



Rewiring
Australia

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SUBMISSION TO THE ELECTRICITY AND ENERGY SECTOR PLAN DISCUSSION PAPER CONSULTATION

Rewiring Australia submission to Electricity and Energy Sector Plan Discussion Paper Consultation

About Rewiring Australia

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

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 respects to their Elders, past and present and extend that respect to all Aboriginal and Torres Strait Islander peoples today.

Contents

About Rewiring Australia.....	2
Acknowledgement of country.....	2
Recommendations.....	4
1. Introduction.....	5
2. Setting ambitious targets.....	6
2.1. Paris Agreement Target.....	6
2.2. Climate Aligned Targets.....	7
3. The opportunity of electrification.....	8
3.1. Emissions reductions through electrification.....	8
3.2. The vision of an electric future.....	9
3.3. Sequencing electrification efforts.....	11
3.4. Data, Modelling and Sector Planning.....	12
4. Mobilising investment to transform energy and providing equitable access.....	14
4.1. Investing in household and commercial electrification.....	14
4.2. Investing in the electrification of industry.....	16
5. Enabling electrification for a smooth transition.....	17
5.1. Future System Operation.....	17
5.2. Energy Market Reform and Governance.....	18
5.3. Markets for Electrification.....	20
5.4. Wholesale Demand Response Mechanism.....	22
5.5. Innovation Zones.....	22
6. Growing alternative low-carbon fuels.....	23
6.1. Fair, equitable and orderly transition for decarbonising natural gas and liquid fuels?.....	24
6.2. Liquid fuels.....	24
6.3. No efficient role for fossil gas and other forms of gas.....	24
6.4. Hydrogen.....	26
6.5. Production Pathways to low-carbon fuel industries.....	27
6.6. Gas substitution and gas networks.....	27
7. Conclusion.....	28

Recommendations

1. By the end of 2025, legislate for an Australian Energy Information Agency, to provide impartial, centralised energy data analysis and advice across government.
2. Set climate-aligned targets within the Electricity and Energy Sector Plan (and all other sectoral plans). Review progress regularly using the new Australian Energy Information Agency. Targets should be centred around electrification and coupled across transport, industry, and electricity sectors.
3. By June 2024 convene a cross-departmental electrification modelling workshop in Canberra with senior officials and independent expert (including Rewiring Australia Chief Scientist Dr Saul Griffith) to share methodologies and input data for energy modelling, with a focus on electrification and sector coupling in an international context.
4. Electrify all social housing by 2030, with joint funding provided by the Federal and State and Territory Governments
5. By November 2024, consult with jurisdictions and stakeholders to design the framework for a universal household electrification finance scheme funded by the Australian Government. Support this by facilitating financial innovation and market development to crowd-in institutional investment to support public and household investment.
6. Develop a comprehensive innovation strategy supported by additional funding and industry-specific innovation plans. Examples include agriculture, renewable industrial processes, commercial buildings, and renewable heating.
7. Develop a clear vision of the future energy system dominated by distributed energy, storage and electrification.

8. By October 2024, conduct a short, sharp review of the governance of the National Electricity Market.
9. By end of 2025, implement governance reforms designed by the governance review. Energy ministers to direct the design of markets for electrification using expedited, government-led policy making and not the usual incremental and slow market body rule making and review processes. Deliver new markets by end 2026.
10. Coordination between Federal and State jurisdictions for the creation of markets for electrification that value the commodification of demand flexibility and electrification.
11. By November 2024 energy ministers make a direction to the Australian Energy Market Commission and Australian Energy Market Operator to fix the Wholesale Demand Response Mechanism.
12. By end of 2024, use regulatory sandboxing and an update to the Australian Renewable Energy Agency's funding strategies to create a framework for 4 Innovation Zones to deploy electrification and inform the redesign of markets for electrification.
13. By November 2024, commission an independent assessment of future green hydrogen and biofuel production volumes and prices to improve planning and avoid overinvestment in green fuels.

1. Introduction

Rewiring Australia welcomes the opportunity to make a submission to the Department of Climate Change Energy, the Environment and Water consultation on the Electricity and Energy Sector Plan Discussion Paper (the Discussion Paper). We are pleased that electrification is the key new policy approach proposed. This submission argues for the need for the Australian government to coordinate policy across sectors to enable accelerated decarbonisation of the electricity, industry and transport sectors through

electrification. Targets and rates of decarbonisation should be updated with the latest climate science observations.

The Rewiring Australia submission covers five content areas. First, the importance of ambitious climate targets being incorporated into Sectoral Plans. Second, the opportunity and role of electrification in decarbonisation and the energy system. Third we outline the importance of investing in households, businesses and industry to support their electrification. In this section we also consider the importance of Government investment and planning that takes into account equity outcomes. Fourth is a discussion and recommendations for reforms to the regulatory and market framework to ensure the most benefit is captured from electrification and the rapid deployment of DERs. Finally, the paper explores the limitations of alternative low-carbon fuels, cautioning against over investment.

2. Setting ambitious targets

2.1. Paris Agreement Target

As a signatory of the United Nations Framework on Climate Change, Australia has agreed to “resolve to pursue further efforts to limit the temperature increase to 1.5 °C¹”. Accordingly, governments, including Australia, must transform their national economies to zero net carbon emissions by 2050. As the energy sector accounts for nearly 90 per cent of global CO₂ emissions, the challenge requires transitioning the electricity generation and transportation sectors to renewable energy sources. The decade to 2030 is critical for action on climate change, and the key to this challenge is the complete energy transition to clean energy sources and the transformation of Australia’s energy system.

The Electricity and Energy Sector Plan (the Sector Plan) is the most appropriate place to design the machinery of government required to deliver coordination of decarbonisation through electrification. This will support the other sectoral plans and allow the Net Zero Plan to deliver climate-aligned targets necessary for Australia to propose a credible Nationally Determined Contribution to the UNFCCC in 2025.

¹ UNFCCC. (2022). COP 27 Sharm el-Sheikh Implementation Plan (Sharm el-Sheikh Climate Change Conference - November 2022, Issue. United Nations Framework Convention on Climate Change. Available from: https://unfccc.int/sites/default/files/resource/cp2022_L19_adv.pdf

2.2. Climate Aligned Targets

If Australia aims to hit a 1.5-degree or 2-degree warming target, greater ambition in emission reduction targets is urgently needed. Net zero by 2050 will not be sufficient. The required negative emissions levels modelled under the UN International Panel on Climate Change (IPCC) process are uneconomic and unrealistic. Thus, if the Australian government is targeting a 1.5-degree future, targets must be fast-tracked to actual zero emissions by 2035.

Legislated targets are needed to achieve net zero by 2050, and these must be supported by interim renewable energy targets. In order to reach these targets, the future state of the electricity and energy sector will need to have:

- Very high levels of renewable energy generation at large, medium, and small scales.
- No coal-fired power plants.
- Strategic use of gas-fired power stations in the short term and ceasing all gas use in the short to medium term.
- An end consumer sector electrified and with saturation levels of solar and storage connected to the distribution network.
- Additional power system flexibility and new commodity markets, such as demand flexibility.

The Discussion Paper has acknowledged this future. In this submission, Rewiring Australia will provide recommendations to assist in fast-tracking Australia's emissions reductions through rapid electrification.

Key to meeting set targets is reliable and robust data to track progress and identify opportunities. Multiple departments, agencies, and market bodies currently collect and share energy, industry, and decarbonisation data to inform decarbonisation pathways. A more efficient approach would be to centralise data collection and analysis into a single federal government agency. This could be modelled on the approach in the United States with the Energy Information Administration. This recommendation is discussed further, particularly in relation to the Integrated Systems Plan in section 3.4.

Recommendation One

By the end of 2025, legislate for an Australian Energy Information Agency, to provide impartial, centralised energy data analysis and advice across government.

Recommendation Two

Set climate-aligned targets within the Electricity and Energy Sector Plan (and all other sectoral plans). Review progress regularly using the new Australian Energy Information Agency. Targets should be centred around electrification and coupled across transport, industry, and electricity.

3. The opportunity of electrification

Rewiring Australia advocates aggressive electrification of the end-use sector as the most cost-effective way to manage the energy sector's transition. To support the Australian government's ambitions of a smooth transition, we outline a pathway based on 10 core principles. It requires consideration of the sequencing of government policy and industry-specific plans, energy sector innovation strategies, and supporting innovation funding.

3.1. Emissions reductions through electrification

Traditionally, energy sectors were broken into artificial economic sectors. These sectors are residential, commercial, industrial, transport and electricity sector. This categorisation approach has constrained our understanding and thinking about transforming our energy economy and therefore, emissions. The energy use and emissions across these sectors are intrinsically linked, especially with electrification, and mapping the actual decarbonisation decision points provides a clearer view of emissions reduction opportunities.

Analysis conducted by Rewiring Australia has represented Australia's domestic emissions data in a way that enables us to think about domestic economy decarbonisation separately from export economy decarbonisation. We separate out 2 categories: (1) the domestic emissions that support our domestic economy and (2) the trade emissions that count on Australia's emissions budget but are, in fact, emissions associated with creating our exports.

This categorisation quickly demonstrates that our household decisions are responsible for a significant amount of our emissions reduction opportunity. Decisions made around the dinner table impact about 42% of Australia's domestic emissions. Commercial emissions refer to Australian businesses and contribute about 29% of domestic emissions. These emissions are largely derived from decisions similar to those

households make decisions about what appliances are used in those businesses, where their electricity and heat come from, and the vehicles and transport used.

Simultaneously, because of technology cost curves, efficient electric machines are the lowest cost emissions reductions available today. They are the spearhead of our climate response, and Australia can and should move faster to give time for the harder-to-mitigate areas.

3.2. The vision of an electric future

Electrification is the cheapest pathway to decarbonisation. Rewiring Australia proposes the following 10 core principles to unlock the electrification pathway. Rewiring Australia's modelling has demonstrated that the economic opportunities of household electrification are significant. Electrification powered by rooftop solar and supported by batteries is anti-inflationary.

Electrification couples all of the sectors. One can no longer think of them separately. Good policy promotes synergies between industry, residential, commercial, and transportation loads so that they complement each other and work together to match daily and seasonal renewable energy generation periods. Residential loads peak during the mornings and evenings when solar generation is low.

Loads average, generation averages, geography and network connection matters. Electricity needs to be used or stored as it is generated. Individual instantaneous and varied loads are difficult to meet independently, but they average out to a much broader demand. This averaging effect also works for the supply of electricity and demand. The more connected our loads and supplies are, the more the averaging effect helps balance the loads and lowers the amount of storage required. Going completely off-grid is difficult – connecting to the grid and having your loads and generation contribute to network averaging makes electrification easier for everyone else.

Tens of millions of batteries will be needed. In an electrified future, there will be ~10 million water heaters that can store energy, 20 million vehicle batteries, and as many as 5 million home batteries. We need charging stations where cars are during daylight hours—workplaces, for example. These prolific batteries can do much of the work of balancing the grid.

Everything continues to get cheaper and better. The economies of scale are still picking up with the technologies that are our climate solution. A technology improving

at 7% a year is twice as good ten years from now. Solar, batteries, and electric vehicles are all climbing this performance curve while also becoming cheaper. This is not to say wait until everything is perfect but to commit to a continuously improving ecosystem.

Electrical assets are appreciating climate assets. The grid might be dirty today, but it won't be dirty forever. While electric vehicles and appliances currently draw in part on a fossil fuel grid, this is only for the short term. We should think of electric machines as appreciating climate assets as they improve their climate performance every day as we decarbonise the grid.

Electrification is the biggest efficiency. Efficiency has been emphasised since the 1970s as a conservative solution to energy problems. However, thorough thermal efficiency is difficult and expensive to retrofit. We should emphasise higher-quality building codes that will insulate floors, ceilings, walls, and windows. When homes are renovated, there are opportunities to upgrade these insulations. However, completely retrofitting older homes is often less cost-effective than merely electrifying all of the gas-powered machines with electric and heat pumps. A heat pump is 3-4 times more efficient in terms of energy than natural gas for heating homes or heating water. Induction cooking is 2 times more efficient than gas for cooking. Electric cars are also 3-4 times more efficient than petrol or diesel vehicles. A poorly insulated, all-electric home can have zero emissions at a lower cost than a perfectly insulated home.

Local is cheapest. Generation should be close to where it is used, minimising transmission and distribution costs and resulting in fewer hot spots and choke points in the electrical grid. Behind-the-metre solar will be the cheapest energy in almost all cases. Around one-third of our retail electricity cost is the distribution system, and about 10% is the transmission cost. We can utilise the local distribution system more effectively with more neighbour-to-neighbour transactions, leading to lower system costs.

Finance vs. fuels. Access to finance is everything. The machines that utilise fossil fuels are often cheaper, but the fuels are expensive. Electrification can be seen as the substitution of finance for fuels. A more expensive machine at purchase (such as an electric car or heat pump) can be far cheaper over the long term as the cost of electricity to run it can be as much as one-tenth of the price of fossil fuels. Who has access to finance and at what interest rate will determine who benefits economically from electrification.

Focus on the purchasing decisions eliminates friction. Reduce, reuse, and recycle are good principles, but they emphasise the wrong actions regarding decarbonisation. Our emissions are determined by a small number of decisions made infrequently. The decisions are whether your car is electric (or not), whether your water is heated electrically or with fossil fuels, whether you cook with gas or electricity, and whether your home is heated with a heat pump or gas. We need to replace every fossil-fueled machine in Australia with an electric equivalent when they need replacing. It is imperative to make those purchasing decision moments as easy as possible. The knowledge, the workforce, and the finance need to be in place as people make these decisions. Each of them happens every 10-20 years when the car needs replacing, the water heater dies, or the kitchen is upgraded. It is useful to plan policy around these real-life purchasing decisions to consider how to make each one as frictionless as possible.

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

3.3. Sequencing electrification efforts

Rewiring Australia recommends considering the following sequencing of electrification efforts: short, mid, and longer term. This would require a comprehensive Sector Plan with a 50-year outlook and a clear government commitment to electrification, which would provide economy-wide investment security.

Short term: Huge investments in rooftop solar, residential, small business and commercial electrification, including all building heating systems and all vehicles. Expand the network capacity with rooftop and community generation to allow ourselves the decade to design and build the long-lead transmission networks critical to industrial electrification and decarbonisation. Prioritise market and NEM reform to enable the most efficient operation of the energy system under increased electrification rates.

Prioritise early-stage R&D in universities, small businesses, and start-ups to tackle the difficult and hard-to-decarbonise components of industry and agriculture. Align

incentives with electricity market reform and building standards optimisation to incentivise very rapid electrification of these sectors. The short-term focus is to develop skilled trades for deployment. Begin long-term investments in industrial research capacity and a disruptive innovation ecosystem that gets treated equally or preferentially over investments in existing market players who don't move fast enough.

Mid-term: continue to develop transmission, lower costs of renewables and batteries, and develop electric aviation and electric rail for long-distance transportation. Electrify agricultural operations and long-distance freight trucking.

Long-term: Electrify the majority of industrial processes, including perhaps ammonia production and some hydrogen for iron reduction and steel production.

3.4. Data, Modelling and Sector Planning

The current NEM planning document, the Integrated System Plan (ISP) prepared by AEMO, does not anticipate the required (and achievable) rate of electrification. Consequently, the renewable generation targets are set too low and conservative. Critical shortfalls exist in the ISP methodology. For example, the role of DERs and technically proven and economic renewable energy alternatives, such as industrial renewable heating, was underestimated, and gas was overestimated in the energy mix.

Given DERs' potential to contribute to achieving renewable energy targets and secure electricity system operation, their role must be fully understood. These inconsistencies and missing data sets need to be addressed, and a more comprehensive approach to longitudinal data collection and modelling is needed to inform energy sector planning.

To adequately deal with an energy crisis and plan energy policy, it is urgent to establish base truths about the energy system with good data. Therefore, Rewiring Australia recommends creating an independent government-funded Australian Energy Information Agency (AEIA) to provide government policymakers with impartial and centralised energy data analysis and advice. The AEIA would be based on the USA equivalent Energy Information Administration².

² The U.S. Energy Information Administration (EIA) collects, analyses, and disseminates independent and impartial energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment. [Homepage - U.S. Energy Information Administration \(EIA\)](https://www.eia.gov/)

The AEIA would make energy sector models and data sets open source and freely available to the public. The AEIA would be responsible for developing an energy and electricity sector model. This research and data would become an input into the ISP and other energy sector modelling. Rewiring Australia would recommend the AEIA be responsible for the development of an electricity sector model with the following scope:

- Saturation levels of household solar generation and electrification. Modelling of current uptake trends of 30 million consumer energy resource batteries (EVs, behind-the-metre lithium batteries and thermal batteries in the form of hot water storage);
- Load growth levels are consistent with Australia as a clean energy superpower scenario.
- Assess the potential contribution by sector that is, the residential, commercial, and industrial sectors disaggregated by ASIC category.
- Model saturation levels of electrified, efficient, and flexibility-enabled appliances, equipment, and industrial processes powered by renewable energy.
- Model the wholesale transmission level demand and supply alongside the distribution level demand and supply dynamics.
- Extend existing energy data sets to include the NEM, Western Australia SWIS, Northern Territory DKIS, and off-grid energy consumption.
- Undertake an independent review of the Integrated System Plan.

Rewiring Australia would like to contribute to and collaborate on scoping these data sets and modelling needs. We suggest a workshop in Canberra with Dr Saul Griffith, independent experts, senior government officials, and interdepartmental senior officials to share methodologies and input data for energy model development.

Recommendation Three

By June 2024 convene a cross-departmental electrification modelling workshop in Canberra with senior officials and independent experts (including Rewiring Australia Chief Scientist Dr Saul Griffith) to share methodologies and input data for energy modelling, with a focus on electrification and sector coupling in an international context.

4. Mobilising investment to transform energy and providing equitable access

Mass electrification requires millions of homeowners, landlords, owners' corporations, and businesses (large and small) to make an investment decision to replace fossil fuel machines with electric versions. Every household will have a different electrification journey and it will be easier for some homes to afford and access than others. The Government must coordinate household electrification using the full set of policy levers, from reforms of the energy market to support for training electricians to direct investment through concessional finance. "Investment" in the transition is often characterised by the need to fund and support large-scale infrastructure. It is critical that government recognise that supporting households, businesses, and industries in their individual electrification journeys is a critical investment in the transition.

Government plays a key role in influencing and incentivising millions of electrification decisions. Government must also provide significant government financial support targeted to low income households and a range of regulatory measures to nudge households across all income deciles to make clean energy choices.

For business and industry, the Government needs to invest not just in supporting the purchase of infrastructure but also in supporting innovative ideas that will help drive up rates of electrification in "harder to decarbonise" sectors.

4.1. Investing in household and commercial electrification

Electric vehicles, heat pumps, HVAC systems, batteries, and rooftop and community solar are easy and ready-to-go technologies. These are already an economic boon to people who participate. A household running all-electric vehicles or an all-electric house and running half of it on rooftop solar energy can expect to save \$3-5,000 per year on the cost of all of their energy inputs.

A whopping \$1.7 trillion economic savings for the nation by 2050 is already on the table with a wholesale commitment to electrification - it would also eliminate the majority of non-export related emissions in Australia. This project could be completed by 2040 if we were aggressive about assisting Australian households in the transition and creating various financing options and incentive schemes to help cash-poor households save money over the long term by investing in electrification in the short term.

Between now and 2050, Australian households will spend \$2 trillion on cars, water heaters, gas heaters, and kitchen stoves alone. End consumer (commercial, industrial, and residential sector) spending on appliances, equipment, and processes will determine over 40% of Australia's carbon emissions. The investment required of Australia to meet the future end state of a clean energy transition has been estimated to be hundreds of billions of dollars. This highlights the need for efficient investment and aligned incentives for long-term investment stability.

The opportunity for government is to influence these decisions and provide investment certainty and policies that create investment environments to leverage private sector investment.

As noted in the Discussion Paper, Electrification provides the opportunity for substantial energy cost savings. Rewiring Australia recommends that the Sector Plan include considerations for supporting all homes in gaining access to the long-term savings of electrification. This would involve investment from the Government to smooth the upfront costs of electrification upgrades through concessional finance. Government also needs to support homes who will find it harder to electrify, including renters, social housing tenants and people living in apartments. Reaching energy decarbonisation targets will require enabling all homes to electrify. Previous submissions and publications from Rewiring Australia have provided extensive discussions on the many barriers faced by households and businesses to electrify, and recommendations for addressing these refer to Rewiring Australia's recent Submission into Residential Electrification³. Two priority reforms from the Federal Government are the electrification of all social housing and the provision of a universal electrification finance scheme.

Recommendation four

Electrify all social housing by 2030, with joint funding provided by the Federal and State and Territory Governments

Recommendation five

By November 2024, consult with jurisdictions and stakeholders to design the framework for a universal household electrification finance scheme funded by the Australian Government. Support this by facilitating financial innovation and

³ Rewiring Australia, 2023, Submission to the Senate Inquiry on Residential Electrification 2023, Senate Standing Committee on Economics. Available [here](#)

market development to crowd-in institutional investment to support public and household investment.

4.2. Investing in the electrification of industry

It is reasonable to anticipate that the electrification of existing residential, commercial, and industrial loads will require an additional 250-300% of electrical demand. If Australia has ambitions to export energy, the potential is immense. Whether as hydrogen (a less favourable option) or as metals (a highly promising avenue), the demand for additional energy beyond this 300% could skyrocket. This could potentially reach up to 1,000% of our existing electrical load if, for instance, we were to (up)-process most of our iron ore that currently goes to export as green iron or green steel and our bauxite to alumina or aluminium. Our potential for energy export is limited only by international demand for green metals and our own willingness to generate this much electricity. The opportunity for economic growth and global leadership is within our grasp.

The electrification of manufacturing is also inevitable, but to date, it has not been economical in most cases. Manufacturers have access to wholesale rather than retail gas prices for their industrial heat, which makes gas competitive with electricity. So, for industrial electrification to occur at scale, we need further cost reductions in batteries, wind, solar, and other zero-emission energy generation. We must also support innovation and technological inventions to electrify the heavy industry, especially in metal refining and production. An Innovation strategy needs to be a 20-year project requiring heavy investment in research, development, deployment and encouraging Australia's best and brightest to focus their careers in science and engineering and topics people are currently trending away from.

Australia has a tradition of investing in existing companies as the innovators. There is ample evidence, most elegantly expressed in *The Innovator's Dilemma*⁴, that these companies are precisely the ones that will not invent the future. Australia makes it very difficult for start-ups and small companies, the traditional engines of innovation, to participate in the necessary innovation. We create artificial monopolies for incumbents, and this needs to be addressed.

⁴ Christensen, C.M., *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*, Harvard Business Review Press, 2016.

Agriculture, a sector ripe for electrification, presents a unique opportunity for Australia to lead the way. With diesel costs soaring, the shift to locally generated electricity for running vehicles could bring enormous benefits to farms. As technologies like Monarch Tractors of California pave the way for the inevitable electrification of farm equipment, Australia could easily become an innovator in the electrification and digitisation of agriculture, sparking a sense of national pride and innovation.

Recommendation six

Develop a comprehensive innovation strategy supported by additional funding and industry-specific innovation plans. Examples include agriculture, renewable industrial processes, commercial buildings, and renewable heating.

5. Enabling electrification for a smooth transition

5.1. Future System Operation

How the future energy system and its operation are defined will have economic and political implications in the near and long term. It will affect the National Energy Market (NEM) governance and the success of government policies and spending. Australia's energy transition to renewable energy is well underway and characterised by a high uptake of domestic-scale solar PV and increasing electricity storage and electric vehicles (EV). The potential of the demand side is already defining a future energy system with high levels of decentralised energy resources (DERs).

It is not unreasonable to define a vision of a future system operation as having saturation levels of Solar PV on all available roof space, saturation levels of efficient, electric, and flexible appliances and equipment that are enabled and grid-integrated, and saturation levels of distributed storage, including batteries and electric vehicles. Demand flexibility is estimated to save \$19 billion by 2040⁵ in avoided network and generation capacity. Therefore, maximising the role of the demand side and the power system services, such as demand flexibility, must be central to the future energy system operation.

AER, AEMO, and the existing agencies have not traditionally focused on market design to encourage and incentivise distribution-level activity. It could easily be said that they

⁵ Kuiper, G., 2024. [DER could provide \\$19 billion economic boost by 2040_Feb24](#) Institute for Energy Economics and Financial Analysis.

are actively biased against this and incentivised to protect centralised generation and long-distance transmission at the expense of the appropriate investments in residential and commercial electrification and DER and what that means for DNSPs.

5.2. Energy Market Reform and Governance

There have been long-term indicators and tipping points of the NEM's failure to deliver the energy transformation at least cost to the end consumer. While the Energy Security Board delivered supply-side reforms, it has failed to provide demand-side reforms. This experience makes the case that without government leadership, there is a risk of entrenched old energy market rules and incumbent business models blocking rapid and cost-effective decarbonisation.

Getting the market and regulatory settings right can unlock hundreds of billions of dollars in private investment in solar, EVs and electric machines for households. It would reduce energy price inflation and eliminate energy emissions. Therefore, the design of the NEM and supporting energy markets need to be fundamentally revisited.

Governance and market rules must reflect these changes and address emerging risks. To date, energy market reform has been a process of layering rules changes into the existing market. However, opportunities need to be made to realign the market to reflect the changed composition of Australia's electricity mix toward variable renewable energy sources.

Vertigan led the last review of the NEM in 2015. Not only was a follow-up review recommended for 2023, but the composition of energy market participation has significantly changed since then. Such a review would necessarily include a review of AEMO's role and responsibilities and its ability to deliver the energy transition at the least cost to the end consumer.

While it is acknowledged that there are critical differences between the UK and Australian energy markets and governments, the UK provides an example for Australia. In 2021, Ofgem led a review of the Energy System Operator (ESO), the AEMO equivalent, into its ability to deliver the energy transition at the least cost to the consumer. The outcome was to create a Future System Operator (FSO), which will work in parallel with the ESO over 2024 and take over full responsibility in 2025⁶.

⁶ Ofgem, 2021. [Future System Operation \(FSO\)](#) UK Government

Rewiring Australia recommends that the ECMC provide the timely leadership required to define energy market reform. NEM reforms must value and incentivise the clean energy transition, specifically demand-side electrification. In this context, agile governance arrangements become increasingly essential, with the ECMC providing ultimate oversight of the NEM market design and rule-making processes.

Rewiring Australia recommends that Australian, State, and Territory Government Energy Ministers acting as Energy and Climate Change Ministerial Council (ECMC) ensure executive processes are consistent with the Future Energy State.

It includes actions by ECMC to:

- Endorse a clear vision of the Future Energy System.
- Streamline legislative and regulatory reform arrangements that allow agile legislative changes. The WA Government's Project Eagle is an example.
- Provide the Market bodies (AEMO, AER, AEMC) and regulated market participants with clear statutory obligations.
- Create an independent energy data agency with modelling capacity and responsibility for planning documents such as the Integrated System plan currently with AEMO.
- Create a pathway for successful ARENA-funded trials to be adopted into NEM regulatory reform and rule-making change process.

As part of this work, it is critical that the ECMC initiate:

- A review of the governance arrangements of the market bodies against the Future Energy State and amend them as required.
- Strengthen end consumer representation within the NEM market bodies by extending board representation to end consumers and climate scientists.
- Increase resourcing for Energy Consumers Australia.
- DER integration and the demand side receive the same focus, planning, and investment as the large-scale transmission network-level transition.
- Create an AEMO equivalent to represent the demand side.

Recommendation Seven

Develop a comprehensive innovation strategy supported by additional funding and industry-specific innovation plans. Examples include agriculture, renewable industrial processes, commercial buildings, and renewable heating.

Recommendation Eight

By October 2024, conduct a short, sharp review of the governance of the National Electricity Market.

Recommendation Nine

By end of 2025, implement governance reforms designed by the governance review. Energy ministers direct the design of markets for electrification using expedited, government-led policy making and not the usual incremental and slow market body rule-making and review processes. Deliver new markets by the end of 2026.

5.3. Markets for Electrification

With the increasing levels of DERs, the distribution network needs to move to active network management. Tariff setting is being discussed as the primary solution for integrating DERs on the grid and changing end consumer behaviour. However, only a small proportion of end consumers will understand and be able to respond to tariff setting. The more significant issue is the DNSP-regulated business model, which is responsible for increasing network charges and upward pressure on electricity bills. The more significant opportunity is to reform and align the DNSP business model to support higher levels of DERs on the network.

Rewiring Australia recommends creating “Markets for Electrification” so that the obligation to deliver electrification and improved energy performance does not rely on consumer choice but is delivered by the energy market. This includes aligning regulations on market participants, introducing incentives, and valuing commodities not currently valued by the NEM, such as demand flexibility. Valuing new commodities and creating a value chain around the production and delivery to “Markets for Electrification” will mobilise and leverage greater levels of private investment.

The state-based energy efficiency obligation (EEO) schemes are a subset of commodities traded in “Markets for electrification”. The EEO schemes are designed to retrofit inefficient appliances and equipment before the end of technical life. They place a regulatory obligation on a NEM market participant to deliver their portion of the annual energy efficiency target. The key EEO design objective is to create a service industry with the capacity and technical expertise to engage with the end consumer and be a market intermediary on the end consumer’s behalf.

While these schemes work alongside the NEM, they are proven to attract private sector investment, leverage private energy end-consumer investment, and create a regulated demand for commodities currently not valued by the NEM. With considered design, such “markets for electrification” could be trading in commodities essential for future energy system operation, such as aggregated and orchestrated demand flexibility and fast frequency response. Such markets would also create investment certainty for intermediaries such as Aggregators, Virtual Power Plant operators and other energy service businesses.

The Australian government then faces a choice between redesigning the NEM to introduce “Markets for Electrification” and establishing these markets outside the NEM. Introducing the reforms within the NEM risks repeating the Energy Security Board's experience with the “Two-Sided Market” and the current situation with the Wholesale Demand Response Mechanism. However, as DER take-up approaches saturation levels, some form of multiparty local energy markets will be required.

The creation of markets for electrification should provide for the following factors: :

- Commoditise and value the services that DERs can provide.
- Create “Markets for Electrification” by valuing commodities such as DER services, Demand Flexibility, and the demand side in general. Allow for value stacking value streams (including carbon offsets) to the market and create value chains for demand-side energy services and products, such as demand flexibility.
- Align incentives, remove perverse disincentives and resolve the DNSPs' utility business model and economic regulation.
- Create environmental and energy markets, align incentives, and introduce penalties to guide investment direction.
- Policy review of the operation and the role of the demand side. Development of a Demand Flexibility Roadmap and supporting demand flexibility plans for the residential, commercial, and industrial sectors.

Recommendation Ten

Coordination between Federal and State jurisdictions for creating markets for electrification that value the commodification of demand flexibility and electrification.

5.4. Wholesale Demand Response Mechanism

Commencing in March 2021, the WDRM has delivered only 2% of the estimated capacity of flexible demand in Australian industrial sectors. Industry participants in WDRM have communicated their frustration with the market bodies for purposefully undermining the scheme.

Reports suggest that AEMO operates under a groupthink culture and is overly focused on dispatching demand response through the NEM Dispatch Engine. From an engineering standpoint, this approach is impractical and costly. More importantly, it jeopardises the achievement of the 82% renewable energy target by 2030, posing significant threats to energy security and cybersecurity.

Recommendation Eleven

Energy ministers will direct the Australian Energy Market Commission and Australian Energy Market Operator to fix the Wholesale Demand Response Mechanism by November 2024.

5.5. Innovation Zones

The current regulatory-defined business model results in the DNSP having perverse incentives against DER integration. Examples are aligning incentives to reward demand flexibility, using DER services as non-network options, and using active network management over the more expensive network augmentation options.

The DNSPs' utility business model must be realigned to support higher levels of renewable energy connected to the distribution network. The five-year regulatory reset is an opportunity to do this, but in the absence of agreed-upon reforms, innovation is more needed to resolve this impasse.

Rewiring Australia recommends that "Innovation Zones" be created to allow the opportunity for market realignment. "Innovation Zones" are place-based where technical and business model innovation can be nurtured alongside regulatory innovation. An innovation zone would require declaration as a regulatory sandbox. This approach would allow the government to manage sovereign risks associated with the 5-year reset timeframe and progress energy market reforms. The UK "Smart Local Energy Systems" (SLES) is an example for Australia. Ideally, an Innovation Zone would be declared in each State and Territory, but a minimum of four would be required.

"Innovations Zones" should be designated and funded in order to:

- Create an ecosystem to support social licence, such as One-Stop shops providing information, retailers supporting a point of sale, and trades and skills.
- Test methods to promote and gain community social licence for saturation levels of DERs and preparedness for Local Energy Market trading.
- Test coordination with the wholesale market and ability to bid into the Wholesale Demand Response Mechanism and the energy, frequency, and reliability markets.
- Test new approaches to medium scale front of meter assets and business models such as “Community Batteries”, and “Solar Banks”.
- Test the Distribution System Operator (DSO) roles and responsibilities in action.
- Create a regulatory pathway for successful outcomes from ARENA-funded trials into NEM reforms.
- Create a pathway to achieving the potential of the demand side and at scale and support innovation, regulatory, technology and business model innovation.

Recommendation 12

By end of 2024, use regulatory sandboxing and an update to the Australian Renewable Energy Agency’s funding strategies to create a framework for 4 Innovation Zones to deploy electrification and inform the redesign of markets for electrification.

6. Growing alternative low-carbon fuels

Rewiring Australia and other researchers have demonstrated that electrical appliances (water heaters, space heaters, ovens, and stoves) are cheaper than gas appliances on a total cost of ownership basis (capital plus running costs) for nearly every household. The same is true of EVs as they become cheaper on a total cost of ownership basis than internal combustion engines (ICE) and a purchase cost basis.

The cost-benefit of electric appliances is even greater if they are partially powered by rooftop solar. The financial challenge is that the up-front cost of electric appliance upgrades means that poorer households are unable to invest in electrification. Without government assistance, they will be stuck with higher energy costs while more wealthy households electrify and enjoy lower energy (and vehicle) bills.

6.1. Fair, equitable and orderly transition for decarbonising natural gas and liquid fuels?

The transition to renewable energy in household gas consumption and personal transport is not just a matter of choice but a pressing necessity. To ensure a fair, orderly, and equitable transition for household gas consumers, it is imperative to assist them in electrifying their households while the grid undergoes its own transition. Similarly, the most effective transition for personal transport necessitates a combination of mass transit, vehicle emissions standards, and EV policies that stimulate the market for EVs.

As discussed, Rewiring Australia has proposed that the Australian government create a universal finance scheme to support households electrifying using concessional loans. Universal access to finance, minimum energy performance standards, and specific strategies to target disadvantage would ensure a more equitable energy transition society and accelerate decarbonisation.

6.2. Liquid fuels

Trends in improved battery charging speed, energy density, and life cycle will mean that much of the imagined “hard to decarbonise” sectors will readily yield to battery electrification. These include short-haul electric aviation (under ~1000km), agriculture (the first all-electric tractors are already available and proving to save significant sums in on-farm diesel use), heavy road transportation, and much of the mining and construction equipment. The economics of the technology will drive demand. Diesel fuel at \$2/Litre converts to about 20c/kWh, yet because the diesel fuel only operates at 25-35% efficiency, it effectively means that diesel machinery is operating at 70-80c/kWh. A stand-alone solar and battery system can now economically provide 24-hour power at around 20c/kWh, which is still dropping. A significant component of this cost is financing, so low-cost government financing has a place to improve this electric vs. diesel economics.

6.3. No efficient role for fossil gas and other forms of gas

Fossil or other forms of gas will not efficiently serve the commercial or residential sector beyond 2030. Gas applications can be easily replaced with electrification at a lower cost and less environmental impact. Biofuel sources—agricultural waste, forestry waste, sewage, and landfill—are highly distributed and cost more to the consumer than existing fossil gas or liquid fuels. Electrification of gas heating and transportation is

already cheaper than existing fossil gas and liquid fuels, and that advantage will only be larger against biofuels.

There is not enough biofuel source material available to make biogas at the scale of consumption levels of Australia's residential and commercial sectors, let alone industry. Except for bagasse, the feedstocks are not concentrated sources and are expensive to process. Australia's domestic demand for gas is 980 Petajoules, yet all of our current bagasse, wood, and biofuels total only 207 Petajoules. These fuels do not convert to high-efficiency biogas and are only roughly equivalent to 100PJ.

Bio-fuel processing facilities leak more methane than existing gas processing facilities. These leaks will likely mean that "low carbon" biofuels will be equivalent to or even higher net greenhouse gas emissions than natural gas. The only way to fully decarbonise gas is to electrify the end user while replacing fossil fuel generation with renewables. It would take 2-3 times the amount of renewable facilities to make renewable hydrogen instead of just using electricity for our heating systems. Hydrogen will only ever be more expensive than electrification. It is more dangerous and incompatible with existing heating or cooking systems or the existing gas network. An analysis and summary of the shortfall of natural gas in the USA has been published by Rewiring America in the report "Circuit Breaker"⁷.

The main equity challenge for gas-using households is vigorous economic regulation of gas networks to retire the network. The first equity outcome to be realised is to prevent private operators of gas networks from shifting costs onto the public purse while retaining unreasonable profit rates.

The second equity outcome is to ensure that the death spiral of gas networks does not result in the poorest households being left on the networks. The challenge is that as wealthy households defect away from the network to all-electric homes, the cost of maintaining the network increases per remaining household. Households unable to electrify will stay on the network and pay more and more.

The only realistic pathway is a rapid decommissioning of the gas network, likely with assistance to low-income households, who will struggle the most to afford the upgrades

⁷ Rewiring America, 2023. Circuit Breakers Decarbonizing buildings with "renewable natural gas" doesn't stand up to scrutiny, and it's a distraction from our clean electric future. Available here [Rewiring America](#)

required to electrify. *The Future of Gas in New York State*⁸ is an excellent reference to the challenges of decommissioning gas. The problem and its solution are well beyond the realm of regulatory decisions and require Australian Government leadership.

For a fair, equitable and orderly transition for the decarbonisation of both natural gas and liquid fuels, Rewiring Australia recommends that the Energy Minister works with ECMC on transition plans, including through the development of national and state gas substitution roadmaps.

Recommendation thirteen

Energy ministers working as ECMC provide a vision of a cost-effective transition beyond fossil fuel gas and liquid fuels, supported through Intergovernmental partnership agreements, including the development of a national gas substitution roadmap and a Beyond Liquid Fuels roadmap.

6.4. Hydrogen

Hydrogen is not a source of energy like petroleum or fossil gas; it is an energy carrier. As a carrier of clean energy, it is so inefficient that it will never be used as a substitute for fossil gas and liquid fuels across the economy. Hydrogen will be too expensive and infeasible to produce at scale. It will have critical applications in industry and some transport but will replace only a fraction of the current fossil fuels. The petroleum and gas industries promote confusion around the role of hydrogen, as it is in their interest to delay real action on climate change and extend their business model.

The only form of hydrogen that could play a significant role is green hydrogen, which is produced using renewable electricity. The efficiency problem is that conversion to hydrogen, compression, transportation, storage, and reconversion to heat or transport means that hydrogen is only a 25-40% efficient storage mechanism. This compares to batteries at 95%. It takes at least three times as much renewable energy supply to make renewable hydrogen to achieve the same end-user outcome as just using electricity to provide the same energy. The economic outcome of this thermodynamic inefficiency is that electrification will always have a lower cost than green hydrogen.

⁸ Walsh, M.J., Bloomberg, M. E., *The Future of Gas in New York State*. A report by the Building Decarbonization Coalition. Available here - [The-Future-of-Gas-in-NYS](#)

Hydrogen has other challenges, such as it can only be blended up to about 20% of the gas content. It cannot be carried in existing gas networks because it is incompatible with the steel pipes. Gas heating and cooking appliances cannot burn 100% hydrogen.

It is also known that hydrogen leaks at all stages of production, transport, and consumption. Hydrogen gas is a smaller molecule than methane and is more challenging to contain. Hydrogen leaks are indirectly greenhouse gas contributors, and the likely outcome of a hydrogen network would be high emissions.

Australia will struggle to reach the 82% by 2030 renewable energy target. There are profound constraints on the deployment rates of large-scale wind and solar. It is inconceivable to imagine that Australia can overcome these challenges and build all the additional generation required to manufacture green hydrogen sufficient to replace fossil gas in the next two decades, even if it were cost-effective.

6.5. Production Pathways to low-carbon fuel industries

The final option we address here is the “electro-fuels”. Low-carbon electro-fuels would use renewable electricity to recreate hydrocarbons, most typically by taking long carbon chain molecules from a feed source such as biofuels, purifying them, and adding green hydrogen. Thermodynamically, this is an even more challenging and energy-inefficient pathway to produce an end-fuel than hydrogen or biogas. They require a large amount of primary energy to create an energy carrier. It makes them expensive and unable to compete with electrification except in exceptional circumstances such as aviation. As in the section above, the only credible energy input for electro-fuels would be renewable energy, requiring a massive overbuild of wind and solar power.

Australia should actively pursue research and hope for electro-fuel breakthroughs, but these research projects are not ready to finance technologies. The powerful petroleum industries will overhype low-carbon fuels to delay electrification and renewable energy. However, Rewiring Australia strongly cautions the Australian government against overinvesting in “low-carbon fuel industries.”

6.6. Gas substitution and gas networks

The most urgent policy gap is the need for a national plan to write down and decommission gas networks while educating the community to understand the benefits and necessity of electrification. Australia’s regulated gas monopolies are currently waging a dishonest PR campaign through MasterChef and other channels to convince

consumers that the kitchens of the future will be cooking with “green” gas, which is patently false. It is vital for government, consumer, and energy regulators to police misinformation and provide accurate information.

The discussion paper presents unrealistic thinking about the capacity to produce and the cost of liquid fuels while underestimating the capacity of electrification to address “hard-to-decarbonise sectors.” Much of the diesel fuel used in non-transport applications is used in remote-site electricity generation with small (and inefficient) generators, and it would already be economically replaced with renewables and battery storage. The existing diesel fuel subsidy to the mining industry would be more efficiently spent financing solar and battery storage.

Hydrogen gas blends should be ignored, as by the time they can be brought to market, it will already be too late to decommission the gas component. The time for gas “transition” was the 1990s. Now is the time for a more robust and rigorous commitment to electrification without these expensive, hopeful, and technically naive solutions.

Bottled biogas could be used for the hardest-to-satisfy customers and cases. Gas networks should be decommissioned as they have no role in a future energy system. The government could consider using the network footprint to run fibre for faster internet or as geothermal ground loops. Creative reuse of these gas networks for carrying things other than gas is their only viable future use.

7. Conclusion

Rewiring Australia welcomes the Sectoral Plan Discussion Paper’s central positioning of Electrification. Australia cannot reach its emission reductions targets without a plan to rapidly electrify homes, businesses and industry. As such, the Sector Plan must prioritise investment in electrification efforts, including substantial reforms to the energy regulatory and market environment.