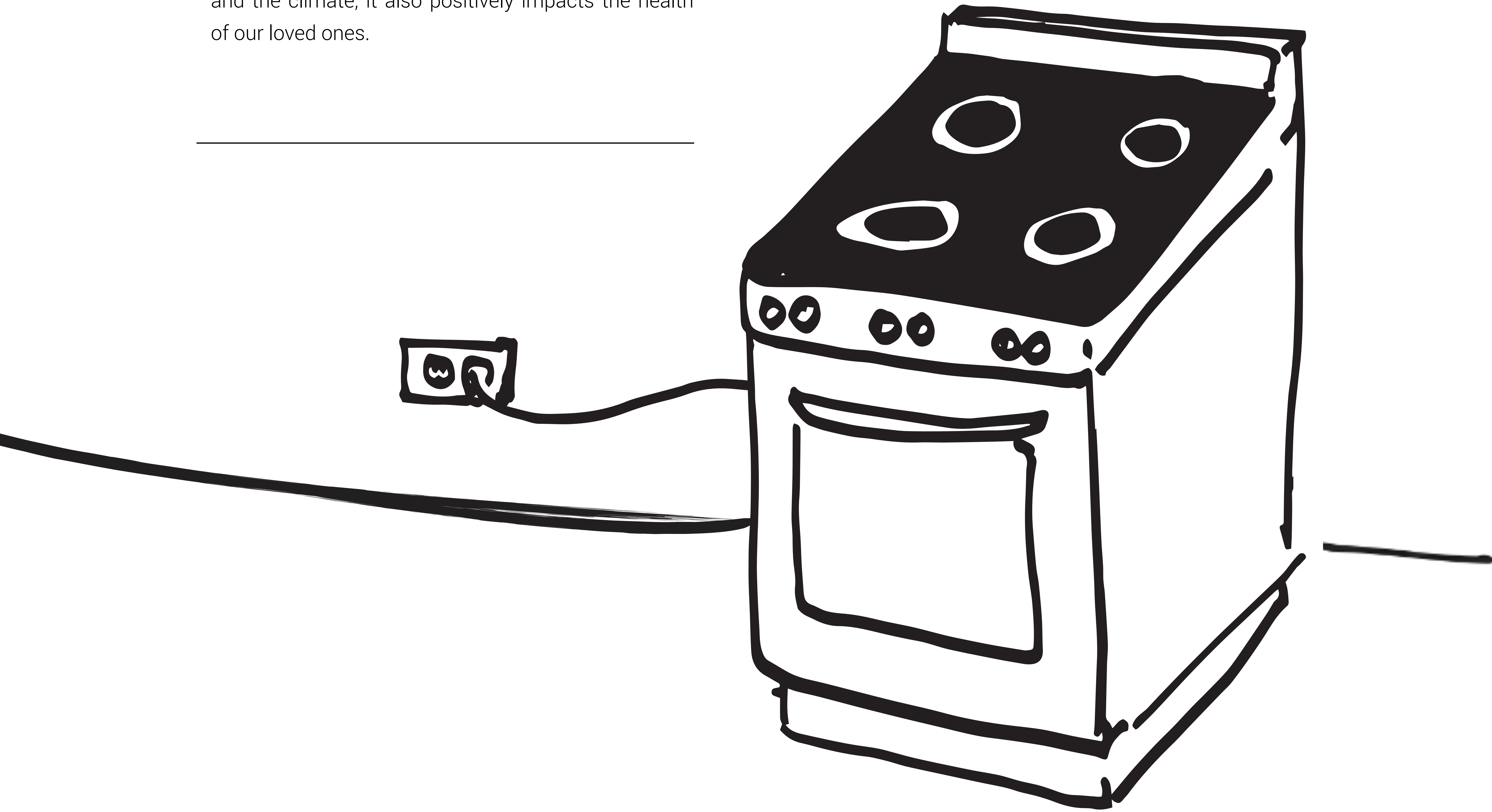
In 2021, Australia’s cooking energy use is split roughly 50/50 between electricity use and gas use.

This gas use contributes to the emissions in a household, and gas cooking has been shown to make indoor air up to 2 to 5 times more polluted. Electrifying stovetops is not only great for our wallets and the climate, it also positively impacts the health of our loved ones.

Yearly Stovetop Cooking Cost Comparison, Australia.

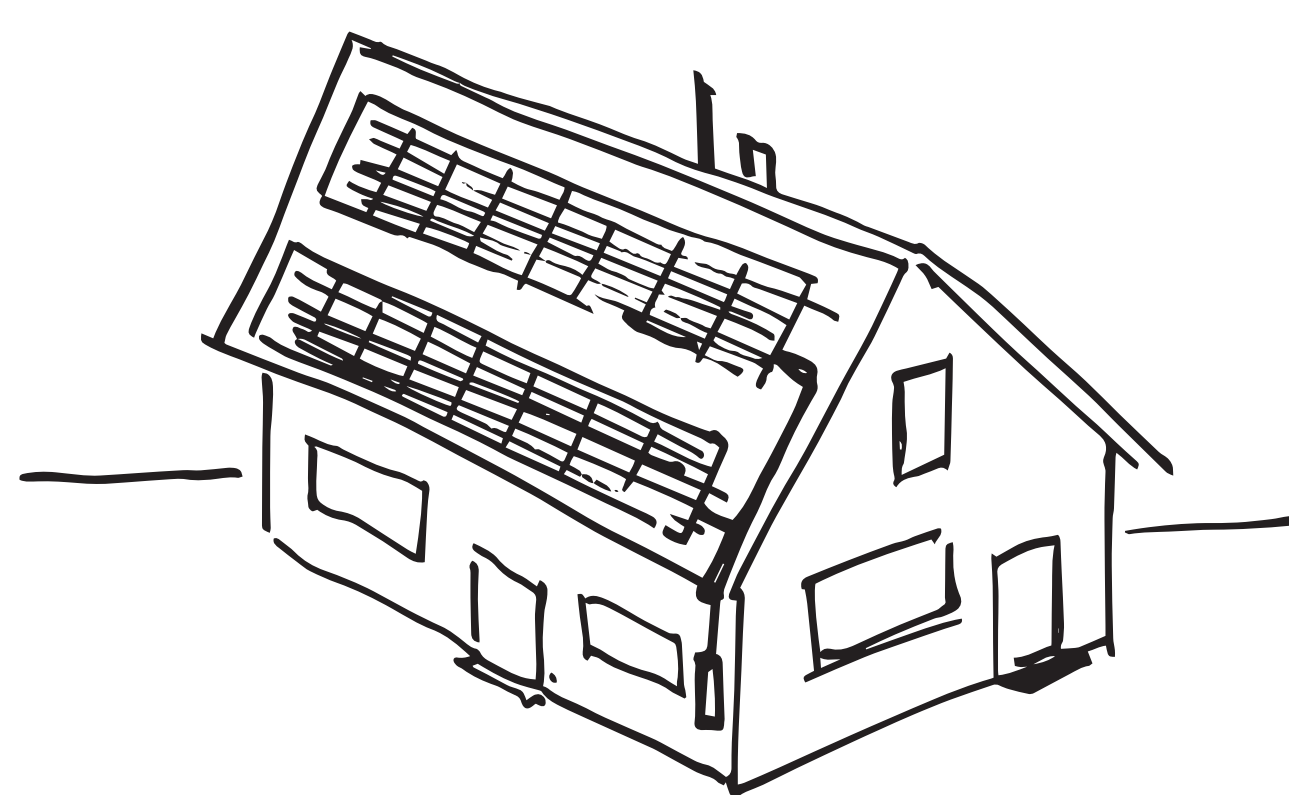


Assumes 0.75kWh Stovetop Heat Per Day with Coefficient Of Performance of 0.30 and 0.71



CLEAN TECHNOLOGY IS BECOMING CHEAPER

Clean energy technologies get cheaper as they are deployed, through economies of scale. Unlike speculative predictions about future tech breakthroughs, economies of scale have been observed in clean energy for 40 years and can be relied on when planning for the future.

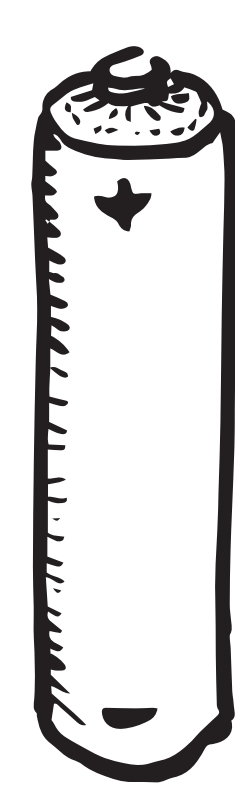
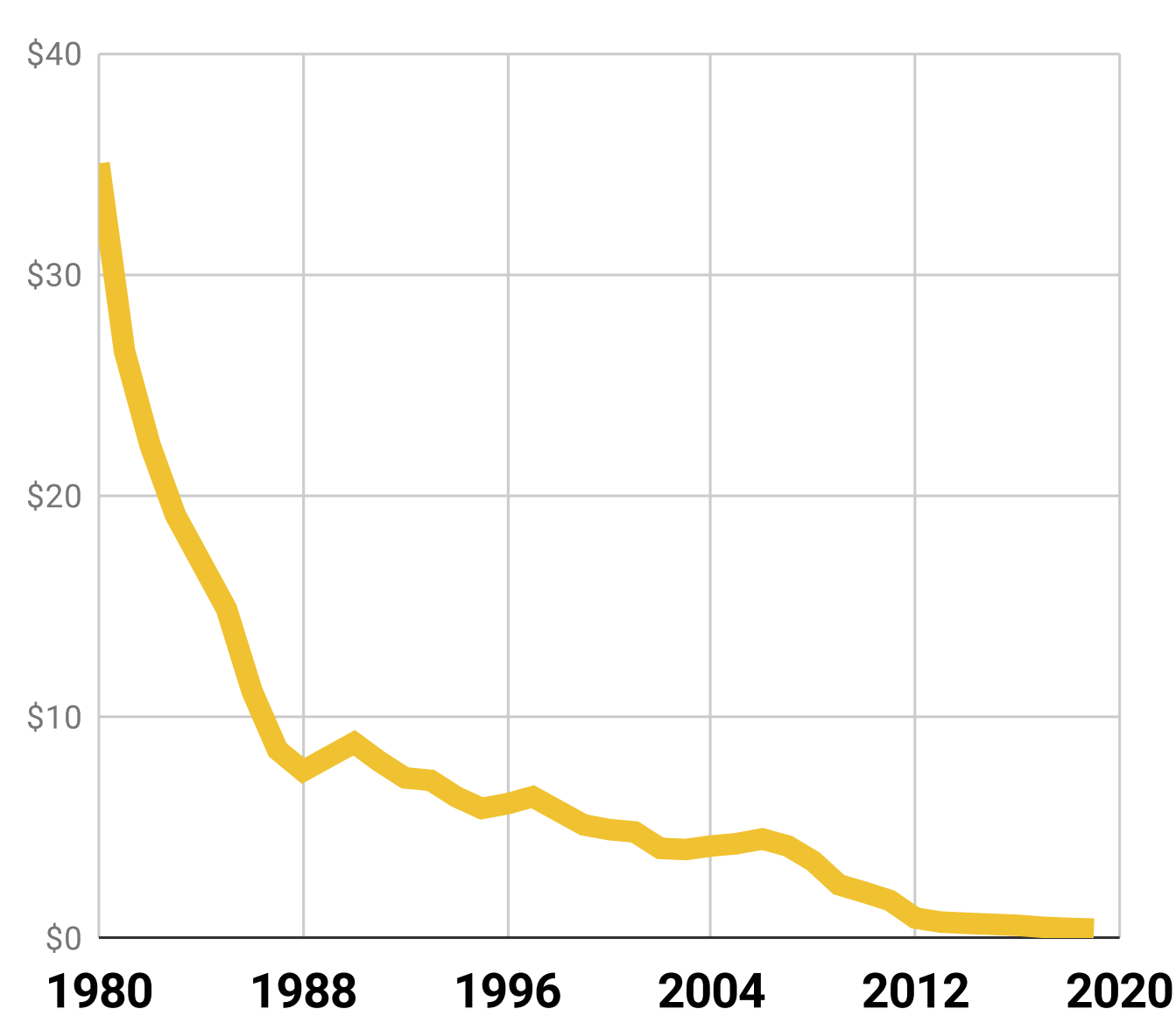


SOLAR

This has been most striking with solar, which has reduced in price by 99% since the late 1970s. It is the cheapest source of new energy generation in most countries.

Historic Solar PV Module Cost (2019 US\$ per W)

Source: OurWorldInData.org, LaFond et al. & IRENA Database.



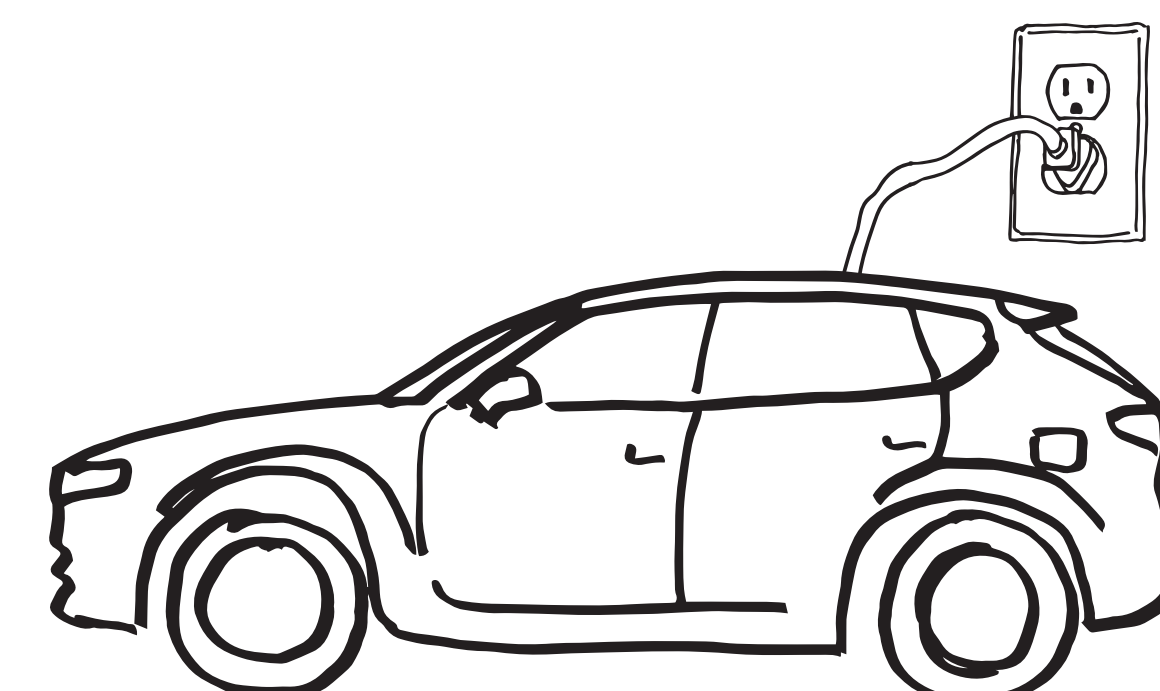
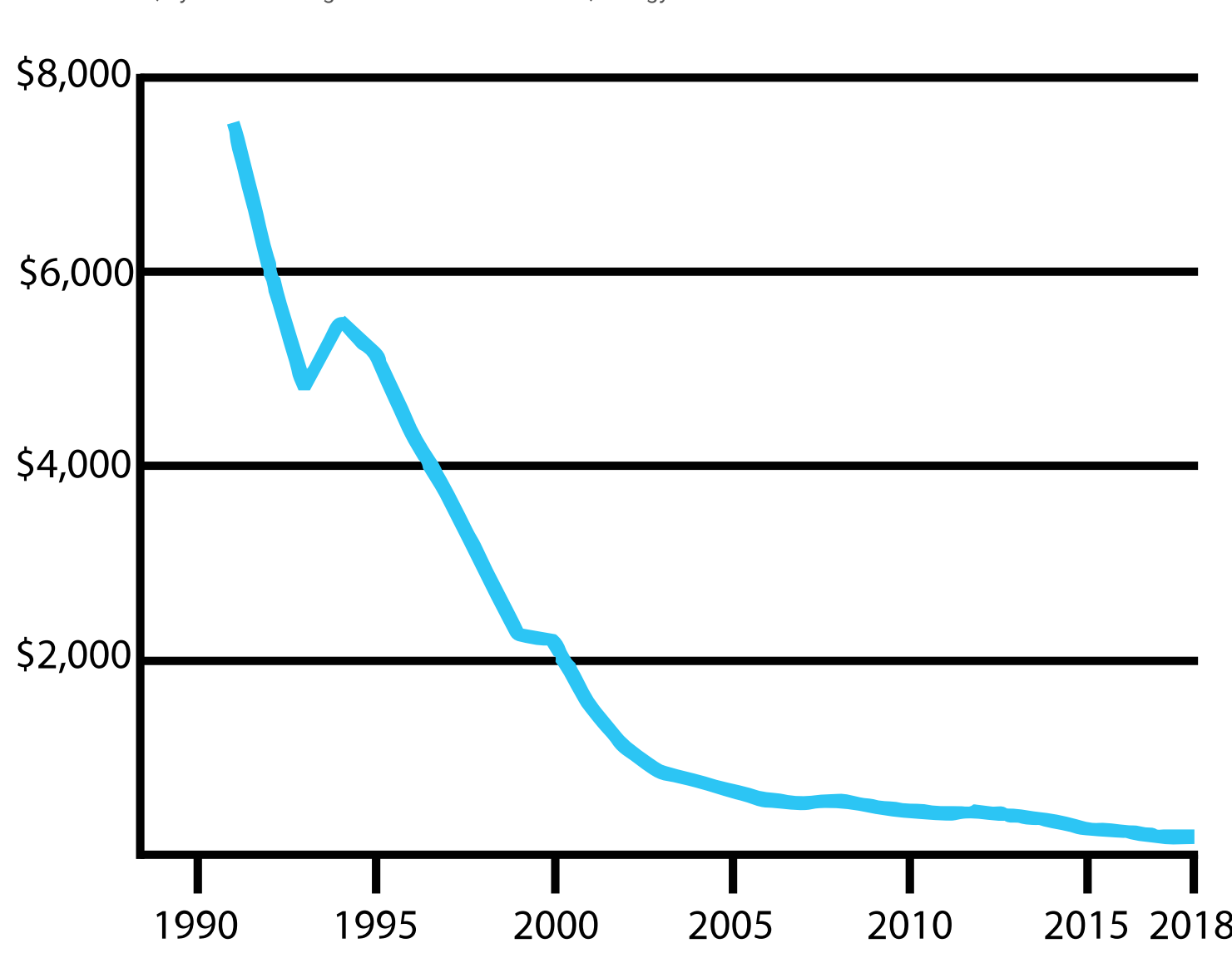
BATTERIES

Lithium batteries prices have also declined rapidly. Batteries are predicted to drop even faster than solar over the coming years as production ramps up globally.

This means that households can now cost-effectively generate and store energy, reducing their bills and increasing their autonomy and resilience. Australia is incredibly fortunate to have the cheapest residential rooftop solar prices in the world, and solar prices are still falling.

Worldwide Lithium-ion Battery Price History \$/kWh USD

Source: The Economist and "Re-examining rates of lithium-ion battery technology improvement and cost decline", by Micah S. Ziegler and Jessica E. Trancik, Energy & Environmental Science March 2021.



ELECTRIC VEHICLES

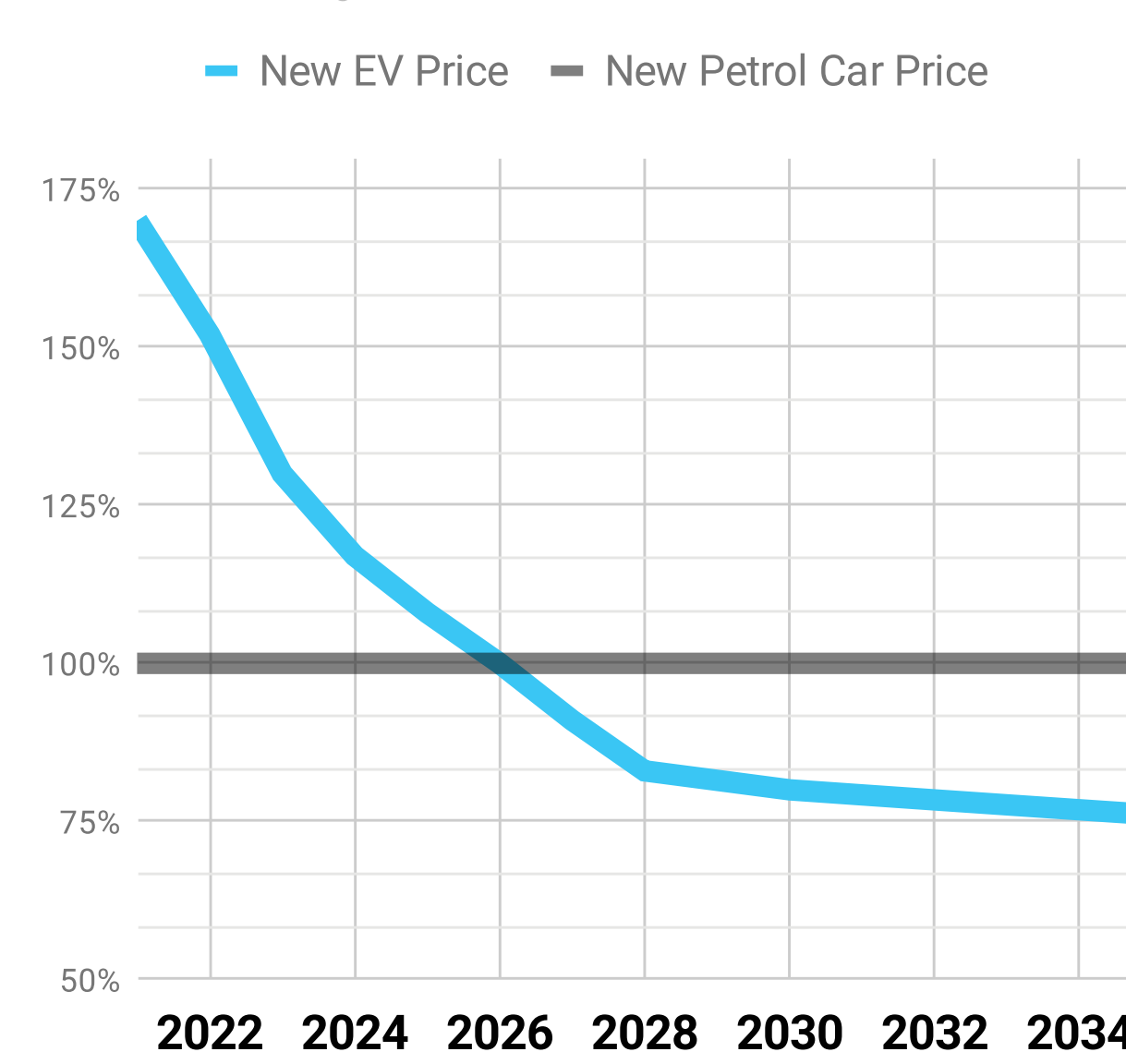
Electric vehicle production has only ramped up in recent years so EVs have not shown the same historical cost reductions as solar or wind turbines.

However this is all changing as nations impose deadlines for the sale of petrol cars, production scales up and the cost of sale drops. Bloomberg NEF predicts EVs to be the same price as their petrol counterparts in 2026, and 20% cheaper by 2030.

EVs also cost far less in fuel and maintenance.

Electric Vehicle Price Forecast

Source: BloombergNEF

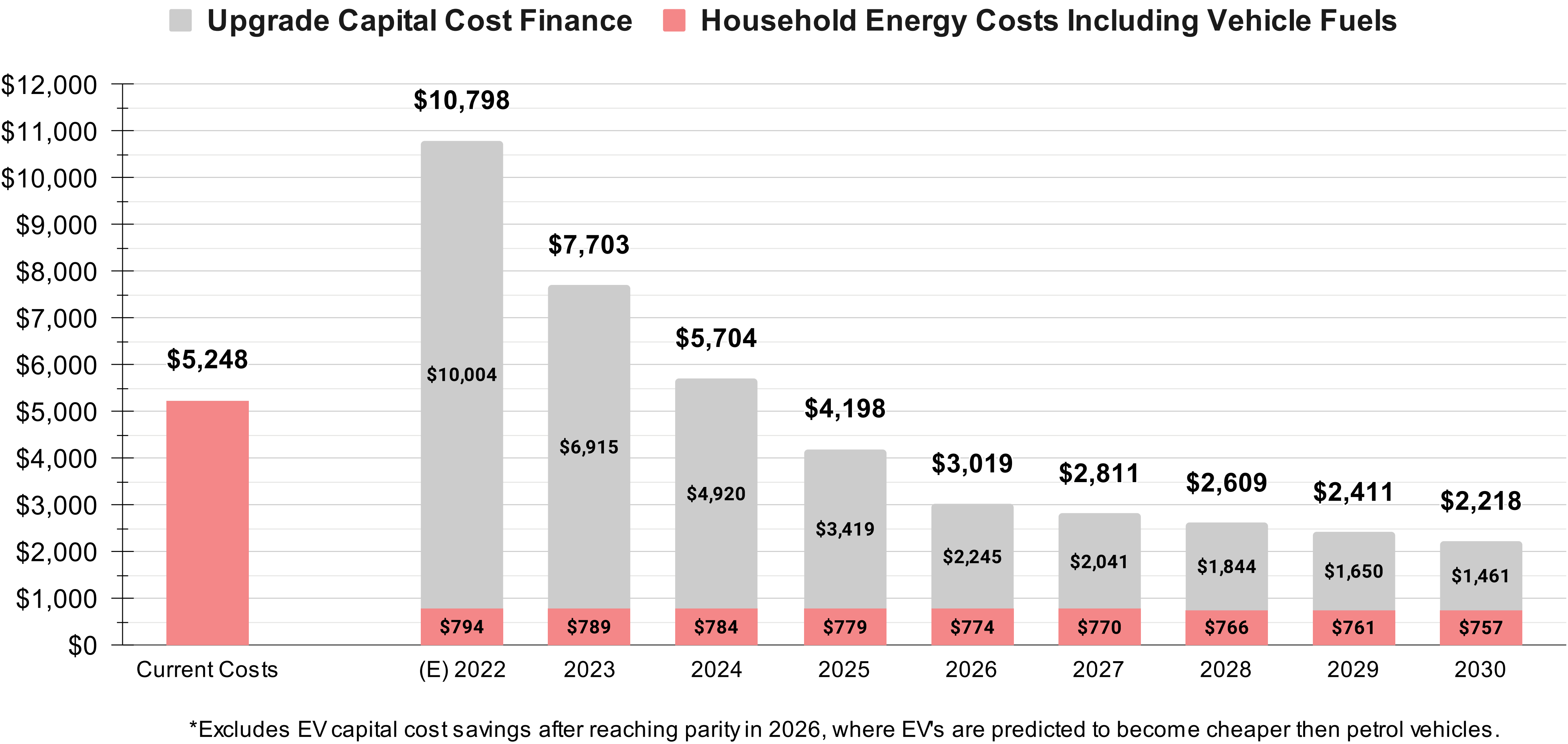


UP-FRONT FINANCE FOR LONG-TERM SAVINGS

If we electrified every Australian home overnight and maximised the amount generated in rooftop (and community solar), our average energy and fuel bills would drop from ~\$5000 a year to just ~\$800 a year. Our homes would have solar on the roof, electric appliances, a home battery, and electric vehicles in the garage. But most households cannot afford this capital investment up front and so they are deprived of the savings. Providing rebates and financing to low income households in this transition phase needs to be a national priority.

Current Energy Costs and Costs with Electrification

Electrified household has solar, battery, electric appliances, and electric vehicles. *Excludes more EV savings after 2026.



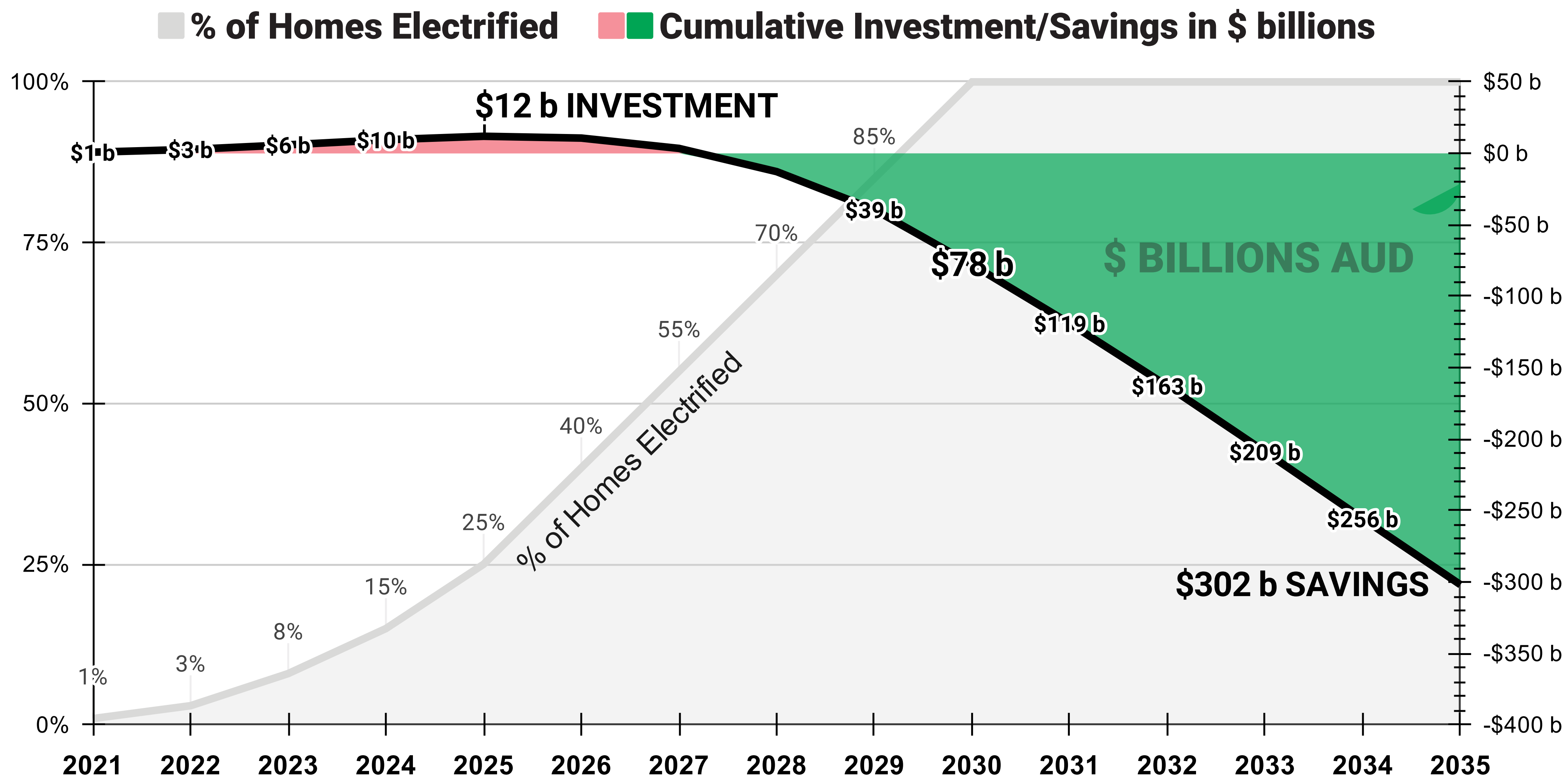
We should consider this type of investment to be national infrastructure, and in the same category as projects like the Snowy.

This chart shows that even when finance costs are taken into account, rewiring the average household is cheaper than conventional technology, in just a few short years (from 2024-2025.) Some households would realize the savings as soon as 2022.

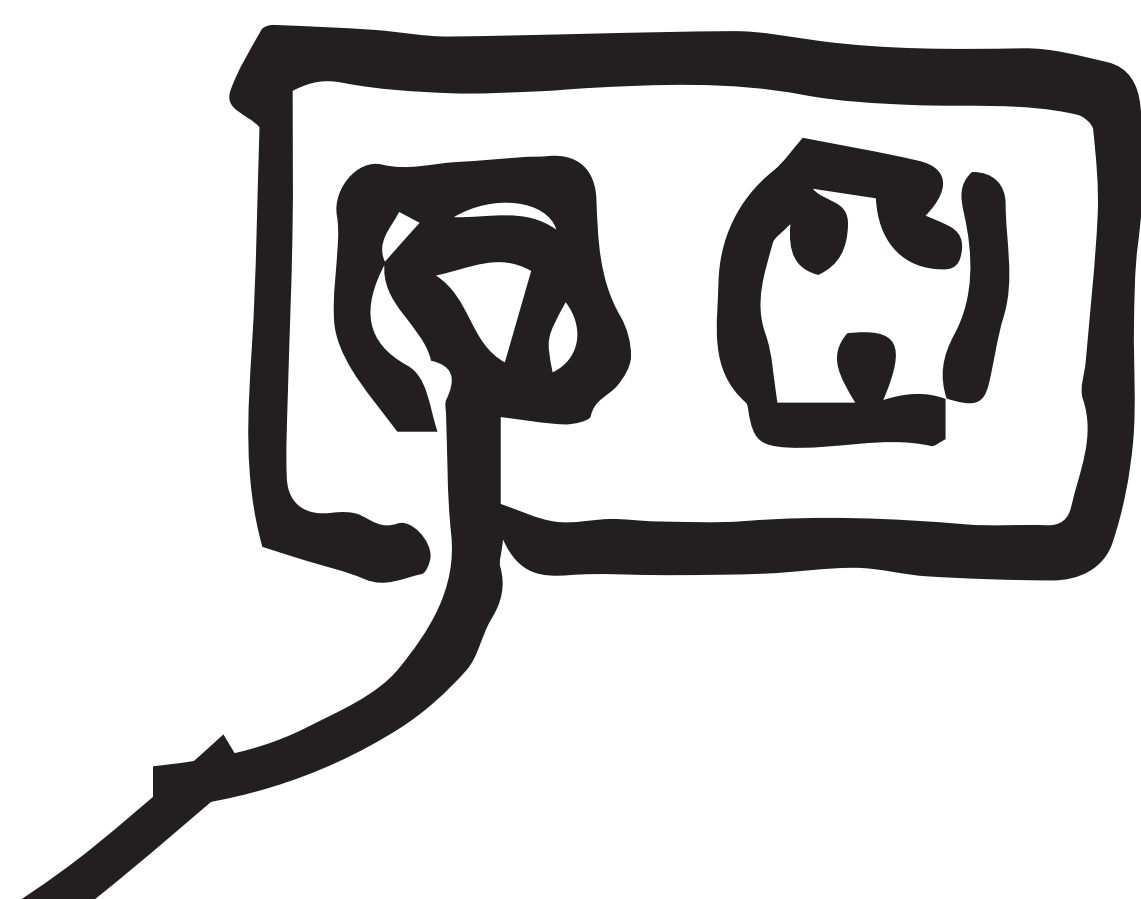
Australia - Cumulative Investment and Savings with Accelerated Electrification

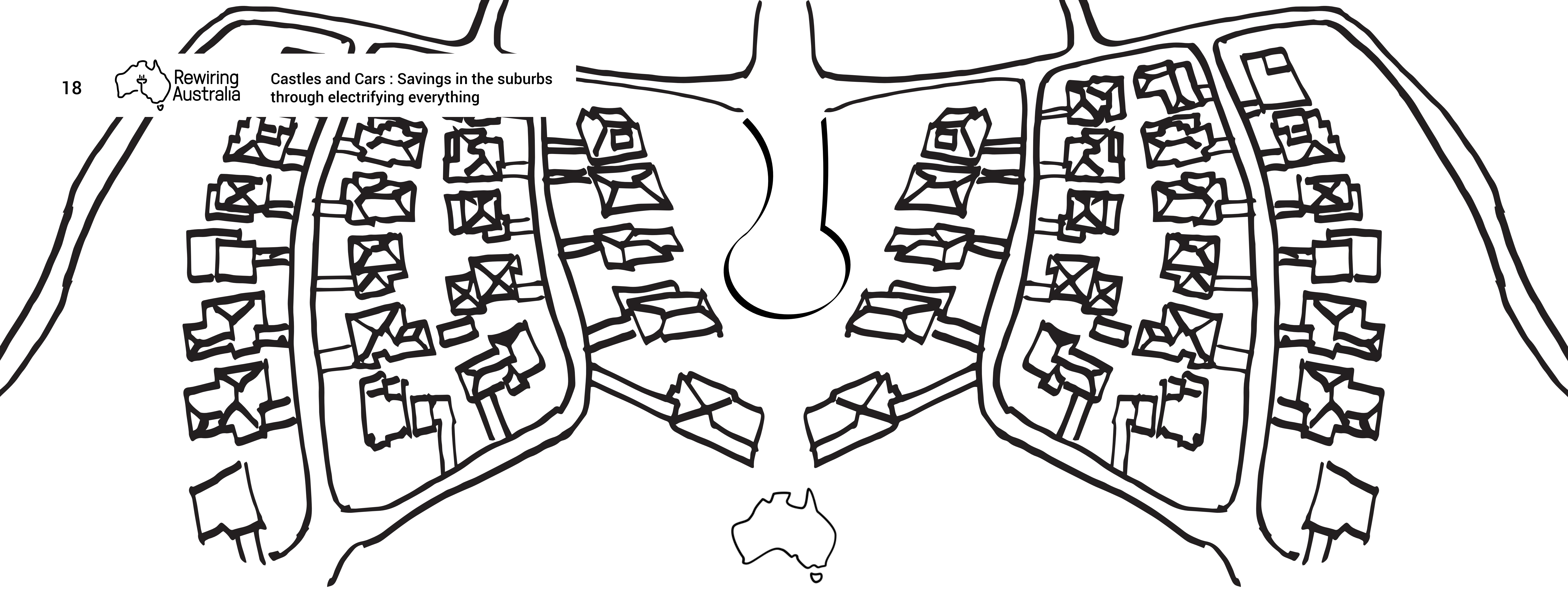
Accelerated ramp in homes electrified per year to 100% electrified in 2030. Investment/Savings in \$ billions.

In order for the electrification industry to be ready for scale when the technology is competitive mid-decade, governments should develop the sector with trials and subsidised early commercial deployment from 2022. This will allow industry and skills development, capacity building, and any permitting and supply chain issues to be resolved. Then in the mid 2020s, when electrification is financially viable without subsidies, households can finance it on a commercial basis, through their mortgage provider or a commercial lender.



If we begin electrifying our homes with roughly 3% in 2022, 15% in 2024, and 40% in 2026, the spending required to pay for the capital cost difference (or break even point) is predicted to be around \$12 billion in total. For context, that's just roughly ~9% of what we are predicted to have spent on the COVID-19 response in the last two financial years, or roughly ~18% of our defence spending in those two years. As this electrification continues past the break even point, we predict gigantic economic savings for the Australian economy. This should be understood as an investment that returns enormous dividends to our households and the country as a whole, not as an expense that "costs too much."





THE STATES ARE LEADING, IT'S TIME TO **AMPLIFY**

Australian states and territories have already put in place many of the elements of a comprehensive policy for electrification. Three million households have invested in solar PV. The national energy innovation agencies, Australian Renewable Energy Agency (ARENA) and the Clean Energy Finance Corporation (CEFC), have funded important trials and deployment projects in electrification. The Energy Security Board and the NEM market bodies have set up some of the regulatory infrastructure for electrification, through what is mostly referred to as “distributed energy resources integration.”

South Australia is supporting home batteries and prioritising installs in public housing. Victoria, in its post-pandemic stimulus, is funding neighbourhood batteries, community-owned renewable energy hubs and is assisting homes with upgrades to electric machines and is already planning on retrofitting one million homes with a critical electrification device by 2028.

New South Wales is bringing forward to 2030 the retirement of four (of five) fossil electricity generators and is promoting fuel switching (to electric devices) under the energy savings scheme. Queensland has the highest penetration of rooftop PV and is now engaging deeply in demand response including water heaters and pool pumps and smarter air conditioners. The NT is providing substantial rebates on home batteries and free registration on EVs. The ACT is providing stamp duty exemptions and interest-free loans for EVs and phasing out its natural gas network

with plans for no new gas connections to newly built homes in 2023. Tasmania is planning its role in being interconnected more tightly to the rest of the nation's electricity network and the role of Tasmanian hydro in supporting the national electrification project. In addition to our state governments running pilots and templating good legislation, our government agencies are making significant contributions such as the managed EV charging pilots and significant programs in load shifting and demand response. The clean energy finance corporation (CEFC) is providing critical funding to whole community electrification projects with developers, and investments in critical clean tech companies that are enabling deep electrification.

We know what to do, and are already doing a lot of it. We are running experiments and learning best practices in each state that could be sensible programs to amplify at the federal level and apply across the whole nation. We need to increase the ambition and the speed. To electrify all of our households by 2035 we need to average the electrification of 66,000 households a month, every month, starting in 2022. We should aspire to do it even sooner.

If we focus on optimizing all of our policies to work together, remove barriers and build the market, Australia will be on the right track to lead the world. We would suggest the following additional policy provisions to make sure that Australian families win in this climate critical energy transition.

THE STATES ARE LEADING, IT'S TIME TO AMPLIFY.

CONT'D

HOUSEHOLDS FOR THE WIN

Our research demonstrates there is going to be significant “money on the table” from all of those household savings. There will also be multiple groups competing for their share of these billions in the form of financial benefits: from households to installers and contractors, innovative tech companies, networks, retailers, aggregators and banks.

The guiding equity principle for electrification policy is to prioritize the economic benefit going to households and the installers and contractors that will deliver the prize. Other players need to be sufficiently remunerated to invest in innovative technologies and business models that deliver for households.

Because of the implied timeline and urgency, we need all policies to be focused on how to get us to 100% uptake of electrified end uses and fuelling this new eco-system with clean energy as soon as possible.

REMOVE BARRIERS

We need to swiftly eliminate the red tape, including building codes, permitting processes, zoning rules, grid standards and wholesale electricity market participation. Anything that acts as a barrier to these technologies being installed needs to be removed so individuals and businesses can actively participate in the new energy market.

Essential is a “Grid Neutrality” policy for the National Electricity Market, which works like the internet, where all packets of information have the same priority. This will ensure that all storage and generation assets on the grid have equality in dispatch.

It isn't rocket science, we need to abolish subsidies for gas appliances, stop expanding gas reticulation networks, and aggressively phase out natural gas for both new households and existing households.

The Australian Government needs to invest \$12 billion in the early 2020s to turbocharge electrification to enable us to decarbonise households by 2035 and in turn, save them up to \$5,000 per year.

We can build on the best state programmes already in place in social housing and low income settings which focus on household PV, compatible batteries and efficient appliances, and expand these electrification programmes into community and commercial solar and storage.

New programmes will be required to build battery and EV markets, with a priority on low-income homes.

Australia will need to develop financing solutions for the lowest income households including policies that incentivise both landlords and renters to help appropriately distribute the savings.

Point-of-purchase rebates that mean electrified machines are equivalent in cost to their fossil fuel counterparts until such time as they reach maturity and cost parity by themselves, will be essential to ensure the point-of-purchase decision to electrify and decarbonize is the easiest decision for Aussies to make.

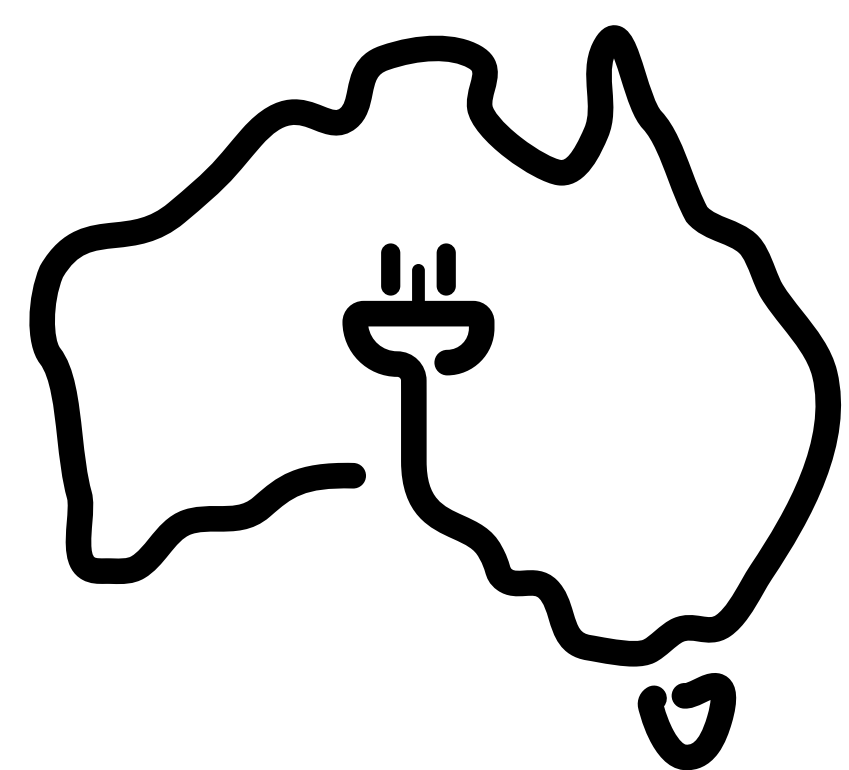
INDUSTRY DEVELOPMENT

We need to work with unions and industry to develop certification and training programs similar to those in place for solar powered heat pump installations and battery and vehicle charging installations to build workforce capacity while simultaneously reducing the regulatory burden.

ELECTRIC VEHICLES

Electrification of our vehicles is central to the realised savings of Aussie households and to our national economic and environmental future. We need to thoughtfully design EV incentives, as well as considering elements like road taxes and costs, to encourage, where appropriate, lighter EV's, fewer kilometers travelled and more public transit, electric scooters and electric bicycles. All of these initiatives will pay benefits in terms of safer and healthier communities.





Rewiring
Australia

METHODOLOGY SUMMARY

This is a summary of the methodology used. For the detailed methodology used please view the detailed report at: rewiringaustralia.org/households-report

Summary of methodology, step-by-step:

1. We use existing datasets (RBS, ABS motor vehicle survey) to estimate the total current average household energy use by state.
2. We use current energy pricing data by state to estimate household energy costs.
3. We model energy savings through electrification by converting all energy loads (gas, petrol, etc) to electricity using common performance numbers for electrical versus fossil machinery. Everything is converted to kWh electrical equivalent.
4. We model upgrade capital costs for all associated household machinery based on current retail prices (2021), and forecast future prices based on historical price curves and established cost models (eg. Bloomberg New Energy Finance).
5. We model future appliance efficiency gains based on recent historical efficiency data.
6. We combine the energy savings and efficiency and cost forecasts into a total household cost of energy and vehicles and compare existing costs to electrification over multiple years.
7. Only the relative difference between today's costs of household items and future costs of household items is accounted for in order to hold all other aspects of household economics constant.
8. We localize the forecast analysis state by state and cumulatively for Australia.
9. We run the model with different input assumptions around our price forecasts to give us a sense of the sensitivity of the model to various inputs.
10. We calculate national, and state-level annual and cumulative savings by all households.
11. For current and future household numbers, we use the Australian Bureau of Statistics (ABS) Household and Family Projections - Series II.
12. We categorize emissions in their respective sectors using existing data sets on electricity use, exports, and transport.

ELECTRIFY



EVERYTHING
