

Nuclear Energy Report

2024



ACKNOWLEDGEMENT

In the spirit of reconciliation, the ETU acknowledges the Traditional Custodians of country throughout Australia and their connections to land, sea and community. We pay our respect to their Elders past and present and extend that respect to all First Nations peoples today.

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EXECUTIVE SUMMARY

Our nation is in the midst of an industrial revolution, founded on the transition from old to new sources of energy.

Against a backdrop of global and domestic net zero emissions policy, coal-fired power station closures, availability of lower priced energy sources and dynamic changes to how our energy system operates, the need for a transformation of our energy system has become clear and irrefutable. Against the evidence, however, some are advocating nuclear power to have a role in Australia's energy transition.

This report investigates the feasibility of establishing a nuclear power industry in Australia, by bringing together research from a broad range of experts across academia and industry in areas such as engineering, economics, environmental science, and energy markets. We find that nuclear is not the solution to Australia's energy needs because it simply is not needed. It is vastly more expensive than alternative forms of clean energy, it will not be delivered in time and there are a range of technical, environmental and health challenges involved in nuclear power for which there are no proposed solutions. Additionally, the 'firming the system' and 'baseload' arguments do not stack up.

Geopolitical considerations have not been contemplated for our Pacific neighbours, including New Zealand. The potential consequences of any emergency event, as well as the shipping transport corridors associated with the industry passing through their regions, means our international strategic relationships may be jeopardised by nuclear reactors in Australia.

- Vanuatu's first deputy speaker of Parliament Andrew Solomon Napuat said "that Australia could set up nuclear activities in the Pacific is something that's very concerning to us, and we would not support Australia doing that".¹
- Former Kiribati president Anote Tong says he fears building nuclear reactors "undermines Australia's work in the climate space".²

Nuclear power is a dangerous and unnecessary distraction from the real movement on the pressing energy decisions and climate actions Australia desperately needs. The political energy, investment and time that would be required to deploy nuclear reactors would be much better spent delivering a significantly faster and better transition for workers and their communities through a fairer and quicker transition to renewables.

¹ Kyle Evans. Dutton nuclear energy ambitions stokes concern in Pacific. ABC.

² Kyle Evans. Former Kiribati president calls on Australia to end coal exports. ABC.

ENDORSEMENTS



Emma Dawson

No-one better understands the nature and needs of Australia's energy system than the people who built it. The ETU has been engaged in the debate over nuclear energy for Australia since the 1950s and, as their sharp and timely analysis shows, the case for nuclear is weaker now than it has ever been.

When it comes to energy policy, we should listen to the experts. The ETU's timely intervention in this debate exposes the late enthusiasm of some for a gamble on nuclear energy as exactly what it is – a deliberate distraction from the work that is already underway to turn Australia's reliable old energy system into a world-leading renewable source of superpower for future generations.

Emma Dawson
Executive Director, Per Capita



Tim Buckley

The chance of Australia producing any nuclear energy in the next 15-20 years is remote to non-existent, and even the Federal LNP know this. That is why their policy is nothing more than a single page of talking points with no substantive modelling or credible references.

In 2023, China built 293GW of new renewables capacity versus just 1GW of nuclear. The US this year will add 45GW of renewable energy versus just 1GW of new nuclear. And India in FY2024 added 18GW of renewables capacity versus just 1GW of nuclear. All three have established nuclear industries and supply chains.

For Australia, with no existing supply chains nor skilled workforce available, the cost and delay nuclear involves is entirely prohibitive. A distraction in the global race to decarbonise. We need to implement energy solutions applicable to this decade, not two decades out.

Tim Buckley
Director, Climate Energy Finance



Jim Stanford

Far-fetched claims about the viability and cost of nuclear power are distracting Australia's energy policy debate from real issues, and real solutions. This timely report from the ETU compiles the evidence we need to evaluate energy options, and identify a feasible strategy for a net zero energy system (and the tens of thousands of jobs that will be created by it). This report's analysis of the costs and risks of nuclear power in Australia is rigorous, evidence-based, and compelling.

Dr Jim Stanford
*Economist and Director,
Centre for Future Work*

INTRODUCTION

The Electrical Trades Union of Australia (ETU) is the Electrical, Energy and Services Division of the Communications, Electrical, Electronic, Energy, Information, Postal, Plumbing and Allied Services Union of Australia (CEPU).

The ETU represents approximately 67,000 electrical and electronic workers around the country, and the CEPU as a whole represents over 100,000 workers nationally.

ETU members make up a critical pillar of the workforce responsible for delivering the efficient, affordable and secure emissions-free renewable energy network that will create jobs for up to 42,000 more electricians by 2030.³

The official policy of the ETU regarding nuclear energy dates back to the 1950s, resulting from the shared experiences of ETU members who had dutifully served their country when called upon and as returning servicemen, resumed their former jobs as electrical workers. Returning from Japan following World War II, these ETU members shared their experiences of the aftermath of the United States detonating two atomic bombs over the Japanese cities of Nagasaki and Hiroshima on the 6th and 9th of August 1945. These bombings killed between 129,000 and 226,000 people, most of whom were civilians, and left such an enduring memory in the minds of those who saw that destruction, that many returned soldiers became the forebears of the anti-nuclear sentiment in Australia.

Shortly thereafter, ETU members were again engaged in the debate about nuclear following the 1952 to 1963 nuclear testing which occurred at the Monte Bello Islands off the coast of Western Australia, and Emu Field and Maralinga in South Australia. In the years after these nuclear 'tests', reports increased about chronic illness and birth defects among the people who had been living near the testing sites.

In the 70+ years since establishing this policy, the ETU has regularly revisited this issue through branch meetings, biennial conferences and at various national conferences of the union. The ETU has been engaging with experts, scientists and both pro and anti-nuclear advocates to learn more about the nuclear fuel cycle, changes and advances to technologies, the interaction of the industry and its outcomes for the environment, health, safety, farmers, First Nations peoples, as well as matters such as its technical interaction with the network.

As this report demonstrates, Australia has much cheaper, faster and safer options available to it, making it obvious there is no future for nuclear in our energy transition.

The ETU represents approximately 67,000 electrical and electronic workers around the country, and the CEPU as a whole represents over 100,000 workers nationally.

³ Jobs and Skills Australia. The Clean Energy Generation Report.

WHY IS OUR ENERGY SYSTEM TRANSITIONING?

Greenhouse gases, primarily carbon dioxide (CO₂) and methane (CH₄), generated from human activities are causing an increase in average temperatures.⁴ It is estimated that burning coal, gas and oil accounts for more than three-quarters of total greenhouse gas emissions globally.⁵ In 2019, atmospheric CO₂ concentrations were higher than at any time in at least 2 million years. This has resulted in global surface temperature in 2023 reaching 1.1°C above the average from 1961 to 1990.⁶ Global surface temperature has increased faster since 1970 than in any other 50-year period for at least the last 2000 years.⁷

Over the past 50 years, climate change has slowed agricultural productivity growth, contributed to a decrease in fish catch potential and resulted in increased frequency and severity of natural disasters, which have exposed millions of people to acute food insecurity and reduced water security, and destroyed individual livelihoods through the destruction of homes and infrastructure.⁸

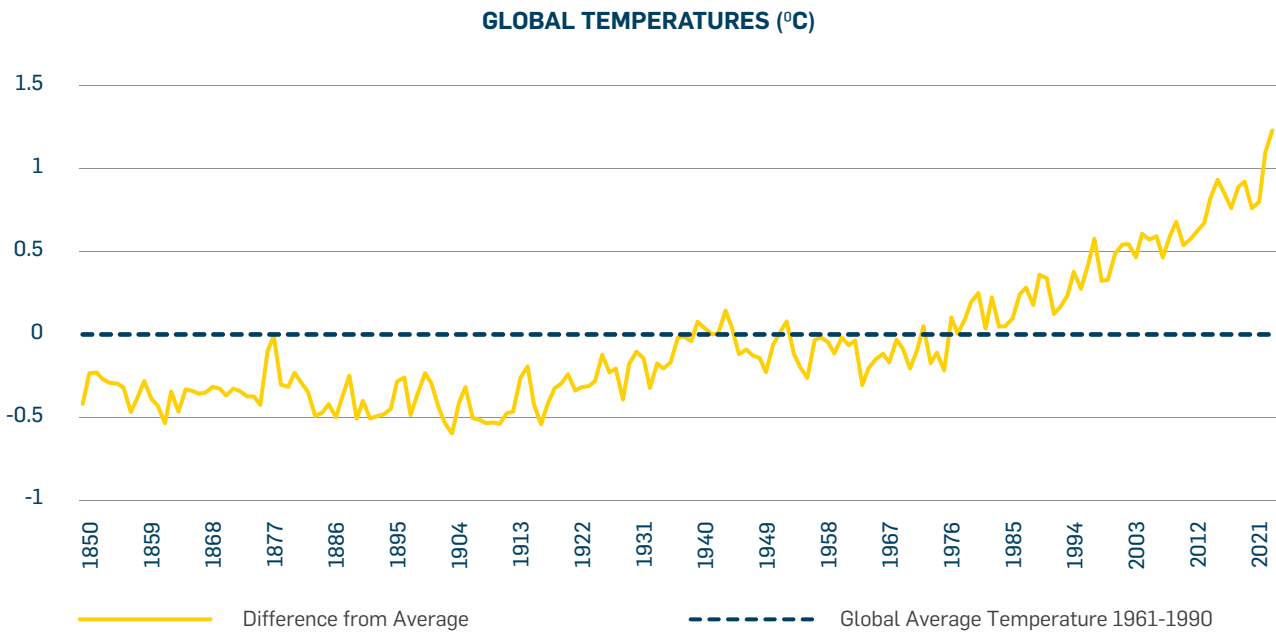


Figure 1: Global average temperatures - Our World in Data. Average temperature anomaly, Global.

4 IPCC. Climate Change 2023 Synthesis Report.
 5 International Energy Agency. Greenhouse Gas Emissions from Energy Data Explorer.
 6 Our World in Data. Average temperature anomaly, Global.
 7 IPCC. Climate Change 2023 Synthesis Report.
 8 Ibid.

Why net zero?

Achieving an economy that produces no more emissions than it sequesters - net zero - is the only way to prevent an ongoing escalation of average temperature rises and even more frequent and severe natural disasters. If we are to minimise the damage to people, property and the environment we live in, we need to achieve net zero by at least 2050.⁹ The global scientific consensus on the causes and consequences of climate change are uncontested by our international diplomatic and trading partners. The Paris Climate Agreement is an international treaty that aims to prevent global average temperatures from increasing above pre-industrial levels by at most 2°C, with a preference for 1.5°C, including by achieving net zero emissions by 2050.¹⁰ The agreement is signed by 195 countries, including all G20 countries.¹¹ Australia signed the agreement under Tony Abbott. Prior to that, Australia signed its predecessor, the Kyoto Protocol, during the Howard Government.¹²

Aging coal-fired power stations

Australia needs a plan to rapidly replace its aging coal-fired power station fleet. We have already lost 11 coal-fired power stations since 2012 and the remaining nine are scheduled to close by 2040. The independent Australian Energy Market Operator has forecast that 90% of our coal-fired power generation capacity will retire by 2035 and 100% before 2040.¹³

Price

In the Australian context, nuclear power is the most expensive form of energy. The CSIRO estimates that building a 1,000-megawatt nuclear reactor in Australia would cost up to \$17 billion. This is 1.5-3 times the cost per kw/h of coal and 4-8 times the cost per kw/h of solar, when considering 'first of a kind' premiums.¹⁴

Power Station	State	Closure
Munmorah	NSW	2012
Collinsville	QLD	2012
Swanbank B	QLD	2012
Redbank	NSW	2014
Wallerawang C	NSW	2014
Morwell	VIC	2014
Anglesea	VIC	2015
Northern	SA	2016
Playford	SA	2016
Hazelwood	VIC	2017
Liddell	NSW	2023
Eraring	NSW	2027
Collie	WA	2027
Yallourn	VIC	2028
Callide	QLD	2028
Muja	WA	2029
Bayswater	NSW	2033
Vales Point	NSW	2033
Gladstone	QLD	2035
Tarong	QLD	2037

Figure 2: Coal-fired power station closures.

⁹ IPCC. Global Warming of 1.5°C.

¹⁰ United Nations. Paris Agreement.

¹¹ United Nations. Paris Agreement - Status of Ratification.

¹² Parliament of Australia. Climate change and the Kyoto Protocol.

¹³ AEMO. 2024 Integrated System Plan.

¹⁴ CSIRO. GenCost 2023-24.

Renewables or nuclear?

The world is moving fast to replace fossil fuel generation and is choosing renewables for speed of deployment, and because the cost curve is low and continues to fall.

- US Inflation Reduction Act AUD \$550b
- EU Net Zero Industry Plan AUD \$390b
- South Korea Green New Deal AUD \$90b
- Saudi Arabia Vision 2030 AUD \$400b
- Canada IRA Response AUD \$90b

Even countries with existing nuclear capability are choosing renewables over nuclear. China now routinely reduces its nuclear forecasts, expecting just 60 terawatt-hours to be added to the system annually. At the same time, it is building renewable energy projects at an astonishing 400 terawatt-hours of new generation per year and growing.¹⁵ The U.S. has closed more nuclear capacity than it has added in the last 25 years.¹⁶

GLOBAL RENEWABLE AND NUCLEAR ENERGY TREND (TWh)

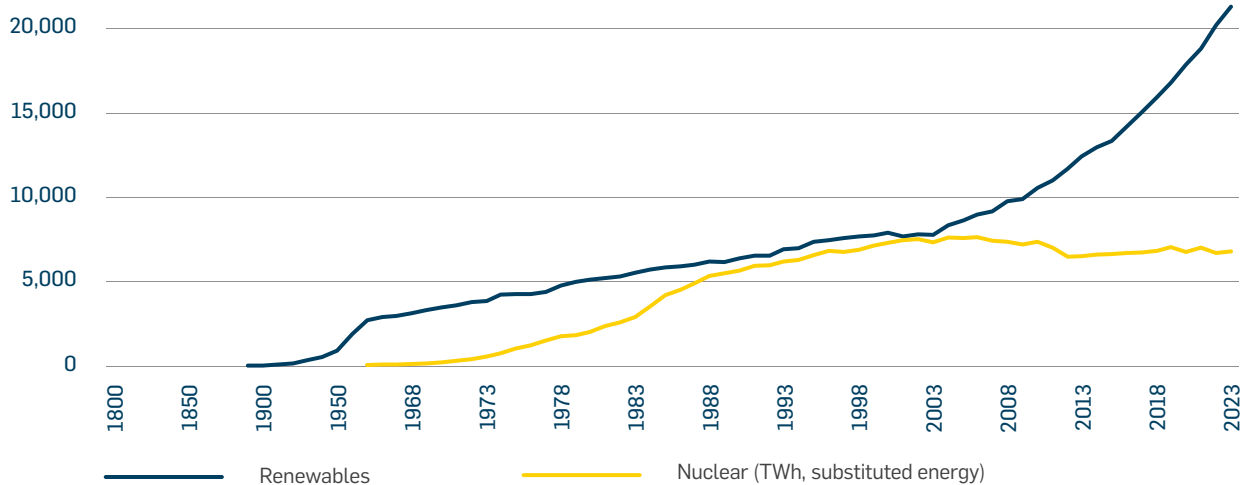


Figure 3: Global energy consumption - Energy Mix. Our World in Data.

15 David Glynn Jones & Derek Woolner. China's quiet energy revolution: The switch from nuclear to renewable energy. Renew Economy.

16 U.S. Energy Information Administration. U.S. nuclear electricity generation continues to decline as more reactors retire.

Even countries with existing nuclear capability are choosing renewables over nuclear.



HOW MUCH DOES IT COST?

Nuclear power is the most expensive form of energy. The CSIRO estimates that building a 1,000 megawatt nuclear reactor in Australia would cost up to \$17 billion. This is 1.5-3 times the cost per kw/h of coal and 4-8 times the cost per kw/h of solar, when considering 'first of their kind' premiums.¹⁷ These costs would be passed on to consumers.

If Australia tried to replace its aging coal-fired power stations with nuclear reactors, the average Australian household would pay \$590 per year more on their power bill with nuclear.¹⁸

Multiple parliamentary inquiries across the country have concluded that nuclear is too expensive to survive in the Australian market:

- The 2016 South Australian Nuclear Fuel Cycle Royal Commission concluded nuclear power was not economically viable.¹⁹
- The 2020 Victorian Inquiry into Nuclear Prohibition found that "nuclear power is significantly more expensive than other forms of power generation".²⁰
- The 2019 Commonwealth Inquiry into the Prerequisites for Nuclear Energy in Australia chaired by Coalition shadow energy minister Ted O'Brien recommended that Australia maintain the ban on large-scale nuclear reactors because they are not suitable for our energy market.²¹

In the 2019 inquiry, Dr. Ziggy Switkowski, who led the Howard Government's inquiry into nuclear power in 2006, gave evidence that since his investigation "nuclear power has got more expensive, rather than less expensive," and that there is currently "no coherent business case to finance an Australian nuclear industry".²²

COST OF NUCLEAR AND RENEWABLES (\$/MWh)

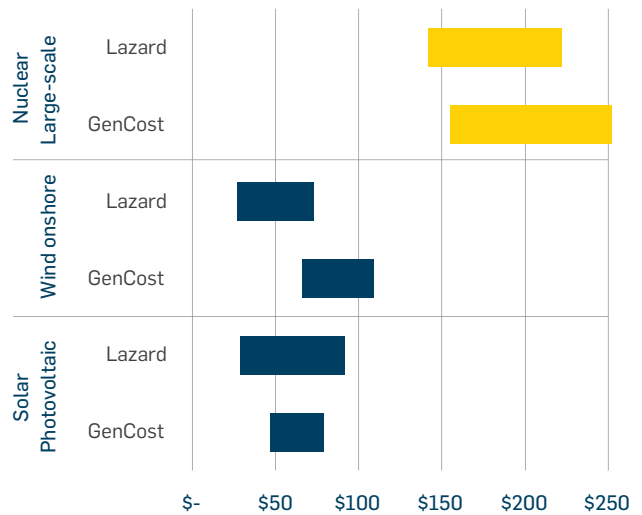


Figure 4: Levelised cost of nuclear and renewables, estimations from Lazard and GenCost 2023-24.

NUCLEAR IMPACT ON POWER BILLS



Figure 5: Nuclear Impact on Power Bills – CSIRO. GenCost 2023-24, Default Market Offer 2023-24, Victorian Default Offer 2023-24.

17 CSIRO. GenCost 2023-24.

18 No Future for Nuclear. Nuclear: A Waste of Money.

19 Nuclear Fuel Cycle Royal Commission. Final Report.

20 Parliament of Victoria. 2023 Briefing e-book..

21 House of Representatives Standing Committee on the Environment and Energy. Not without your approval

22 Ibid.

Global financial advisory and asset management firm Lazard's 2023 report on the levelised cost of energy around the world found that nuclear power is becoming more expensive over time, while renewable energy is becoming cheaper.²³

Forecast generation costs released by the CSIRO show renewables are outperforming all other fuel types and demonstrate a strong ongoing learning rate, leading to further reductions in cost over time. Learning rates of other fuel types remain steady with little gains in efficiency forecast compared to renewables.²⁴

Cost overruns and delays must also be taken into account. Around the world, the final cost of building a reactor has far exceeded the initial announcement:²⁵

- The Vogtle 3 and Vogtle 4 nuclear reactors in Georgia, USA were originally budgeted at US\$14 billion. The total cost of the project is now estimated at more than US\$35 billion (AUD \$52.5 billion).
- A French reactor, Flamanville, has seen its cost soar from €3.3 billion to €19 billion (AUD \$5-31 billion).
- Hinkley Point C in the UK is costing an incredible £70 billion (A\$132 billion), up from £16 billion (AUD \$30 billion).
- Olkiluto 3 in Finland saw its cost balloon from an initial estimate of €3 billion (AUD \$5 billion) to around €11 billion (AUD \$18 billion).
- The Virgil C plant in the USA cost US\$9 billion (AUD \$14 billion) and wasn't even completed before cost overruns led to the project being abandoned.

On average, globally, the final cost of building a nuclear reactor is 120% more than initially announced.²⁶

NUCLEAR COST OVERRUNS (BILLIONS)

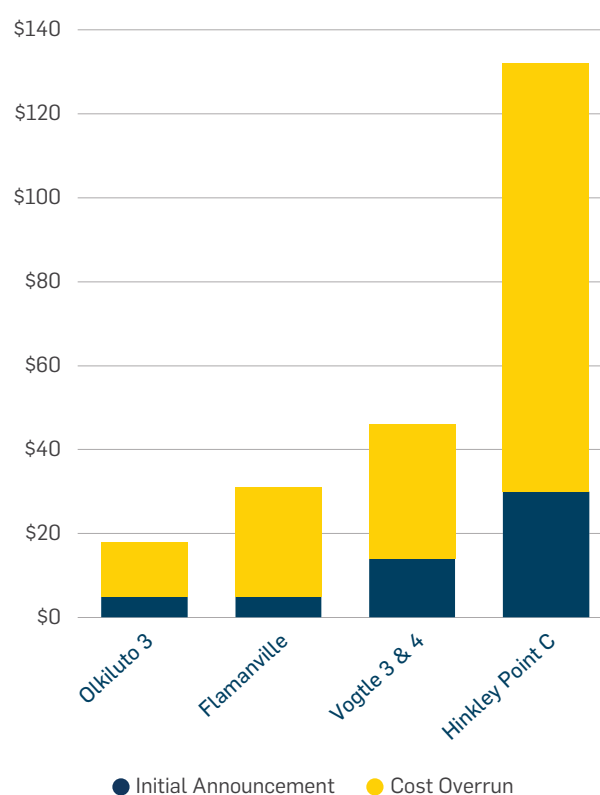


Figure 6: Nuclear Cost Overruns - Reuben Finighan. Is nuclear the answer to Australia's climate crisis?

23 Lazard. Levelised Cost of Energy Analysis.

24 CSIRO. GenCost 2023-24.

25 Reuben Finighan. Is nuclear the answer to Australia's climate crisis? The Mandarin.

26 Mycle Schneider Consulting. The World Nuclear Industry Status Report 2023.

HOW LONG WILL IT TAKE?

Australia needs to move quickly to replace its aging coal-fired power stations. We have already lost eleven coal-fired power stations since 2012, and the remaining nine are scheduled to close by 2040. The independent Australian Energy Market Operator has forecast that 90% of our coal-fired power generation capacity will retire by 2035 and all will close before 2040.²⁷

After extensive scientific inquiry and consultation with industry leaders, the CSIRO concluded that the earliest date Australia could acquire a nuclear reactor would be after 2040.²⁸ This means that our entire coal-fired generation capacity would be extinguished before we could get one nuclear reactor online.

Replacing coal-fired power stations with nuclear reactors would be a long and complicated process which includes not only the shutdown of the power station but also its decommissioning. This additional process involves removing equipment and demolishing facilities as well as remediation, including cleaning up contaminants and hazardous material. These processes must all be completed before the long construction process can begin.²⁹

The Munmorah Power Station in New South Wales started shutting down in 2012, but was not completely demolished until six years later. The remediation process is still unfinished with the surrounding land and water declared in May 2024 by the NSW Environment Protection Authority to be “significantly contaminated” from the former power station, preventing it from being “redeployed for another use”.³⁰ The average nuclear reactor takes 9.4 years just to build, and that’s after several years in the designing, planning and development approval phases.³¹ With no workers in Australia currently trained to operate nuclear reactors, it would take 10-15 years to develop the necessary workforce and none of these jobs are guaranteed.³²

All these issues result in a costly and lengthy process to switch a coal-fired power station with a nuclear power station, which is not even guaranteed to be successful.

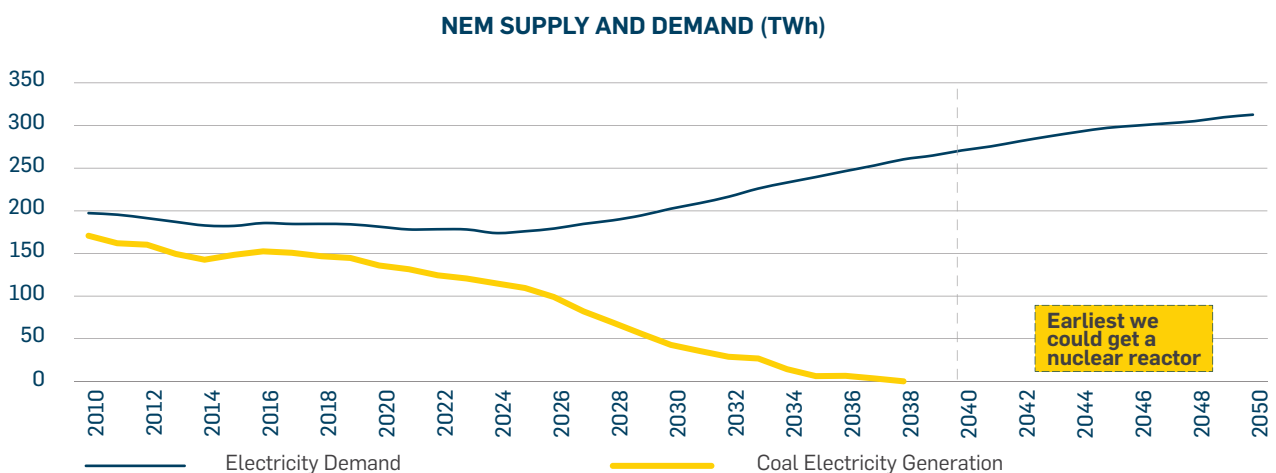


Figure 7: NEM supply and demand – AEMO. Integrated Systems Plan 2024.

27 AEMO. 2024 Integrated System Plan.
 28 CSIRO. GenCost 2023-24.
 29 U.S. Environmental Protection Agency. Plant Decommissioning, Remediation and Redevelopment.
 30 NSW Environment Protection Authority. Next steps for contaminated land at Lake Munmorah.
 31 Mycle Schneider Consulting. The World Nuclear Industry Status Report 2023.
 32 Industry, Innovation and Science. Not without your approval.

TIMELINE TO REPLACE A COAL-FIRED POWER STATION WITH A NUCLEAR REACTOR

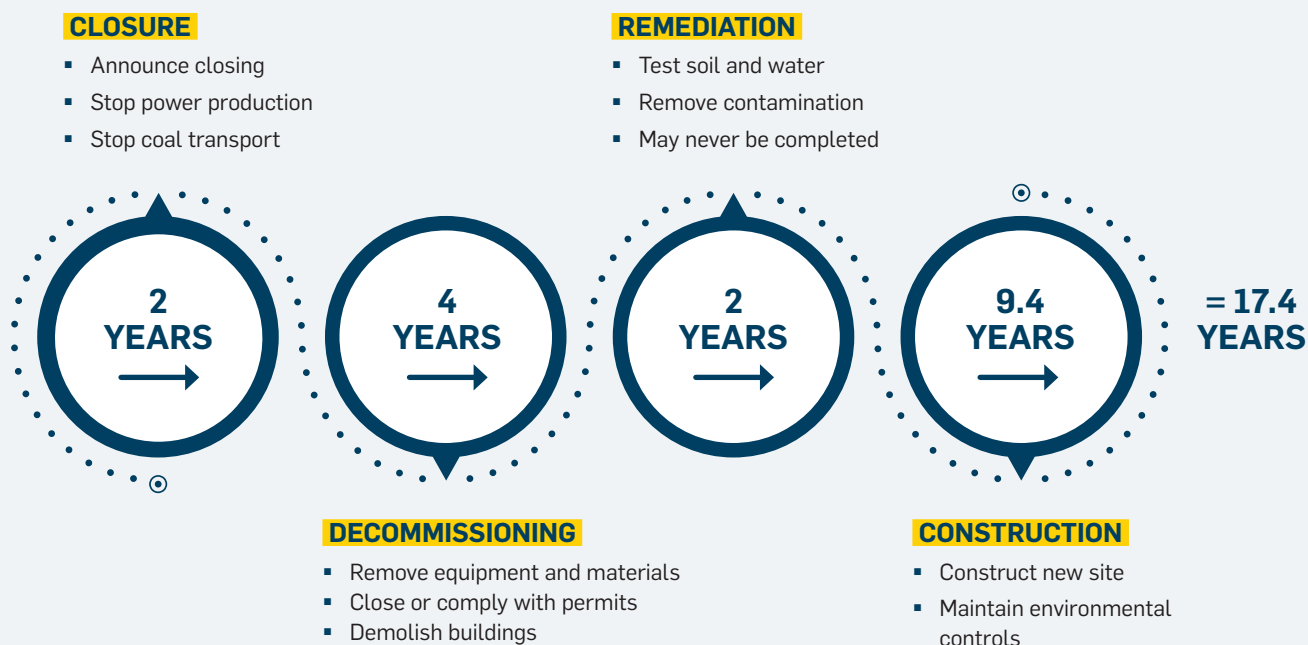


Figure 8: Time to replace a Coal-Fired Power Station with a Nuclear Reactor (based on Munmorah and Flinders Power Stations).

The above timetable does not take into account the time it takes to set up a regulatory environment and choose a model and provider. It is a best-case scenario if everything goes right and we know from international experience that it doesn't. In 2005, the Polish Government resolved to "immediately" build nuclear reactors with a view to have one online around 2020. It is now not projected to be completed until 2033, 28 years later.³³

Currently, Australian federal, state and territory laws prohibit the construction of nuclear reactors and there is neither a mandate, nor broad political support or consensus to change those laws.³⁴

If nuclear was somehow the answer to either network stability or emission reductions, by the time a nuclear generator was planned, built and brought online, consumers would likely experience at least 10 years of escalating blackouts and Australia would be many thousands of kilo tonnes over its emissions reduction targets.

33 World Nuclear Association. Nuclear Power in Poland.

34 Parliament of Australia. Current prohibitions on nuclear activities in Australia: a quick guide.

WILL NUCLEAR KILL JOBS?

Australian workers can't afford to lose the opportunity to create more secure, well-paid jobs in the already existing renewable sector by wasting time and money waiting nearly two decades for nuclear reactors which offer a fraction of the employment and may never even be built.

The average 1GW nuclear reactor needs approximately 3,500 jobs at the construction peak and approximately 400 direct jobs once its operating. However, because the regulation, building and development phases are riddled with so many problems, those jobs are not guaranteed. Even if they are built, we would not see the first nuclear reactor job until at least 2040.³⁵

Right now, ETU members are installing solar panels and EV charging equipment on houses, installing and maintaining new large scale solar and wind projects, building and commissioning big battery projects and building new transmission lines. By 2030 there will be more than 1.8 million people employed in renewable energy jobs, growing to over 2.2 million by 2050.³⁶

Solar, wind and battery projects are lining up across the country to create millions of jobs, particularly for electricians. There are currently 81 renewable energy projects under construction or due to start construction around Australia, which will provide 12,832MW of generation capacity.³⁷ Increasingly, these are being delivered under good union EBA's, though there is more work to do. The Federal Government's Capacity Investment Scheme, which sought to develop a pipeline of battery projects, received bids for 32 times more capacity than expected and is set to create new energy

jobs and deliver 32GW of new dispatchable energy storage capacity to be operational by 2027.³⁸

Including nuclear power in the electricity grid threatens these projects and jobs, because nuclear reactors' generation profile displaces renewables. Senior researcher and energy analyst at the University of NSW Dr Dylan McConnell explains that because nuclear power is so expensive and cannot be quickly switched off, the only way it could operate without making significant losses would be by "curtailing rooftop solar".³⁹ This would need to be achieved by restricting new solar installations and switching off existing panels.

We need certainty over Australia's energy policy to ensure there is a constant pipeline of renewable energy projects to deliver the clean, reliable and affordable energy which will reduce emissions and create millions of jobs. Our efforts need to be on improving the quality of these existing jobs. Australia can't afford to waste nearly two decades of policy uncertainty, foregoing jobs and energy projects right now, to accommodate a much smaller number of jobs that may never come. If they do, we will need to start from scratch on ensuring they are quality jobs.

35 Nuclear Energy Agency. Measuring Employment Generated by the Nuclear Power Sector.

36 Jobs and Skills Australia. The Clean Energy Generation Report.

37 Clean Energy Council. Project Tracker.

38 Renew Economy. Bowen says first battery storage tender is "massively oversubscribed" with 19,000 MW of projects.

39 Daniel Mercer. Is rooftop solar a fatal flaw in the Coalition's grand nuclear plans?

WHERE WILL WE STORE THE WASTE?

Nuclear reactors generate radioactive waste such as spent reactor fuel, reprocessing effluents, mill tailings, and contaminated tools and work clothing. It poses a direct threat to the environment and imposes a profound burden on future generations. Nuclear waste needs to be transported on public roads and may not break down for hundreds of millions of years.⁴⁰ Radioactive waste management is costly, complex, contested and unresolved, globally and in the current Australian context. Nuclear power cannot be considered a clean source of energy given its intractable legacy of nuclear waste.

Australia does not have a dedicated national radioactive waste facility and there is no plan for where to put the waste from a nuclear power industry.⁴¹

Nearly all of Australia's intermediate level waste is held where it was created at the Australian Nuclear Science and Technology Organisation's (ANSTO) Lucas Heights medical research facility in southern Sydney. This material is Australia's highest-level radioactive waste and is the most significant management challenge. Most of the low-level waste is at the Defence Department's Woomera site in South Australia.⁴²

The most recent location chosen by the previous Morrison Government to store radioactive waste generated by nuclear medicine technologies and radiation procedures was a site in Napandee, near Kimba in regional South Australia, but the majority of local residents and the region's Barngarla Traditional Owners opposed this plan.⁴³ This location has now been abandoned and no alternative has been proposed.

In addition to the challenge of storing radioactive waste is the challenge of transporting it safely. While Australia currently has a regulatory framework in place to deal with the transport of radioactive substances, it is in no way up to the task of dealing with the size, volume and complexities of the transportation that be needed if a nuclear power generation industry was introduced in Australia.

All radioactive waste will need to be transported from the reactor to the waste dump along public roads. This is dangerous and costly, with trucks exposed to accidents or even sabotage. In the US, in the eight years from 2005 to 2012, 72 incidents involving trucks carrying radioactive material on highways caused US\$2.4 million in damage and one death.⁴⁴

Nuclear waste storage facilities are also incredibly expensive, deliver little economic benefit other than a handful of security jobs and have an average cost blowout of 238%.⁴⁵

40 United States Environmental Protection Agency. Radioactive Waste.

41 Tim Brennan, Hunter Laidlaw. Radioactive waste management in Australia 2012–2022: a chronology.

42 Department of Industry, Innovation, and Science. Australian Radioactive Waste Management Framework.

43 Declan Gooch, Emma Pedler. Napandee chosen as nuclear waste storage site after 'six years of consultation'.

44 Nna M. Tinsley. Radioactive waste may soon travel on DFW highways.

45 Mycle Schneider Consulting. The World Nuclear Industry Status Report 2023.

DO WE STILL NEED BASELOAD POWER?

Existing nuclear reactors are highly centralised and inflexible generators of electricity. They lack capacity to respond to changes in demand and usage, are slow to deploy and not well suited to modern energy grids or markets.⁴⁶ Multiple organisations have now published extensive information on the challenges faced by the national electricity grid and baseload is not one of them.

The concept of baseload is a product of technical and economic design choices from the early to mid-1900s, engineering decisions based on technology, fuel sources and how society used energy at the time. Much of Australia's electricity network was historically designed to attach large volumes of inefficient load to the network to allow fossil fuel generators to run continuously at high outputs to achieve maximum plant efficiency so that they remain profitable.⁴⁷

The current levels of renewable deployment have already rendered the concept of baseload power redundant in some parts of the network, as identified in the August 2019 National Energy Emissions Audit released by The Australia Institute.⁴⁸

The already planned deployment of additional renewable energy, combined with increasing demand responsiveness from energy efficiency and smart appliances, will render the need for traditional baseload obsolete well before a nuclear plant could be constructed.

Australia is already nearly halfway through transitioning to a flexible and responsive energy system where the increasing challenge is maintaining system stability and grid inertia, not baseload. This challenge is being addressed by combining appropriate levels of intermittent generation sources that are adequately firmed through hydro, pumped hydro, battery storage and demand response solutions. South Australia and Tasmania now run from 100% renewable energy at regular intervals with excess generation being transmitted to Victoria.⁴⁹

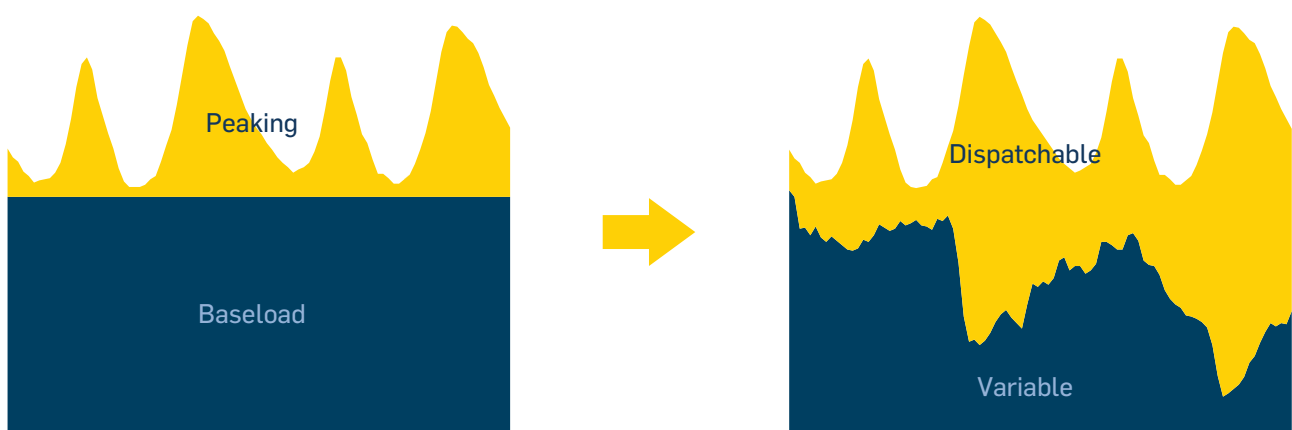


Figure 9: Macgill, I. (2024). Collaboration on Energy and Environmental Markets. University of NSW.

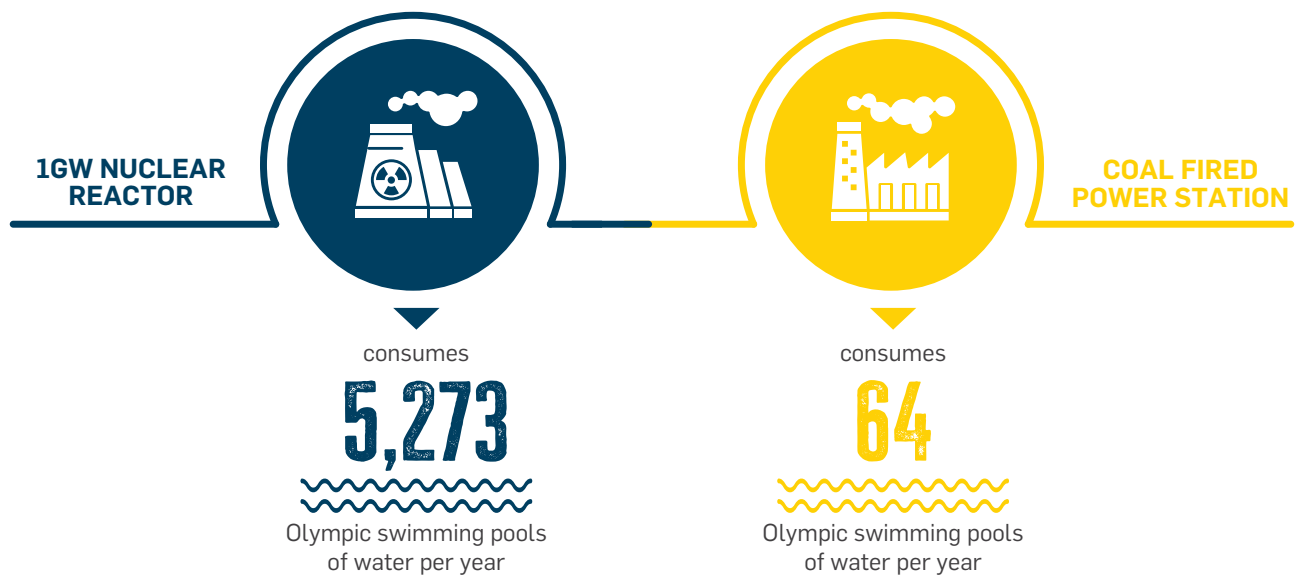
46 Friends of the Earth Australia, et al., Submission to the Senate Environment and Communications Legislation Committee.

47 Renew Economy. "Base load" power: a myth used to defend the fossil fuel industry.

48 The Australia Institute. National Energy Emissions Audit Electricity Update.

49 Australian Energy Regulator. State of the energy market 2023.

WHERE DO WE FIND THE WATER?



Australia is the driest inhabited continent on Earth and water is an important resource.⁵⁰ Nuclear reactors pose a challenge in this environment, as they consume large volumes of water, from uranium mining and processing through to reactor cooling. A 1GW nuclear reactor consumes an average of 5,273 Olympic swimming pools of water per year⁵¹, compared to the average of just 64 from a coal-fired power station.⁵²

On a planet experiencing more frequent heat waves, cool water can sometimes be difficult to get hold of – as Europe discovered when it experienced many days with temperatures of 40°C or more and the river water used to cool reactors in France and Germany was too warm to use.⁵³

Even if a location can be found for the necessary supply of cooling water, discharge temperatures from nuclear reactors presents additional challenges. On average the seawater-cooled Gladstone Power Station increases the water temperature at the outlet by 8.2°C.⁵⁴ This is compared to the average 14-15°C increase in seawater outlet temperatures to intake temperatures of the AP1000 nuclear reactor.⁵⁵ This additional warming of almost 6 degrees would have significant environmental impacts on recreational activities, fish stocks, biodiversity, and water life in the impacted discharge zones.

By choosing renewable energy sources, Australia has the opportunity to produce electricity without the need to burn huge volumes of water or materially impact water quality. In such a dry country, it is folly to continue to invest in unnecessary water-intensive industries.

⁵⁰ Department of Climate Change, Energy, the Environment and Water. Outback Australia - the rangelands.

⁵¹ Nuclear Monitor Issue. How much water does a nuclear power plant consume?

⁵² Mork Water. Water use by fossil fuels in the Australian power sector.

⁵³ Reuters. Hot weather cuts French, German nuclear power output.

⁵⁴ CSIRO. Macrobenthos of the cooling water discharge canal of the Gladstone Power Station, Queensland.

⁵⁵ Westinghouse Nuclear. Generic Assessment of the Impacts of Cooling Options for the Candidate.

IS NUCLEAR UNSAFE?

All human-made systems fail. When nuclear power fails, it does so on a massive scale.

The human, environmental and economic costs of nuclear accidents like Chernobyl and Fukushima have been massive and ongoing. By comparison, when a renewable energy generation site fails, remediation and repairs are usually a matter of hours or days, and following repairs, sites are immediately safe for humans to return to.

Decommissioning and cleaning up old reactors and nuclear sites, even in the absence of any accidents, is technically challenging, poses serious health risks and is very costly. Unexpected incidents have been reported during decommissioning, including releases of radioactive elements, at times dispersed by fires and floods. Exposure to radiation during equipment disassembly is a serious risk, since protective safety barriers are dismantled and a large amount of radioactive substances can migrate outside the confines of the units.⁵⁶

The UK has spent \$629 million storing decommissioned nuclear submarines while they try to figure out a safe way to dispose of them. The 27 submarines have sat in dry docks with the first unit entering dry dock in 1992.⁵⁷ According to the UK Government's most recent estimates, it will cost current and future generations of UK taxpayers £132 billion to decommission the UK's civil nuclear sites and the work will not be completed for another 120 years - with significant impacts on the lives of those who live near the sites.⁵⁸ Even this is a conservative estimate - the Guardian estimates it to be double this.⁵⁹

The issue of decommissioning nuclear reactor facilities is brought into stark contrast in the case of Trawsfynydd Nuclear Reactor, which closed in 1991 after just 26 years of operation. Attempting to decommission the facility safely involved a plan that would take almost 100 years to complete the task. Recently the UK Government announced it was exploring plans to instead repurpose the site with new reactors, but subsequently abandoned those plans based on cost and is resuming the long process of determining how to fully decommission the facility safely.⁶⁰

56 United Nations Environmental Programme. The Decommissioning of Nuclear Reactors and Related Environmental Consequences.

57 Naval Technology. UK to restart nuclear submarine reactor dismantling this year.

58 UK Parliament. "Sorry saga" of disused nuclear sites will cost generations of UK taxpayer.

59 Sandra Laville. UK's nuclear waste cleanup operation could cost £260bn. The Guardian.

60 BBC. Trawsfynydd: Nuclear reactors to go under new decommissioning plan.

Even in the most controlled and regulated environment of the Lucas Heights facility in New South Wales, as recently as June 2019 workers were exposed to radiation above the statutory limits.⁶¹ An independent review of the Lucas Heights facility in October 2018 found it failed modern nuclear safety standards and should be replaced.⁶² Ranger uranium mine, now closed, was marred by a culture of underreporting, secrecy and safety incidents.⁶³

Globally, governments have recognised the importance of taking precautionary measures to protect citizens adjacent to nuclear reactors. New York State holds a public policy for its people, especially those who live within ten miles of a nuclear reactor, who may be exposed to radiation from a nuclear plant emergency. As part of community safety precautions, people are issued with drugs to help protect them from thyroid cancer. This drug is called potassium iodide (KI).⁶⁴

Further risks include to homes and businesses located in the vicinity of nuclear reactors, or along the transport corridors for nuclear waste, which would not be insured in the event of an emergency. QBE Insurance holds the largest market share of insurance in Australia. QBE's home and contents product disclosure statement, like all insurers in Australia, specifically excludes insurance coverage for events involving nuclear energy.⁶⁵

Under the general exclusions, QBE's policy states:

“[QBE Insurance excludes] the use, existence or escape of nuclear fuel, waste, radiation or material, or nuclear fission or fusion”.

The consequences of inevitable safety breaches are extreme. Australia's emergency services personnel are neither trained nor equipped to deal with this kind of potential emergency. Nor have they been asked if they would be prepared to put themselves in harm's way to this extreme level of risk should an incident occur.

61 Bellinda Kontominas. Lucas Heights nuclear medicine production halts after workers exposed to unsafe radiation. Australian Broadcasting Corporation.

62 David Jones, et al. Independent Safety Review of the Ansto Health Approach to Occupational Radiation Safety and Operational Procedures. Australian Nuclear Science and Technology Organisation.

63 WISE Uranium Project. Issues at Operating Uranium Mines and Mills - Ranger, Australia.

64 New York State. Potassium Iodide (KI) and Radiation Emergencies: Fact Sheet.

65 QBE Insurance. QBE Home Insurance Product Disclosure Statement (PDS) QM8697-1020.

DOES NUCLEAR MAKE US A TARGET?

Nuclear power plants have been described as “pre-deployed terrorist targets” and pose a major security risk.⁶⁶ This in turn would likely see an increase in policing and security operations and costs and a commensurate impact on civil liberties and public access to information. A 2004 Congressional Budget Office paper⁶⁷ estimated that:

“The human, environmental and economic costs from a successful attack on the nuclear power industry could far exceed the value of the nuclear plants themselves”.

Security measures adopted by other nations with nuclear power generation incorporate utilisation of significant military resources, a further cost and domestic consideration which is not currently factored into Australian electricity prices or energy plans.

WILL PEOPLE AND LAND BE DISPLACED?

The nuclear industry has a history of adverse impacts on Aboriginal communities, lands and waters. This began in the 1950s with British atomic testing and continues today with uranium mining and proposed nuclear waste dumps.⁶⁸ These problems would be magnified if Australia ever advanced domestic nuclear power.

- Indigenous elder Aunty Jannine Smith has vowed to fight plans to build a nuclear power plant on her country at Tarong Power Station, warning the development would be a “death sentence” for her connection to country.⁶⁹
- Adnyamathanha elder Vince Coulthard said plans to build a nuclear reactor at Port Augusta were “crazy and illogical”.⁷⁰

Nuclear waste also presents a serious concern for Australia’s agricultural sector. In addition to the issues associated with water consumption outlined earlier in this report and geological stability required for nuclear waste facilities means they will almost certainly be situated on prime agricultural land. Further, any leakage or emergency in a waste facility runs the risk of contaminating ground water and aquifers.

66 Dave Sweeney. Thirty-eight years on, lessons from Chernobyl. Australian Conservation Foundation.

67 Congressional Budget Office. Homeland Security and the Private Sector.

68 National Archives of Australia. British nuclear tests at Maralinga.

69 AAP. Nuclear policy a ‘death sentence’ for Indigenous land. Michael West Media.

70 Viki Ntafillis and Annabel Francis. Coalition’s nuclear power plant proposal draws mixed opinions from Port Augusta community. Australian Broadcasting Corporation.

DO SMALL MODULAR REACTORS EXIST?

Small Modular Reactors (SMRs) are not in commercial production or use, and remain unproven and uncertain.⁷¹ There are only two SMR prototypes in the world that are currently operating, one in Russia and one in China. These reactors do not technically meet the definition of 'modular' as the components were not made using serial factory production (as opposed to the usual practice of construction being concentrated at the reactor site).

- The electricity produced by Russia's floating nuclear power plant costs US\$200/MWh (AUD \$302).⁷² To put that in perspective, the Minerals Council of Australia states that SMRs won't find a market unless they can produce power at a cost of AUD \$60-80/MWh, about one-quarter of the cost of electricity produced by the Russian plant.⁷³
- China's demonstration HTGR cost US\$6,000/kW (AUD \$9,060),⁷⁴ three times higher than a 2009 cost estimate from Tsinghua University researchers, and two to three times higher than the cost-per-kW of China's conventional Hualong reactors.⁷⁵

Commenced in 2015, with a delivery date of 2030, the Carbon Free Power Project is the only SMR to have received design certification in the US.⁷⁶ Last year construction was abandoned following a cost blowout of 56%.⁷⁷

Energy produced by SMRs is forecast to be vastly more expensive than energy produced through any other means, with the CSIRO estimating that it would cost \$28,581 per kilowatt.⁷⁸ This is nearly eighteen times more expensive than energy produced by large-scale solar, and more than double that of energy produced by coal - that is, assuming Small Modular Reactors ever become commercially viable in the first place.

Small Modular Reactors (SMRs)
are not in commercial production or use
and remain unproven and uncertain.

71 Energy Monitor. Small modular reactors: What is taking so long?

72 Nuclear Energy Agency. Small Modular Reactors: Nuclear Energy Market Potential for Near-term Deployment.

73 Inquiry Into Nuclear Prohibition. Legislative Council Environment and Planning Committee.

74 World Nuclear Association. Nuclear Power in China.

75 Zhang. Current status and technical description of Chinese 2 × 250 MW th HTR-PM demonstration plant.

76 Office of Nuclear Energy. NRC Certifies First U.S. Small Modular Reactor Design.

77 Timothy Gardner, Manas Mishra. NuScale ends Utah project, in blow to US nuclear power ambitions. Reuters.

78 CSIRO. GenCost 2023-24.

CONCLUSION

Australia has a natural abundance of renewable energy solutions and extensive opportunities for both intermittent energy resources and for firming capacity. They are all available to us now and at a much lower cost and risk than nuclear reactors.

A study by the Australian National University (ANU) included the completion of an audit of 22,000 potential sites across Australia for hydroelectricity opportunities, which can be used to support a secure and cheap national electricity grid with 100 per cent renewable energy.⁷⁹ Battery technology advancements are delivering cheaper and faster solutions for storing energy, ready to be deployed at scale during periods of low output from variable renewable sources.

Further evidence of the opportunities presented by renewable energy is demonstrated by the extensive development proposals in place to build renewable energy projects in Australia, including projects to export clean energy offshore such as the Asian Renewable Energy Hub project in Western Australia.⁸⁰

As this report demonstrates, Australia has much cheaper, faster and safer options available to it. Our nation has extensive renewable energy options and resources and Australians have shown clear support for increased use of renewable and lower emissions energy sources. The changing dynamic of our energy systems and the deployment of battery and other storage technologies means the role of baseload

power will soon be rendered obsolete. Pursuing public investment in high emissions, inefficient, costly and higher risk energy sources designed for an energy system of the past would be reckless and irresponsible in the circumstances.

The transition to low emissions, safer, renewable energy could re-power the national economy. The development and commercialisation of manufacturing and infrastructure and new energy thinking would provide skills and sustainable employment opportunities, particularly in regional Australia. There is no debate that this energy transition is already occurring, however choices and decisions are needed on how to make sure the transition serves the interests of workers, their communities and the broader Australian community.

Across the 70+ years that the ETU has regularly revisited the prospect of nuclear in Australia, the case for nuclear has become weaker, not stronger. Individually, each matter set out in this paper may not on its own lead to ruling out nuclear entirely, however, taken together, the collective conclusion is obvious that there is no future for nuclear in Australia.

⁷⁹ Australian National University. ANU finds 22,000 potential pumped hydro sites in Australia.

⁸⁰ The Asian Renewable Energy Hub.

ABOUT THE ETU

The ETU is one of Australia's largest trade unions, with more than 70,000 members who are electricians, apprentices and electrical workers. Our members are involved in the construction, operation, and maintenance of power generation throughout Australia, including in the fossil fuel sectors and the ever-expanding renewable industry sector.

The Electrical Trades Union has a long history of opposing the nuclear power industry.

The ETU's official policy against the nuclear industry dates back to the 1950s, resulting from the shared experiences of ETU members who returned from Japan after World War II. In the decades since, our Union has regularly revisited this policy to learn more about the nuclear fuel cycle, changes and advances to technologies, technical interaction with the network and economic viability. We are also deeply concerned about the effect of the nuclear industry on First Nations People and the environment.

At the ETU national conference in 2019, over 350 delegates and members debated and reaffirmed the Union's policy of opposition to nuclear energy.

As a union representing workers in all energy industries, we have a responsibility to speak out on energy issues. Our position is clear: nuclear power is not a solution to our energy needs: it's a waste of time, a waste of money and it lays waste to jobs. All while leaving us with the huge problem of what to do with radioactive waste.

For more information, visit www.nofuture4nuclear.org

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