Exploring clean energy futures

RAC
For the better

Exploring clean energy futures

Electric vehicles (EVs) and plug-in hybrid electric vehicles (PHEVs) may have only represented 8.5 per cent of new vehicle sales[1] in 2023, but it's a sizeable increase of almost 120 per cent from the year prior[2].

While more than eight out of every 10 vehicles sold in Australia still relies on petrol or diesel, the dominance of these fuels will decrease over time and the demand for electricity will increase. Without significant investment, our electricity grids will likely experience widespread outages over the coming years. In pursuit of a low-carbon future, it is critical that WA both continues to enable the integration of clean energies into the grid to support clean transport, and ensure the ongoing reliability and efficiency of our power system.

Transport is a major contributor to greenhouse-gases (GHGs) and other harmful pollutants. In WA, in 2021, almost 18 per cent of carbon dioxide equivalent (CO_2-e)[3] emissions were from transport. Road transport contributed close to 75 per cent of transport emissions, with almost 48 per cent of those road transport emissions coming from cars[4].

New modelling estimates more than 11,100 Australian adults die prematurely each year due to exposure to traffic emissions.

- University of Melbourne[5]

Transport decarbonisation is a critical part of our transition towards a net zero-emissions future. The broad adoption of low and zero emissions vehicles will significantly reduce harmful vehicle emissions and the impact on our health and the environment. However, the emissions reduction potential of EVs depends on the relevant energy source. We are experiencing an energy transition, moving away from fossil fuels (petrol and diesel), and scaling up supplies of renewable energy, also known as 'clean energy'. This transition, while positive, presents significant challenges to maintaining both reliable and affordable electricity.

Electric vehicles

According to Commonwealth Scientific and Industrial Research Organisation (CSIRO) EV projections for WA's Wholesale Electricity Market[6], the likely scenario[7] is that in 2030 there will be approximately 287,000 passenger battery electric vehicles (BEVs) within the South-West Interconnected System (SWIS) area, the largest interconnected power system in WA[8]. At a national level, CSIRO's modelling suggests that EVs[9] could account for around 52 per cent of new passenger vehicle sales and almost 15 per cent of the total vehicle fleet in Australia in 2030[10] (in 2023, only 0.4 per cent of the WA fleet was fully electric[11]).

As EVs become more popular, a greater portion of WA's overall energy mix will be electricity as opposed to fossil fuels, increasing demand on the grid. At the same time, the challenge of how to adjust the grid and generation mix to accommodate renewables, whilst achieving end user needs for reliability and cost performance, is a major issue worldwide and a significant challenge for WA. Preparing the grid for increased electricity demand through investment in grid infrastructure and firming capacity[12] is needed to integrate grid-scale renewables and distributed energy resources[13], and enable the increasing supply of low emissions electricity to consumers.

1 Includes passenger, SUV and light commercial vehicles.
2 Federal Chamber of Automotive Industries (2023). VFACTs National Report – New Vehicle Sales December 2023 (subscription).
3 Carbon dioxide equivalent (CO_2-e) is a measurement of the total greenhouse gases emitted, expressed in terms of the equivalent measurement of carbon dioxide. We use this to compare the emissions from gases on the basis of their global-warming potential, by converting amounts to the equivalent amount of carbon dioxide with the same global warming potential.
4 Department of Climate Change, Energy, the Environment and Water (2023). Australia's National Greenhouse Accounts. Retrieved from: https://ageis.climatechange.gov.au/
5 University of Melbourne (Melbourne Climate Futures) (2023). Health Impacts Associated With Traffic Emissions In Australia. Retrieved from: https://www.unimelb.edu.au/_data/assets/pdf_file/0006/4498161/Expert-Position-Statement_Vehicle-emissions_FINAL.pdf
6 Australian Energy Market Operator (2022). WEM Electricity Statement of Opportunities. Retrieved from: https://aemo.com.au/en/energy-systems/electricity/wholesale-electricity-market-wem/wem-forecasting-and-planning/wem-electricity-statement-of-opportunities-wem-esoo
7 CSIRO has modelled four scenarios: Exploring Alternatives; Progressive Change; Step Change; and Hydrogen export. It has been noted that the tentative mappings for the 2023 WEM Electricity Statement of Opportunities indicate that Step Change is the expected scenario.
8 Modelling covers the South-West Interconnected System project area, and does not include the North-West Interconnected System or regional power.
9 Includes battery electric vehicles; plug-in hybrid vehicles; and fuel-cell electric vehicles.
10 Commonwealth Scientific and Industrial Research Organisation (2023). Electric vehicle projections 2022. Retrieved from: https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2022/2023-inputs-assumptions-and-scenarios-consultation/supporting-materials-for-2023/csiro-2022-electric-vehicles-projections-report.pdf?la=en
11 Department of Infrastructure, Transport, Regional Development, Communications and the Arts (2023). Road Vehicles, Australia, January 2023. Retrieved from: https://www.bitre.gov.au/publications/2023/road-vehicles-australia-january-2023
12 Grid firming is used as a flexible energy supply to keep the grid stable in the event of power intermittency (e.g. solar or wind resources are not sufficient/available).
13 Distributed energy resources are small-scale energy resources usually situated near sites of electricity use, such as rooftop solar panels and battery storage. Their rapid expansion is transforming not only the way electricity is generated, but also how it is traded, delivered and consumed.

How 'clean' is our energy grid today?

WA has three major electricity networks that cover different regions of the state[14]: the SWIS, WA's primary electricity system; the North-West Interconnected System, which covers part of the Pilbara region; and 'off grid' regional power, which is comprised of multiple local microgrids[15].

A decade ago, 90 per cent of electricity through the SWIS was supplied by burning coal and gas. In 2023, wind and solar generation accounts for around a third of our annual electricity supply, peaking at about 84 per cent, at times.

- Australian Energy Market Operator[16]

The generation mix

Annual generation by fuel type (1 July 2022 - 30 June 2023)

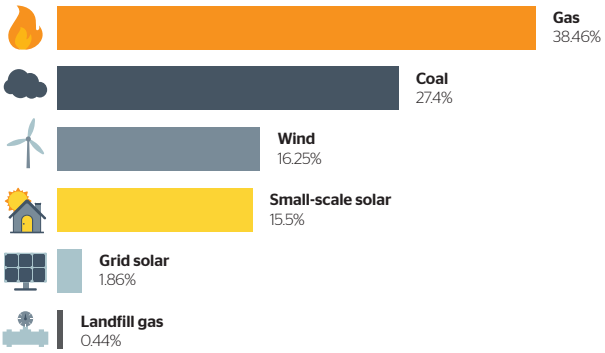

Figure 1 - SWIS annual generation by fuel type (1 July 2022 - 30 June 2023)

According to the WA Government, massive uptake of rooftop solar means WA's remaining state-owned coal power stations are set to be retired by 2030 - the WA Government plans to retire Collie Power Station in late-2027 and Muja D units 7 and 8 in late-2029[17]. While Muja C Unit 6 was due to be closed in October 2024, due to concerns about increased demand leading to an electricity supply shortfall, it will remain in 'reserve outage mode' and be made available during peak demand over summer until April 2025[18].

There are six key types of clean energy being developed and deployed around the world - solar, wind, hydropower, geothermal, biomass, and green hydrogen. When considering *all* electricity generation[19] throughout each Australian state and territory[20,21], it is still dominated by non-renewable sources, with the exception of Tasmania whose electricity is almost solely generated from renewable sources. However when it comes to electricity generated by renewable sources specifically, solar and wind tend to come out on top (Figure 2)[22]. While solar and wind are the dominant sources, they are referred to as 'intermittent' energy resources as they aren't predictable and constantly available. Therefore a combination of renewable energy resource diversification, energy storage, and gas firming generation, will be required to maintain reliability until the grid can be fully reliant on renewables.

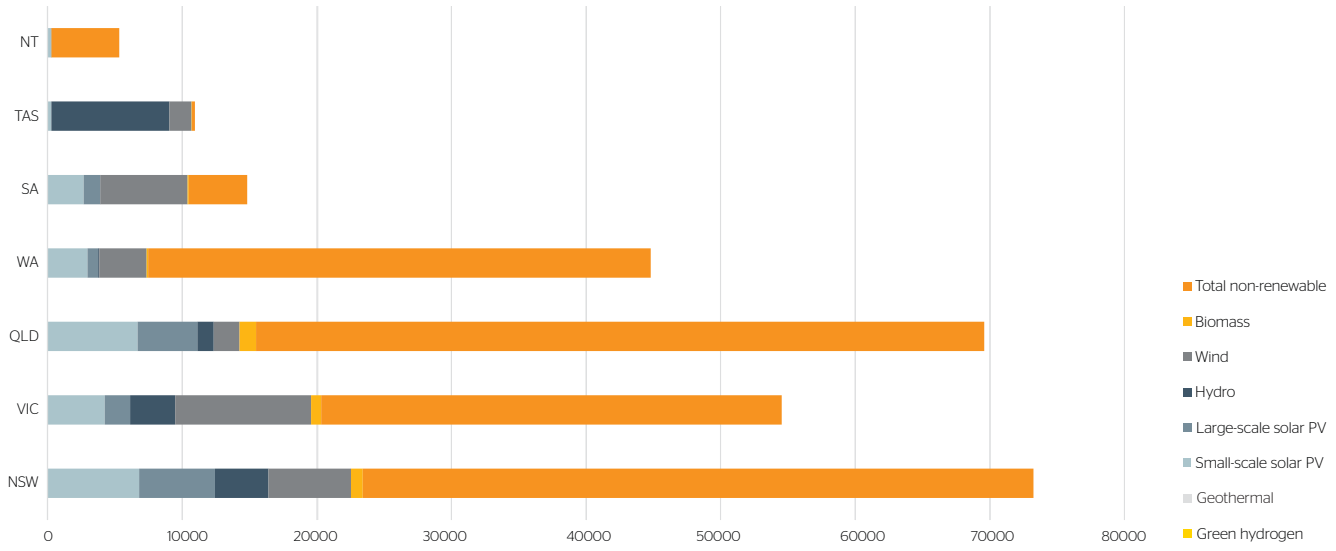

Figure 2 - Australian jurisdiction's electricity generation (GWh) by fuel type in 2022

14 Energy Policy WA (2022). Electricity industry. Retrieved from: https://www.wa.gov.au/organisation/energy-policy-wa/electricity-industry
15 A microgrid can be thought of as a small 'subset' of the electricity grid that provides energy generation and storage at a local level. They can incorporate renewable energy generation (for example, from solar panels or wind turbines) as well as battery energy storage. Some microgrids can operate independently of the grid during power outages, which can be particularly helpful for communities in regional and rural settings. Retrieved from: https://www.energy.vic.gov.au/renewable-energy/microgrids
16 Australian Energy Market Operator (2023). The Wholesale Electricity Market – fact sheet. Retrieved from: https://aemo.com.au/-/media/files/electricity/wem/wholesale-electricity-market-fact-sheet.pdf
17 Department of the Premier and Cabinet (2022). State-owned coal power stations to be retired by 2030 with move towards renewable energy. Retrieved from: https://www.wa.gov.au/government/announcements/state-owned-coal-power-stations-be-retired-2030-move-towards-renewable-energy
18 ABC News (2023). Muja coal-fired power station to stay open longer as future WA energy shortfall revealed in AEMO report. Retrieved from: https://www.abc.net.au/news/2023-08-17/wa-electricity-gas-energy-shortage-muja-coal-extension/102740940
19 Including by power plants, and by businesses and households for their own use. This also includes both on and off grid generation.
20 Department of Climate Change, Energy, the Environment and Water (2023). Australian Energy Statistics, Table O, September 2023. Retrieved from: https://www.energy.gov.au/publications/australian-energy-update-2023
21 Due to there being too few electricity generation facilities in the ACT, electricity generation data is not available due to confidentiality. The vast majority of electricity generated in the ACT is from large- and small-scale solar, with the remainder consisting of biogas, and small amounts of oil, gas, and other renewables.
22 With the exception of Tasmania, whose renewable energy electricity generation is dominated by hydropower.

Renewable energy sources

Solar

Converts energy from the sun into electricity.

Solar is a proven, low cost, low emissions technology, which can in most cases readily be installed on our buildings and homes. Australia has an abundance of solar resources and per square metre, the highest solar radiation of any continent in the world[23]. Due to its size, solar is possibly the only viable renewable energy resource for residential use, and there is growing interest to use home solar to power EVs. While there are many opportunities for solar implementation in stand-alone housing there are limitations for solar installation in apartments and for renters, which creates a potential inequality in access.

The *Distributed Energy Resources Roadmap*, released in 2020, is a five-year plan that will 'guide the better integration of all distributed energy resources, including solar panels, battery storage and electric vehicles, and ensure that the benefits are shared across all members of the community'[24].

Consumers are increasingly installing rooftop solar panels to charge their EVs. A survey commissioned by the WA Government found that EV owners were more likely to have solar than the general population, and in fact, that 73 per cent of EV owners already have solar[25]. The key operational issue surrounding solar is its intermittency, as its consistency and efficiency is affected by unavoidable changes such as cloud cover, and evening and night time hours[26].

With regard to the life-cycle environmental impacts of solar, the life span of rooftop solar panels is approximately 25 years, however the attached inverters[27] used by household systems use have a smaller life span of around 15 years[28]. Solar panel recycling is in the early stages in Australia, and while up to 95 per cent can be recycled[29], currently much of the product is sent to landfill despite containing valuable materials.

Wind

Uses the energy of the wind to spin an electric generator, which produces electricity.

Like solar, Australia has abundant wind resources and wind turbines are a proven, low cost, low emissions technology. Wind turbines can be deployed on and offshore, and improving technology for offshore wind is allowing for larger blades, which capture more wind, and in turn increases efficiency and produces more electricity. However, wind intermittency remains an issue.

Unlike solar, which can be modular in implementation (e.g. individual houses and microgrids), wind farms must be rolled out on a larger scale and require significant capital investment, as well as land and investor coordination. Wind farms need extensive amounts of land, but only a very small amount of that land is used for turbines due to technical considerations such as airflow, and associated infrastructure, such as access roads. Wind turbines have a lifespan of 20-30 years and wind turbine materials (excluding the blades) are highly recyclable[30], with more than 80 per cent of the mass of a wind turbine being made from recyclable materials (mostly steel in the tower).

23 Geoscience Australia (2023). Solar Energy. Retrieved from: https://www.ga.gov.au/scientific-topics/energy/resources/other-renewable-energy-resources/solar-energy
24 Energy Policy WA (2023). Distributed Energy Resources Roadmap. Retrieved from: https://www.wa.gov.au/government/distributed-energy-resources-roadmap
25 Energy Policy WA (2023). Western Australia Electric Vehicle Owners – Behaviours, Attitudes, and Policy. Retrieved from: https://www.wa.gov.au/media/42760/download?inline
26 Energy Education (n.d.). Intermittent electricity. Retrieved from: https://energyeducation.ca/encyclopedia/Intermittent_electricity
27 A solar inverter takes in the variable direct current, or 'DC' output, from the solar panels and transforms it into alternating current, or 'AC' output. Home appliances run on AC, which is why the solar inverter must change the DC output that is collected by the solar panel.
28 Forbes Home (2023). How Long Do Solar Panels Last? Retrieved from: https://www.forbes.com/home-improvement/solar/how-long-do-solar-panels-last/
29 UNSW Sydney (2023). Repair, reuse and recycle: dealing with solar panels at the end of their useful life. Retrieved from: https://www.unsw.edu.au/news/2023/06/repair--reuse-and-recycle--dealing-with-solar-panels-at-the-end-
30 Renew Economy (2021). Explainer: What happens to old wind turbines. Retrieved from: https://reneweconomy.com.au/explainer-what-happens-to-old-wind-turbines/

Hydropower

Converts the energy of moving water into electricity.

Much of Australia's economically feasible traditional[31] hydropower energy resource has already been harnessed, and Australia is a water scarce country with water having competing uses. Pumped[32] hydropower is more likely to present future opportunities as opposed to expanding traditional hydropower projects, and the WA Government is exploring options for further developing pumped hydropower[33].

While hydropower has lower emissions compared to fossil fuels, generation and storage takes large amounts of land and often involves flooding habituated land to create a reservoir. Despite the upfront costs and capital investment required to develop hydropower projects, the ability to time the dispatch of hydropower to suit the energy market (i.e. when demand is high) is beneficial and would help address the intermittency issues associated with wind and solar, and support grid stability.

Geothermal

Extracts underground reservoirs to produce steam, which spins turbines that generate electricity.

WA has low to medium temperature geothermal resources that could be exploited to provide moderate levels of electrical power and low-temperature heat energy[34]. The exploitation and establishment of geothermal power plants requires high up-front investment and generates significant emissions, but once established, still produce fewer CO_2 emissions than a fossil fuels plant of a similar size[35].

However, geothermal power plants also emit harmful pollutants such as sulfur dioxide and hydrogen sulfide[36]. The main environmental consideration with geothermal power plants is the potential for surface instability. As geothermal plants remove water and steam from reservoirs within the earth, the land above can slowly sink over time. However, water is typically re-injected via an injection well to reduce the risk of subsidence[37]. A key benefit of geothermal electricity is that it is an unlimited heat resource and can operate regardless of weather[38].

31 Traditional hydropower is from rain fall on hills/mountains, which collects in a natural lake or a human-made dam and falls down a steep decline (typically >80m) to power a turbine.
32 For pumped hydropower, when intermittent generation is working (e.g. sun, wind), water is pumped up a steep incline from a lower to an upper dam; when intermittent generation is not operable, water is gravity fed down to the lower dam to power a turbine.
33 Energy Policy WA (2023). SWIS Demand Assessment 2023 to 2042. Retrieved from: https://www.wa.gov.au/system/files/2023-05/swisda_report.pdf
34 Department of Energy, Mines, Industry Regulation and Safety (n.d.). Geothermal energy resources. Retrieved from: https://www.dmp.wa.gov.au/Petroleum/Geothermal-Energy-resources-1594.aspx
35 U.S. Energy Information Administration (2022). Geothermal explained – Geothermal energy and the environment. Retrieved from: https://www.eia.gov/energyexplained/geothermal/geothermal-energy-and-the-environment.php
36 Cordis (2022). The next big thing in the geothermal power industry. Retrieved from: https://cordis.europa.eu/article/id/441952-the-next-big-thing-in-the-geothermal-power-industry
37 EnergySage (2019). Environmental impacts of geothermal energy. Retrieved from: https://www.energysage.com/about-clean-energy/geothermal/environmental-impacts-geothermal-energy/
38 The heat flowing from the earth's interior is continually replenished by the decay of naturally occurring radioactive elements and will remain available for billions of years. Office of Energy Efficiency & Renewable Energy (2022). Geothermal Basics. Retrieved from: https://www.energy.gov/eere/geothermal/geothermal-basics

Biomass

Burns organic materials for heat, where the steam spins a turbine producing electricity.

According to *Australia's Bioenergy Roadmap*, Australia's bioenergy sector could divert 6 per cent of waste from landfill by 2030. Biomass is organic material, and can come from sources such as forestry, agriculture, or waste – however, it can also include combustible components of municipal solid waste[39], more commonly known as trash or garbage. While using biomass to create bioenergy is a mature process, Australia does not have many bioenergy manufacturing facilities. Further, bioenergy is not widely adopted in WA or Australia and makes a minimal contribution to the energy generation mix[40,41].

A key issue surrounding biomass is that it has multiple uses, which makes it a competitive resource that is largely used for food, animal feed etc. The 'sustainability' of biomass is linked with the production of the fuel, which typically involves the release of emissions through growing, harvesting, transporting, and burning. However, it is possible for these emissions to be balanced by the CO_2 captured in the biomass' own growth. Further, if the biomass source is sustainably farmed and replenished, and the CO_2 that is reabsorbed exceeds the CO_2 that is released, the fuel can be considered to be overall 'carbon neutral', or even 'carbon positive'. Beyond emissions, the space required is often arable land, and the conversion of natural ecosystems to land for farming biomass causes environmental damage.

Green hydrogen

Requires separating hydrogen from water with an electrolyser powered by renewable energy[42]. The hydrogen then flows into a fuel cell which generates electricity by a chemical reaction[43].

Australia's *National Hydrogen Strategy* aims to position Australia as a major global player by 2030[44]. The *Western Australian Renewable Hydrogen Strategy* sets out the strategic focus areas for the development of the hydrogen industry in WA[45]. There is a high cost associated with hydrogen production, and in particular, green hydrogen is currently significantly more expensive than grey[46]. The cost of securing water and its availability are key considerations for hydrogen production[47]. While concerns have been raised around the safety considerations of storing, handling and transporting hydrogen, with proper controls, hydrogen can be as safe as other fuels we use today[48].

The main barriers to fuelling vehicles with hydrogen are vehicle availability, high capital cost, and refuelling infrastructure availability. Although the availability of fuel cell electric vehicle (FCEV) technology is currently very limited, there are some advantages over BEV and internal combustion engine vehicle technologies. With longer range, better payload, and shorter refuelling times, FCEVs are ideal for buses (particularly for long-distance routes), medium duty vehicles in regional transportation, and heavy-duty vehicles in long-haul transportation.

39 Australian Renewable Energy Agency (2021). Australia's Bioenergy Roadmap. Retrieved from: https://arena.gov.au/assets/2021/11/australia-bioenergy-roadmap-report.pdf
40 In 2022, biomass contributed to 0.26 per cent of WA's electricity generation and 1.14 per cent of Australia's electricity generation.
41 Department of Climate Change, Energy, the Environment and Water (2023). Australian Energy Statistics, Table O, September 2023. Retrieved from: https://www.energy.gov.au/publications/australian-energy-update-2023
42 Office of Energy Efficiency & Renewable Energy (n.d.). Hydrogen Production: Electrolysis. Retrieved from: https://www.energy.gov/eere/fuelcells/hydrogen-production-electrolysis
43 Fuel Cells (n.d.). Fuel Cell Basics. Retrieved from: https://americanhistory.si.edu/fuelcells/basics.htm
44 Department of Climate Change, Energy, the Environment and Water (2023). Australia's National Hydrogen Strategy. Retrieved from: https://www.dcceew.gov.au/energy/publications/australias-national-hydrogen-strategy
45 Department of Jobs, Tourism, Science and Innovation (2023). The Western Australian renewable hydrogen industry. Retrieved from: https://www.wa.gov.au/organisation/department-of-jobs-tourism-science-and-innovation/the-western-australian-renewable-hydrogen-industry
46 Green hydrogen is powered entirely by renewable energy, so produces no emissions and is the cleanest and most sustainable hydrogen. Grey hydrogen is extracted from natural gas, however the emissions are not captured or stored, and are released into the atmosphere.
47 Allens Linklaters (2021). Water access for hydrogen projects. Retrieved from: https://www.allens.com.au/insights-news/insights/2021/10/Water-access-for-hydrogen-projects/
48 Office of Energy Efficiency & Renewable Energy (n.d.). Safety, Codes and Standards Basics. Retrieved from: https://www.energy.gov/eere/fuelcells/safety-codes-and-standards-basics

Impact of the transition on the grid

Grid assessments undertaken by the Australian Energy Market Operator have warned that without planning for, and responding to, the challenges associated with transport electrification, the grid will be at risk of widespread outages within the next five years[49]. Similar conclusions were drawn from the WA Government's *Whole of System Plan*, which is a detailed study of how WA's principal electricity system, the SWIS, may evolve over 20 years[50]. According to the WA Government "The scale of work required is unprecedented, reflecting the nature of how electricity will be generated in a clean energy future." [51]

WA has experienced an exponential growth in distributed (rooftop) solar over recent years. Households and small businesses are installing solar photovoltaic and battery systems to take control of their electricity bills[52]. With the popularity of solar panels growing, there has been a steady decline in minimum operational demand[53] as a direct result of residents using electricity from their own solar panels, and an increase of energy 'prosumers' (consumers and suppliers) - this has exacerbated the challenge of how to adjust the grid and generation mix[54]. In addition to solar, large-scale renewable generators such as wind farms are supplying an increasing amount of WA's electricity needs[55].

The rapid expansion of renewables will lead to challenges in operating power systems, and the result is that some excess supply needs to be curtailed[56] to balance the system[57]. The is an issue faced by countries across the globe, and while curtailment may be seen as wasteful, surplus power leads to reductions in energy efficiency, power supply reliability, total system stability, and affordability of electricity[58].

So what's next?

The Australian and WA Governments' commitments towards net zero GHG emissions will lead to new waves of investment in renewable energy generation, such as grid-scale solar and wind. As the grid is not currently well designed for new renewables integration, the existing network will need to be expanded and reinforced to meet the additional demand from industries, organisations, and individuals looking to reduce their emissions[59].

Fortunately recent funding announcements will help address these challenges.

For example, the WA Government allocated around $3 billion in the 2023-24 State Budget to help tackle climate change and achieve net zero by 2050 - this included $2.8 billion for battery energy storage ($2.3 billion), wind power generation and transmission network upgrades on the SWIS. In addition to the projects to be progressed by Synergy, Western Power will invest $126 million over 2022-23 to 2023-24 on its transmission network, including planning works and procurement to support the electricity network's transition away from coal-fired power generation[60]. In its 2023-24 budget, the Australian Government invested a further $4 billion in Australia's plan to become a renewable energy superpower, including unlocking $10 billion in new investment in firmed renewable generation and storage by funding the Capacity Investment Scheme's initial auctions[61]. These commitments bring the Australian Government's total investment to more than $40 billion[62].

While switching road transport towards zero emission vehicle technologies must be a focus to reduce Australia's transport emissions, EVs will add a significant load to the future electricity network, particularly if charging times are not managed. Preparing for forecast future demand, understanding EV charging patterns among different members of the community, and influencing their behaviours to manage peak load demand, will be necessary to help balance soaring levels of solar power already generated in WA each day. Pleasingly the WA Government is assessing strategies to mitigate potential grid challenges posed by EV charging[63]. The WA Government recently completed a project to understand community charging behaviours and views on ways to manage EV charging, and intends to use the findings to help influence positive charging practices (e.g. charging during the middle of the day or overnight, avoiding charging during peak periods etc.).

49 Australian Energy Market Operator (2022). 2022 Integrated System Plan for the National Electricity Market. Retrieved from: https://aemo.com.au/-/media/files/major-publications/isp/2022/2022-documents/2022-integrated-system-plan-isp.pdf?la=en
50 Energy Policy WA (2022). Whole of System Plan. Retrieved from: https://www.wa.gov.au/government/document-collections/whole-of-system-plan
51 Energy Policy WA (2023). SWIS Demand Assessment 2023 to 2042. Retrieved from: https://www.wa.gov.au/system/files/2023-05/swisda_report.pdf
52 Energy Policy WA (2021). Energy Transformation Strategy. Retrieved from: https://www.wa.gov.au/organisation/energy-policy-wa/energy-transformation-strategy
53 Minimum demand is the lowest level of energy demanded from the grid at a point in time. Under certain scenarios it can place the grid under strain and make the energy system vulnerable.
54 Egart, R., Daubert, J., Marsh, S. & Muhlauser, M. (2021). Exploring energy grid resilience: The impact of data, prosumer awareness, and action. Patterns. Retrieved from: https://www.sciencedirect.com/science/article/pii/S2666389921000842
55 Energy Policy WA (2021). Energy Transformation Strategy. Retrieved from: https://www.wa.gov.au/organisation/energy-policy-wa/energy-transformation-strategy
56 In the energy sector, the term curtailment refers to the reduction of power production (generation curtailment) or, less frequently, power consumption (load curtailment), when there is too much electricity in the grid or when there is not enough power in the grid (respectively).
57 International Energy Agency (2019). More of a good thing – is surplus renewable electricity an opportunity for early decarbonisation? Retrieved from: https://www.iea.org/commentaries/more-of-a-good-thing-is-surplus-renewable-electricity-an-opportunity-for-early-decarbonisation
58 Rad, M., Kasaeian, A., Niu, X. & Zhang, K. (2023). Excess electricity problem in off-grid hybrid renewable energy systems: A comprehensive review from challenges to prevalent solutions. Renewable Energy. Retrieved from: https://www.sciencedirect.com/science/article/abs/pii/S0960148123006961
59 Energy Policy WA (2023). SWIS Demand Assessment 2023 to 2042. Retrieved from: https://www.wa.gov.au/system/files/2023-05/swisda_report.pdf
60 Government of Western Australia (2023). 2023-24 Budget Economic and Fiscal Outlook - Budget Paper No. 3. Retrieved from: https://www.ourstatebudget.wa.gov.au/2023-24/budget-papers/bp3/2023-24-wa-state-budget-bp3.pdf
61 The Capacity Investment Scheme (CIS) provides a national framework to encourage new investment that will support reliability in Australia's rapidly changing energy market and our energy system to reach 82 per cent renewables by 2030. The CIS involves seeking competitive tender bids for renewable energy generation and clean dispatchable capacity projects that can fill expected reliability gaps. Retrieved from: https://www.dcceew.gov.au/energy/renewable/capacity-investment-scheme
62 Commonwealth of Australia (2023). Budget 2023-24 - Growing the economy. Retrieved from: https://budget.gov.au/content/03-economy.htm
63 Energy Policy WA (2023). Western Australia Electric Vehicle Owners – Behaviours, Attitudes, and Policy. Retrieved from: https://www.wa.gov.au/media/42760/download?inline

Where we stand

RAC's **Vision** is for a safe, sustainable and connected future for Western Australians.

We have been a long-standing **advocate** for reducing vehicle emissions, through addressing all of the factors that impact emissions, including emissions standards, fuel quality, low and zero emissions vehicle uptake, and EV charging infrastructure. **We have also been calling on the WA and Australian Governments** to take action to introduce policies and scale up funding for infrastructure and initiatives that will significantly accelerate and support the transition to clean transport.

We have welcomed both the WA and Australian Government's commitments to reaching net zero emissions by 2050. It's important we have strong leadership and credible policy decisions aligned with achieving this, with further action to work towards a target for reducing transport emissions, reflective of its contribution to total emissions in the context of net zero. It will be essential to have robust transport emissions reduction strategies and action plans that are developed in the context of those from other sectors, to ensure we meet economy-wide targets and support a transition to a thriving, resilient, low carbon economy.

The government is taking steps to assess the existing capabilities of the network and prepare for forecast future demand, including investing in public charging infrastructure. Beyond infrastructure planning and investment, campaigns and education which help motorists understand and manage the energy consumption of their vehicle and reduce emissions will play a role. This includes education on purchasing vehicles that produce lower or zero emissions, the impact of vehicle emissions on health and the environment, the need to integrate EVs into the electricity network, the importance of managing charging times, as well as using more sustainable and active modes of transport.

With the pace of change in all areas affecting WA's energy transition, from new technologies to industries, the time to act for a future with cleaner, healthier air is now.

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