New Energy Outlook

Australia

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Section 1. Summary and key policy recommendations

Australia's transition to one of the most diversified and low-carbon energy systems in the world is already underway, driven by favorable economics and an abundance of natural renewable energy resources. However, a complicated patchwork of legislation, enacted over a decade of tumultuous climate politics, threatens to derail this early momentum. Federal and state governments, urged on by a renewed political mandate, must accelerate the deployment of established decarbonization technologies, and the development of others, if Australia is to meet its Paris Agreement goals.

This outlook explores the decarbonization pathways for the Australian energy transition to 2050, building on the long-term scenarios developed in *BloombergNEF's New Energy Outlook.* This report also introduces a *Hydrogen Export Scenario*, in which Australia achieves net zero and emerges as a low-carbon hydrogen export superpower by mid-century.

1.1. Key findings of the Economic Transition Scenario

Australia's energy-related emissions decline 55% over 2022-50 in our base case Economic Transition Scenario (ETS). This scenario describes how the energy sector might evolve out to 2050 as a result of cost-based technology changes. In this scenario, the transition only occurs if it lowers the overall system cost or offers an attractive payback proposition for consumers.

Our base case shows Australia's power sector becoming one of the most decentralized and decarbonized in the world. Customer-driven uptake of behind-the-meter PV and batteries continues to put pressure on the country's ageing coal and gas fleet, which today still makes up the backbone of the power mix. As these large thermal generators retire, a mix of competitive renewables, balanced with flexible generation technologies, emerges as the lowest-cost portfolio to reliably keep the lights on. Total solar, wind and batteries installations reach nearly 300 gigawatts (GW) by mid-century – around 6.5 times as much as in 2022. As a result, emissions from the power sector fall 85% from 160 million metric tonnes of carbon dioxide (MtCO2) in 2022 to 23MtCO2 in 2050 – the biggest contributor to Australia's economy-wide emissions reduction during this period.

While progress in the power sector is encouraging, the outlook for Australia's transport sector under the ETS is mixed. A lack of fuel emissions standards has significantly held back the supply of electric vehicles (EVs), restricting adoption rates. Under the ETS, adoption increases as EVs become cheaper than internal combustion engines (ICE), causing direct transport-related emissions to decline 40% from 106MtCO2 to 63MtCO2 over 2022-50. However, the poor economics of clean fuels and lack of competitive options for electrification based on current

technology costs in the aviation and rail sectors sees their emissions rise through to 2050 by 132% and 14%, respectively.

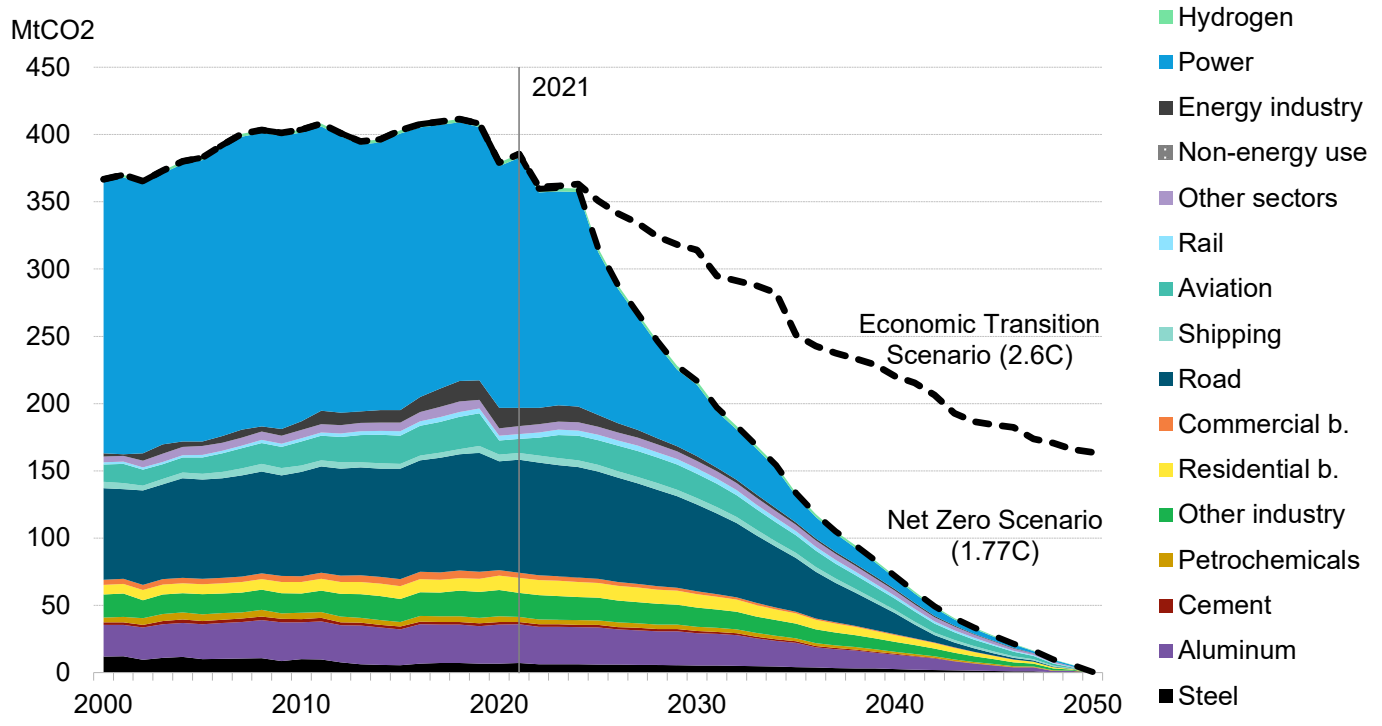
Similarly, energy use in buildings and industry faces more continuity rather than change. Direct emissions from Australian buildings and industry fall by 11% from 74MtCO2 to 65MtCO2 by 2050, while gas use for final energy consumption in buildings falls just 3% to 204PJ between 2022 and 2050. Aluminum – the largest emitting industrial subsector – sees emissions flatline over the same period at 29MtCO2 per year but emissions from steelmaking decline 86% from 7MtCO2 to 4MtCO2.

Total investment over Australia's energy system is nearly $1.2 trillion between 2022 and 2050 in the ETS, representing $42 billion each year on average. The rising uptake of EVs represents significant investment, amounting to $557 billion from 2022 until 2050. As Australia's power system grows while decarbonizing between 2022 and 2050, investment will follow accordingly, with $204 billion invested on the power grid and $193 billion on power capacity. This amounts to $14 billion per year on average invested in power capacity and the grid to 2050. Capital requirements for fossil fuel processes total $187 billion to 2050, representing 16% of overall investment.

1.2. Key findings of the Net Zero Scenario

Our Net Zero Scenario (NZS) charts a credible transition pathway that is consistent with the Paris Agreement goal of keeping warming well below 2C and achieving net-zero emissions by 2050. In this scenario, technology transitions are driven not only by cost changes, but also an applied sector-level carbon constraint.

Figure 1: Australia's energy-related emissions and net-zero carbon budget



Source: BloombergNEF

A rapidly decarbonized power system becomes the backbone of Australia's energy transition in the NZS. Higher power demand from increased electrification in the Net Zero Scenario means Australia installs 300GW of wind and solar by 2050 – around 102GW more than in the ETS. Power system flexibility is also crucial to back up and enable this rapid electrification and decarbonization of the power mix. Around 74GW of dispatchable capacity in the form of batteries, pumped hydro, hydrogen-fired gas plants, and gas plants paired with carbon capture and storage (CCS) are operational under the NZS in 2050 – 9GW more than in the ETS – to fully decarbonize the power system. Around 14GW of CCS-paired coal is also built.

Road transport electrification under the NZS picks up momentum much faster than in the ETS, accounting for 13% of Australia's emissions abatement over 2022-50. Improving economics of EVs, aided by additional policy support, sees EV's share of new passenger vehicle sales reach 100% by 2032 – a milestone not achieved in the ETS before 2050. Australia relies heavily on EV adoption in passenger and commercial transport to displace carbon emissions from oil and gas consumption.

Our modeling suggests economic deployment of CCS technologies spurs the decarbonization of domestic industries, primarily in clean hydrogen and electricity production. CCS gains in importance in the 2030s, as the carbon budget forces hard-to-abate sectors to tackle unabated fossil fuel plants through retrofits or greenfield projects. CCS accounts for 7% of emissions abated over 2022-50. As the carbon budget bites, the annual rate of emissions captured by CCS grows from very low levels in 2022 to 5MtCO2 in 2030, 38MtCO2 in 2040, and 41MtCO2 in 2050. Coal consumption in 2050 in the NZS is 21Mt (600kcal/kg) – more than double that in the ETS – driven by a sixfold increase in the amount of coal used in CCS-paired facilities in the power sector under the NZS.

Domestic demand for hydrogen increases nearly 13 times by 2050 under the NZS, growing from a low base of 0.3Mt-H_2 today to 3.7Mt-H_2. Growth is driven by legacy uses in feedstock production and for use in the energy industry (1.2Mt-H_2 in 2050), where it helps decarbonize fuel refining, fuel extraction and equipment operation. Another significant sector is aluminum, with 0.6Mt-H_2 of demand in 2050. In transport, some 0.9Mt-H_2 is used either in its pure form or as derivative fuels such as methanol or ammonia to propel planes and vessels over medium to long distances. Hydrogen consumption in the power sector reaches a meager 0.12Mt-H_2 by 2050 – confined to providing critical backup generation. Today, most hydrogen is produced from unabated fossil fuels. By 2050, low-carbon hydrogen produced with flexible grid-connected electrolyzers powered by renewables becomes the dominant pathway in Australia under the NZS.

To reach net-zero emissions by mid-century, $1.9 trillion would need to be invested in Australia's energy system, representing an average of $68 billion per year. The increasing adoption of EVs and electrolyzers for hydrogen production requires a commensurate expansion of Australia's power grid. Under the NZS, around $300 billion of investment flows toward the grid in Australia (compared to $204 billion in the ETS), doubling the length of the network to over 1,600,000 kilometers from 2022 to 2050. The scale of this investment will likely necessitate a revision to the investment regimes currently in place. A new investment framework, in which private capital can accelerate grid investment without adversely impacting rate payers and landowners, could be a politically palatable way forward.

1.3. Key findings of the Hydrogen Export Scenario

In addition to the two scenarios from the global NEO 2022 report, BNEF created an additional Hydrogen Export Scenario (HES) for Australia. This scenario charts a net-zero transition pathway for Australia's power sector in which the country also emerges as a leading exporter of clean hydrogen. Australian-produced green hydrogen in this scenario accounts for 5.7% of the world's consumption of clean hydrogen in 2050 – an opportunity that will necessitate a clean power transition of monumental speed and scale.

In the HES, Australia's green hydrogen production rises from a negligible amount today to over 28Mt-H_2 per year in 2050. Exports rise from just 0.08Mt-H_2 in 2025 to over 25Mt-H_2 per year in 2050, making up 90% of Australia's hydrogen production. While the form and shape of a potential global hydrogen trade is still unknown today, we assume that under this scenario most hydrogen could be exported as ammonia or used domestically in the production of green steel or other materials, which are then exported.

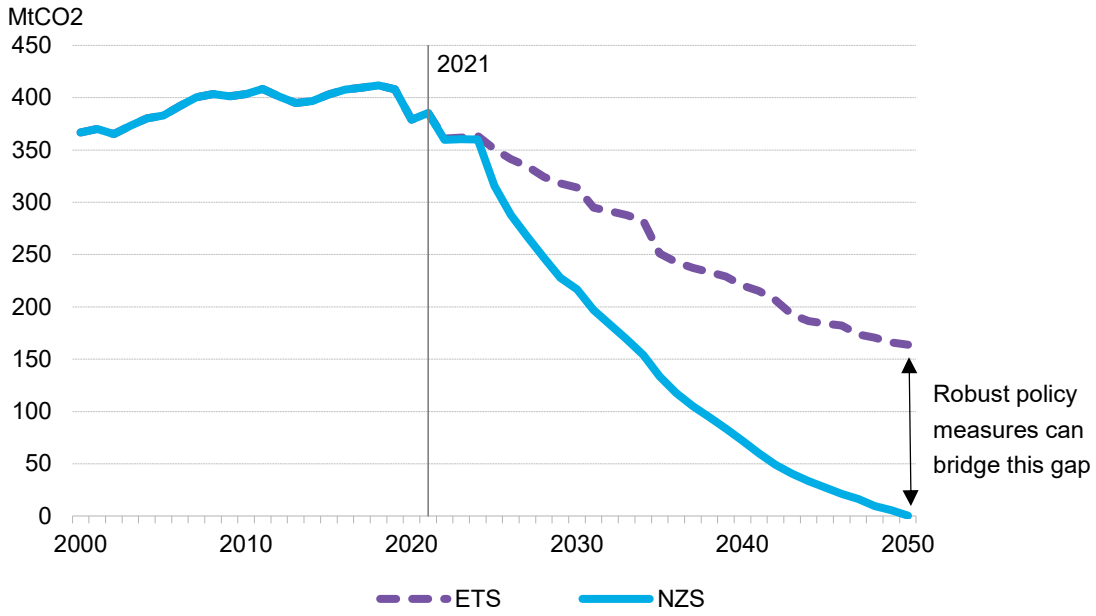
The twin goals of achieving net zero and emerging as a green hydrogen superpower by 2050 completely transforms Australia's power. Driven by greater demand from electrolyzers to produce green hydrogen, wind and solar deployment in the HES increases 21 times to 812GW over 2022-50. Solar takes up most of this capacity growth, with 457GW of utility-scale PV and 89GW of rooftop PV operational in 2050.

A renewable energy buildout of such massive proportions requires $592 billion in investment over 2022-50 – around 2.5 times more than the NZS. Around $369 billion, or 62%, will flow into new wind capacity, with the remaining going to solar.

1.4. Policy recommendations

The past decade of climate politics in Australia has been tumultuous, leading to a complicated patchwork of legislation implemented by federal and state governments. Australian governments will need to enact robust, coordinated policies if it is to reach net zero by 2050. To bridge the gap between our ETS and NZS, federal and state governments will need to work together to bolster existing policies and adopt new ones – to scale investment, align incentives, and target sectors like power, transport, and industry to achieve net zero emissions.

Figure 2: Australia's total emissions trajectory, by scenario



Source: BloombergNEF

- **Power:** The power sector is Australia's largest emitter, accounting for 44% of all emissions in 2022. It is also the sector with the most mature technologies and decarbonization momentum. Displacing fossil fuel generation with clean power sources is the main decarbonization driver in both our scenarios. To incentivize further adoption of clean power generation, federal and state governments may develop a national coal phase-out plan, bolster state-based auction programs, accelerate grid expansion, and introduce a mechanism to create more revenue certainty for wind and solar projects.
- **Transport:** Australia has long been considered a laggard to its peers when it comes to transport decarbonization, and policy must play a crucial role if the sector is to reach net zero emissions by 2050. The government has promised to introduce a fuel emissions standard by the end of 2023 to incentivize automakers to increase the supply of zero emissions vehicles into Australia. It might also consider implementing a phaseout of internal combustion engine vehicles and providing tax concessions/subsidies for zero emissions vehicles.
- **Emerging technologies:** Hydrogen and CCS are almost always more expensive than alternative technologies and so only play a minor role in the ETS but will be crucial in the NZS. Policy intervention from federal and state governments will almost certainly be needed to encourage uptake. These technologies, while expensive, can help Australia achieve deep decarbonization in hard-to-abate sectors like heavy industry and transport – to drive the country to net zero by 2050. Robust policy measures, like tax incentives and subsidies, will be required to increase these technologies' cost-competitiveness and drive greater adoption.

Further policy analysis and recommendations can be found in Section 11.

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