

Should Australia use nuclear power to reduce its greenhouse gas emissions?

'No country can run effectively on solar, wind and batteries alone'
Peter Dutton, leader of the federal Opposition

'The Coalition's plan to pause new renewable investment...will result in massive supply shortages over the next decade'
Chris Bowen, Minister for Climate Change and Energy

On September 23, 2024, the leader of the federal Opposition, Peter Dutton, gave a speech to the Committee for Economic Development of Australia. He reiterated the Coalition's position that, as it moves away from coal and gas, Australia needs to include nuclear power to 'firm up' renewables in its energy mix. <https://tinyurl.com/34xmjfh>

The Coalition is planning to build seven nuclear reactors on the sites of current or former coal-fired power stations. <https://www.liberal.org.au/latest-news/2024/06/19/australias-energy-future>

The Coalition's proposal has been condemned by the government, many climate scientists, and others as prohibitively expensive, unachievable within the necessary timeframe and a destructive diversion from renewables. <https://tinyurl.com/5brvzmx>

Background

Nuclear power in Australia <https://tinyurl.com/3ec94vzn>

Australia has one nuclear reactor at Lucas Heights, New South Wales, which is used only to produce radiotherapy for nuclear medicine and does not produce electricity.

Uranium mining in Australia <https://tinyurl.com/4hyaapcd>

Australia has 33 percent of the world's proven uranium deposits and is currently the world's third largest producer of uranium after Kazakhstan and Canada. As of 2018 there are three active Australian uranium mines – Ranger in Northern Territory, Olympic Dam in South Australia, and Beverley with Four Mile in South Australia.

Federal laws prohibiting nuclear power <https://www.energycouncil.com.au/analysis/nuclear-power-for-australia-a-potted-history/>

Nuclear power is prohibited in Australia, principally by two pieces of Federal legislation. These are the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act); and the Australian Radiation Protection and Nuclear Safety Act 1998 (ARPANS Act). These laws effectively prevent the construction or operation of nuclear facilities for power generation, as well as facilities for the fabrication of nuclear fuel, uranium enrichment and the reprocessing of nuclear waste.

State restrictions on nuclear power and the transport of nuclear materials

<https://www.corrs.com.au/insights/legal-and-social-licence-considerations-for-nuclear-energy-in-australia>

Three Australian states have legislation prohibiting nuclear power stations. The Activities (Prohibition) Act 1983 (Vic), the Nuclear Facilities Prohibition Act 2000 (Qld) and the Uranium Mining and Nuclear Facilities (Prohibitions) Act 1986 (NSW) would prevent the

construction or operation of a nuclear energy plant in Victoria, New South Wales, or Queensland.

Under the Queensland legislation (section 21), if the relevant Minister is satisfied that the government of the Commonwealth has taken, or is likely to, take any step supporting or allowing the construction of a prohibited nuclear facility in Queensland, the Minister must take steps to conduct a plebiscite in Queensland. This would obtain the people's views about the construction of a prohibited nuclear facility in Queensland.

In addition, while the mining of uranium is permitted in South Australia, conversion and enrichment activities are prohibited under the Radiation Protection and Control Act 2021 (SA).

State and territory laws also provide for the regulation of the transport of nuclear fuel or waste. Additional permits or approvals may be required for transporting nuclear fuel and waste, and for the disposal of nuclear waste. Some states and territories have imposed express bans on the transportation of nuclear waste, including the Northern Territory, South Australia, and Western Australia.

Any federal government seeking to establish nuclear power plants in states and territories with the above laws would need to co-ordinate new Commonwealth and state and territory legislation to implement the broad range of powers and functions required to deliver a nuclear program over the long-term, and possibly also modify local government laws.

Renewable energy as a power source in Australia <https://tinyurl.com/ywsh8e9e>
In 2023, 35 percent of Australia's total electricity generation was from renewable energy sources, including solar (16 percent), wind (12 percent) and hydro (6 percent). The share of renewables in total electricity generation in 2023 was the highest on record, a share of 1 percent higher than the earlier 2022-23 financial year. The previous peak of renewables share of total generation was 26 percent in the mid-1960s as the Snowy Mountains hydroelectric scheme came progressively online.

Solar and wind have been the primary drivers in more than doubling renewable generation expansion over the last decade. Small-scale solar generation grew 17 percent in 2023, and by an average of 21 percent per year since 2015. Wind generation grew 6 percent in 2023 and by an average of 13 percent per year since 2015. Hydro power output has fluctuated around a consistent level according to rainfall and market conditions, losing predominance as generation sources diversified.

Recently, large-scale solar generation has begun rapid expansion. Large-scale solar generation has grown from negligible levels before 2016 to 6 percent of all Australian electricity generation in 2023, representing a growth rate of 2,777 percent from 2016.

Internet information

On September 28, 2024, The Australian published an opinion piece by columnist Chris Uhlmann titled 'Will it take an energy crisis before we act?'

The comment criticises claims made by the federal Climate Change and Energy Minister, Chris Bowen and defends the Opposition's nuclear proposal.

<https://www.theaustralian.com.au/commentary/will-it-take-an-energy-crisis-before-we-act/news-story/8030f236ba019ba355efe805b21abf45>

On September 28, 2024, The Saturday Paper published an article titled “‘Just a bloody mess’: The Coalition confronts the energy market’

The report includes interviews with Coalition backbenchers presenting views from within the parties on their new policy position.

The full text can be accessed at

<https://www.thesaturdaypaper.com.au/news/politics/2024/09/28/just-bloody-mess-the-coalition-confronts-the-energy-market#mtr>

On September 27, 2024, the Australian Independent Media Network published a comment titled ‘Nuclear Concerns – Hiroshima, Maralinga and Dutton’s Australia’

The point of view piece gives an historical background to Australia’s concerns about nuclear development and criticises nuclear power plants based on their being too, slow, too expensive, unnecessary and unsafe.

The full text can be accessed at <https://theaimn.com/nuclear-concerns-hiroshima-maralinga-and-duttons-australia/>

On September 26, 2024, former Coalition Treasurer Joe Hockey addressed the National Press Club arguing that the power demands of AI would require Australia to adopt nuclear power generation.

Hockey cited recent developments in the United States in support of his claim.

The full text can be accessed at <https://www.townsvillebulletin.com.au/news/breaking-news/former-treasurer-joe-hockey-says-small-nuclear-reactors-are-coming/news-story/815012900ef085aa465c03ad35169987>

On September 26, 2024, the Institute for Energy, Economics and Financial Analysis released a report criticising the Coalition’s nuclear reactor plan for Australia.

The Institute stated, ‘Recent nuclear projects in economies comparable to Australia faced significant cost overruns and delays with multi-billion-dollar consequences. All projects commencing construction in the past 20 years in comparable economies experienced major budget blowouts ... and construction delays of many years.’

The full text can be accessed at <https://ieefa.org/resources/nuclear-proposal-will-increase-power-bills>

On September 25, 2024, The Conversation published a comment and analysis by Alison Reeve titled ‘Peter Dutton’s nuclear plan would mean at least 12 more years of coal’.

The article explains why the Coalition’s nuclear proposal would delay transition to renewables and rely on extended use of fossil fuels. Reeve is Deputy the Program Director, Energy and Climate Change, at the Grattan Institute.

The full text can be accessed at <https://theconversation.com/duttons-nuclear-plan-would-mean-propping-up-coal-for-at-least-12-more-years-and-we-dont-know-what-it-would-cost-239720>

On September 25, 2024, Sky News commentator Chris Kenny interviewed Opposition leader Peter Dutton.

The closing two thirds of the interview deals with criticisms of the government’s renewables policy and a defence of the Opposition’s position on nuclear power.

The full transcript can be accessed at <https://www.peterdutton.com.au/leader-of-the-opposition-transcript-interview-with-chris-kenny-sky-news-2/>

On September 24, 2024, The Hobart Mercury published an article by Clare Armstrong titled ‘Coalition says Labor is “isolated” on nuclear energy plan as major US banks announce plans to back tripling of global output’

The piece argues that the Australian government’s renewables policy is out of step with the decisions being taken by the US banks.

The full text can be accessed at <https://www.themercury.com.au/news/national/coalition-says-labor-is-isolated-on-nuclear-energy-plan-as-major-us-banks-announce-plans-to-back-tripling-of-global-output/news-story/970f2f93d04196d088b07fa125b8f56c>

On September 23, 2024, the leader of the federal Opposition, Peter Dutton, gave a speech to the Committee for Economic Development of Australia outline the Coalition’s proposals for the development of nuclear power in Australia.

The full text of the speech can be accessed at <https://www.peterdutton.com.au/leader-of-the-opposition-speech-to-the-committee-for-economic-development-australia-ceda-sydney-check-against-delivery/>

On September 22, 2024, The Australia Institute published an opinion piece by Matt Saunders titled ‘We don’t need nuclear power – the path to cheaper electricity is renewables’

The comment explains in detail the different how the price of electricity is set and demonstrates that renewable energy is the cheapest power source available.

The full text can be accessed at <https://australiainstitute.org.au/post/we-dont-need-nuclear-power-the-path-to-cheaper-electricity-is-renewables/>

On September 20, 2024, the federal Minister for Climate Change and Energy, Chris Bowen, issued a media release in which he presented a detailed criticism of the Coalition’s nuclear reactor proposals. He condemned the plan in terms of cost, feasibility and as a distraction from the completion of the country’s renewables network.

The full text can be accessed at <https://minister.dcceew.gov.au/bowen/transcripts/press-conference-fairfield-west-sydney-0>

On September 20, 2024, Australian Manufacturing News published a report based on a study just completed by Institute for Energy Economics and Financial Analysis which claims that the cost of household electricity would rise between 1.5 and 3.8 times if the Coalition’s nuclear proposal were adopted.

The full text can be accessed at <https://www.aumanufacturing.com.au/nuclear-electricity-1-5-to-3-8-times-more-expensive-study>

On September 18, 2024, The Australian Mining Review published a comment and analysis by Kathleen Southway titled ‘How long does it take to build a nuclear reactor in Australia?’

The article cites Dr Adi Paterson, former chief executive for ANSTO (Australia’s Nuclear Science and Technology Organisation) who claims that Australia could have a nuclear reactor built and operational within 12 years.

The full text can be accessed at <https://australianminingreview.com.au/news/how-long-does-it-take-to-build-a-nuclear-reactor-in-australia/>

On September 17, 2024, the Smart Energy Council released the results of an analysis which claims that the inflexibility of nuclear power means it would displace the power supplied by some three million solar rooftop suppliers. It is claimed this would dramatically increase power costs for domestic consumers.

The full text can be accessed at <https://smartenergy.org.au/articles/coalitions-nuclear-plan-to-switch-off-solar-for-up-to-3-million-homes/>

On September 5, 2024, the CSIRO released its 2023-4 GenCost report detailing the costs and benefits associated with the current policies and proposals regarding electricity generation in Australia.

CSIRO found the cost per megawatt hour for nuclear would be roughly the same as coal and gas, but even at its cheapest would cost more than solar and wind power, at roughly \$155 per MWh compared to \$134 for solar power. Commercially unproven small modular reactors were estimated to be even more expensive, costing at least \$387 per MWh.

<https://www.csiro.au/en/research/technology-space/energy/gencost>

On September 3, 2024, John Menadue's Public Policy Journal 'Pearls and Irritations' published a comment by emeritus Professor Joseph G Davis titled 'Achieving net-zero: is nuclear the answer?' The comment argues why nuclear energy is not a solution to either Australia or the world's greenhouse gas emission problems.

The full text can be accessed at <https://johnmenadue.com/achieving-net-zero-is-nuclear-the-answer/>

On July 3, 2024, IEEE Spectrum published an analysis titled 'Australia Debates Going Nuclear'. The piece supplies background on the issue and an overview of some of the arguments for and against the use of nuclear power in Australia.

The full text can be accessed at <https://spectrum.ieee.org/nuclear-power-in-australia>

On June 21, 2024, Renew Economy published a comment by Giles Parkinson titled 'Dutton's plan to nuke Australia's renewable energy transition explained in full'

The opinion piece of the Opposition's proposal and gives information about each and arguments against them.

The full text can be accessed at https://reneweconomy.com.au/duttons-plan-to-nuke-australias-renewable-energy-transition-explained-in-full/#google_vignette

On June 19, 2024, the leader of the federal Opposition, Peter Dutton issued a media release detailing the Coalition's plan to build seven nuclear reactors on the sites of disused coal-fired power plants across in five Australian states.

The full text can be accessed at <https://www.peterdutton.com.au/dutton-littleproud-obrien-media-release-australias-energy-future/>

On June 19, 2024, The Australian Science News Media Centre released a report titled 'EXPERT REACTION: Proposed nuclear power plants'

The article cites the views of several scientists giving differing opinions on whether Australia should use nuclear power to generate electricity.

The full text can be accessed at <https://www.scimex.org/newsfeed/expert-reaction-proposed-nuclear-power-plants>

Arguments in favour of Australia generating nuclear power

1. Nuclear energy production will help Australia reduce its carbon emissions

Those who support Australia generating nuclear power argue that this is a clean, non-CO₂-emitting energy source that would help Australia meet its greenhouse gas emission targets.

They claim it is an important way for Australia to contribute to global efforts to limit climate change. They argue that Australia will be unable to meet its 2030 emissions target relying on renewable energy and that it will need nuclear power to meet its 2050 target of zero carbon emissions.

Supporters of nuclear power as a means of combating climate change argue that it has lower greenhouse gas emissions than either wind or solar power. In a Parliamentary submission made on August 10, 2022, the lobby group Nuclear for Climate Australia stated, 'Nuclear energy has lower emissions than any other generating source including wind and solar. Current nuclear plants have emissions as low as 4 gr CO₂/kWh. Wind is typically around 30 gr CO₂/kWh but, with the addition of material's hungry batteries, emissions climb to 110 gr CO₂/kWh. Solar is similarly afflicted with emissions intensities up around 70 gr CO₂/kWh inclusive of batteries even in ideal conditions.' <https://tinyurl.com/3m44v58k> The World Nuclear Association has also argued that making the transition from fossil fuels to wind and solar is not enough to reduce greenhouse gas emissions to the level the world requires. Though its figures do not exactly replicate those offered by Nuclear for Climate Australia, the World Nuclear Association similarly claims that nuclear power is either more or equally as effective as wind and solar in reducing emissions. The Association states, 'Nuclear power plants produce no greenhouse gas emissions during operation, and over the course of its life cycle, nuclear produces about the same amount of carbon dioxide-equivalent emissions per unit of electricity as wind, and one-third of the emissions per unit of electricity when compared with solar.' The Association has further stated, 'Concerted international efforts over the past 20 years have increased the amount of electricity generated by wind, solar and other renewable sources, but have failed to displace fossil fuels from the mix. As a matter of fact, in 2017, fossil fuels produced more electricity – in relative and absolute terms – than ever before.' The Association has further stated, 'Experts have concluded that in order to achieve the deep decarbonization required to keep the average rise in global temperatures to below 1.5°C, combating climate change would be much harder, without an increased role for nuclear.' <https://world-nuclear.org/nuclear-essentials/how-can-nuclear-combat-climate-change>

The Liberal Opposition believe that Australia cannot achieve its 2030 emissions targets and that attempting to do so will damage the Australian economy. If elected, the Opposition leader, Peter Dutton, plans to adjust Australia's climate policy. A government he led would step away from Australia's 2030 emissions target and away from the Albanese government's reliance on wind and solar as their primary means of achieving the country's emissions targets. Instead, a Dutton government would pledge to continue using gas as a bridging power source and keep coal power stations operational until they had been fully replaced. Mr Dutton also plans to substantially incorporate nuclear power into Australia's energy mix. He claims that the current 43 percent reduction in emissions is unachievable by 2030. He further argues that the 2050 zero emissions target cannot be reached unless nuclear power becomes one of Australia's energy sources. <https://www.abc.net.au/news/2024-06-08/coalition-to-dump-paris-emissions-target-focus-nuclear/103955342> In a media release issued on June 19, 2024, Peter Dutton stated, 'Nuclear energy for Australia is an idea whose time has come. Today, we are announcing that a future Federal Coalition Government will introduce zero-emissions nuclear energy in Australia, which has proven to get electricity prices and emissions down all over the world, to work in partnership with renewable energy and gas as part of a balanced energy mix.' Explaining why nuclear power was necessary, he stated, 'If you are serious about meeting our net zero by 2050 emissions commitments, then you must include zero-emission nuclear as part of your energy mix. Zero-emission nuclear power plants produce no

air pollution or carbon emissions. For example, a 1.1 GW AP-1000 reactor cuts approximately seven million metric tonnes of CO₂ emissions, equivalent to removing 1.5 million cars from the road. <https://www.peterdutton.com.au/dutton-littleproud-obrien-media-release-australias-energy-future/>

Supporters of Australia using nuclear energy to help reduce Australia's greenhouse gas emissions argue that nations all around the world are relying on a combination of renewable energies and nuclear power to replace fossil fuels. In his June 19, 2024, media release, Mr Dutton stated, 'No country in the world relies solely on solar and wind as Labor is proposing. By contrast, there are 32 countries operating zero-emissions nuclear plants. Another 50 countries are looking to do so. Of the world's 20 largest economies, Australia is the only one not using nuclear energy, or moving towards using it.'

<https://www.peterdutton.com.au/dutton-littleproud-obrien-media-release-australias-energy-future/> The World Nuclear Association also claims that around the world nuclear power is becoming a viable clean energy option. The Association states, 'Nuclear energy now provides about 9 percent of the world's electricity from about 440 power reactors. Nuclear provides about one-quarter of the world's low-carbon electricity. Nuclear is the world's second largest source of low-carbon power.' The most recent world data the Association provides maintains, 'Fourteen countries in 2023 produced at least one-quarter of their electricity from nuclear. France gets up to around 70 percent of its electricity from nuclear energy, while Ukraine, Slovakia and Hungary get about half from nuclear. Japan was used to relying on nuclear power for more than one-quarter of its electricity and is expected to return to somewhere near that level.' <https://world-nuclear.org/information-library/current-and-future-generation/nuclear-power-in-the-world-today>

2. Renewable energy sources have limitations that make them unsuitable as a sole source of power

Those who argue that Australia should include nuclear power in its energy mix claim that wind and solar power have limitations which make them unsuited to being Australia's sole sources of energy. They claim that drawing on nuclear power to supplement renewables would stabilise Australia's energy supply.

Opponents of the exclusive use of renewable power sources argue that they have significant limitations. They claim their reliability fluctuates as they are dependent on wind and sunlight which are not constants and cannot be dependably predicted. There is also the problem that their best collection points (such as coastal regions in the case of wind power) are not always located where power demand is greatest. The World Nuclear Association has summarised these concerns. The Association has stated, 'First, [renewable power sources'] maximum output fluctuates according to the real-time availability of wind and sunlight. Second, such fluctuations can be predicted accurately only a few hours to days in advance...[Finally] unlike fossil or nuclear fuels, wind and sunlight cannot be transported, and while renewable energy resources are available in many areas, the best resources are frequently located at a distance from load centres thus, in some cases, increasing connection costs.' <https://world-nuclear.org/information-library/energy-and-the-environment/renewable-energy-and-electricity> The Association has used the availability of wind power in Germany as an example of its apparent unreliability. It has stated, 'In Germany, with high dependence on wind, there is corresponding high uncertainty of supply. Winter load factors averaged about 25 percent over 2013-17.... Summer monthly load factors averaged only 14 percent... Annual capacity factors were 17-20 percent over 2014-16. Daily average wind load factors have

ranged from 2 percent to 68 percent.’ <https://world-nuclear.org/information-library/energy-and-the-environment/renewable-energy-and-electricity>

Supporters of nuclear energy production in Australia argue that it would provide the additional power necessary to meet baseload consumer demand which cannot be reliably supplied by variable power sources such as wind and solar. Dr Jeremy (Jing) Qiu, a Senior Lecturer in Electrical Engineering in the School of Electrical and Computer Engineering at the University of Sydney, has stated, ‘Nuclear power offers a reliable, base-load energy option, complementing intermittent renewables and reducing reliance on fossil fuels. By strategically locating these plants, we can ensure a robust and resilient energy infrastructure, less vulnerable to supply disruptions.’ <https://www.openforum.com.au/what-the-experts-say-on-nuclear-power/>

Critics of the exclusive use of variable renewable energy (VRE) argue that its reliability is dependent on suitable storage systems, such as batteries, which allow fluctuating power sources to supply energy stored in advance of demand. Critics claim that suitable storage systems are either not yet available or are prohibitively expensive. The global technology distributor AVNET has claimed, ‘A battery array large enough to store the energy from a solar or wind farm could cost more than the solar panels or windmills themselves. And that is not a one-time cost, as batteries have a brief service life and require...frequent replacement. The situation from an environmental perspective is even worse. Most modern battery types require heavy metals and other toxic materials. Not only are elements like cadmium and lithium finite resources, just like fossil fuels, but they also pose a significant risk to the environment—both during the mining process and after use.’ <https://tinyurl.com/5ssyc4uv>

Some critics have stressed that renewable energy production is not environmentally neutral and can have major negative impacts both through battery construction/disposal and through the building of windfarms and solar cell arrays. Chris Moorman, a professor and coordinator of the Fisheries, Wildlife and Conservation Biology program at North Carolina State’s College of Natural Resources, has warned, ‘Renewable energy often requires more land than fossil fuel production, with infrastructure fragmenting or even eliminating high-quality wildlife habitat.’ <https://cnr.ncsu.edu/news/2019/11/renewable-energy-wildlife-conservation/>

Critics of the exclusive use of renewable power sources such as wind and solar have also argued that these energy sources have additional costs that are not always considered. These additional costs, it is claimed, reduce their supposed cost advantage over nuclear power. The British technology energy company EDNOLA has claimed that there are significant costs associated with adding a fluctuating energy source such as wind power to a national grid. EDNOLA claimed that in Britain these costs have risen fourfold between 2020 and 2022. <https://enodatech.com/news-insight/the-hidden-costs-of-delivered-renewable-energy> The Centre for Independent Studies in Australia has argued that an undeclared carbon tax is being proposed to help fund the establishment of renewable energy networks in Australia. An editorial published in The Australian on May 9, 2024, has claimed, that this carbon price ‘could result in an estimated maximum of \$508bn being passed on to consumers through electricity bills.’ The editorial concludes, ‘In the long term, nuclear energy built efficiently at scale and allowed to recoup the upfront investment across many years may be the most economical of all generation sources.’ <https://www.theaustralian.com.au/commentary/editorials/telling-the-truth-on-renewables/news-story/57d4cd34328706b220b5eabac8c7e4c9>

3. Australia has abundant uranium supplies and an appropriate potential workforce Those who support Australia developing a nuclear energy industry claim that it is foolish not to do so as the country has extensive supplies of uranium. They also note that Australia would be able to supply a suitable workforce to produce nuclear energy.

Uranium is the raw material used to produce nuclear energy. As of December 31, 2021, Australia had the world's largest Economic Demonstrated Resources (EDR) of uranium and was the world's fourth largest exporter of uranium, behind Kazakhstan, Namibia and Canada. <https://tinyurl.com/5fkw5447> EDR refers to resources which can be extracted in a profitable manner. <https://tinyurl.com/3fzzwurd> Currently, none of the uranium that Australia mines is used for local power production. The leader of the federal Opposition, Peter Dutton, has argued that Australia is wasting a valuable opportunity to increase its energy security by not using any of the country's abundant uranium resources to produce electricity. He has suggested that Australia should increase its uranium production to boost exports and for electricity generation in Australia. Mr Dutton has argued, 'At present, Australia supplies just under 10 per cent of global demand, with all our production exported. So aside from a burgeoning export opportunity, our nation has an ability to be energy self-sufficient well into the future.' <https://www.afr.com/politics/federal/australia-must-join-nuclear-renaissance-dutton-20230706-p5dmap> The Minerals Council of Australia has supported the use of Australian uranium to produce electricity within Australia since at least 2019, stating, 'In Australia outdated regulations in some states ban the exploration and mining of uranium, and under federal law nuclear energy is prohibited. The result is that Australians are denied a zero emissions 24/7 energy source ... So, Australia has a clear choice – it can reconsider the role nuclear energy can play in a low carbon future and remove the obstacles prohibiting the development of a nuclear industry.' https://minerals.org.au/wp-content/uploads/2022/12/Untapped-Potential-The-case-for-nuclear-energy_2020.pdf

Australia has remained ethically aware in its export of uranium, being careful not to support the use of its uranium to create nuclear weapons. Australia's uranium is sold strictly for electrical power generation, and safeguards are in place to ensure this. Australia is a party to the Nuclear Non-Proliferation Treaty (NPT) as a non-nuclear weapons state. Its safeguards agreement under the NPT came into force in 1974. Australia was the first country in the world to bring into force the Additional Protocol in relation to this – in 1997. States that have signed the Additional Protocol agree to have their uranium production monitored to ensure it is not being used for military purposes. In addition to these international arrangements Australia requires customer countries to have entered a bilateral safeguards treaty which is more rigorous than NPT arrangements. <https://tinyurl.com/2sfussz2> Supporters of Australia developing its own nuclear power industry argue that it is illogical to export uranium for other countries to use for power generation and not to use Australian uranium for this purpose in our own country.

Supporters of nuclear energy in Australia either claim that the country already has a suitable workforce or that it will be able to acquire one. The federal Opposition claims that its plan to build nuclear power stations on the sites of decommissioned coal power stations will provide an immediate labour supply. This has been predicted to come from the workers in these communities made redundant by the closures of the former facilities. In a Liberal media release issued on July 19, 2024, it was stated that each new plant would be able to draw on 'a local community which has a skilled workforce.' <https://www.liberal.org.au/latest-news/2024/06/19/australias-energy-future> Among those who doubt that the expertise of this labour force would be sufficient, there is confidence that they could supply the initial basis of

a labour force that could be retrained. In an article published in Science Meets Business on June 13, 2023, it was stated, ‘The future nuclear workforce will need a diverse range of skills, knowledge, and experience to meet the challenges of an evolving nuclear industry... It will require a concerted effort to attract more young people to the profession, an increased commitment to diversity and inclusion to maximise the skills in the profession, and the development of a “nuclear mindset” across all industries.’

<https://sciencemeetsbusiness.com.au/strengthening-the-future-of-the-nuclear-workforce/> The University of New South Wales is currently the only Australian tertiary institution offering a nuclear engineering program. It states, ‘Its programs [are] aimed at creating the next generation of nuclear technologists and supporting Australian industry to learn more about nuclear technology.’ <https://www.unsw.edu.au/news/2022/03/australia-s-nuclear-energy-industry--how-to-build-skills-and-eng> Supporters of Australian nuclear power generation claim that other institutions would implement similar training programs if Australia decides to build nuclear power plants.

4. Nuclear energy would support Australian economic growth

Supporters of nuclear power generation in Australia argue it would be of major benefit to the Australian economy. The federal Opposition has claimed that introducing nuclear power will have significant economic advantages for Australia through a smoother transition to low emissions energy, a cheaper and more reliable energy mix, and a boost to the economy via increased employment.

The Australian federal Opposition has claimed that establishing nuclear reactors on the current or former sites of conventional coal-fuelled power stations will reduce the costs and the delays of transitioning to non-emitting energy sources. Currently it is anticipated that changing to renewable power will be delayed and made more expensive by the need to set up new power distribution systems. The Australian Energy Market Operator's Integrated System Plan of 2022 stated priority transmission projects are expected to cost \$12.8 billion, the Plan also makes clear this will only deliver four per cent of total transmission lines required for the federal government's renewables-based plan. <https://tinyurl.com/4dfessjr> In its June 19, 2024, media release, the opposition Liberal Party stated, ‘A key advantage of modern zero-emissions nuclear plants is they can be plugged into existing grids. This means they can effectively replace retired or retiring coal plants and avoid much of the new spending needed for Labor’s “renewables-only” system, including new transmission poles and wires. All of which will be passed on in the form of higher bills.’ The media release lists the seven locations where the Opposition plans to locate nuclear power stations, all are current or recently retired sites of coal-powered facilities. The media release states, ‘Each of these locations offer important technical attributes needed for a zero-emissions nuclear plant, including cooling water capacity and transmission infrastructure, that is, we can use the existing poles and wires, along with a local community which has a skilled workforce.’ <https://www.liberal.org.au/latest-news/2024/06/19/australias-energy-future>

The Australian federal Opposition has also claimed that establishing nuclear reactors on the current or former sites of conventional coal-fuelled power stations will have large advantages for the regions where the nuclear plants are set up. This is particularly important because the closure of the old facilities will otherwise create large-scale unemployment and local dislocation. Regarding employment in the regions affected, the Opposition’s media release states, ‘Not only will local communities benefit from high paying, multi-generational jobs but communities will be empowered to maximise the benefits from hosting an asset of national importance.’ <https://www.liberal.org.au/latest-news/2024/06/19/australias-energy-future>

Among the economic benefits the media release lists are ‘A multi-billion dollar facility guaranteeing high-paying jobs for generations to come... An integrated economic development zone to attract manufacturing, value-add and high-tech industry [and] A regional deal unlocking investment in modern infrastructure, services and community priorities.’ <https://www.liberal.org.au/latest-news/2024/06/19/australias-energy-future>

Supporters of Australia developing nuclear power plants argue that this would not only create jobs in constructing and maintaining power facilities but would also boost employment in Australia’s uranium mining industry. This view has been endorsed by both potential workers within the mining industry and by mining industry leaders. The Australian Workers Union has claimed that nuclear power generation ‘could bring tens of thousands of jobs...jobs in Uranium mining are set to exceed 10,000 over the next decade, and could be several times that with a complete Nuclear Fuel Cycle.’ The Queensland Resources Council stated that in the event of Australia introducing nuclear energy, ‘[t]he number of jobs would be in the thousands in terms of both the actual mining operation and also the processing’. A report commissioned by the Minerals Council of Australia similarly estimated that as many as 22,600 direct and indirect jobs could be created by 2040 by expanding the nuclear industry in Australia. <https://www6.austlii.edu.au/au/other/AUHRStACEP/2020/2.pdf>

Finally, it has been claimed that developing a nuclear power industry in Australia could have wider applications. It has been suggested that these could include nuclear desalination for water security, analysis of pollutants in water and measuring water quality; food irradiation to reduce post-harvest contaminants; radiography to inspect concrete and welds for invisible flaws; and the production of hydrogen as an alternative to fossil fuels. <https://www6.austlii.edu.au/au/other/AUHRStACEP/2020/2.pdf>

5. Nuclear energy is safe

Supporters of Australia generating nuclear power argue that the technology is not dangerous, and that waste management issues have largely been resolved. Supporters claim there have been few major nuclear accidents, that these were avoidable, and that the technology used in more modern reactors lower the risks even further.

The World Nuclear Association has stated, ‘The evidence over six decades shows that nuclear power is a safe means of generating electricity. The risk of accidents in nuclear power plants is low and declining.’ <https://tinyurl.com/5mpe5msa> The Association has observed ‘There have been two major reactor accidents in the history of civil nuclear power – Chernobyl and Fukushima Daiichi. Chernobyl involved an intense fire without provision for containment, and Fukushima Daiichi severely tested the containment, allowing some release of radioactivity.’ <https://tinyurl.com/5mpe5msa> Experts have claimed that each of these accidents occurred under exceptional circumstances and could have been prevented. The Association has noted, ‘The Chernobyl accident in 1986 was the result of a flawed reactor design that was operated with inadequately trained personnel.’ <https://world-nuclear.org/information-library/safety-and-security/safety-of-plants/chernobyl-accident> The International Atomic Energy Agency has stated, ‘Safety measures were ignored.’ <https://www.iaea.org/newscenter/focus/chernobyl/faqs> The Fukushima incident occurred ‘following a major earthquake, [when] a 15-metre tsunami disabled the power supply and cooling of three Fukushima Daiichi reactors, causing a nuclear accident...’ <https://world-nuclear.org/information-library/safety-and-security/safety-of-plants/fukushima-daiichi-accident> The Carnegie Endowment for International Peace has stated, ‘The [Fukushima Daiichi] plant would have withstood the tsunami had its design previously been upgraded in

accordance with state-of-the-art safety approaches.’ The Endowment’s final judgement is ‘The Fukushima accident was ...preventable.’

<https://carnegieendowment.org/research/2012/03/why-fukushima-was-preventable?lang=en>

Supporters of nuclear power generation argue that both these major historic accidents occurred under exceptional circumstances and that both were avoidable. They argue that such events are highly unlikely to recur. In an article published in The Bulletin of the Atomic Scientists on August 31, 2020, it was claimed of these incidents, ‘They should be viewed as lessons for the future, rather than reasons to eliminate this useful, low-carbon source of energy.’ <https://thebulletin.org/2020/08/dont-let-nuclear-accidents-scare-you-away-from-nuclear-power/>

Supporters of the continued and extended use of nuclear reactors for power generation claim that modern reactors are even less likely to experience accidents than earlier units. Third and fourth generation power plants are claimed to be particularly stable. GIS (Geopolitical Intelligence Services) has claimed, ‘These systems use the fuel more efficiently by using more of the uranium built into the reactor core. They are economically competitive, produce less radioactive waste and are even safer. The goal of . . . these improvements is an inherently safe system – protection by natural laws against a meltdown, accidents, or human error.’

<https://www.gisreportsonline.com/r/nuclear-energy-safe/> Small modular reactors of the type currently proposed by Opposition leader Peter Dutton <https://www.abc.net.au/news/2024-06-19/dutton-reveals-seven-sites-for-proposed-nuclear-power-plants/103995310>

are claimed to be particularly safe. GIS notes, ‘They...use significantly fewer pumps and pipelines and can also be built underground...A core meltdown is impossible due to the low power and passive cooling systems.’ <https://www.gisreportsonline.com/r/nuclear-energy-safe/> Peter Dutton has accused his opponents of ‘scaremongering’ and has claimed that nuclear power is a ‘very safe technology’. <https://www.skynews.com.au/australia-news/politics/nuclear-power-is-a-very-safe-technology-peter-dutton/video/80ec855253cf3a800913f32ec5d7ba0b>

Supporters of nuclear power stations also claim that the risks associated with nuclear waste disposal are exaggerated and that Australia is well placed to deal with waste management. The largest risk is radioactivity which poses health hazards for human and other animal and plant life. Supporters of nuclear power note that the amount of waste produced is small. The World Nuclear Association states, ‘The amount of HLW [High Level Waste] produced (including used fuel) ...is small; a typical large reactor (1 GWe) produces about 25-30 tonnes of used fuel per year. About 400,000 tonnes of used fuel has been discharged from reactors worldwide, with about one-third having been reprocessed.’ <https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-waste/radioactive-wastes-myths-and-realities>

Currently, this waste is stored securely either above or below ground until such time as its radioactivity has decayed to the point where it is considered safe. The World Nuclear Association notes that after 40 years radioactivity has generally dissipated to the point where the waste product is a thousand times less radioactive than it was originally. Long term underground facilities are currently being developed in geologically stable areas in Finland and Sweden. <https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-waste/radioactive-wastes-myths-and-realities>

Peter Dutton has explained that Australia will also have to develop such a long-term facility deep underground to store the waste from the nuclear-powered AUKUS submarines it has ordered from the United States. Mr Dutton argues that this new Australian facility could be used to store the waste from nuclear power reactors as well. <https://www.sbs.com.au/news/article/the-fundamental-nuclear-waste-problem-peter-dutton-would-have-to-solve/7in4qrtym>

Arguments against Australia generating nuclear power

1. Renewable energy can provide a reliable power supply

The Clean Energy Australia 2024 Report noted that in 2023 renewables accounted for 39.4 per cent of Australia's total electricity supply. <https://tinyurl.com/bdct25mr> Supporters of renewables claim that this can be boosted to 100 percent and that natural fluctuations in renewable energy supply can be overcome. The measures that can ensure consistent supply to meet demand include smart grids and improved storage systems.

Smart grids use advanced technology to optimise power supply to consumers and minimise the effect of variations in supply and demand. The European Union Commission Task Force for Smart Grids has defined smart grids as 'an electricity network that can cost efficiently integrate the behaviour and actions of all users connected to it – generators, consumers and those that do both – to ensure [an] economically efficient, sustainable power system with low losses and high levels of quality and security of supply and safety. A smart grid employs innovative products and services together with intelligent monitoring, control, communication, and self-healing technologies to... facilitate the connection and operation of generators of all sizes and technologies and allow consumers to play a part in optimising the operation of the system.' <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52011DC0202>

Smart grid technology has begun to be employed in Australia. On September 4, 2024, Associate Professor Hemanshu Pota of the university of New South Wales, Sydney, explained the benefits of smart grids as applied to Australia. He stated, 'Australia's electricity network is the longest in the world, and perhaps with the least number of users. Smart grids can reduce transmission losses and achieve a high level of renewable integration, especially suited to Australia with abundant sunshine and coastal wind... We develop algorithms that use data from a few key network locations to accurately predict the grid's capacity in real-time. These predictions help with smart scheduling, ensuring the grid stays stable and uses its capacity to the fullest.'

<https://www.unsw.edu.au/news/2024/09/ask-an-expert-what-is-a-smart-grid-and-will-it-make-our-electricity-cheaper> Milton Contracting, MC Electrical & Communications, a major Australian supplier of smart grid technology has claimed, 'In Australia, smart grids are emerging as a solution to rising electricity costs, aging infrastructure, and the shift away from coal-fired power stations. They are pivotal in ensuring a robust and secure electricity supply, which is crucial for Australia's economic growth and technological advancement.'

<https://mcelectricalcommunications.com.au/articles/how-does-smart-grid-work/> Among the countries that have or will begin investing in substantial smart grid infrastructure are Canada, Mexico, Brazil, the EU including many member states, Japan, Korea, Australia, India, and China. <https://tinyurl.com/y6prbn9>

Supporters of renewable power generation claim that reliable power supply can also be achieved through existing and improved long-term energy storage. There are many energy storage technologies available. Mature energy storage technologies include lithium-ion battery (LIB) and pumped hydro energy storage (PHES). LIB provide short to mid duration energy services. PHES provide medium to long duration services.

<https://tinyurl.com/48kv44dj> The Australian Renewable Energy Agency has explained, 'Coupling batteries with renewable energy generation allows that energy to be stored during times of low demand and released (or dispatched) at times of peak demand. Unlike many other forms of energy storage and generation, batteries are particularly valuable because they provide flexibility. They can respond faster than other energy storage or generation technologies and help maintain grid stability by turning on and off in fractions of a second.'

<https://tinyurl.com/58jt43dy> Australia is the largest producer of lithium in the world.

<https://www.iea.org/reports/australia-2023/executive-summary> In 2021, the Australian Renewable Energy Agency announced funding for Australia's first PHES system in 37 years. Located at the former Kidston Gold Mine in north Queensland, the project will be the first to support the integration of variable renewable energy generation from solar and wind. Further, in 2020, construction began on the Snowy 2.0 project, which will link two existing dams in the Snowy Mountains and provide 2000 MW of capacity and 350,000 MWh of storage...able to power approximately 3 million homes over a week. <https://tinyurl.com/mpbea94c> The target date for commercial operation of all units is December 2028, with first power expected in the second half of 2027. <https://tinyurl.com/43ss88tj>

Additional long duration energy storage technologies, including compressed air, thermal energy, and redox flow batteries, are already becoming available in Australia.

<https://tinyurl.com/mpbea94c> On May 24, 2024, the Australian Government released a National Battery Strategy that sets out a plan to establish a battery design and development industry in Australia. <https://www.industry.gov.au/news/charging-australias-renewable-future-through-national-battery-strategy>

Developments such as those outlined above are used to justify claims that it is possible to provide energy for Australia using only renewable power sources. At least ten nations in the world use renewables to generate between 95 and 100 percent of their power. These are Albania, Bhutan, Costa Rica, Democratic Republic of the Congo, Ethiopia, Iceland, Norway, Paraguay, Tajikistan, Uruguay and Scotland.

https://en.wikipedia.org/wiki/100%25_renewable_energy

2. Nuclear energy will take too long to establish in Australia

Critics of the Coalition's nuclear proposal argue that not only will the seven planned power stations supply a very small amount of the country's total energy needs, but they also complain that these plants will take more than ten years each to construct. This will not allow Australia to meet its greenhouse gas emission targets.

The Coalition has claimed that nuclear power plants could be operational in Australia by 2035. This figure has been widely disputed. Peter Farley, a fellow of the Australian Institution of Engineers, has argued that it would take several years before a nuclear power plant could even begin to be constructed. Farley notes, 'Let's start with an assessment of how long it would take to place an order. The first thing is for the Opposition to win an election, where they control both the House and Senate. That is possible but quite unlikely before 2028 but let's assume they get into power and draft very detailed legislation and get it passed by the end of 2025.'

'Then we must vastly expand the nuclear safety agency ARPANSA to include people with experience in nuclear power plants. The UK has 700 people doing this job with only nine reactors. Will we build a new industry with fewer inspectors?'

'Then regulations must be drafted which are updated versions of the very antiquated regulations in the UK and US...Every page must be scrutinised to ensure conflicts with existing...rules and regulations are resolved. This is not trivial. Let's say based on other new bureaucratic endeavours, two years from when the legislation is passed.'

<https://www.aumanufacturing.com.au/a-realistic-time-frame-for-building-nuclear-by-peter-farley> Therefore, according to Farley, it would be at least three to four years before the sites could be selected.

The Coalition has indicated the seven sites where it wishes to have the nuclear power stations built. However, three of the states concerned (Queensland, New South Wales, and Victoria), accounting for four of the proposed reactors, have their own laws banning the construction of nuclear power plants. There are also laws in other states (and regulations in various municipalities) banning the transportation of nuclear material. All these laws and regulations will have to be overturned by compulsory acquisition and legal challenge or through negotiated agreements. <https://www.abc.net.au/news/2024-06-20/dutton-nuclear-plan-must-convince-states/103999636>

Then there is the question of how long it will take to construct the nuclear power plants. The CSIRO has estimated that building a nuclear power plant in Australia is likely to take at least 15 years. <https://www.csiro.au/en/news/all/articles/2023/december/nuclear-explainer> The Climate Council has noted, ‘A nuclear power station has never been built in Australia. As a result, we are not at the starting line for a nuclear energy industry... The nuclear industry’s own analysis shows power stations take an average of 9.4 years to build — and, with no domestic nuclear industry experience, Australia’s first nuclear power station will almost certainly take much longer.’ <https://www.climatecouncil.org.au/nuclear-power-stations-are-not-appropriate-for-australia-and-probably-never-will-be/> Jack Lloyd, writing for Manufacturers’ Monthly in an article published on August 7, 2024, noted, ‘Australia’s energy transition is already struggling, and adding the monumental task of building nuclear power plants without a sufficient workforce is impractical.’ <https://www.manmonthly.com.au/worker-shortage-barrier-to-nuclear-ambitions/>

Nuclear power plants are inherently dangerous, requiring elaborate safeguards as part of their construction. This makes them both expensive and time-consuming to build. The World Nuclear Association has acknowledged this, noting on September 29, 2023, ‘Nuclear power plants are more complex than other large-scale power generation plants, and so are more capital-intensive and may take longer to construct.’ <https://tinyurl.com/39xuhy8j>

The Coalition’s nuclear plan includes two small modular reactors (SMRs); however, overseas experience has not suggested that these are either a quicker or cheaper alternative. The Australian Academy of Technological Sciences and Engineering has noted ‘SMRs are not ready for deployment yet. The earliest they could be built in Australia would be in the 2040s.’ It was further claimed, ‘The “least risky option” would be to buy them after the technology has been commercialised and successfully operated overseas.’ <https://theconversation.com/small-modular-reactors-have-promise-but-we-found-theyre-unlikely-to-help-australia-hit-net-zero-by-2050-235198> An Australian Conservation Foundation report has found only two small modular reactors (SMRs) are known to be operating around the world, in Russia and China, and both have seen large cost blowouts. <https://www.theguardian.com/australia-news/2022/oct/05/unproven-small-nuclear-reactors-would-raise-energy-costs-and-delay-renewable-uptake-report-says>

3. Nuclear energy poses significant safety and waste disposal hazards
Opponents of nuclear energy claim that the dangers associated with nuclear power generation have been underestimated. They also claim that there is no effective way of managing the long-term risks connected with storage and disposal of nuclear waste.

Critics note there is a narrow focus on the two most serious accidents to occur at a nuclear reactor (Chernobyl, 1986, and Fukushima, 2011); however, many other significant nuclear

incidents are not generally known about. The International Nuclear and Radiological Event Scale (INES) was introduced in 1990 by the International Atomic Energy Agency. It is a seven-point scale which ranges from Level 1 – Anomaly (including incidents such as the overexposure of a member of the public to radiation above statutory annual limits) to Level 7 – Major Accident (involving major release of radioactive material with widespread health and environmental effects). Both the Chernobyl and Fukushima accidents were rated at Level 7. https://en.wikipedia.org/wiki/International_Nuclear_Event_Scale This rating scale has been criticised as conservative and excluding nuclear incidents which have caused serious harm. <https://onlinelibrary.wiley.com/doi/full/10.1111/risa.12587>

On March 16, 2011, a report was published by Benjamin K. Sovacool, a professor at the Lee Kuan Yew School of Public Policy, National University of Singapore. Professor Sovacool stated, ‘Under these classifications [International Nuclear and Radiological Event Scale], the number of nuclear accidents, even including the meltdowns at Fukushima Daiichi and Fukushima Daini, is low. But if one redefines an accident to include incidents that either resulted in the loss of human life or more than \$50,000 in property damage, a very different picture emerges.’ Professor Sovacool then explained, ‘At least 99 nuclear accidents meeting this definition, totalling more than \$20.5 billion in damages, occurred worldwide from 1952 to 2009 – or more than one incident and \$330 million in damage every year... Indeed, when compared to other energy sources, nuclear power ranks higher than oil, coal, and natural gas systems in terms of fatalities... There have been 57 accidents since the Chernobyl disaster in 1986. While only a few involved fatalities, those that did collectively killed more people than have died in commercial US airline accidents since 1982.’ <https://www.project-syndicate.org/commentary/the-dirt-on-nuclear-power>

The storage and disposal of nuclear waste also poses major risks. In an article published in The Conversation on June 26, 2024, Professors Rosemary Hill and Ian Lowe explained, ‘Nuclear power plants produce high-level waste, which is radioactive for a very long time. Negative health effects in humans from exposure to high-level radiation include birth defects, impaired tissue and organ functioning, and increased risk of cancer. Nuclear waste only becomes safe after it decays... That means the waste must be disposed of and stored for a . . . long time.’ <https://theconversation.com/nuclear-energy-creates-the-most-dangerous-form-of-radioactive-waste-where-does-peter-dutton-plan-to-put-it-233213> Decay rates vary depending on the types of radioactive material generated as waste. The radioactive waste from spent fuel rods consists primarily of cesium-137 and strontium-90, but it may also include plutonium. Cesium-137 and strontium-90 have half-lives of approximately 30 years. However, plutonium has a half-life that be as long as 24,000 years. <https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/radwaste.html>

Professors Hill and Lowe further explained some of the problems associated with storage of radioactive waste. They stated, ‘The current temporary [storage] options are either “wet” or “dry” storage. Wet storage entails putting the waste in a pond and covering it with several metres of water to keep it cool. Dry storage involves putting the waste in containers made of concrete and steel. These options are not a long-term solution. They are vulnerable to corrosion as well as natural disasters such as cyclones, tsunamis, earthquakes, fires, and floods.’ <https://theconversation.com/nuclear-energy-creates-the-most-dangerous-form-of-radioactive-waste-where-does-peter-dutton-plan-to-put-it-233213> Both wet and dry storage take place at the reactor site. Both forms of storage are technically considered temporary; however, Finland is the only country in the world with a permanent, underground high-level

nuclear waste disposal site. <https://www.science.org/content/article/finland-built-tomb-store-nuclear-waste-can-it-survive-100000-years>

The United States Nuclear Regulators Commission has produced a fact sheet detailing the risks associated with exposure to ‘spent’ fuel from nuclear reactors. The Commission states, ‘High-level wastes are hazardous because they produce fatal radiation doses during short periods of direct exposure. For example, 10 years after removal from a reactor, the surface dose rate for a typical spent fuel assembly exceeds 10,000 rem/hour – far greater than the fatal whole-body dose for humans of about 500 rem received all at once.’ The Commission also considered the risks posed by these radioactive substances if they contaminate waterways. The Commission explains, ‘If isotopes from these high-level wastes get into groundwater or rivers, they may enter food chains. The dose produced through this indirect exposure would be much smaller than a direct-exposure dose, but a much larger population could be exposed.’ <https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/radwaste.html>

Studies have demonstrated that there are radioactivity-related health risks for those who live in communities where nuclear reactors operate. This risk has been found to be higher among children as they are more susceptible to the effects of radiation. A paediatric study published in the British Medical Journal on October 7, 2022, noted, ‘Nuclear power plants routinely release radioactivity as part of daily operation. In 2008, a landmark case-control study was published in Germany... It revealed an unsettling 1.6-fold increase in all cancers and a 2.2-fold increase in leukaemias among children under 5 years old living within 5 km of operating nuclear power plants. In general, the incidences were higher the closer the children lived to the nuclear plant.’ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9557777/>

In relation to the planned locations for nuclear reactors in Australia, critics have noted that the Coalition has had no studies made of the geological suitability of the seven sites where it proposes to build these facilities. On August 27, 2024, shortly after the Newcastle earthquakes, Dave Sweeney of the Australian Climate Foundation noted, ‘A magnitude 4.8 earthquake not far from one of Peter Dutton’s proposed nuclear reactor sites is further evidence of the risky nature of the Coalition’s radioactive plan. The Coalition failed to do any detailed site analysis or community consultation and has instead based its plan on politics rather than evidence. The Fukushima nuclear disaster was caused by a tsunami following an earthquake off the coast of Japan. Nuclear facilities are particularly vulnerable to external – and often unpredictable – seismic and climate events. Many Australians will have clear memories of the scenes of devastation that followed the December 1989 Newcastle earthquake that killed 13, injured more than 150 and caused a damage bill of around \$5 billion. If this event had involved a nuclear reactor, the scale of destruction and impact would have been far greater.’ <https://antinuclear.net/2024/08/25/2-b1-nsw-earthquake-shows-peter-duttons-nuclear-plans-are-on-shaky-ground-acf/>

4. Nuclear energy is far more expensive than energy produced from wind or solar
Critics of building nuclear reactors in Australia argue they are a far more expensive source of energy than solar or wind farms.

Critics claim that the Coalition’s statements about the low cost of nuclear power are inaccurate. The Opposition leader, Peter Dutton, has based many of his favourable predictions regarding the price of nuclear energy on figures from Canada, especially Ontario. In his speech to the Committee for Economic Development of Australia, given on September 23, 2024, Peter Dutton claimed, ‘The Canadian province of Ontario has 8.5 percent

renewables, 52 percent nuclear, 25 percent hydro – with the balance from gas.’ He then claimed that Ontarians pay about 18 cents a kilowatt hour for their electricity and that this was a third of the cost that most Australians pay. <https://www.peterdutton.com.au/leader-of-the-opposition-speech-to-the-committee-for-economic-development-australia-ceda-sydney-check-against-delivery/> In his budget reply address on May 16, 2024, Mr Dutton gave a lower figure, claiming, ‘Because of nuclear power, residents in Ontario, Canada pay up to a quarter of the cost of what some Australians pay for electricity. <https://www.liberal.org.au/latest-news/2024/05/16/leader-oppositions-budget-address-reply> These figures have been repeatedly challenged. Dylan McConnell, Senior Research Associate at the School of Photovoltaic and Renewable Energy Engineering, at the University of New South Wales, has claimed that the current wholesale cost of power in Ontario — at \$110 a megawatt hour — was comparable to or higher than the wholesale cost of energy across much of Australia. <https://www.abc.net.au/news/2024-06-20/power-prices-wont-fall-with-nuclear/103998172> Other critics have noted that the initial cost of nuclear power in Ontario was much higher and that the current rates only apply because the cost of constructing the province’s nuclear facilities has finally been paid. In an article published in The Age on September 27, 2024, Mike Foley explained, ‘Ontarian consumers and energy companies [have] paid down debts from the construction and maintenance of nuclear plants that had ballooned to \$38 billion by 1999, so that cost no longer appears on their power bills.’ <https://www.theage.com.au/politics/federal/cheaper-with-nuclear-what-will-dutton-s-nuclear-plan-really-cost-20240920-p5kc8z.html>

Australian research from multiple sources has found that nuclear power plants are a far more expensive source of power than solar or wind farms. The CSIRO’s GenCost report has stated, ‘By 2030, electricity from a combination of solar and wind would cost between \$73 and \$128 a megawatt hour, depending on how much renewable energy was already in the system. This compared with large-scale nuclear at \$141 to \$233/MWh and \$230 to \$382/MWh for small modular reactors.’ <https://tinyurl.com/bdersh2a> An independent report commissioned and published by the Clean Energy Council in May 2024 reviewing the estimates of the CSIRO and others suggested that the cost difference could be even greater. The Clean Energy Council stated, ‘Nuclear energy is up to six times more expensive than renewable energy and even on the most favourable reading for nuclear, renewables remain the cheapest form of new-build electricity.’ The report also states, ‘Nuclear may be even higher cost than currently forecast as waste management and decommissioning of nuclear plants have been omitted by cost calculations in the relevant research available.’ <https://tinyurl.com/232yz4wb>

The Institute for Energy Economics and Financial Analysis (IEEFA) has examined the cost of nuclear power plants around the world to predict what outlays Australia may have to make. In a report released on September 26, 2024, the IEEFA stated, ‘We found that recent nuclear projects in economies comparable to Australia faced significant cost overruns and delays with multi-billion-dollar consequences. All projects commencing construction in the past 20 years in comparable economies experienced major budget blowouts up to 3½ times original capital costs (excluding financing cost) and construction delays of many years.’ The IEEFA also considered the viability of small modular reactors and concluded, ‘Small modular reactors (SMRs), often touted as a solution to the nuclear industry’s cost and construction time problems, remain costly and unproven, with no reactors in operation in the OECD. The reactor closest to becoming a reality – NuScale in Utah, the US – was cancelled due to cost blowouts and delays.’ <https://ieefa.org/resources/nuclear-proposal-will-increase-power-bills>

The Institute for Energy Economics and Financial Analysis (IEEFA) has also investigated the potential impact of nuclear power on the price paid by electricity users. It states, ‘Scenarios we modelled showed that median electricity bills could rise by \$665 a year on average across regions. The bill increase could range from \$260 for the cheapest projected nuclear project in Czechia to more than \$1,200 for projects such as Hinkley Point C in the UK. For larger households, the increase would be even more pronounced. A four-person household could pay \$972 more per year on average across scenarios, and for even larger households, bills might rise by \$1,182. From the examples we analysed, we found the cost of electricity generated from nuclear plants would be 1.5 to 3.8 times higher than current electricity generation costs in Australia.’ <https://ieefa.org/resources/nuclear-proposal-will-increase-power-bills>

5. Australia’s proposed nuclear plants are insufficient and will divert investors from renewables

Critics of establishing nuclear energy plants in Australia argue that they will generate too little power to service most of Australia’s power needs and they will undermine the development of renewable energy by reducing government policy support and curtailing investment.

Critics of the Coalition’s nuclear scheme argue that the seven proposed nuclear plants would not provide a major portion of Australia’s power supply. In June 2024, analysis from Bloomberg New Energy Finance (BNEF) warned that these power stations would make only a minor contribution to Australia’s non-emitting sources of energy. BNEF have stated, ‘Adding nuclear power into Australia’s energy mix would only reduce the country’s [reliance on] ... solar power capacity by 7 percent and require 12 percent less wind power capacity.’ <https://www.afr.com/companies/energy/nuclear-power-would-do-little-to-reduce-need-for-renewables-report-20240627-p5jpd4> The BNEF analysis suggests that renewables would still be required to produce most of the nation’s energy. The Australian Climate Council has similarly stated, ‘The electricity delivered by seven nuclear reactors would only provide around 12 percent of the power we’ll need by 2050.’ <https://www.climatecouncil.org.au/resources/peter-duttons-energy-scheme-everything-you-need-to-know/> Cost appears to be a primary obstacle to using nuclear reactors to generate more of Australia’s power. Modelling prepared by the CSIRO and the Australian Energy Market Operator has indicated that replacing Australia’s coal-fired power stations with nuclear energy would require more than 70 small modular reactors (SMRs) and cost \$387 billion. <https://www.herbertysmithfreehills.com/notes/energy/2024-posts/Is-Nuclear-Power-the-solution-to-Australia-s-Energy-Transition-#:~:text=Referencing%20the%20GenCost%202022%2D23,and%20cost%20taxpayers%20%24387%20billion.>

Critics claim the Opposition’s policy favouring nuclear power plants will prevent renewables from covering the power shortfall not supplied by nuclear reactors. The Opposition leader, Peter Dutton, has suggested seven power plants could remove the need for many of the currently proposed wind and solar farms. He has also stated that much less infrastructure would be required as nuclear power stations could use existing power lines. In his speech delivered on September 23, 2024, Mr Dutton stated, ‘With nuclear, there’s no need to carpet our landscape and coastline with industrial-scale solar and wind farms. Or the 28,000 kilometres of new transmission lines needed to make them work.’ <https://www.peterdutton.com.au/leader-of-the-opposition-speech-to-the-committee-for-economic-development-australia-ceda-sydney-check-against-delivery/> However, critics

believe that the Coalition has got the balance wrong and is undermining renewables without offering an adequate replacement. Matthew Warren, former chief executive of the Australian Energy Council, has noted, ‘The Coalition has not explained where the other 80 per cent-plus of non-nuclear generation would come from.’ <https://www.afr.com/policy/energy-and-climate/dutton-s-nuclear-policy-put-to-the-test-20240924-p5kd3o>

Some analysts fear that the Coalition’s nuclear proposal and negative comments about renewables will undermine investment and dramatically slow the building of further solar and wind farms. Chris Bowen, the federal government Minister for Climate Change and Energy, has accused Mr Dutton of wanting ‘to stop renewable investment [and] tear up contracts for new renewable and transmission projects’. Commentators outside of politics have expressed similar fears regarding the effect of the current debate. Rennie Co chief executive, Matt Rennie, has stated that if Australia’s energy direction becomes uncertain, ‘investors would take time to regain confidence in Australia’s energy policy settings, leading to a significant stalling in all energy investments. This would have catastrophic implications for [power supply] reliability which would flow through to prices.’ <https://www.afr.com/policy/energy-and-climate/dutton-s-nuclear-policy-put-to-the-test-20240924-p5kd3o> Bloomberg New Energy Finance (BNEF) has similarly warned that the nuclear debate could serve as a distraction from policy support for renewable energy investment, in which case it would ‘sound the death knell for [Australia’s] decarbonisation.’ <https://tinyurl.com/552fryzp>

Critics from other nations also claim the nuclear debate threatens to undermine renewables’ progress. Sharon Squassoni, research professor at the Institute for International Science and Technology Policy, Elliott School of International Affairs, at the George Washington University, has argued that extending nuclear energy ‘will slow the transition to a net-zero emissions future and should therefore be trimmed from our set of options. Continuing to support nuclear energy at the expense of faster and cheaper alternatives for cutting greenhouse gas emissions is a losing strategy.’

<https://www.tandfonline.com/doi/full/10.1080/00963402.2021.1990488> Similar concerns have been expressed by the Climate Action Network Europe which has stated, ‘As the nuclear debate aggressively dominates political negotiations, media, and public discourse, it blatantly diverts critical attention from advancing the existing, affordable, sustainable solutions to the energy transition. This overwhelming focus on nuclear power not only overshadows but also poses a risk of derailing the European energy transition, hindering progress towards aligning with the ambitious yet achievable goal of a 100% renewable energy system by 2040.’ <https://caneurope.org/myth-buster-nuclear-energy/>

Further implications

Australia confronts a potential energy crisis. The country faces three converging exigencies – the immanent closure of all coal-fired power stations, an anticipated decline in renewable energy projects, and increasing electricity demand.

<https://independentaustralia.net/environment/environment-display/australia-facing-looming-power-shortage-crisis-in-2027,18600#:~:text=This%20crisis%20stems%20from%20the,unless%20immediate%20action%20is%20taken.>

In December 2023, the Australian Energy Market Operator announced that Australia’s coal power stations would all be closed by 2038 – five years earlier than expected. <https://theconversation.com/coal-will-be-all-but-gone-by-2034-under-australias-latest-energy-roadmap-219714> This is not the result of penalties imposed by governments

seeking to meet emissions targets. It is the result of ageing power plants that private owners, foreign and Australian, do not consider sufficiently profitable to refurbish. Coal-fired power plants are suffering from the commercial pressure created by solar-generated power. In the financial year ending June 2024, renewables contributed 39.4 percent of the nation's total electricity production according to the Clean Energy Council's most recent report. <https://cleanenergycouncil.org.au/news-resources/clean-energy-australia-report#:~:text=Key%20statistics%20from%20the%20Clean,was%20added%20to%20the%20grid> Just rooftop solar now accounts for 11.2 percent of Australia's electricity supply. <https://cleanenergycouncil.org.au/news-resources/rooftop-solar-generates-over-10-per-cent-of-australias-electricity>

What complicates this picture is that renewables' success has not been fast enough. There is also concern that the impetus may be levelling out or trailing off. While rooftop solar and investments in battery development, large and small, continued to grow, investments in renewable energy plants slowed in 2023. Financial approvals for new solar farms shrank over a third and no new wind farms won backing. By the end of that year, Australia had 56 renewable energy projects under construction, down from 72 the year before. <https://www.theguardian.com/environment/2024/mar/13/australian-renewable-sector-recorded-alarming-slowdown-in-2023-energy-body-finds> One of the major disincentives to further development in the renewable sector is that the distribution network is not keeping pace with the construction of solar and wind farms. The Australian Energy Market Operator estimates that 50 percent of the transmission needed to deliver a clean, reliable, affordable energy supply in 2050 must be constructed in the next six years. At present, renewable generators are forced to connect to existing lines, which have become congested. So even when new renewable installations are approved for construction, their output can be curtailed because they are unable to reach their consumers. <https://iced.su.se/news-events/news/clean-energy-slump-%E2%80%93-why-australia%E2%80%99s-renewables-revolution-behind-schedule-and-how> Power distribution networks in Australia are in a patchwork of hands which makes co-ordinated development more difficult. Currently, Victorian, and South Australian networks are 100 percent privately owned, while Tasmanian, Western Australian, Northern Territory, and Queensland electricity networks are 100 percent government-owned. <https://www.climateactioncard.org/2023/01/australia-power-grid-systems/#:~:text=Since%20its%20establishment%20some%20states,are%20100%25%20government%20Owned>.

Compounding these issues further is that electricity demand is expected to increase across Australia as the economy recovers from the pandemic and population growth continues. Increased demand will put further upward pressure on prices. <https://www.gardelectrical.com.au/blog/navigating-the-energy-landscape#:~:text=Increased%20demand%3A%20As%20Australia's%20economy,putting%20upward%20pressure%20on%20prices>. From the mid-2020s, consumption is projected to accelerate due to the anticipated increase in the number of electric vehicles. <https://tinyurl.com/5e838n2v> Growth in the use of AI is also expected to increase Australia's electricity usage. According to the International Energy Agency, an AI Google search consumes 10 times the electricity of a standard search. Electricity supply problems have already been observed in the United States because of the commercial use of AI. However, the Australian Energy Market Operator has not yet factored AI into Australian electricity producers' future challenges. <https://www.afr.com/policy/economy/ai-could-stretch-australia-s-electricity-supply-to-the-limits-20240408-p5fi2w>

Where does this leave the debate around Australia's use of nuclear power?

Three issues appear to make it an unwelcome intrusion into this complex of problems. Firstly, it seems unlikely that nuclear plants will appear on the scene soon enough, or generate enough power, to cover the early closure of coal-fired power plants. Secondly, they are unlikely to prompt governments or private owners to improve Australia's electricity distribution networks and boost further renewables development. Peter Dutton has stressed that nuclear power stations would use existing distribution networks. He is anticipating a 'mixed system' of nuclear power and renewables, yet he appears not to have allowed for smart grids to facilitate this nor the problems created by trying to integrate nuclear power into a mixed system. <https://tinyurl.com/59u3e2bj> Finally, diverting investment into nuclear power would take finance away from the renewables anticipated to produce most of the country's power.

If the Coalition's scheme were adopted, the shift from coal-fired power stations to renewables would slow beyond the present decline in projected start-ups. Were this to happen, state and federal governments would have to subsidise coal-fired plants to induce them to remain in operation past their preferred closing dates, as is already happening in New South Wales. <https://tinyurl.com/mtf4znhf> The Coalition plans to increase gas-generated electricity in the bridging period before its nuclear power stations come online. The Labor government has estimated that closing the electricity gap with gas power will increase gas usage to 2035 by five times the existing annual production. <https://www.abc.net.au/news/2024-09-26/coalition-nuclear-plan-gas-gap-labor/104396316> Currently more than 80 percent of Australia's gas is exported, placing artificial pressure on domestic supply, inflating prices, and creating a justification for new drilling. <https://australiainstitute.org.au/initiative/gas-the-facts/> Further, even with additional drilling, most of Australia's undeveloped gas reserves are in the north of the country, requiring new pipelines or LNG terminals to service southern population centres. <https://theconversation.com/duttons-nuclear-plan-would-mean-propping-up-coal-for-at-least-12-more-years-and-we-dont-know-what-it-would-cost-239720> Thus it seems the plan to build these nuclear plants may protract the problem of uncertain electricity supply rather than provide a solution. The only sector immediately to benefit appears to be the fossil-fuel industry.

At a National Press Club address given on February 26, 2024, mining and renewable energy magnate Andrew 'Twiggy' Forrest claimed, 'If you think that nuclear came out of nowhere, no, it didn't. It's been pushed by the fossil fuel sector as a great way to delay the whole country for 20 years from switching over to cheaper energy.' <https://www.abc.net.au/news/2024-02-26/andrew-forrest-slams-fossil-fuel-industry-nuclear-distraction/103512770>