National Energy Performance Strategy Consultation Paper Submission

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Rewiring Australia

www.rewiringaustralia.org

Contents

Summary

Rewiring Australia supports the development of a National Energy Performance Strategy (NEPS). We endorse the ambition of the portfolio Ministers who have stated that the NEPS should 'empower Australians to take control over their energy use' and at the same time reduce energy bills, support jobs, increase the resilience of the energy system and cut emissions.[1]

The key to delivering such ambitious goals is a paradigm shift that combines electrification and energy conservation (or efficiency). These climate and energy performance goals cannot be achieved without simultaneously tackling (1) technology, (2) governance, (3) regulatory & policy environment, and (4) finance. We advocate that this transition must give equal weight to supply and demand side aspects of the energy equation, and raise the profile of demand-side electrification to match supply-side renewable generation.

In this submission we respond to questions in the NEPS Consultation Paper. We provide recommendations to improve governance, set targets and deliver electrification and conservation across the household, commercial and industrial sectors of the Australian economy. We propose how to target benefits to the lowest income households.

About Rewiring Australia

Dr Saul Griffith is an Australian-American inventor, serial entrepreneur, author and climate and energy expert. In 2021 he and Dan Cass co-founded Rewiring Australia as an independent research organisation to demonstrate and realise the opportunities of electrification to reduce consumer costs, eliminate emissions, improve the energy system and create new industries. Saul co-founded Rewiring America with Alex Laskey in 2019 and it was instrumental in architecting and drafting the demand-side of the U.S. Inflation Reduction Act of 2022.

[1] Commonwealth of Australia (2022) *National Energy Performance Strategy: Consultation paper*, p.2

Electrification redefines energy performance

Introduction: electrification is economic policy

The NEPS Consultation Paper begins with an ambitious forward from Chris Bowen, the Minister for Climate Change and Energy and Senator Jenny McAllister, Assistant Minister for Climate Change and Energy. They reframe energy performance and the clean energy transition overall from being an environmental issue to a core part of the national economic agenda.

This new frame is a big step forwards in policy and politics. When the new federal government came to power it inherited a climate policy with no integrity and a rudderless energy system. The federal government and the Minister for Climate Change and Energy should be congratulated for reacting so quickly and effectively to the international energy crisis.

The government has put electrification at the centre of its energy and therefore its economic policy. In December 2022 Minister Bowen announced that the next federal budget would include a 'meaningful and substantial package' of electrification measures[2]. This is reflected in the *Household and Business Electrification Package* agreement reached with the Australian Greens and supported by Senator Pocock to secure passage of energy price relief legislation.[3]

In January 2023 the Australian Treasurer Jim Chalmers published an essay calling for a new form of capitalism in Australia. The energy transition is front and centre of his vision. The essay begins by highlighting the risks of the present era. The Treasurer cites the deep vulnerability of 'communities, economies, budgets, environment, financial and energy markets, international relationships, and our politics'.[4] The thesis is that if we can actively shape the economy, we can increase the resilience of these systems, the equity of our society, quality of our lives and health of the environment.

Treasurer Chalmers has repeatedly singled out energy as a prime example of a vulnerable system which we can make resilient, if the government plans and coordinates investment.[5] Rewiring Australia endorses this vision. If Australia embraces the clean energy transition and makes plans to deliver it efficiently and equitably, this current crisis is the last one we need ever face. Australia has all the solar, wind and ocean energy it could ever use and the critical minerals the world needs. We have high community affection for clean energy and could use this social licence to rapidly pivot from fossil fuels to a clean energy future. But this will not happen without an almost 'war time' mobilisation effort. The government's stated intent to focus on electrification of low-income households is vital. Only if we also include Australia's vulnerable low-income households can we build the momentum we need to hit 1.5 degrees.

Rewiring Australia's research demonstrates a new model for energy which will turn our vulnerability into resilience. Australia could deploy commercially available technologies today to

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[2] Bowen (2022) *Press conference - Canberra* (14 December) https://minister.dcceew.gov.au/bowen/transcripts/press-conference-canberra-0

[3] Australian Government (2022) *Household and Business Electrification Package* (14 December); *Treasury Laws Amendment (Energy Price Relief Plan) Bill 2022*

[4] Chalmers (2023) 'Capitalism after the crises', *The Monthly*

[5] Chalmers (2023) *Opinion piece: A new agenda for growth in the 2020s* https://ministers.treasury.gov.au/ministers/jim-chalmers-2022/articles/opinion-piece-new-agenda-growth- 2020s

supply the main energy services used by households and commerce: driving light vehicles, heating and cooling, lighting and cooking. These electric devices can be powered by renewables - in particular rooftop solar - and backed up with batteries, to provide low-cost, reliable energy.

Electrification will reduce costs for consumers. It is anti-inflationary, jobs rich and zero emissions. It would leverage Australia's leadership as the number one solar home nation in the world and create export markets for our energy and our low carbon minerals and manufactures. The NEPS is an important milestone in climate policy which can bring together traditional approaches to efficiency with the burgeoning agenda of electrification.

In the rest of this section, we describe our research on electrification and show how it can be used to build the NEPS. Then in section II we address the consultation questions in the NEPS Consultation Paper.

Contextualizing and prioritising Australian Emissions reductions

In 2021 Rewiring Australia developed models of economy wide and household energy use in Australia. These allow us to better understand the emissions reduction challenge and develop a strategy for maximising the efficiency of the transition to a 1.5 degree economy. This work was based on models of the American energy economy developed by Dr Griffith and published by Rewiring America.

In October 2021 Rewiring Australia published the *Castles and Cars* technical report and discussion paper.[6] This quantified the economic and climate benefits of electrification in the Australian economy. It showed that a one-off investment of around $12 billion - roughly what governments spend subsidising fossil fuels annually - would decarbonise the household economy and produce savings of hundreds of billions of dollars over the next decade. It showed that electrification would roughly halve total energy consumption across the domestic economy (while trebling household electricity use).

The *Castles and Cars* modelling found that an average Australian household that switches from using fossil fuels for transport, cooking, space and water heating to electricity and efficient electric devices would reduce daily energy use by about two thirds from 102 kWh to 37 kWh, annual energy emissions from 11 tonnes / year to zero and realise annual savings of about $3000 - $5000 per year.

Before explaining details of electrification benefits and how it can be used to guide the NEPS, we provide the broader economic context.

Figure 1 below breaks down Australia's emissions inventory into domestic and exported emissions. The upper Sankey diagram depicts the 554 MT of emissions that are counted in Australia's national carbon accounts. The top 'domestic emissions' flow is what we call our 'domestic' economy - the goods and services we need to sustain our society. The bottom part of the upper Sankey represents 'trade emissions'; the 40% of our emissions which enable trade and exports but are produced on our shores. These are fossil fuels being used in the fossil and primary industry supply chain as well as exported meat and dairy products where the animal emissions including methane count on Australia's budget because the animals are grazed here.

[6] Griffith et.al. (2021) *Castles and Cars - Savings in the suburbs through electrifying everything*, https://www.rewiringaustralia.org/report/castles-and-cars-discussion-paper

The lower Sankey diagram depicts the 1289 MT of emissions produced when consumers in other countries use the fossil fuels we export. It is notable that the total emissions caused by the export of fossil fuels, both onshore and offshore, is about five times the total emissions needed to sustain our domestic economy.

Australia is only starting to have a serious conversation about our responsibility to limit the export of fossil fuels. We support limits to the extraction and export of fossil fuels but our strategy focuses on the emissions in the top diagram, which is the Australia domestic emissions. The flows highlighted in green represent technologies that are commercially available now. Our view is that these should be the primary focus of climate policy because this is where we can eliminate emissions now.

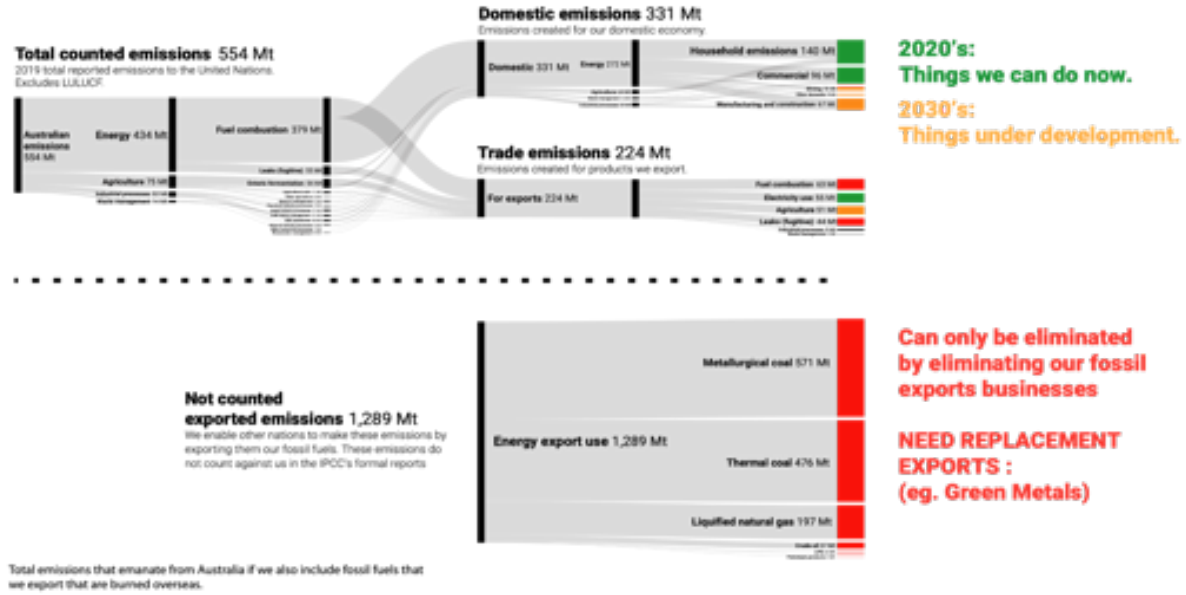

Figure 1. Australian emissions categorized as domestic emissions (used in our domestic economy) trade emissions (count on our domestic emissions but are embodied in our export products) and exported emissions (which don't count on Australia under IPCC rules but on the country in which the fuels are burned).

The great news is that if we use available electrification technologies, we could eliminate emissions from households and small businesses and commercial buildings in about a decade and reap an enormous economic dividend. These technologies are electric vehicles, heat pumps, electric cooking, and renewable energy backed up by storage, including batteries, as well as demand response. With this basket of technologies, we can heat and cool our homes and commercial buildings, heat water, cook food, light our buildings and power our electronics and electric appliances.

Rewiring Australia strongly recommends a 25-year energy strategy for Australia. This would prioritise efficiency and carbon reductions in the short term through electrification - the green flows in figure 1. This will buy us the time to innovate solutions for the orange flows in the Sankey diagram. RD&D can create the industrial solutions for a new export economy. There are considerable export, employment and regional benefits from this strategy which are beyond the scope of the NEPS but we return to them briefly in section 2 where we purpose a governance and policy coordination structure.

Electrification is the big energy performance win

We now turn to the energy performance impact that electrification will have. The commercially available electric technologies, solar and batteries will rewire energy flows in the domestic economy. Figure 2 below illustrates that replacing fossil fuels has a twofold impact on energy use. The primary change is that energy use is cut by almost two thirds. The secondary change is that electricity use is roughly trebled.

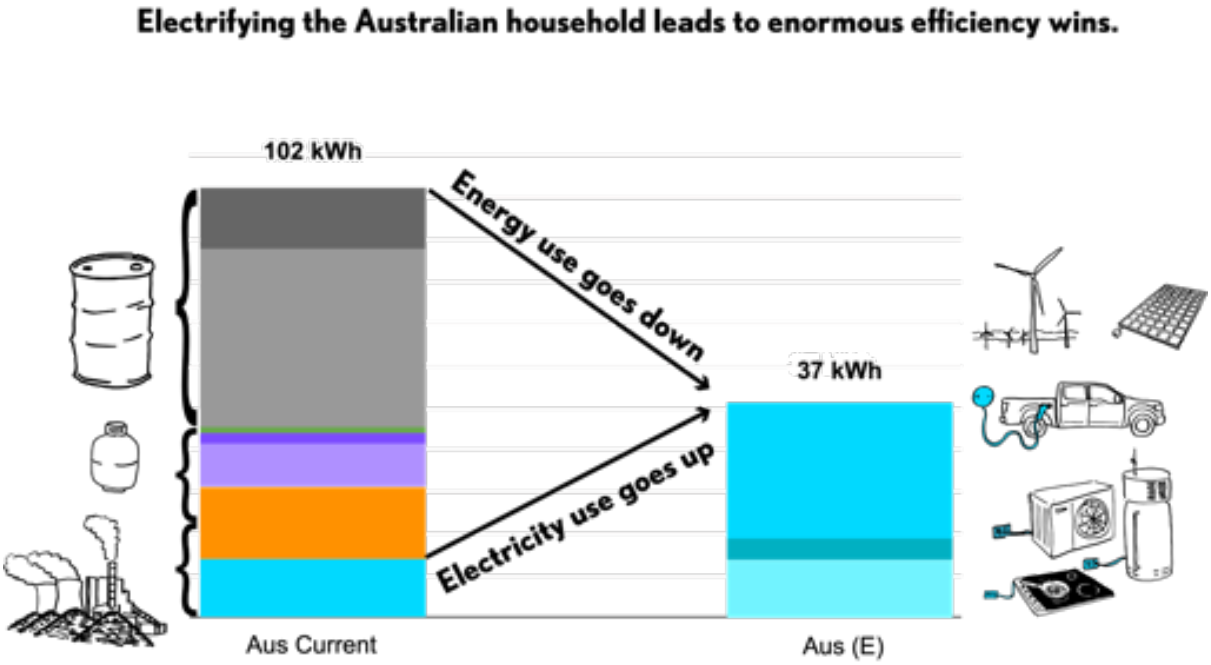

Figure 2. Total energy expenditure of an `average' Australian household today, and if completely electrified and powered with renewable energy. Australians use 102kWh today, mostly liquid fuels as represented in dark grey (diesel), light grey (petrol). A small amount of wood (green) a slightly larger amount of propane (purple) and quite a lot of natural gas as one of our principal heating fuels (mauve). The total delivered electricity delivered today is around 14kWh/day per household (light blue at bottom) and the thermo-electric losses from generating that electricity with fossil fuels is shown in orange. On the right a future all electric household with similar cars (but electric) similar heating loads (but electrified) and powered with renewables uses about 37kWh of electricity per day, the largest component (around 20-22kWh per day) for the vehicle kilometres travelled within the home.

That reduction in primary energy consumed comes about because electrification eliminates the thermodynamic waste of fossil fuel combustion. An electric car powered by renewables uses approximately ⅓ to ¼ of the energy per passenger km of a similarly sized internal combustion vehicle. Electric heat pumps similarly do an extraordinary job of reducing the primary energy consumption of space and water heating. In Australia's mild climate the typically have a coefficient of performance of 3 - 4, which means they use ⅓ or ¼ of the amount of energy that a natural gas appliance would use for the same amount of heating. Even electric cooking on modern induction cooktops uses only half the energy of a similar gas cooktop.

All told this means that without any of the traditional efficiency measures such as envelope sealing and insulation, merely electrifying similarly sized cars and similarly sized and insulated homes, an Electrify Everything strategy will reduce the primary energy consumption of the

average Australian household by around 60%, or from 102kWh per day to 37kWh per day. This extraordinary gain in efficiency will require the provision of 250-280% of the electricity that the average household currently consumes, from around 14kWh/day to 37kWh per day. Additional improvements in traditional energy efficiency strategies such as insulation and envelope sealing might lower the 37kWh/day to 34kWh per day for an average household. For wealthier households and efficient or new properties, electrification should be the priority energy performance policy. However, the policy focus changes when we consider the poorest households and the most inefficient housing.

Rewiring Australia does support traditional energy efficiency measures. The question is the cost effectiveness of electrification versus efficiency measures, how we prioritise them and how we deliver equity benefits as part of the NEPS. A case study will illustrate the issues. In southern states where winter heating is the major energy peak load, low-income households in very energy inefficient houses and flats should get envelope sealing and insulation at the same time as they receive heat pumps and solar. NEPS can address energy poverty in a very targeted way. The practical issues around cost will be largely about the practicalities of installation. Unions and installer companies should be involved in discussions about how to deliver retrofits cost effectively and safely.

What we are arguing against is a mindset inherited from the 1970s energy crisis which is sometimes translated into an overemphasis on energy conservation and an insufficiency emphasis on distributed solar, electrification and now, batteries. In the U.S. good policies delivered vehicle emissions standards and appliance and building efficiency standards and some of those have been implemented here. These were successful in arresting the rapid growth in energy use but did not achieve wide-spread gains in energy use reduction. If we now accelerate electrification as our priority climate strategy and optimise it with energy conservation where this is most efficiently and equitable, we can deliver the most energy performance and social policy benefits.

Australia has about 10 million older buildings and will only build around 1-2 million new housing units in the next 2 decades. The best strategy is a targeted program for the lowest income and lowest efficiency households and a broad-based policy of electrification retrofits with cost effective insulation and sealing, high efficiency standards for new buildings and renovations including 100% gas elimination and electrification.

Electrification is Anti-Inflationary

If the NEPS is used to drive rapid electrification of households and commercial buildings, this will have an anti-inflationary impact compared to business as usual.

Figure 3 below charts the comparative cost of energy from 1990 to 2040 under two scenarios. The first scenario is business as usual. It shows the cost of using fossil fuels to power an average Australian household, including the cost of running an internal combustion engine vehicle. This is the black line and red trend line. It traces upwards from 1990. This is the total sum of money spent on petrol, diesel, LPG, electricity, and natural gas in a year. It increases year-on-year at roughly the rate of inflation. Based on the linear trend from the last 30 years, by 2040, homes are forecast to be paying almost $9,000 a year in energy bills. That is what we call ‘fossil-flation’.

Inflation is calculated by a basket of goods that comprises the ‘consumer price index’, which includes our (fossil) fuels. The marginal cost of extracting fossil fuels is increasing over time as the resources become scarcer and of lower concentration and quality. The cost of externalities is increasingly being priced in, bringing the cost to a more realistic higher figure. From around $2,000 a year in 1990, our 2021 *Castles and Cars* report modelling predicted the ongoing cost around $5-6,000 a year. Due to the extraordinary inflation and supply chain disruptions of 2022, caused by, among other things, the war in Ukraine and COVID–19, the cost is tipping $7,000 a year in 2022-23.

The second scenario is electrification and it is shown on the green lines. The first one starts at 2022. It includes the running costs and the finance cost of the purchase of the electric machines (assuming they are financed efficiently over their useful lifetimes). This means replacing all of the gas appliances with state-of-the-art electric appliances, and the 1.8 petrol or diesel vehicles in the ’average’ Australian driveway with 1.8 electric vehicles. It assumes the household is fully utilising its own rooftop solar generation (finance of this capacity is included in the estimate) and mixing that 50% with the average price of zero-emission electricity purchased at retail from the grid.

In this second scenario the household owns half its generation supply. It is not dependent on the rising and fluctuating cost of fossil fuels. The financed cost sits at around $2000 per year. In reality it will rise and fall as half of the input energy comes from the grid but it is a very different financial scenario to the first. Not only is the cost of energy about one third going forward into the future, but it is stable for the next 20 years! Once financed and installed on your roof, that solar energy costs just the fixed cost of financing.

This chart tells an extraordinary story of possibility, especially coming in an inflationary cost-of-living crisis such as the one that Australians are experiencing in 2022 and 2023.

Clean electrification is the transformation of our energy economy away from one based on (relatively) low-cost machines that require expensive future fossil-fuel purchasing commitments to higher-cost machines that are powered by cheaper clean electricity. This turns the energy economy away from one of fuels to one of finance, and the beauty of finance is that it locks in the cost of something for the period of that finance. It is literally anti-inflationary.

Given that the likely result for fossil fuels through this energy transition is increased price volatility, what might be even more important is that electrification of households makes energy costs predictable and stable far into the future. No more price shocks the likes of what we have seen in the last few years.

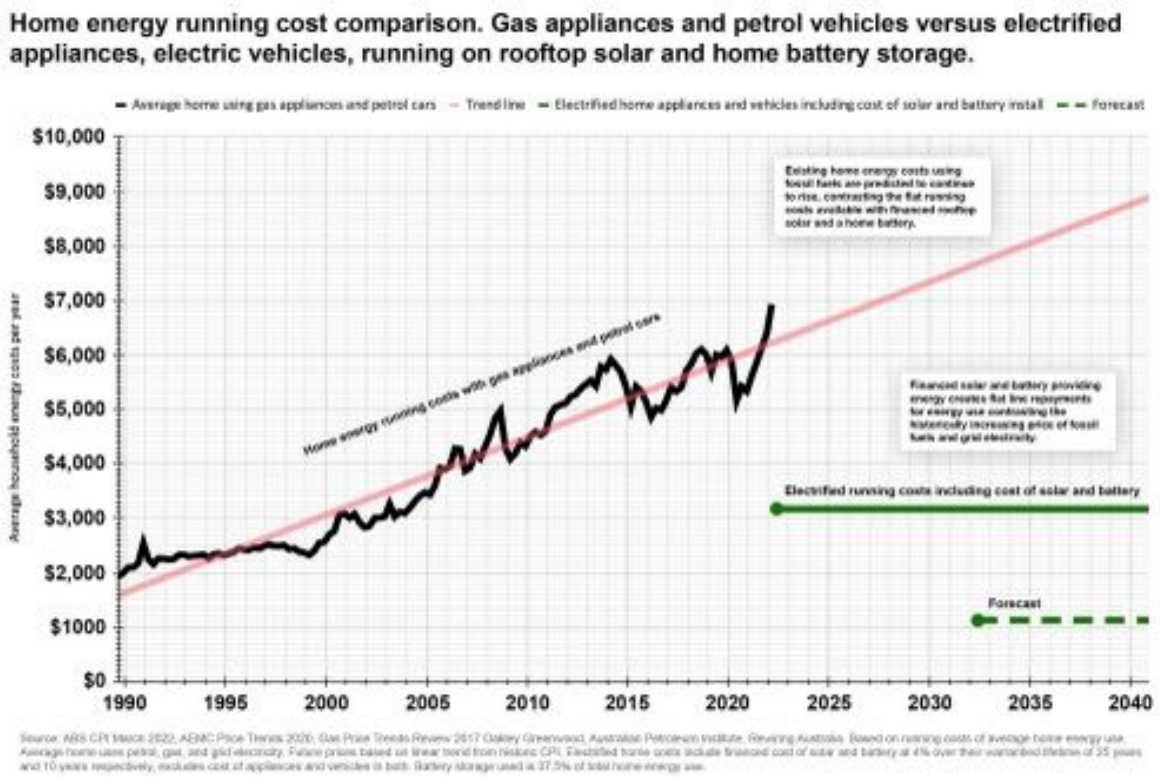

Figure 3. Electrification is anti-inflationary. The total cost of energy from the Australian household is the line in black, rising at about the price of inflation from 1990-2020. The green line is the total cost of energy, and finance of electric vehicles and appliances, if electrified today. This cost goes down as the industry gets to scale by 2030.

Energy performance requires transport strategy

Light vehicles dominate the energy use and thus cost of energy for households and much of the commercial sector. Figure 4 below shows that for an average household, vehicle fuels are almost 70% of the total energy consumed. Addressing vehicle energy must be a priority in the NEPS. Aside from the NEPS there are vehicle and liquid fuels policies so the question will be one of coordination, which we address later in section 2.

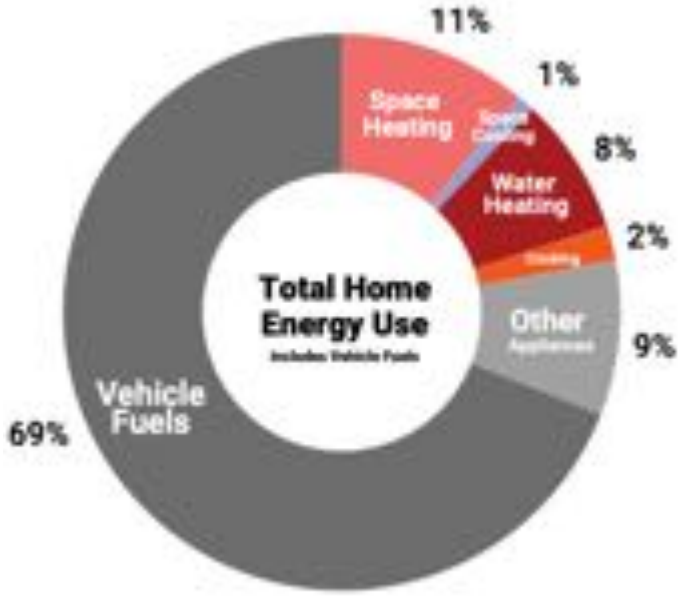

Figure 4 : Vehicles dominate home energy use. Source: Griffith et. al. (2021) Castles and Cars : Discussion paper, p.10

The primary energy performance outcome we need in the transport sector is electrification of vehicles. The largest efficiency win after electrification comes from limiting the weight and the speed of the household vehicles or substituting walking, mass transit, cycling or e-mobility for short and mid-length trips.

Given the dominance of vehicle energy consumption in both the fossil fuelled world of today, and the all-electric world of tomorrow, the other biggest energy performance improvement to be made is in transit modal change to bicycles, walking, and small and light electric mobility solutions including e-bikes, e-scooters, and Neighbourhood Electric Vehicles. Rudimentary analysis suggests that lowering suburban speed limits in residential streets to 40km/h with main streets at 60km/h is the largest efficiency / energy performance win available, even more so than public mass transit. This can be understood simply because 1.4 people in a Tesla model 3 consume around 100Wh/passenger km which is as good as the best-in-class high occupancy electric mass transit that is the Victorian electric tram system. Sydney rail is closer to 150-200Wh/passenger km.

Economy-wide savings: electrification as infrastructure

The electrification of households and businesses is a change in energy technology, but it is also a spatial redistribution of energy infrastructure. We are used to thinking of energy infrastructure as civic-scale projects: long transmission lines, deep dams, and big power stations. The energy transition is an historic change in the distribution and scale of energy infrastructure. One solar panel is a small device. One hundred and fifty million solar panels on ten million households is infrastructure.

If we extrapolate the savings of electrification across the economy, we can see the scale of benefits that NEPS can deliver and start to work out how best to finance this distributed energy infrastructure and design appropriate policies.

Figure 5. below charts the cost and savings of electrification from 2021 to 2035. Under this scenario, an aggressive policy drives electrification of all appropriate houses and apartments over a decade to 2030. The period to 2027 would require a government subsidy of around $12 billion. This subsidy is required because the financed cost of buying the new devices - mostly the cost of the EVs- is more expensive than the running costs including fuels of keeping the old devices.

As the market gets to scale, the cost of EVs falls, the cost of batteries falls, and the soft costs of installing and wiring everything together falls. We have seen these aggressive learning curves in solar and batteries. By about 2025, the economics of all the pieces of the solution work in most places, and the subsidies can fall so that by 2027 or so no more subsidies are required at all and we collectively start recognizing the savings.

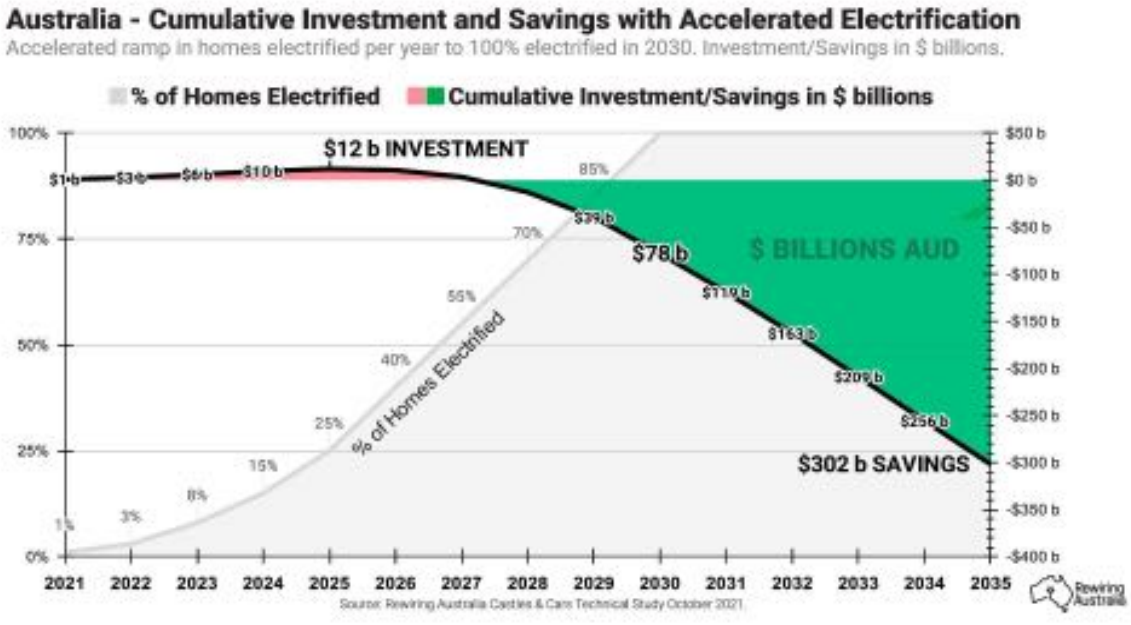

Figure 5: Economy wide cost and savings from electrification Source: Griffith et. al. (2021) Castles and Cars : Discussion paper, p.17

Around the middle of this decade the economics has switched, and it becomes increasingly profitable for households to be investing in the full spectrum of electric devices, solar and EVs. The *annual* savings reach around $40 billion once all homes are electrified. This transition timetable can be criticised for being very ambitious, but it should be noted that a slower transition would have a higher benefit: cost ratio because more of it would be done after the economics switch to cash positive around the middle of the decade.

This data is only a computer model and there are many variables. But even if it cost Australia twice as much ($24 billion) to get to parity, and we only end up saving half as much ($20 billion a year), the cost-benefit is still incredibly positive; a $24 billion investment yields $200 billion in savings over the next decade.

The NEPS could help drive the transition much like the one we charted above. The early phase sees government subsidise electrification. This would take the market to scale, train and organise the workforce, and deliver pilots and Solar Electric Suburb lighthouse projects to develop the technological glue that will hold the whole system together.

The ‘natural’ timetable for electrification would be set by the retirement of devices. Every time a new device is purchased, it would be an electric one, not a fossil fuelled one. The problem is that this might take twenty to twenty-five years and we are in a climate emergency and cannot afford to wait that long. The economic graph above shows it would be more efficient to subsidise and accelerate the millions of small consumer decisions so we deliver the big economic savings across the economy as early as we can.

Electrification and NEPS is an infrastructure-level transition. It is nation building investment and should be prioritised accordingly. From an engineering and system performance perspective, millions of distributed energy resources deliver infrastructure-grade outcomes. For example, once electrified, the 20 million vehicles in our domestic fleet will have a battery capacity approximately 5 times that of the Snowy 2.0 pumped hydro project. If that battery capacity is used efficiently, it is a significant source of reliability (and security) for the electricity system.

Individual household electrification journeys

We now turn the focus to the experience of a hypothetical individual household that is improving energy performance. The economics summarised above suggests that even without a concerted policy effort, most Australian households would be likely to be completely electrified by 2040. It will become increasingly difficult for consumers to source fossil appliances.

Figure 6 below, is a cartoon of an electrification journey for an average Australian household. All 10 million households will go on a similar electrification journey, though the details and order of machines purchases might be subtly different. This graph emphasises that every household has 6-10 machines that define the energy infrastructure, or emissions profile of that house. Targeting the purchasing decisions of those half dozen machines with the best in class regulatory, finance, and technology policy is the challenge in decarbonization for all Australians. Traditional efficiency measures that can be applied at retrofit moments will further improve this picture, particularly for the lowest income and lowest efficiency households.

This is a fictional representation of a series of ten purchasing decisions. The timing of each decision would be based on a range of factors beyond finance. There are also serious

challenges around supply chains including workforce. Can the household find tradespeople who are familiar with the new machines and can fit them at a reasonable price?

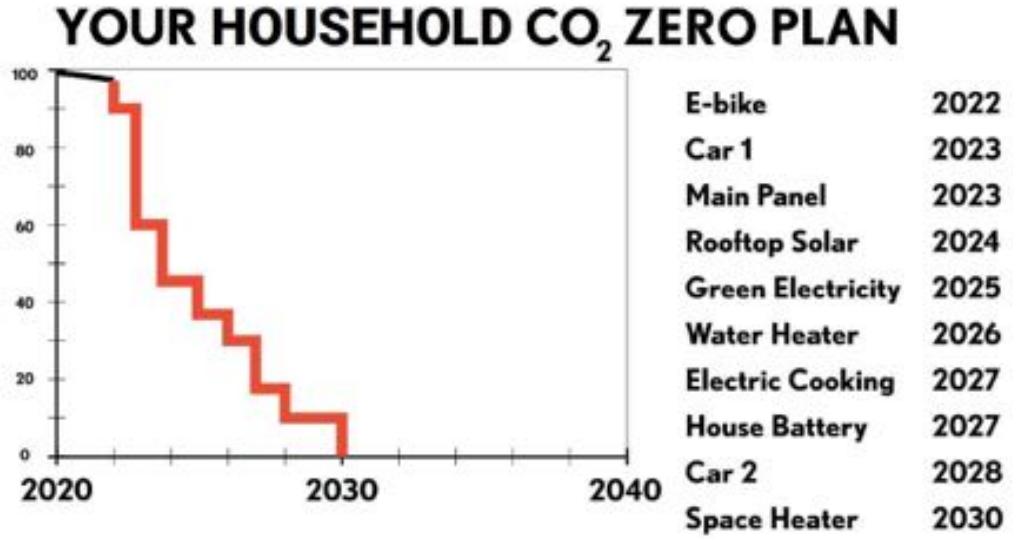

Figure 6. A "household electrification journey" that takes a household to zero emissions over a decade.

In this case the household can be seen to be dipping the toe into the electrification waters with an e-bike in 2022, their first electric car in 2023, a switchboard upgrade enables the vehicle charger and then more rooftop solar in 2024 and in 2025 with so many climate wins under their belt they switch to an all-green electricity plan and when the water heater and cooktop need replacing at retirement they go with all electric models in 2026 and 2027. Battery prices have fallen so far by 2027 and 2028 that they invest in a large household battery as well as a second electric car. The last source of emissions goes in 2030 when they replace their gas space heaters with heat pump mini-split A/C units. The whole household is zero emission by 2031.

In some cases, a household might purchase an electric machine out of convenience (such as the E-bike in 2022) but in other cases they might wait until they renovate the house or a machine needs replacing before making their electrification purchase (such as the electric induction stove in 2027).

Our argument in this submission is that the NEPS should anticipate these millions of electrification journeys and understand the complex array of policy factors that will impact on the timing and economics of the process. This will mean engaging diverse communities, reforming building and device standards and NEM market design, planning and municipal engagement, and bringing existing energy industry and peak business constituencies along.

If the NEPS is designed to support these millions of household transition journeys, then Australia has a much higher chance of hitting a climate target of 1.5 degrees.

The critical role of finance

The government has recognized the critical role that government-funded concessional finance will play in electrification, particularly for low-income households. Rewiring Australia's 2023 - 2024 pre-budget submission proposed that the Clean Energy Finance Corporation (CEFC) should allocate $2 billion - $3 billion for low-income households, social housing, and businesses to purchase electrification at low or zero interest. This scale of CEFC investment could see 500,000 households partially or wholly electrified, depending on finance terms and the type of devices that are funded. More details of this proposal are provided in section 2 below.

Figure 7. below shows how important finance will be. The left bars in red are the current model where consumers purchase mostly dirty energy and generally own cars and household machines (for heating, cooling, cooking) outright. The transition to clean energy for households and business will see them financing their own energy infrastructure which is shown by the mostly grey bars. Most of the cost for electrified households is the grey section that dominates these bars.

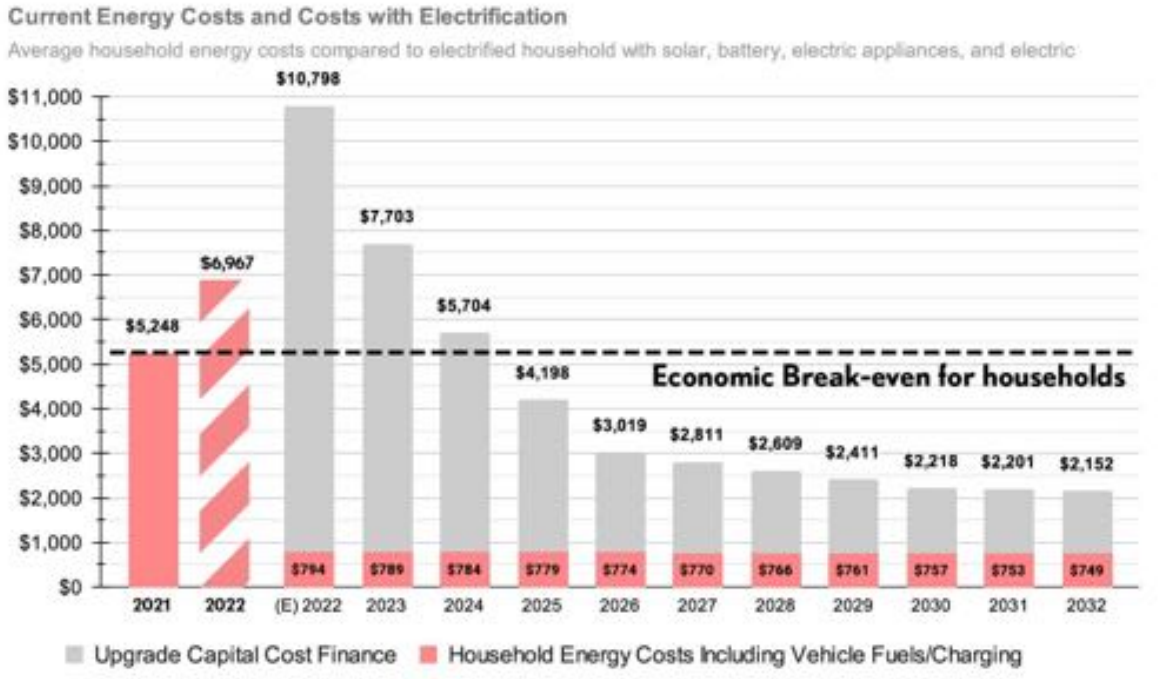

Figure 7. Source: Household costs of electrification. Modelling from Griffith et. al. (2021) Castles and Cars: Technical Study

If governments provide concessional finance from now until late in the decade then this will accelerate the transition and improve equity outcomes. CEFC finance will crowd in commercial finance and allow more people to access financed electrification. CEFC finance should also be targeted to assist low-income households.

The overall cost of ownership of the financed household infrastructure is cheaper than fossil fuels from mid-decade. The decreasing cost of the financed machinery is due to the falling cost curves of the underlying technologies - EV's, batteries, heat pumps, and power electronics. This is the least understood and most dramatic economic aspect of the transition; the falling total cost of energy for households.

Our 2021 modelling indicated the break even point somewhere in 2024-2025. This means that the break-even point has already been reached for some households and that the story only gets better each year. Since 2021 supply chain constraints imposed by COVID and the Russia-Ukraine war have increased costs and delays for electrification, but these factors may be partially cancelled out by the increasing costs for fossil fuels. We have not updated the model to reflect these changes. Even if the curve is shifted right one or two years, it does not alter the cost-driven inevitability of a transition to all electric households.

Electrification reduces energy costs

Even before the current international energy crisis, Australians were paying too much for electricity. Electrification is the best way to address rising energy costs and the only way to do this in a way that helps us hit 1.5 degrees.

Figure 8 below shows the real cost of electricity from the post-war era until five years ago. The real price for consumers of electricity in Australia decreased significantly from 1955-1980. These were enabled by improved productivity of the mining sector, but improved efficiencies of generators and by increasing scale of the industry (increasing the TWh delivered). Inflation in the early 1980's arrested this downward trend, and from approximately 2000 onwards there has been a difficult and pronounced upward trend in electricity cost. This was due to underinvestment in fossil at the time when renewables were expensive, but also due to things like our `gold plating' of distribution networks, increased retailer margins and other aspects of the privatisation and `competition' that were introduced to the market in the mid 1990's. Our track record at electricity market reform is plainly bad, and a failure for the Australian electricity consumer.

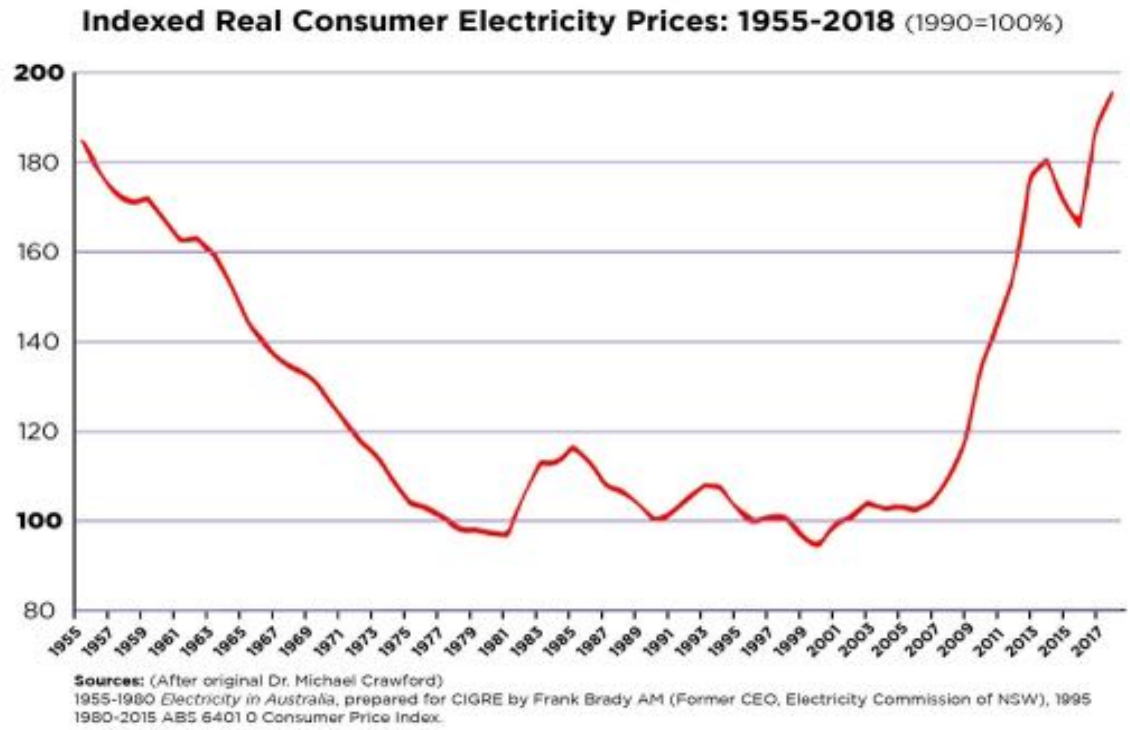

Figure 8. Price of retail to the consumer electricity in Australia indexed to 1990 cost of retail electricity.

If we look to Figure 9, we can see how solar, and electrification and community energy can reduce prices for consumers. The bar on the left is business as usual, the grid electricity that most consumers purchase for most of their energy, which is delivered today at approximately 27.5c/kWh.

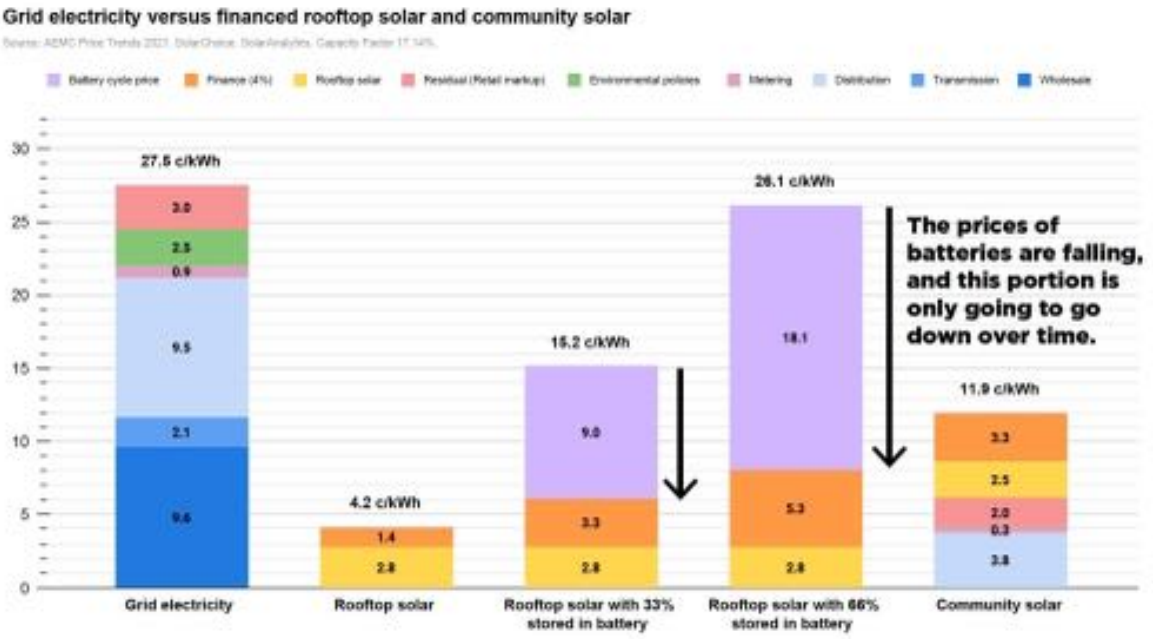

Figure 9. Breakdown of cost of retail electricity from ARENA (1st column) with estimates of cost of rooftop solar, 24/7 rooftop solar with battery (columns 3 and 4) and cost of community solar without TNSP or Generation charges.

The next bars illustrate the cost stack for electrification. The first bar shows the cost for financed rooftop solar at approximately 4.2c/kWh and decreasing. A household cannot run on solar 24/7 so the next two bars show the cost of solar backed up by batteries to store one third and two thirds of household demand. Even with today's quite expensive batteries, solar plus battery can easily keep one's electricity price below 27.5c at 15.2 or 26.1c/kWh if use is managed such that only ⅓ or ⅔ respectively of electricity is stored in the battery. The prices of batteries are likely to fall by perhaps 60-80% in the next decade making this equation very favourable.

The last bar shows the community-based model of electrification. This is optimal economically because it efficiently utilises all the solar and storage in a community (technically, under the substation). It assumes that network tariff reform allows solar households and other energy producers in a community household to access the distribution network and incur fair distribution costs for doing so. The consumer cost of electricity in this model could be around 12c/kWh.

Again, we note that Australia will need ~280% of the electricity that is currently delivered if we electrify our domestic economy. If we electrify our export industries, we would ramp up from 280% renewables to as much as 1000% renewables. Under either the domestic electrification or superpower scenarios we could expect greater cost reductions due to market development, technology learning and increasingly efficient utilisation of distribution networks and community assets.

These trends and this chart clearly indicate that the lowest cost electricity blend for Australian households will be the blend that achieves desired levels of reliability while maximising rooftop generation, followed by maximising community generation, with the remainder coming from the grid.

Energy management at the household level

Electrification will allow unprecedented coordination of energy demand, and this will increasingly become a key resource for the reliability and security of the grid. In Figure 10 below we illustrate how the household-level orchestration of devices will be used to shift most load into the solar production window that peaks in the middle of the day. The four charts demonstrate the necessity and the opportunity of digitization of our energy systems.

The first chart (A) shows the ad-hoc nature of electricity use in a household as machines and appliances are turned on and off. At the individual household level, this gives a very “spikey” or inconsistent load.

The second chart of the figure (B) is an average of many households with the spikey load profile of the top chart. The averaging demonstrates that every household uses devices differently but there are trends. At a device level, each household runs its dishwasher at a slightly different moment, turns on the lights at different moments, and has a refrigerator compressor that turns on at different moments, but the averaging smooths out into a typical profile. For example, households tend to run air conditioning in the late afternoon when the interior heat peaks and start the dishwasher after dinner.

This effect is even more pronounced for fully electrified houses (C.) which shows the average load of 100 all electric households from a (US) recorded study. The solar generation window is shown superimposed on these collective loads. The mismatch between the solar generation and the household consumption can be dealt with in two ways. One approach would store the solar excess in batteries and discharge this power back to the household when needed. The more efficient approach in the last chart (D) shifts loads (i.e. deploying demand response) as much as possible, to match solar production.

This demonstrates the value of Home Energy Management Systems (HEMS). A HEMS will optimise the energy flows between solar, storage and demand response. Along with batteries, HEMS are critical. The biggest load in the household is the EV so this is the most critical part of the energy management opportunity, to align charging with sunlit hours. NEPS will have to consider multiple approaches including tariff design, deployment of chargers at workplaces and other community locations, and other incentive schemes.

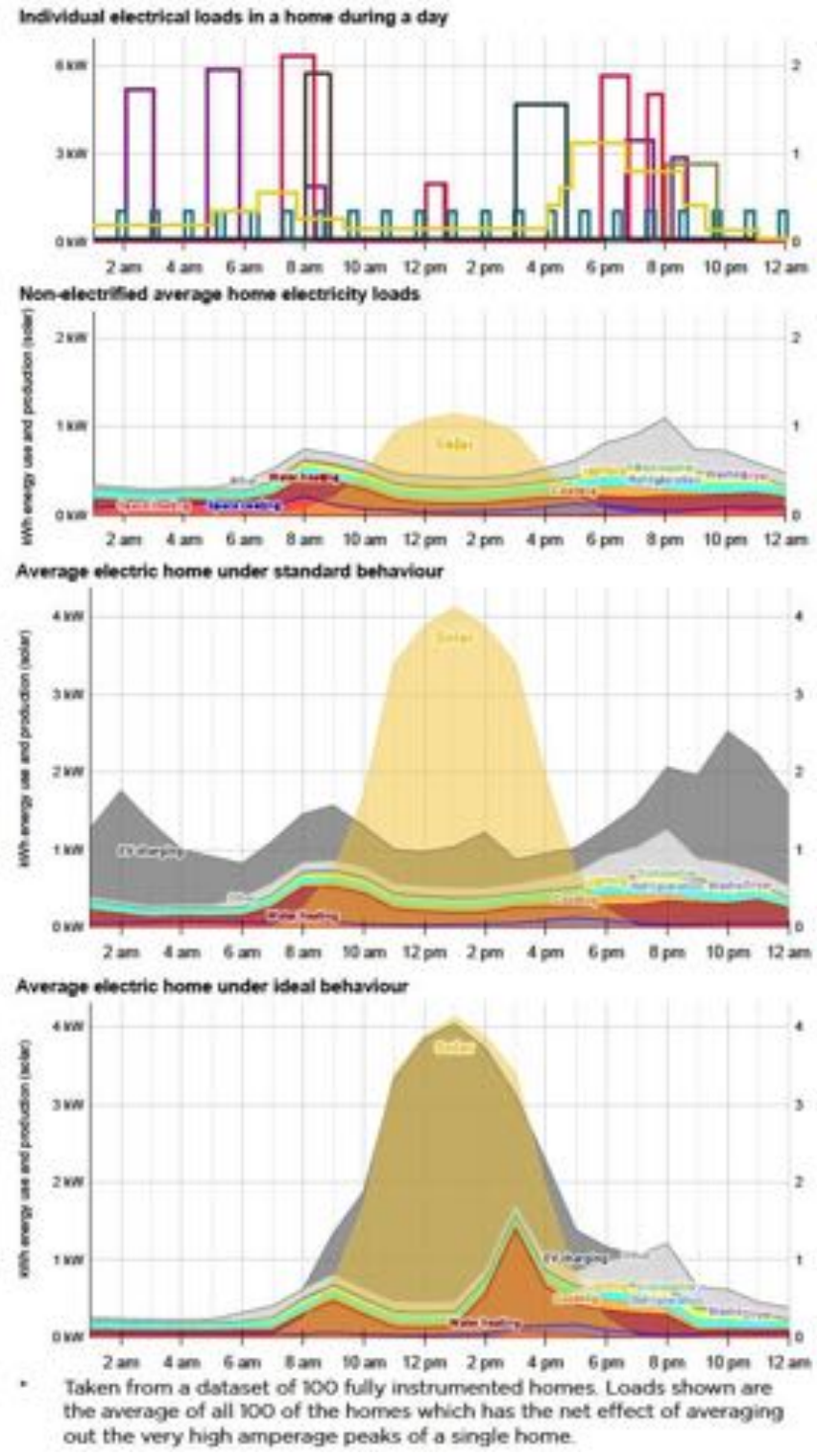

Figure 10. (A) Individual loads of appliances, and lighting, in an individual household over a 24 hour period. (B) Averaging loads of 100 existing, partially electrified households compared to solar generation window. (C.) Averaged loads of 100 fully electrified households over a 24 hour period. (D) An ideally managed all electric household maximising Demand Response and battery storage to fit all household activity under the solar window.

Solar Electric Suburb lighthouse projects

In Rewiring Australia's 2023-24 pre-budget submission we proposed $200 million for Solar Electric Suburb lighthouse projects. There are advanced deployment pilots of electrification across a whole community. The purpose is to understand barriers and opportunities around all aspects of electrification: installation and household integration, grid and system operator integration, community attitudes, workforce and supply chain issues.

These lighthouse projects would drive HEMS innovation. They would provide critical test beds for the NEPS. In the recommendations section below we explain how they would inform policy, targets, and program design.

Aligning Australia with America's Inflation Reduction Act

In 2022 US President Joe Biden signed the *Inflation Reduction Act* (IRA) into law. Rewiring America was instrumental in designing and negotiating the passage of this policy. The intent of this legislation was to tilt the world's markets irreversibly towards clean electricity as the emissions reduction strategy in all sectors other than agriculture.

America's economy has the power to drive the global economy and the IRA leads towards electrification. Independent analysis suggests the IRA could deliver up to around US $900 billion in spending as the total expenditure on electrification measures is uncapped. The IRA. means the federal government will subsidising every American home at likely an average of US $14,000 to electrify and additionally are underwriting the provision of clean electricity to all of those homes. The NEPS is timed perfectly to help align Australian energy policy with America and we should aim to match the IRA.

Australian energy policy dependence on larger economies is due to two factors. Firstly, we are significantly a primary producer of metals, ores, and fossil fuels consumed by other countries. Secondly, we manufacture little of our own energy supply and consuming technologies so are dependent on imported machines. With the passage of the U.S. Inflation Reduction Act, and Europe's policy responses, the world is on an inevitable path to electrification. If the NEPS and complementary trade and investment, manufacturing, transport and regional policies all support our electrification, we could capture significant value from the IRA and position Australia as the incubator of key technologies (and strategic minerals).

In Figure 11 below is a breakdown of the IRA based on the conservative Congressional Budget Office modelling that the total outlay will be US$369 billion. This might as well be called the 'Electrify Everything' act. A small amount of the bill was spent on prescription drug policy, a tiny piece on Internal Revenue Service funding, and some on land-use and land rehabilitation (Superfund). The rest of the money, the huge majority, is electrification of the U.S. economy, either on the supply side, or on the demand side, with roughly an equal expenditure on each.

In this international environment, and as a primary producer not a manufacturer of finished goods, Australia must respond equally or more forcefully, with a national strategy to provide the critical metals and materials and other primary products for this transition and a demand side strategy of preparing our electricity system, homes, commercial buildings and industry, for the electric machines that are now inevitable on the demand side.

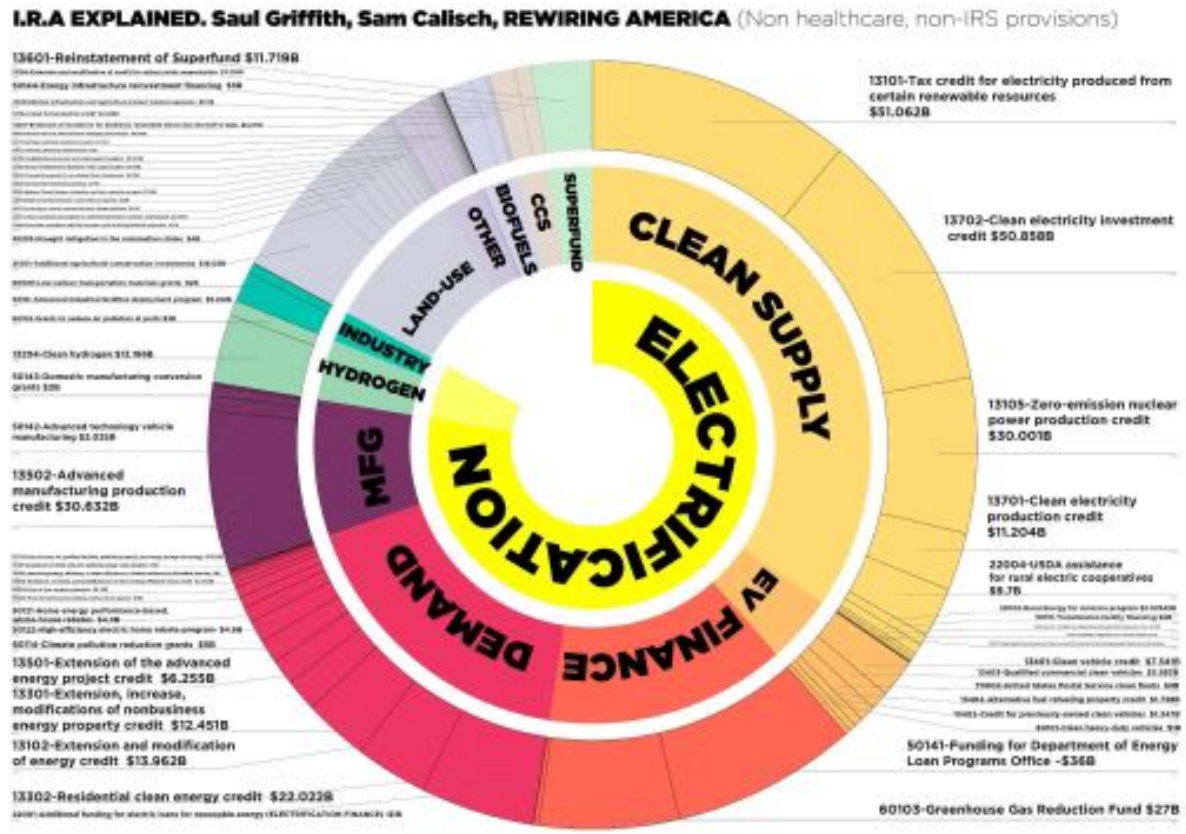

Figure 11. Starburst chart breaking down the IRA into components of electrification and individual line items of the bill.

National Energy Performance Strategy Consultation Paper questions

2.1 (i) Governance

Background
The National Electricity Market (NEM) and the other electricity systems in Australia were designed for the era of large, centralised coal, gas and hydro generation. This centralised supply, dominated by fossil-fuels is reflected in the governance, markets, infrastructure, and culture of the energy sector. Under this model the consumer was a passive price taker who was given little information and no power. The transport fuels sector was similarly based around a small number of large refineries and suppliers.

Electrification is a new paradigm for energy and demands a commensurate shift in how we organise it, from top to bottom. In Rewiring Australia's recent pre-budget submission, we proposed new institutional and policy architecture to guide electrification.[7] In this submission we flesh out that proposal.

Review of energy governance
It is perhaps beyond the scope of this review to look at large scale supply and grid issues and liquid fuels but Rewiring Australia strongly believes that a fundamental restructure of energy governance is required. The current system is entirely out of step with technologies and both investor and consumer sentiment. It fails to provide governments with good advice. The simplest example is the sole emphasis on transmission in the initial framing of 'Rewiring the Nation' ignoring transport and demand side electrification. A new legislative framework is required to deliver new governance arrangements.

For example, it is entirely apparent to independent observers that the NEM is vulnerable and can be plunged into crisis by a major external supply shock. In 2022 the Russian war on Ukraine provided this shock. Where was the advice from the public service warning governments in advance? Where were the contingency plans? Australia has an Energy Security Board (ESB); what did the ESB do to predict such a crisis and prepare for it?

Another example is the electrification of transport. Australia has always managed transport fuels, gas and electricity as separate policy and consumer domains. The rise of EVs as well as the electrification of heating of water, space and cooking in the residential sector and electrification of heat processes in industry, means transport fuels, gas and electricity are now three corners of a single situation. Preparing for the increased energy needs of large scale EV adoption is inextricably linked to the broader energy needs driven by electrification.

If Australia is to have a chance of decarbonising fast enough to achieve a 1.5 degree emissions reduction trajectory, we have to integrate these separate dimensions of energy policy. We need a plan and a powerful agency to deliver it. The boards and culture of market bodies and energy funding agencies must be equipped with expertise in climate, renewable energy and electrification specifically. Consumer bodies must recruit solar 'prosumer' experts and represent

[7] Rewiring Australia (2023) *Pre-budget Submission 2023 – 2024*

the 3 million households that generate their own clean electricity - a population that will only continue to grow.

> *Recommendation: The Energy Minister Meeting (EMM) should commission a broad ranging review of energy governance. An interim report within 6 months would audit the skills and capabilities of the boards of all energy agencies for climate, renewable energy and electrification expertise and solar consumer representation and present options for a new governance model for consideration by the EMM. A final report in 12 months would present a detailed new model. The review would include intergovernmental interactions including energy laws across jurisdictions and interactions with other national laws in particular competition and consumer law.*

Review of entities supporting clean energy investment
Key government entities responsible for driving the take-up of clean energy technologies should be reviewed with a focus on identifying opportunities to further broaden their mandate to reflect opportunities for rapid decarbonisation.

The CEFC has played an important role in driving investment in clean energy projects. To date their focus has largely been on “low risk existing players” in industry. In the early years of the CEFC this was important in the building of new opportunities and business expansions into clean energy. However, the CEFC should refocus its attention towards areas that need additional support through finance to decarbonise. A key priority should be a focus on consumers, particularly households and small businesses, where CEFC low-interest finance should be used to support investment in electrification, installation of solar and batteries. In addition to support for decarbonising homes and businesses, the CEFC should be used to drive the bold and new ideas we need to act swiftly on climate change. Some of these ventures will be high risk but also high reward, and leveraging the CEFC provides a critical opportunity to help drive new ideas, new talent and start ups.

Similar to the CEFC, ARENA must be reformed to play a more prominent and effective role in supporting new and innovative clean energy projects, products and services. The current application processes and funding requirements are time consuming and expensive for applicants and are not conducive to incubating the big, bold ideas we need to seriously tackle the energy and climate change challenges we are facing. The current system is skewed towards large players already in the space and does not allow universities and startups to compete on an even playing field. The models used in the U.S. by the Department of Energy (DOE) and their Advanced Research Projects Agency-Energy (APRA-E) would be a better approach. ARPA-e requires 5-20% of paired funding and waives cost share in the early high risk stages of project development. Australia can never expect to develop fundamental new science based innovations with this structure of funding for our best talent.

Aligned with the recommendation for the CEFC to broaden its mandate, Rewiring Australia also included the following policy recommendations in the 2023-24 Pre-Budget Submission:

- The government can issue a new Investment Mandate Direction for the CEFC to direct it to deploy $2 - $3 billion of its funds to electrification. Two thirds of this available funding could go to households and one-third could go to business.
- Funds should be earmarked for government public housing agencies and private owners of social housing

- For the household stream, the CEFC should be encouraged to develop innovative models to deliver zero interest electrification finance products to the lowest 40-60% of households. These could include bonds to de-risk loans, local government and community-based procurement collectives which have been successful in solar and EV markets and working with energy services companies on new products

Bring energy law in line with policy : incorporate electrification in the national energy objectives

Until such time as governance is fundamentally rewritten as we recommend above, there are interim measures that would facilitate dramatic improvements in energy performance. The first of these has to do with the foundation law in electricity, gas and retail; the National Energy Objectives. These Objectives guide the work of the regulatory bodies and set the direction of the laws they make. The Energy Ministers Meeting (EMM) of August 2022 directed the Department of Climate Change, Energy, the Environment and Water (DCCEEW) to consult and make recommendations for incorporating emissions reduction in the Objectives. Definitions around efficiency should be updated to reflect the foundational efficiency benefit of fuel switching from fossil fuels to electrification. Updated Objectives that are fit for purpose will help the market bodies make rules and may help guide the culture in agencies towards the policy agenda of the federal government.

Lack of coordination undermines policy

Government agencies and governance are designed around the old models and have become a hindrance to decarbonisation and electrification. For example, senior roles in DCCEEW currently reflect historical approaches to climate and energy policy. Government policies and program areas such as Rewiring the Nation, are critically important, but they are fragmented across divisions. This means that officials are required to work very hard to simply coordinate their work and deliver a holistic package of advice to the portfolio Ministers. The departmental structure published in January 2023 is far more integrated and appropriate for current priorities than the August 2022 version, but there is more work to be done.

Table 1 below lists 13 policy areas in DCCEEW that are vital to electrification and energy performance which each have a senior official leading them. These policy areas are siloed across four sections. Government agencies are well versed in integration and coordination across different functional areas and no doubt the officials leading these policy areas collaborate well. The problem is that the pace at which Australia must decarbonise, coupled with the complexity of the process means that these silos are an impediment to policy action.

Table 1 : Electrification and renewable energy transition policies and agencies are spilt across three silos in DCCEEW

Silos	Adaptation and New industries	Gas and Liquid Fuels	Electricity	Energy
Policies	• Clean Technology	• Gas Markets • Liquid Fuels	• Firming Mechanisms Taskforce • Electricity Markets • Market Reform • Networks Reforms & Projects • Rewiring the Nation • Renewables & Distributed Energy	• Residential Energy Efficiency • Industrial Energy Efficiency • Energy Governance • Energy Performance Strategy

Source: Department of Climate Change, Energy, the Environment and Water (2023) (untitled organisational chart)

The even larger problem is that delivery of energy performance and electrification policies and programs requires deep, strategic coordination across Commonwealth portfolios such as housing, industry and trade and with states and territories.

Coordination is vital: establish a new Office of Electrification

Rewiring Australia's 2023-24 Pre-Budget Submission proposed a forward looking governance solution that could work within the existing legislative frameworks. The proposal is to create a new Office of Electrification ('Office'). This would initially be a section within the Electricity Division of the Department of Climate Change, Energy, the Environment and Water (DCCEEW) reporting to the Electricity Head of Division, supporting the Assistant Minister for Climate Change and Energy. It could become a separate agency over time and play a broader coordination role across portfolios. The Office would deliver better coordination of advice to government and program delivery and engagement with jurisdictions.

In Figure 12 below we outline the interim model of governance with a focus on the demand side. The Office sits at the centre of the new structure. It would be funded by the Commonwealth but would support state and territory departments and agencies (see rectangle on the left). The Office would provide intellectual leadership and advice to the EMM (see top rectangle) and empower the Ministers to set the policies Australia needs to deliver electrification and enhance energy performance. The bottom rectangle represents the ESB and its constituent market bodies. These would have a clearly delegated responsibility to design and implement market and system solutions to deliver policy.

To the right of the chart is a rectangle representing a new informal structure, the Energy Minister's Investor and Innovator Roundtable. This is based on an idea proposed by the Clean

Energy Investor Group in 2021, for an Investors and Innovators Advisory Council.[8] In October 2022 the Treasurer announced a Treasurer's Investor Roundtable, which will 'identify and unlock investment opportunities in national priority areas.'[9] The Energy Minister's Investor and Innovator Roundtable would be convened by the Energy Minister and Assistant Minister. It would be small (perhaps 5-9 members), with roughly half clean energy investors and half innovative companies developing new technologies and business models. This should be weighted evenly between large scale supply and demand side (electrification and efficiency) sectors. This cohort of members would sit at the cutting edge of technological and market transformation. It could perhaps be open to state and territory Energy Ministers to attend.

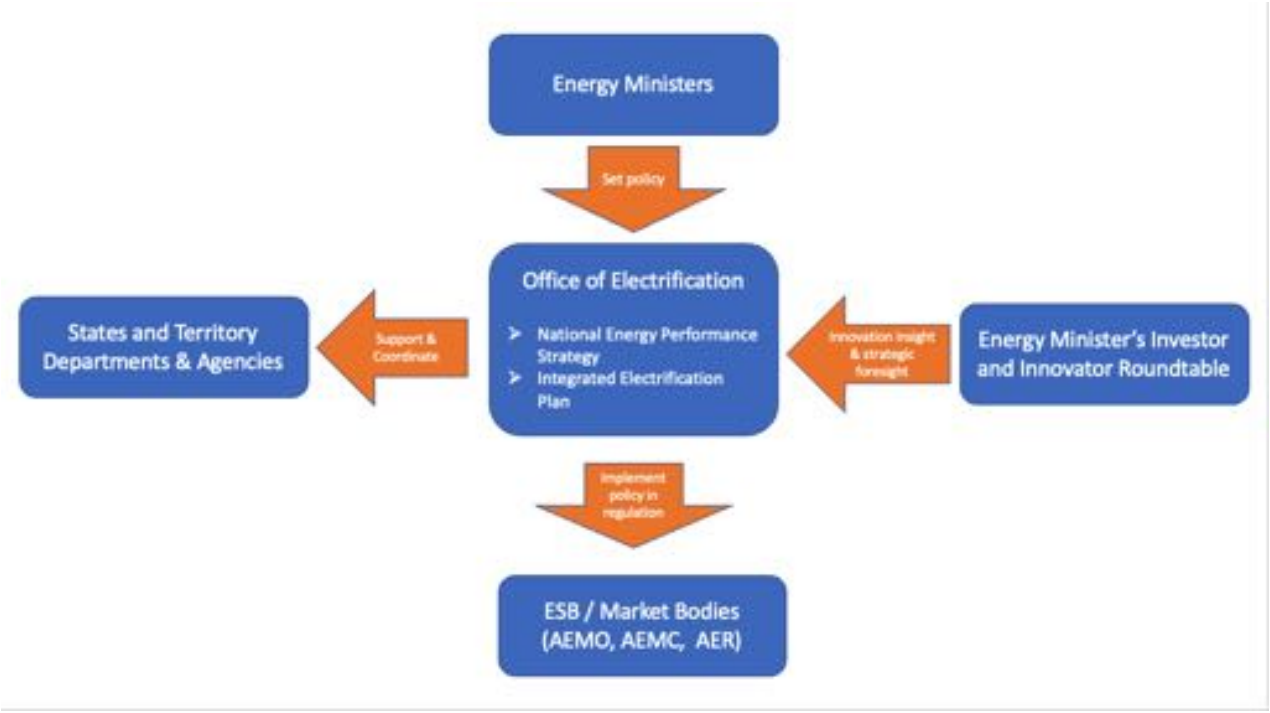

Figure 12 : new governance structure for NEPS and electrification

2.1 (ii) Targets

Australia should have energy performance and electrification targets (see Table 2 below). These would support emissions reductions in line with a 1.5 degree scenario. The sectoral targets would take into account the specific barriers and opportunities faced by those energy consumers. These targets would flow from a top-down carbon budget for sectors designed around the proportional efficient abatement they can deliver on the timeline to meet the Paris Agreement.

> *Recommendation: The government should set national energy performance and electrification targets for all sectors as part of the economy-wide goal of reducing*

[8] Clean Energy Investors Group (2021) *Clean Energy Investor Principles: Unlocking low-cost capital for clean energy investment*, p.17
[9] Chalmers (2021) *Treasurer's Investor Roundtable*, https://ministers.treasury.gov.au/ministers/jim-chalmers-2022/media-releases/treasurers-investor-roundtable

emissions in line with a 1.5 degree scenario. (See proposed sectoral targets listed Table 2 below.)

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

If electrification of households and commercial buildings is deployed with smart technologies, then commercial buildings, homes and private and commercial light vehicles would become a vast resource for the electricity system. This approach would improve reliability, security and resilience in the face of natural disasters. Equity principles should guide the design of targets and delivery programs in the household sector.

Solar Electric Suburb lighthouse projects to provide
Rewiring Australia hopes to commence a two year Solar Electric Suburb lighthouse project in 2023. This would involve a multi-phase process starting with a small sample of households to test methodology and understand installation challenges and soft costs. It would quickly expand to at least 500 homes per suburb in the full electrification deployments. This would provide a living laboratory for household electrification and efficiency policy and programs. It will provide a granular understanding of interaction between technologies, demographics, and behaviour.

Demand response targets to reduce peak load costs and improve reliability and security
Demand response is a vital element of energy performance. Demand response refers to the controlled reduction in demand in response to high prices or tight supply, particularly when it is cheaper and easier than increasing supply. The NEM does not have a coherent strategy for flexible and demand side resources, so in this section we deliberately cut across technical and regulatory categories, to provide an integrated perspective. In particular, two-way batteries are not technically a demand response technology in the same way as a one-way load, but for the purpose of this discussion we are including them here. If batteries are installed through energy performance policies then they should be included in this discussion of responsive demand. In regulatory and technical terms, battery services include sending power to the grid ("V2G") as well as attenuating demand during charging which is the narrower demand response definition.

Commercial office buildings, cool stores, shopping centres and households with air conditioning are all well suited to provide significant demand response value. During cold winter days and hot summer days, the energy used for space heating and cooling of commercial buildings can be shifted to times of lower cost (and lower demand). Heating and cooling loads can be used like batteries and we can choose when we charge them up. Many heating and cooling loads can be shifted so they take place during the night when demand is lower. The technologies required to shift heating, ventilation and air conditioning (HVAC) load are commercially available. There are already innovative Australian companies leading this sector, such as Buildings Alive. Continued investment in commercial building demand response should be a key element of the NEPS.[10]

[10] Buildings Alive (2023) *About us*, https://buildingsalive.com/about/

The NEPS should include a demand response strategy for all sectors. It could use government buildings as a pilot for the commercial building sector, with public buildings required to use load shifting by 2025.

Table 2 : sectoral targets and policies

Sectors and loads	Targets and policies
Low-income households, disadvantaged communities including remote and First Nations communities: building loads	• Short term target for 100% electrification and efficiency retrofit by 2027. • Community-specific (including multicultural) education and grant based programs starting with social and public housing and disadvantaged communities as pilots of broader electrification. • Prioritise early funding to building envelope upgrades and heat pumps, elimination of gas. CEFC funding of zero-interest financial products. • Microgrids where appropriate in remote areas. • Mandatory standards for new builds and rentals. • Gas elimination in all public housing by 2026. • Demand response market in the NEM for households by 2025.
Medium - High income households: building loads	• Medium term target for 100% electrification and efficiency retrofit by 2033. • Public education and advertising programs. • CEFC funding of zero-interest financial products. Consolidation or coordination of state-based subsidies. • Mandatory standards for new builds and rentals.
Light vehicles: private and commercial	• Medium term target for no new ICEs sold by 2027 for petrol and 2030 for diesel engines. Rural or industrial exceptions where appropriate. Exception for qualified bio-diesel. • Demand response market in the NEM for EV chargers by 2025. • Community infrastructure plan and funds for community generation infrastructure and community charging infrastructure.
Commercial buildings (offices, shops)	• Medium term targets for electrification and efficiency retrofit. • Mandatory standards for new builds. • Load shifting target of air conditioning in 50% of commercial office buildings by 2025 and appropriate tariffs or demand response markets for this service.
Industry	• Commission study and report, with recommendations and targets, for the electrification of metals, and heavy industry, and for the demand response capacity of these markets. Push industry to look to how to respond to an overcapacity of renewable generation. • Demand response target of 1 GW by 2025, 2-3 GW by 2027, ~5+ GW by 2029.

Recommendation: Progress towards targets should be measured with mandatory self reporting for large consumers and detailed sampling of households through Solar Electric Suburb lighthouse projects.

2.2 (i) Residential

The residential sector provides a substantial opportunity and challenge to decarbonise and electrify. In addition to supporting homes become electric and more efficient through low interest finance, direct (an co-ordinated) subsidies and pilot projects, the Government should play a leadership role in the setting of standards.

> *Recommendation: Australia has a framework for rating residential properties and it should be broadened to include electrification. The NEPS can drive a reboot of the Nationwide House Energy Rating Scheme (NatHERS) to include this comprehensive definition of performance. The National Construction Code should be reviewed to support electrification. Public and social housing agencies should be encouraged to work with CEFC and ARENA to innovate in electrification, demand response and efficiency.*

Rewiring Australia recommends that landlords be required report building efficiently and average running costs against NatHERS star ratings to prospective tenants. While efficiency rating scores provide some insight into a buildings performance, these also need to be translated into real terms, such as what were the properties energy bills for the last 12 months. Further, the Federal Government should work with States and Territories in the development and implementation of minimum efficiency standards for rental properties.

2.2 (ii) Low-income households

Rewiring Australia's 2023-23 Pre-Budget submission proposed $200 million for grants for low-income households and disadvantaged communities:

> A highly targeted grant program would offer up-front subsidies to disadvantaged communities and households to allow them to purchase efficient electric devices, solar and storage and e-bikes or EVs. This would be designed in consultation with communities and welfare agencies. For example, grants could be designed for remote First Nations communities, refugees or safe houses for women and children. This could be administered by states where appropriate.[11]

Social housing should be prioritised by Governments and be seen as an investment in equity and health.

> *Recommendation: Governments should lead by electrifying public housing and bringing the homes to a NatHERS rating of at least 7 stars by 2030 for apartments or houses that cannot host solar and at least 5 stars for those that can host solar.*

2.2 (iii) Renters

As has been demonstrated with the low uptake of rooftop solar on rental properties, there are substantial barriers in driving efficient electric upgrades for renters. Overtime higher quality, all electric, building codes that slowly improve all building stock, which should include insulation, and targets for envelope seal quality. However, in the short term, direct interventions will be required to lift the standards of rental properties. Some states have subsidies for renters for solar and other electrification technologies.

[11] Rewiring Australia (2023) *Pre-budget Submission 2023 – 2024*, p.3

There are also mechanisms that can assist facilitate upgrades of rental properties. to fund electrification of rental properties, with loan instruments attached to the property title. Under the Solar Savers programs in Victoria the local Council pays for and organises the installation of solar systems which renters and landlords (or homeowners) pay back over 10 years.

> *Recommendation: NEPS should coordinate with state and local governments and the CEFC to develop a strategy to extend rate-based financing from solar to full electrification, including aggregating state subsidies.*

The most impactful support for renters will be on electric vehicle ownership and charging capacity. Many renters own vehicles and like most drivers, will be transitioning to electric vehicles over the next decade. The shift to EVs is where many renters are likely to save the most money in the price arbitrage against (increasingly expensive) petrol and diesel. The investment required for electric vehicle charging should be a priority to ensure renters have access to the benefits of electrification. This could be facilitated through mandates or incentives that landlords must add electric vehicle charging capacity at the request of tenants.

2.2 (iv) Apartments

In the short term low income and disadvantaged communities should have access to grant funding for electrification and some of this should target high-rise social and public housing. There are new technologies and business models for energy management in apartment buildings. Trials and subsidies programs should integrate and assess these new systems.

> *Recommendation: NEPS should support and coordinate ARENA and CEFC to drive innovation in electrification and energy management systems suitable for apartments.*

2.2 (v) Regional, Remote and First Nations

Our analysis above demonstrates that vehicles account for the greatest share of both emissions and energy cost savings from electrification for the average household. This weighting is even greater for regional and remote communities where journeys are longer than average. The challenge however is that these journeys may push the limits of EV battery range.

Where range limits are not prohibitive, the single most important energy performance improvement for regional and remote communities is in providing access to electric vehicles and then solar for charging them. This has ongoing and substantial cost savings against diesel or petrol. Household and community batteries that enable remote communities to maximise their use of rooftop and solar communities will have the highest impact on lowering energy costs.

The Bushlight program successfully deployed mini grids for remote First Nations communities. NEPS should build on that program from the view of the new strategy of electrification with efficiency. Some funding from the grants program we proposed in our Pre-Budget submission should be directed to remote First Nations communities to support mini grids or community energy planning for those connected to the wider grid. First Nations communities and representative bodies should be granted revenue streams and more importantly equity in all energy projects, whether they are community or utility in scale.

2.3 Commercial

Australia has a framework for driving energy efficiency in commercial buildings. The National Australian Built Environment Rating System (NABERS) encourages commercial building owners to have their buildings rated for energy performance. The Commercial Building Disclosure (CBD) Program requires a Building Energy Efficiency Certificate (BEEC) to be provided in most cases when commercial office space of 1000 square metres or more is offered for lease or sale. A BECC includes the NABERs rating.

The NEPS should update the NABERS and CBD frameworks to include electrification targets. They should also be extended to cover the widest range of property types. The energy performance measures should be updated to include real time energy consumption and emissions. Education programs for the property sector should be expanded to include electrification, demand response and real time energy and emissions monitoring.

> *Recommendation: Education programs for building managers, property investors and owners about load shifting and demand side and electrification generally.*
> *Recommendation: mandatory reporting of detailed daily, seasonal load profile and emissions intensity to commercial building owners (online with downloadable data, not paper bills).*
>
> *Recommendation: Tariff structures reformed to reflect cost and emissions intensity*

2.4 Industry

Electrification is commercially viable for households and commercial facilities with similar load types but it is not yet viable for major industries such as steel production. Over the 2020s while NEPS and other policies are deploying household and commercial electrification technologies, the government should be developing the next generation of technologies for industry. A comprehensive strategy is required to drive this process.

Given the scale of American leadership in the IRA, Australia should seek to develop an industrial electrification innovation strategy with collaboration from US government agencies.

> *Recommendation: DCCEEW and the Department of Industry, Science and Resources should work on a R&D strategy for industrial electrification, with ARENA, CSIRO and CEFC, relevant CRCs in collaboration with the US Government.*

Over the 2020s industry can be encouraged to deploy the technologies that are already available. This includes some electrification and efficiency technologies and demand response. Where there are technologies which are already commercial in other countries, education of industrial users may be sufficient to encourage adoption.

The first step for the government is to mandate energy performance plans for major energy users. Companies should be compelled to install energy management systems and report on their energy intensity of production against industry benchmarks. Companies should produce annual updates to their plans.

> *Recommendation: fund industry bodies to run energy efficiency and demand response education programs for industrial users.*

In 2014 the Commonwealth commissioned a study of industrial demand response which found that there was several GW of total potential supply in Australian industry, using available technologies.[12] There was estimated to be 3.1 GW of load that could be shifted or shed for 2-4 hours, 5-10 times per year from industrial sectors with a total demand during summer peaks of 7.6 GW. That is, the demand response potential of these sectors is almost 50% of load.

In 2020 the AEMC opened up the NEM to demand response with the wholesale demand response mechanism rule change. AEMO was charged with developing the operational guidelines to implement this rule change. Unfortunately the baselines and other procedures have not encouraged the level of participation that was expected. In its update covering 24 October 2021 to 12 June 2022, AEMO reported that only 61.6 MW of capacity has been enrolled in the new market and total dispatched energy was 319 MWh.[13]

> *Recommendation: DCCEEW update the 2014 industrial demand response study and review the implementation wholesale demand response mechanism.*

2.5 Supply chains and workforce

Australia needs a reliable supply chain for electrification. The NEPS should investigate supply chains for electric vehicles, solar, heat pumps, batteries, electric heating appliances for both space heat and water heating, wind turbines, and for power electronics and electrical infrastructure including switchboards, HEMS systems, even copper wiring. We need steel and aluminium supply chains as all of these items need steel and aluminium whether it is steel for wind towers, or aluminium for solar module racking systems.

The manufacturing question will be which of these things we should manufacture domestically. Should we manufacture all of these things? Probably not. We will inevitably be key components of the international supply chain as Australia is in the top 4 producers internationally of all critical metals required for everything above. The real supply chain and workforce question is in fact a question that has plagued Australia since the 1980's which is how much of the finished manufacturing and assembly do we do, or do we just provide raw materials to the rest of the world and purchase finished goods in return?

If we built new business models around leasing our metals instead of selling them, we could get recurring revenue for our lithium batteries as they return home for reprocessing. If we designed a regulatory standard for vehicles like the Japanese Kei car vehicle class we could meet many of the demands of our transport sector with locally manufactured vehicles.

The other big question is the workforce. We are short tens of thousands of electricians and a similar number of HVAC technicians. Australia had a huge success with solar training and certification schemes that led to qualifying 8,000 solar installers. We should look to similar programs to not only lead workforce development but also lower soft costs, for vehicle charging stations, heat pump installations, kitchen electrification, switchboard upgrades, battery installations and more.

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[12] ClimateWorks (2014) *Industrial demand side response potentia*l, p.3
[13] AEMO (2022) *Wholesale Demand Response Annual Report: June 2022*, p.3

We really have 3 workforce training problems. The largest by number is training of our tradies and technicians for the enormous job of deployment. The second largest by number is the retraining of existing energy supply chain jobs (coal miners, gas workers) for TLC (technical low carbon) jobs.

Contact

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