CLIMATE CHANGE AUTHORITY

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House Select Committee on Nuclear Energy
Parliament House
Canberra ACT 2600

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Dear Committee Members,

The Climate Change Authority wishes to provide a supplementary submission for your consideration as part of the ongoing *Inquiry into nuclear power generation in Australia*.

The attached report *Assessing the impact of a nuclear pathway on Australia's emissions* builds on the Authority's initial submission provided to the Committee in November 2024. It has been released today as a self-initiated research project in line with the provisions of the *Climate Change Authority Act 2011*.

The Authority has compared published modelling by the Australian Energy Market Operator and Frontier Economics to understand how the adoption of a proposed nuclear pathway could impact national emissions reduction targets and commitments.

Compared with the current national pathway which is set to see coal-fired generators fully replaced by a mix of renewables, storage and firming by 2040, the analysis finds the alternative pathway with nuclear would mean:

- an additional 1 billion tonnes of emissions from the electricity sector, and likely at least that amount again economy-wide by 2050
- pursuing a pace of climate action that is consistent with a global pathway to around 2.6°C of warming, a level at which scientists, economists and governments anticipate major social, economic and environmental harm
- missing Australia's legislated 43% national emissions reduction target for 2030 by five percentage points, and still not achieving this level of reduction by 2035.

The Authority's examination of the emissions impacts of the two pathways has reaffirmed the view presented in its previous submission, that staying the current course by continuing to roll out a mix of renewable generation, storage and firming at pace is the best option – with a focus on accelerating deployment as much as possible in the next 10 years.

We trust the Committee finds this supplementary submission helpful for your ongoing inquiry into these matters.

Yours sincerely

The Hon. Matt Kean
Chair

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Australian Government
Climate Change Authority

Assessing the impact of a nuclear pathway on Australia's emissions

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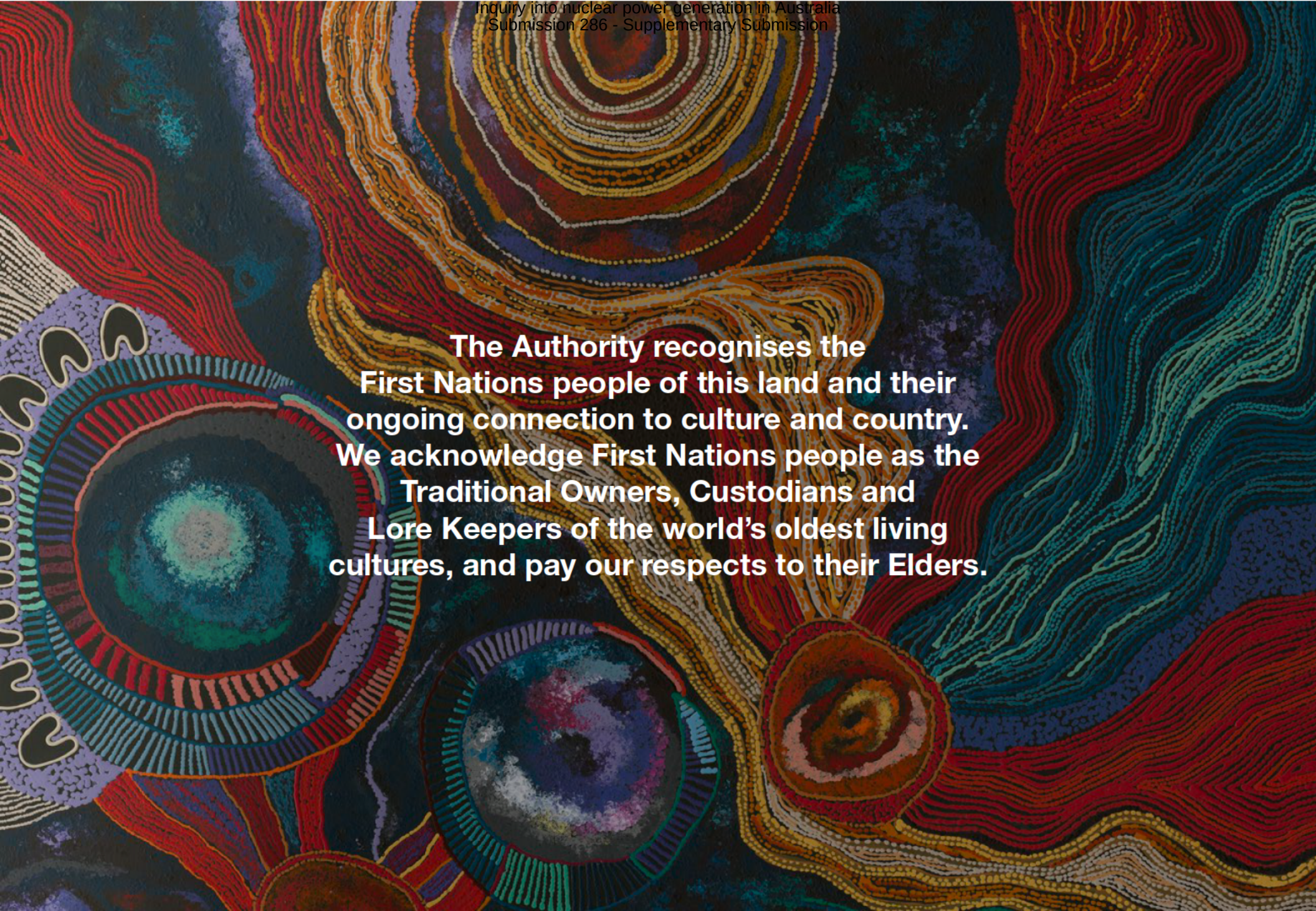
The Authority recognises the
First Nations people of this land and their
ongoing connection to culture and country.
We acknowledge First Nations people as the
Traditional Owners, Custodians and
Lore Keepers of the world's oldest living
cultures, and pay our respects to their Elders.

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Executive summary

Each nation will take its own journey to net zero emissions. In Australia's case, how we reduce emissions in the electricity sector will set the pace for how fast we can reduce emissions across the entire economy.

An overhaul of Australia's electricity infrastructure is already under way. Current national plans and policies are aiming to deliver 82% renewable electricity by 2030, and enable the uptake of electric vehicles, clean hydrogen and other technologies which use low emissions electricity. This approach aims to renovate Australia's ageing grid and reduce emissions across the economy. Modelling of this pathway has been prepared by the Australian Energy Market Operator (AEMO) to help guide government and private sector delivery planning.

The consulting firm Frontier Economics has released modelling exploring the implications for Australia's electricity system of an alternative approach, which would extend the use of some coal-fired generators until they could be replaced with nuclear power from the second half of the 2030s onwards. This pathway with nuclear also envisages more gradual uptake of clean technologies across the economy.

The Climate Change Authority has compared published modelling on these two pathways to explore their respective impacts on national emissions. They represent two alternative approaches to Australia's energy transition.

This work has been undertaken as a self-initiated research project, in line with the Authority's mandate to advise on policies to reduce emissions and address climate change.

It builds on the Authority's previous consideration of nuclear as part of research underpinning the 2024 Sector Pathways Review, and its submission to the Federal Parliament's inquiry into nuclear energy. It also forms part of the Authority's ongoing development of advice on an ambitious, achievable 2035 target that is in Australia's national interest.

Compared with the current national pathway that would see coal-fired generators fully replaced by a mix of renewables and firming by 2040, and strong uptake of low emissions technologies, the alternative pathway with nuclear would mean:

- an additional 1 billion tonnes of emissions from the electricity sector in the National Electricity Market (NEM), and likely at least that amount again economy-wide by 2050
- pursuing a pace of climate action that is consistent with around 2.6 degrees Celsius (°C) of warming, a level at which scientists, economists and governments anticipate major social, economic and environmental harm
- missing Australia's legislated 43% national emissions reduction target for 2030 by five percentage points, and still not achieving this level of reduction by 2035.

The differences between the two pathways are summarised in Table 1.

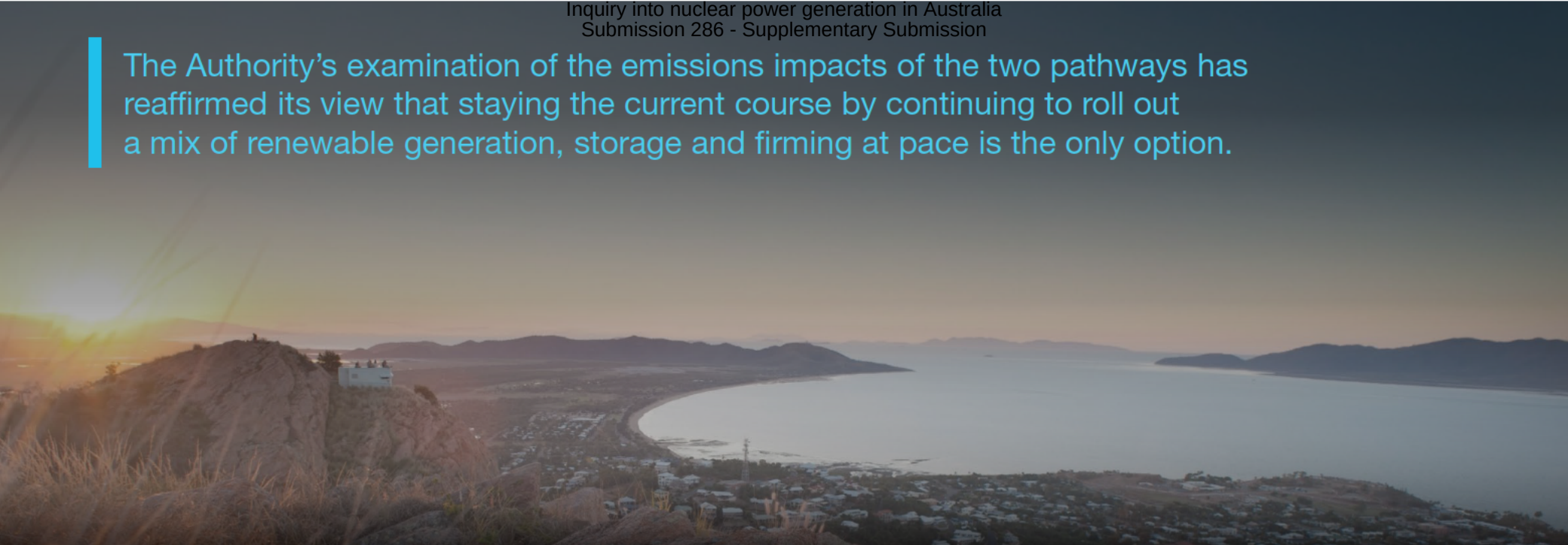
Table 1: Description of pathways and summary of findings[1]

	Modelled scenario used as base	Final electricity system technology mix 2050	Electricity demand (TWh)[2]	Cumulative NEM emissions (Mt CO_2-e) 2025-2050	Reduction in national emissions (% below 2005 levels) 2030	2035	Year reaching 82% renewables in NEM
Current pathway	AEMO *Step change*	Renewable generation and storage, peaking gas	2035 = 240 2051 = 317	657	42.7	50.9	2030
Alternative pathway	Frontier Economics *Progressive change with nuclear*	Renewable generation and storage, nuclear, peaking gas	2035 = 194 2051 = 246	≈1,660	37.1	39.8	2042

Notes: [1] A description of the underlying assumptions and summary of findings for all scenarios examined by the Authority is provided at Appendix A of this report. Data related to cumulative NEM emissions, emissions reduction targets and share of renewables in the grid are based on original Authority calculations based on AEMO (2024) and Frontier Economics (2024).

[2] Operational (sent out) annual consumption in the National Electricity Market for the relevant scenario. This does not include demand met by rooftop solar or other small non-scheduled generation.

> The Authority's examination of the emissions impacts of the two pathways has reaffirmed its view that staying the current course by continuing to roll out a mix of renewable generation, storage and firming at pace is the only option.



The Authority has focused analysis on these two pathways because they represent alternative choices now facing Australian policymakers: pursuing near-term deployment of renewable electricity enabling faster economy-wide decarbonisation, or opting for slower deployment of low emissions electricity with a more modest pace of decarbonisation economy-wide while developing nuclear power.

Both have implementation challenges that would need to be overcome. Success in either case will depend on further focused efforts by governments – working closely together with communities, businesses and investors – to remove barriers to the deployment of new energy infrastructure and accelerate its progress. Work is underway to address these challenges and accelerate the delivery of renewables; the same cannot be said of nuclear. Pursuing this alternative approach would require new and different efforts beyond those already underway, with the risk of arresting growing national momentum.

Alongside reducing emissions, plans to overhaul the grid need to ensure energy remains reliable and affordable for Australian families and businesses. This will protect and grow national prosperity, and the competitiveness of local industries in the context of an ageing fleet of coal-fired generators.

Community trust and acceptance are important preconditions for the successful delivery of all major new energy infrastructure. Government and industry must earn social licence from communities asked to host energy infrastructure, whether renewable or nuclear – including by demonstrating that proposed new facilities are safe, consistent with other local industries and uses of land, and will deliver shared benefits to local communities, traditional owners and other First Nations people.

The Authority notes diverse expert and community commentary about the merits of each pathway in relation to these priorities. This analysis is focused on emissions as the issue most directly within the Authority's remit. In doing so, it takes into account the principles outlined in the Authority's guiding legislation, particularly fostering economic efficiency and minimising negative social impacts.

The Authority's examination of the emissions impacts of the two pathways has reaffirmed its view that staying the current course by continuing to roll out a mix of renewable generation, storage and firming at pace is the only option – with a focus on accelerating deployment as much as possible in the next 10 years.

The mix of solutions adopted to power Australia may change in the decades ahead, as new technologies become available, the relative costs of technologies change and we understand more about the relative strengths of each. But consideration of the possible long-term role of a technology like nuclear power should not distract from the task of cutting emissions now with options that are readily available.

Introduction

Australia has a major national effort underway to overhaul our electricity system to keep electricity reliable and affordable, because most of the coal-fired generators which provide electricity today will reach the end of their operating lives in the next 15 years.

This unavoidable replacement of coal-fired generators is an important opportunity to reduce greenhouse gas emissions and combat climate change. The electricity and energy sector produces 35% of Australia's national emissions – higher than any other sector of the economy (DCCEEW, 2024).

There are proven and widely-available technologies available now to replace high emitting coal-fired generators with clean options – particularly wind and solar for generating electricity, and batteries and pumped hydro for storing it. They can be backed up by lower emissions firming technologies like fast-start gas peaking plants to keep electricity reliable at all times.

The availability and rapidly decreasing price of these technologies means the electricity sector has some of the best and most cost-efficient opportunities to reduce emissions now. Australia's current pathway for decarbonising the grid is based on rapid deployment of these technologies over the next 15 years.

Overhauling Australia's electricity system will directly reduce this sector's emissions and unlock opportunities for further emissions reductions in all other sectors in the years to 2050.

The Climate Change Authority's Sector Pathways Review (2024a) highlighted that low emissions electricity will:

- underpin uptake of electric vehicles to replace those powered by petrol and diesel
- enable a switch to all-electric appliances and equipment in homes, businesses, and industry
- support the production of fuels like renewable hydrogen and biofuels to replace gas and other liquid fuels in sectors like manufacturing, agriculture and heavy transport.

These kinds of changes can deliver important benefits for Australians – like lower petrol bills and homes that are more affordable and comfortable to live in – while reducing national emissions, after a period of substantial investment.

The interlinked priorities described above are often referred to as the energy trilemma: ensuring power is reliable and affordable while reducing emissions. Achieving this is now the shared, legislated objective of governments, regulators, investors, utilities and other partners in Australia's electricity system (AEMC, 2025).

Community support is also an essential enabler of action addressing the energy trilemma. Together, these critical elements – reliability, affordability, emissions and social licence – provide a framework for assessing options for the necessary renovation of Australia's electricity system.

Within this framework, the Climate Change Authority particularly focuses on emissions. We assess and advise on policy options which can accelerate emissions reductions, guide Australia to new opportunities and ways of doing things, and help the nation prepare for, and adapt to, the impacts of climate change. In doing so, we apply the principles outlined in the Authority's guiding legislation, particularly fostering economic efficiency and minimising negative social impacts.

There has been a growing discussion about nuclear power in Australia in recent years, as the overhaul of the electricity system gathers pace and some other countries plan to develop more nuclear facilities to support emissions reduction (OECD NEA, 2023). Although nuclear is a low emissions electricity source, there remain questions about whether it is suitable for meeting Australia's energy needs, and how its incorporation into the electricity system may impact national efforts to reduce emissions.

The Authority briefly examined the role of nuclear in analysis underpinning its major review of emissions and technology pathways to net zero – the 2024 Sector Pathways Review. At that time, the Authority's view was that legislative, technical and economic barriers meant it could not make a timely contribution to replacing the generation capacity of retiring coal-fired power stations or to helping Australia achieve its emissions reduction goals to 2050 (CCA, 2024a).

Since that analysis was undertaken, a proposal has been put forward to incorporate nuclear into Australia's energy mix and scale back existing national plans for some types of renewables like offshore. Modelling presenting a version of this alternative pathway was released in December 2024, outlining high-level implementation details and assumptions (Frontier Economics, 2024).

Policymakers, investors and communities are now presented with two potential pathways for decarbonising Australia's grid and broader economy. The Climate Change Authority has undertaken a focused analysis of the emissions impacts of these two pathways to support informed decision-making.

This report has been undertaken as a self-initiated research project in line with the provisions of the *Climate Change Authority Act 2011*. It was not requested or directed by the Australian Government.

It builds on other recent Authority work which has focused on priorities and opportunities in the electricity system as a key enabler of Australia's decarbonisation, particularly the 2024 Annual Progress Report (CCA, 2024b) and the Sector Pathways Review (CCA, 2024a).

The analysis and policy insights provided in this report are specific to Australia in the next 25 years. They should not be interpreted as a general Authority view on nuclear power as a zero-emissions energy source in the global energy transition.

Furthermore, the Authority's 2024 Sector Pathways Review noted that the size of Australia's decarbonisation task means where technologies are competitive and can make a material contribution to decarbonisation, they should be considered.

Australia has both an urgent priority to replace ageing coal-fired generators and cut emissions in the near term, and to power a thriving economy to net zero by 2050 and net negative beyond. Developments in nuclear technology should continue to be monitored on that basis, without delaying feasible and necessary action with other technologies.

Comparing pathways for decarbonisation

To explore the emissions impacts of different pathways for decarbonising Australia's grid and broader economy, the Authority has compared modelling published by the Australian Energy Market Operator (AEMO, 2024) and Frontier Economics (2024). Both draw on scenarios originally developed for AEMO's Integrated System Plan, which maps potential pathways for the deployment of new electricity infrastructure in the context of Australia's projected energy needs.

One of these scenarios – *Step change* – projects rapid emissions reduction in the electricity sector through the deployment of renewable generation and storage backed up by peaking gas, with much of this activity occurring in the next 15 years.

This scenario also anticipates strong uptake of technologies which rely on low emissions electricity – like electric vehicles, electric appliances and equipment, and renewable hydrogen. This is forecast to increase demand for electricity at the same time as the grid decarbonises, meaning Australia's future grid will need to be bigger than the one we have today.

Current federal and state government policy in Australia is oriented towards setting Australia on this pathway.

Throughout this report, the Authority therefore refers to this as the current pathway when examining expected emissions outcomes.

An alternative scenario in AEMO's Integrated System Plan – *Progressive change* – projects slower deployment of low emissions electricity and slower uptake of technologies which use it economy-wide, relative to the *Step change* scenario. The Frontier Economics (2024) modelling builds on the *Progressive change* scenario by adopting its underlying assumptions for energy demand, economic growth and adoption of clean technologies beyond the electricity system, but with adjustments to prolong the extended use of coal-fired electricity until nuclear generators could be available from 2036 onwards.

This would represent a shift from current national direction in three respects: delaying the replacement of coal generators with low emissions alternatives, incorporating nuclear energy into the mix in place of some renewable generation capacity, and pursuing more gradual uptake of technologies which use clean energy.

The Authority refers to this as the alternative pathway throughout this report.

Table 2 below presents the major differences in underlying assumptions between these two pathways.

The Authority has focused analysis on these two pathways because they represent alternative choices now facing Australian policymakers: pursuing near-term deployment of renewable electricity enabling faster economy-wide decarbonisation, or opting for slower deployment of low emissions electricity with a more modest pace of decarbonisation economy-wide. The Authority notes there are implementation challenges that would need to be overcome on either of those pathways.

These are also the main comparison pathways highlighted by Frontier Economics in its published modelling. Its work provided insights on potential economic and grid impacts of these options but did not explore the implications for cumulative emissions or Australia's national emissions reductions targets and commitments. The Authority's analysis seeks to provide policymakers with this further important context.

The Frontier Economics modelling also provided direct comparisons of each underlying AEMO scenario with and without nuclear. The Authority considered the difference in emissions *within* these two scenarios as part of the analysis for this report; outcomes for those comparisons are provided at Appendix A.

The Authority notes that Frontier Economics did not publish an accompanying dataset with their modelling report and declined the Authority's request to obtain the data. For the purpose of undertaking the analysis presented in this report, the Authority approximated data from published graphs in the Frontier Economics modelling report using an online graph reading tool: www.graphreader.com

Table 2: Major underlying assumptions of comparison pathways

	Modelled scenario used as base	Overview	Projected size of economy ($ trillion) [1]	Emissions & renewable energy targets	NEM demand (TWh)	Utility wind, solar and nuclear capacity (GW)	Coal generation capacity (GW)	Zero emissions generation share[2]	Consistent with global temperature outcome
Current pathway	AEMO *Step change scenario*	Strong industry and consumer investments in low emissions technologies, and actions to lower emissions across Australia's economy.	2035 = 2.7 2051 = 3.5	Australia's emissions reduction and renewable energy targets for 2030 and its net zero 2050 target are applied, as well as state targets.	2035 = 240 2051 = 317	2035 = 83 2051 = 126	2035 = 1 2051 = 0	2035 = 96% 2051 = 97%	1.8 ℃
Alternative pathway	Frontier Economics *Progressive change with nuclear* scenario	Assumes challenges in global economic conditions that limit the pace of Australia's transition to net zero. Coal power station closures are delayed with nuclear generation entering the system from 2036 onwards.	2035 = 2.6 2051 = 3.2	AEMO's original *Progressive change* scenario was consistent with Australia's renewable energy 2030 target and net zero 2050 target. These modeling parameters were removed from the Frontier Economics version.	2035 = 194 2051 = 232	2035 = ≈35 2051 = 60 (of which 13 GW is nuclear)	2035 = ≈13 2051 = 0	2035 = ≈63% 2051 = ≈100%	≈2.6 ℃

Notes: [1] National Electricity Market states only (ACT, NSW, QLD, SA, TAS and Vic), sum of Gross State Product assumptions for these states. For the alternative pathway, this number is from the underlying AEMO *Progressive change* scenario assumptions.

[2] Does not include storage or demand side participation but does include distributed solar. Frontier Economics did not model distributed solar for the alternative pathway, distributed solar generation from AEMO's original *Progressive change* scenario was added to the Frontier generation figures.

INSIGHT 1

Delaying the overhaul of Australia's grid would result in billions of tonnes more cumulative emissions

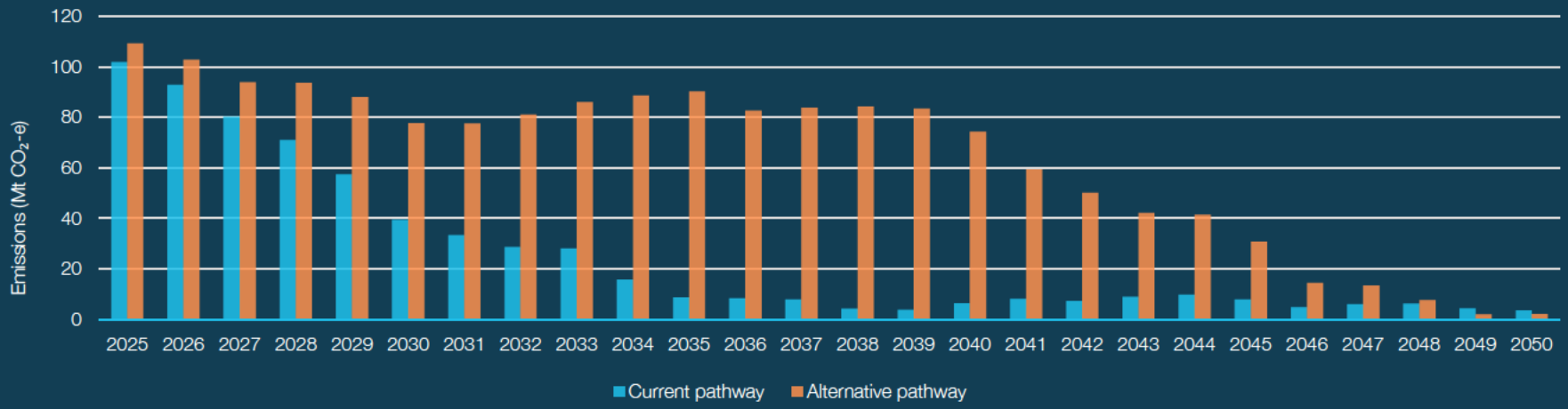
The overhaul of Australia's electricity infrastructure is already underway. Current national electricity plans and policies are aiming to deliver 82% renewable electricity by 2030. The Authority's 2024 Annual Progress Report (CCA, 2024b) noted that the deployment of low emissions infrastructure will need to accelerate to ensure this target is met.

Continuing development of the grid after 2030 will also require ongoing, focused effort – including further policy action by all levels of government. This is necessary to ensure the electricity system is ready for the expected closure of coal-fired generators, and to enable emissions reduction across the Australian economy.

The alternative pathway would delay this overhaul of Australia's grid and planned reductions in emissions, relative to the current pathway. The Authority's analysis of the published modelling indicates the share of zero emissions electricity in the NEM – both renewables and nuclear – would not reach 82% until around 2042 – more than a decade later than current national plans.

As illustrated in Figure 1, emissions in the NEM would be higher in every year until the late 2040s under the alternative pathway, compared with the current one. This gap would be widest in the years between 2034 and 2040, during which coal-fired generators are projected to fully exit the system under the current pathway.

Figure 1: Comparison of annual NEM emissions, 2025–2050



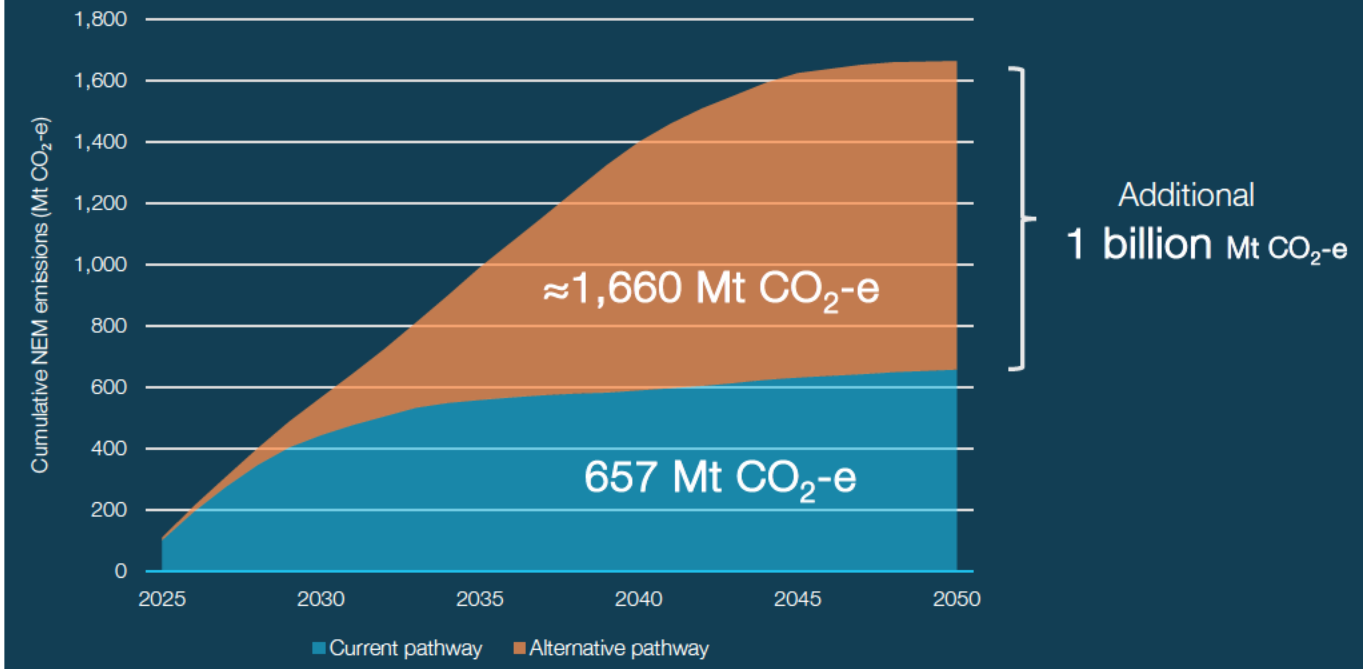
Source: Authority analysis based on data from AEMO (2024) and Frontier Economics (2024).

While the alternative pathway does see the electricity system reach net zero by 2049, it would result in significantly more emissions than the current pathway in most of the intervening years, and cumulatively, to 2050. Minimising the amount of emissions produced globally in coming years is essential for holding warming as close as possible to 1.5 °C. This is why Australia has joined with international partners in committing to progressively reduce emissions on the way to net zero by 2050.

By the time nuclear was fully deployed in 2048-49, the electricity sector would have produced around 1 billion tonnes CO_2-e more cumulative emissions than in the pathway where coal is replaced sooner with renewables. This is equivalent to an additional 8 years of emissions from the NEM, based on 2023-24 emissions levels.

Over the next 10 years, cumulative emissions in the electricity sector would be over 430Mt CO_2-e higher, which would impact Australia's emissions budget target for 2035.

Figure 2: Comparison of cumulative NEM emissions, 2025—2050



Source: Authority analysis based on data from AEMO (2024) and Frontier Economics (2024).

Emissions impacts would be seen beyond the grid

In addition to producing higher cumulative emissions in the NEM, the alternative pathway would also be expected to result in higher cumulative emissions across the Australian economy.

This pathway assumes slower rates of uptake of available and emerging clean technologies in significant sectors like transport, industry, resources and the built environment.

Modelling underpinning AEMO's original scenarios indicates the *Progressive change* results in around 1.4 billion tonnes more cumulative emissions between 2025 and 2050 than the *Step change* scenario. This is before adjusting for the additional emissions associated with slower decarbonisation of the grid with nuclear (CSIRO and Climateworks, 2022).

The Authority's preliminary analysis indicates the combined impact of pursuing the alternative pathway – across both the NEM and the broader economy – could therefore exceed 2 billion tonnes of additional cumulative emissions by 2050. Were this pathway to become national policy, further modelling would be required to better understand the complex interactions between its different components.

Understanding the broader emissions impact of the alternative pathway is important because the AEMO scenario it is based on is consistent with approximately 2.6 °C of warming – if Australia's pace of emissions reduction were replicated internationally. This compares with 1.8 °C of warming for the scenario shaping Australia's current pathway (AEMO, 2023).

At 2.6 °C of warming, scientists, economists and governments globally anticipate major social, economic and environmental harm. It has been estimated the world could lose close to 10% of total economic value if average temperatures rise by this extent (Swiss Re Institute, 2021).

Together with global partners, Australia has committed to work to minimise the build-up of emissions over the next 25 years to address climate warming. Delaying decarbonisation would be inconsistent with Australia's commitments domestically and internationally. It would also diminish Australia's capacity to make the case for accelerated emissions reductions globally.

INSIGHT 2

The alternative pathway would fall short of the legislated emissions reduction target and Australia's Paris Agreement commitments

Australia is currently working towards a legislated national target of reducing emissions by 43% against a 2005 baseline by 2030. The Authority has used Australia's latest whole of economy emissions projections (DCCEEW, 2024) to examine whether the alternative pathway would achieve this target.

As Table 3 illustrates, national emissions are projected to fall by close to this amount based on current national policies. The electricity sector is expected to contribute almost all of the direct emissions reduction required to reach this target (CCA analysis of DCCEEW, 2024).

The Authority's 2024 Annual Progress Report called for an acceleration in the current rate of deployment for renewable energy infrastructure and further government policy action to ensure it is met (CCA, 2024b).

The Authority's analysis indicates the 2030 national emissions reduction target could not be met if the alternative pathway was pursued as national policy. Economy-wide emissions would be approximately 34 Mt CO_2-e higher in 2030 than under the Australian Government's existing policy trajectory.

As a result, Australia would be 37.1% below 2005 levels - more than 5 percentage points short of the legislated national target for that year. The Authority's analysis indicates that there are insufficient alternative opportunities for emissions reductions in other sectors to address this shortfall.

Table 3: Projected point-in-time emissions, 2030 and 2035

	Emissions in 2030 (Mt CO_2-e)	Gap to 2030 target (Mt CO_2-e)	% below 2005	Emissions in 2035 (Mt CO_2-e)	% below 2005
Projected emissions – 2024 national emissions projections*	351	2	42.7%	301	50.9%
Projected emissions – alternative pathway	386	36	37.1%	369	39.8%
Difference*	35	34	-5.6 percentage points	68	-11.1 percentage points

Source: Authority analysis based on data from DCCEEW (2024) and Frontier Economics (2024).
Note: *The Authority's analysis applies the 'with additional measures' scenario from the 2024 national emissions projections as this reflects expected emissions taking into account all currently announced Australian Government policies as of November 2024.

The Authority's analysis indicates that under the alternative pathway, national emissions would still only be 40% below the 2005 baseline by 2035.

Other sectors would need to do more to achieve a stronger 2035 target

Australia is due to submit a stronger national target for 2035 this year as part of its commitments under the global Paris Agreement. The Authority's analysis indicates that under the alternative pathway, national emissions would still only be 40% below the 2005 baseline by 2035. This would make it difficult for Australia to set a stronger national target unless other sectors significantly increased their efforts.

This could be achieved by pursuing other policy mechanisms beyond the electricity system – such as ratcheting up the Safeguard Mechanism settings or implementing stronger electric vehicle mandates. However, these sectors have fewer affordable and efficient opportunities to reduce emissions than the electricity sector, meaning this decarbonisation would be achieved at a relatively higher economic cost.

Furthermore, the Sector Pathways Review highlighted that the available opportunities to reduce emissions in these other sectors to 2035 primarily depend on the availability of low emissions electricity. For example, decarbonising the grid enables industrial manufacturers to adopt efficient electric heat pumps, resources firms to electrify their mines, commercial buildings to go all-electric, and more households to take up electric vehicles. These actions can reduce sector emissions while new technologies and alternative fuels to fully decarbonise them continue to be developed.

Without significant additional supply of low emissions electricity, these other sectors would find it even more difficult and costly to reduce emissions to 2035. Australia could face the choice between pursuing less efficient and more expensive reductions in emissions or failing to meet its commitments under the Paris Agreement.

Government policy is only one driver of Australia's decarbonisation

It should be noted that both the current and alternative pathways are based on forward projections about the pace of adoption for a range of existing and emerging zero emission technologies. Governments can guide the pace of national decarbonisation through policy, but this will also be determined by the individual decisions of businesses, investors, communities and households.

Electricity supply in the NEM would be 24% lower in 2035 under the alternative pathway than on the current one. If uptake of clean technologies ultimately exceeded the pace assumed in the alternative pathway, this would lead to a potential imbalance between electricity demand and available supply.

Australians would either face electricity shortages, or to meet energy demand, it would be necessary to deploy significantly more renewable electricity alongside nuclear than currently proposed.

This highlights the importance of pursuing policies that are designed to address Australia's energy and emissions reduction priorities together, in a rapidly evolving environment that is only partially within the control of governments.

The Climate Change Authority's view

Based on the analysis presented in this report, the Authority reaffirms its view that staying Australia's current course by continuing to roll out a mix of renewable generation, storage and firming at pace is the only option – with a focus on accelerating deployment as much as possible in the next 10 years.

This pathway would make the most of proven technologies available now to rapidly reduce Australia's largest source of emissions.

Prioritising nuclear at this time would be inconsistent with Australia's national emissions reduction priorities and commitments.

Appendix A: Comparison of emissions outcomes within modelled scenarios

The Frontier Economics modelling presented outcomes for scenarios equivalent to AEMO's *Step change* and *Progressive change* cases, with and without the inclusion of nuclear.

Throughout this report, the Authority has discussed the difference in emissions outcomes between AEMO's *Step change* modelled scenario ('current pathway') and the *Progressive change with nuclear* scenario modelled by Frontier Economics ('alternative pathway'). These are the scenarios highlighted in pale blue in Table A1 below.

As noted above, the Authority focused on these two pathways because they represent alternative choices now facing Australian policymakers: pursuing near-term deployment of low emissions electricity enabling faster economy-wide decarbonisation or opting for slower deployment of low emissions electricity with a more modest pace of decarbonisation economy-wide while developing nuclear power. Both have implementation challenges that would need to be overcome.

The Authority also examined the emissions impacts when comparing within each of these scenarios, to isolate the impact of deploying nuclear as a distinct variable from rates of economy-wide decarbonisation. The outcomes of this comparison are presented in Table A1 below, and the underlying assumptions are summarised in Table A2.

This analysis finds the deployment of nuclear in either modelled scenario would lead to significantly more cumulative emissions.

Table A1: NEM emissions Mt CO_2-e, 2025 – 2050

	2025	2030	2035	2040	2045	2050	Cumulative 2025-2050
AEMO *Step change*	102	40	9	6	8	4	657
Frontier Economics *Step change with nuclear*	110	95	95	74	30	2	1,783
Difference	8	55	86	68	22	-2	1,126
AEMO *Progressive change*	107	38	21	20	16	10	893
Frontier Economics *Progressive change with nuclear*	109	78	90	74	31	2	1,662
Difference	2	40	69	54	15	-8	769

Source: Authority analysis based on data from AEMO (2024) and Frontier Economics (2024).

Table A2: Major underlying assumptions of four AEMO and Frontier Economics scenarios

	Modelled scenario	Overview	Emissions & renewable energy targets	Projected size of economy ($ trillion)[1]	Electricity demand (TWh)[2]	Utility wind, solar and nuclear capacity (GW)	Coal generation capacity (GW)	Zero emissions generation share[3]	Global temperature outcome
Current pathway	AEMO *Step change* scenario	Strong industry and consumer investments in low emissions technologies, and actions to lower emissions across Australia's economy.	Australia's emissions reduction and renewable energy targets for 2030 and its net zero 2050 target are applied, as well as state targets. The scenario also applies a NEM carbon budget to 2050 consistent with AEMO's view of the NEM's contribution to limiting the global temperature increase to well below 2 °C.	2035 = 2.7 2051 = 3.5	2035 = 240 2051 = 317	2035 = 83 2051 = 126	2035 = 1 2051 = 0	2035 = 96% 2051 = 97%	1.8 °C
	Frontier Economics *Step change with nuclear* scenario	Uses demand from AEMO *Step change* scenario, where there are strong industry and consumer investments in low emissions technologies, and actions to lower emissions across Australia's economy. In the nuclear scenario, coal power station closures are delayed with nuclear generation entering the system from 2036 onwards.	AEMO's original emissions reduction and renewable energy targets for the NEM have not been applied in the Frontier Economics version of this scenario.	2035 = 2.7 2051 = 3.5	2035 = 240 2051 = 317	2035 = ≈46 2051 = 85 (of which 13 GW is nuclear)	2035 = ≈13 2051 = 0	2035 = ≈68% 2051 = ≈99%	≈1.8 °C

Table A2: Major underlying assumptions of four AEMO and Frontier Economics scenarios (cont.)

	Modelled scenario	Overview	Emissions & renewable energy targets	Projected size of economy ($ trillion)[1]	Electricity demand (TWh)[2]	Utility wind, solar and nuclear capacity (GW)	Coal generation capacity (GW)	Zero emissions generation share[3]	Global temperature outcome
	AEMO *Progressive change* scenario	Assumes challenges in global economic conditions that limit the pace of Australia's transition to net zero.	Consistent with Australia's renewable energy 2030 target and net zero 2050 target.	2035 = 2.6 2051 = 3.2	2035 = 194 2051 = 232	2035 = 58 2051 = 86	2035 = 4 2051 = 2	2035 = 90% 2051 = 94%	2.6 °C
Alternative pathway	Frontier Economics *Progressive change with nuclear* scenario	Assumes challenges in global economic conditions that limit the pace of Australia's transition to net zero. Coal power station closures are delayed with nuclear generation entering the system from 2036 onwards.	AEMO's original *Progressive change* scenario was consistent with Australia's renewable energy 2030 target and net zero 2050 target; these parameters have not been applied in the Frontier Economics version.	2035 = 2.6 2051 = 3.2	2035 = 194 2051 = 232	2035 = ≈35 2051 = 60 (of which 13 GW is nuclear)	2035 = ≈13 2051 = 0	2035 = ≈63% 2051 = ≈100%	≈2.6 °C

Notes: [1] National Electricity Market states only (ACT, NSW, QLD, SA, TAS and Vic), sum of Gross State Product assumptions from the ISP assumptions (AEMO 2023) for these states. For Frontier Economics scenarios, this number is from the underlying AEMO scenario assumptions. Expressed in real 2022-23 Australian dollars.

[2] Operational (sent out) annual consumption in the National Electricity Market for the relevant scenario. This does not include demand met by rooftop solar or other small non-scheduled generation. For Frontier Economics scenarios, this number is from the underlying AEMO scenario assumptions.

[3] Does not include storage or demand side participation but does include distributed solar. Frontier Economics did not model distributed solar, so for the alternative pathway distributed solar from AEMO's original *Progressive change* scenario was added to the Frontier Economics generation figures.

Appendix B: Methodology

NEM emissions 2025-2050 (Figures 1 & 2 and Appendix Table 1)

- For the current pathway, NEM emissions data were taken directly from AEMO's (2024) Integrated System Plan.
- For the alternative pathway, NEM emissions were calculated as the product of emissions intensity and generation data in each year, published in the Frontier Economics (2024) modelling report.
- Frontier Economics' NEM emissions intensity and generation data were extracted from charts in their published modelling report, using the online tool at www.graphreader.com. The Authority contacted Frontier Economics to request its original data; the request was denied.

Whole of economy emissions in 2030 and 2035 (Table 3)

- The base case for economy-wide emissions in 2030 and 2035 was drawn directly from the 2024 Emissions Projections 'With Additional Measures' scenario in the DCCEEW (2024) National Projections chart data workbook.
- For the comparison scenario, the NEM emissions from the 2024 Emissions Projections 'With Additional Measures' scenario were replaced with the NEM emissions from Frontier's *Progressive change with nuclear* scenario.

Whole of economy cumulative emissions 2025-2050 (referred to in text on p.9)

- For AEMO's *Step change* and *Progressive change* scenarios, economy-wide emissions were extracted from a chart in the Multi-sector energy modelling 2022: Methodology and results: Final report produced by the CSIRO and Climateworks to inform the 2024 ISP.
- For an economy-wide comparison, the NEM emissions from AEMO's Progressive change scenario were replaced with the NEM emissions from Frontier Economics' *Progressive change with nuclear* scenario.

References

AEMC (Australian Energy Market Commission). (2025). *National Energy Objectives*. www.aemc.gov.au/regulation/neo

AEMO (Australian Energy Market Operator). (2024). *2024 Integrated System Plan*. https://aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2024- integrated-system-plan-isp

AEMO (Australian Energy Market Operator). (2023). *2023 Inputs, Assumptions and Scenarios Report*. https://aemo.com.au/-/media/files/major-publications/isp/2023/2023-inputs-assumptions-and-scenarios-report.pdf?la=en

CCA (Climate Change Authority). (2024a). *Sector Pathways Review*. www.climatechangeauthority.gov.au/sector-pathways-review

CCA (Climate Change Authority). (2024b). *2024 Annual Progress Report*. www.climatechangeauthority.gov.au/2024-annual-progress-report

CCA (Climate Change Authority). (2024c). *Submissions – 2024 Issues Paper: Targets, pathways and progress*. https://consult.climatechangeauthority.gov.au/2024-issues-paper/targetspathwaysandprogress/list

CCA (Climate Change Authority). (2024d). *Submission to the House Select Committee on Nuclear Energy inquiry into nuclear power generation in Australia.* www.climatechangeauthority.gov.au/sites/default/files/documents/2024-12/CCA%20submission%20-%20Inquiry%20into%20nuclear%20power%20in%20Australia.pdf

CSIRO and Climateworks (Commonwealth Scientific and Industrial Research Organisation and Climateworks). (2022). *Multi-sector energy modelling 2022: Methodology and results: Final report.* https://publications.csiro.au/publications/publication/PIcsiro:EP2022-5553

DCCEEW (Department of Climate Change, Energy, the Environment and Water). (2024). *Australia's emissions projections 2024*. www.dcceew.gov.au/climate-change/publications/australias-emissions-projections-2024

Frontier Economics. (2024). *Economic analysis of including nuclear power in the NEM*. www.frontier-economics.com.au/economic-analysis-of-including-nuclear-power-in-the-nem

OECD NEA (Organisation for Economic Co-operation and Development Nuclear Energy Agency). (2023). www.oecd-nea.org/jcms/pl_89153/cop28-recognises-the-critical-role-of-nuclear-energy-for-reducing-the-effects-of-climate-change

Swiss Re Institute. (2021). *The economics of climate change: no action is not an option*. www.swissre.com/dam/jcr:e73ee7c3-7f83-4c17-a2b8-8ef23a8d3312/swiss-re-institute-expertise-publication-economics-of-climate-change.pdf

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