Friends of the Earth Adelaide
c/- Conservation Council of SA, 111 Franklin St, Adelaide SA 5000
adelaidefoe.org | facebook.com/foe.adelaide | e: adelaide.office@foe.org.au

Submission to House Select Committee on Nuclear Energy

Introduction

We welcome this inquiry as an opportunity to bring critical scrutiny to the Coalition's proposal to introduce nuclear power into Australia's electricity generation mix and would be willing to provide oral evidence to the hearing in Adelaide.

As explained below in our detailed analysis of each of the 13 issues listed in the terms of reference, nuclear is the wrong option for Australia. Many independent experts have pointed to the unrealistic time frame, the high cost and financial risk, and the increase in Australia's carbon emissions that it would entail. We provide extensive references to such expert analysis and to international experience in support of our arguments against the nuclear option.

Nuclear power could not contribute to the decarbonisation of the energy system for at least two decades, but in the meantime it would deter investment in renewables and storage. The transformation to a zero emissions energy system based on renewables and storage is a complex long-term project that must not be de-railed by nuclear distractions.

In response to section h. about safety concerns, we offer insights based on the Fukushima nuclear disaster. The author of this submission was living in Tokyo and working for the Tokyo-based Citizens' Nuclear Information Centre at the time and experienced the crisis first hand. In section m. 'any other relevant matter' we make some remarks about nuclear proliferation. Perhaps it will be considered impolite to raise this issue in relation to the Coalition's nuclear power proposal, but it remains a fundamental consideration and should not be dismissed. Traditional arguments against nuclear energy – on the grounds of safety, proliferation and waste – remain relevant today. They are no less important than arguments against nuclear on economic or climate grounds.

Recommendations

This inquiry should:

- Recommend that nuclear energy for Australia be rejected
- Support the principle of 'free, prior and informed consent', as articulated in the United Nations Declaration on the Rights of Indigenous Peoples
- Recommend that the outdated and confusing term 'baseload' be avoided
- Debunk the labelling of nuclear energy as 'clean', or 'green', or 'zero emissions'

- Fairly balance representation, by seeking views from renewable energy experts with specialist expertise in the area of grid planning and grid reliability (not just the views from the pro-nuclear lobby)
- Suggest ways of overcoming barriers to the rapid uptake and integration of renewables
- Recommend policies and strategies to make Australia a world leader in energy efficiency and flexible demand.

a. deployment timeframes

The Coalition has claimed that its nuclear reactors "will start producing electricity by 2035 (with small modular reactors) or 2037 (if modern larger plants are found to be the best option)".[1] That is a supremely optimistic timeframe. By comparison, for large-scale plants CSIRO's *GenCost 2023-24* suggests 15-20 years,[2] which would give an earliest start date of 2040.

We suspect the Coalition's 2037 date for large plants is based on the 12 years from announcement to grid connection achieved by the United Arab Emirates' (UAE) nuclear power plant, constructed by a South Korean consortium led by Korea Electric Power Corporation. However, UAE benefited from extensive international support because the nuclear industry wanted to promote it as a poster child for a nuclear revival. Furthermore, planning and construction conditions in UAE are completely different from Australia. UAE is a dictatorship, whereas Australia has rigorous planning regulations and laws protecting working conditions and the environment.[3] Public opposition counts for little in the UAE, but social licence matters in Australia.[4]

More relevant comparisons are the nuclear reactors constructed in western democracies in recent years:

Hinkley Point C (EPR, UK) – announced 2010, approved 2016, commenced construction 2017, not expected to be completed until at least 2030.[5,6]
Flamanville 3 (EPR, France) – commenced construction 2007, first criticality 3 September 2024

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[1] Media Release, 'Australia's Energy Future', Liberal Party of Australia, 19 June 2024
https://www.liberal.org.au/latest-news/2024/06/19/australias-energy-future
[2] Paul Graham, Jenny Hayward and James Foster, *GenCost 2023-24*, CSIRO, May 2024, p. 18
https://www.csiro.au/en/news/All/News/2024/May/CSIRO-releases-2023-24-GenCost-report
[3] John Quiggin, 'Dutton wants a 'mature debate' about nuclear power. By the time we've had one, new plants will be too late to replace coal', *The Conversation*, 28 February 2024
https://theconversation.com/dutton-wants-a-mature-debate-about-nuclear-power-by-the-time-weve-had-one-new-plants-will-be-too-late-to-replace-coal-224513
[4] It is worth remembering that there have been several examples of partially or fully constructed nuclear power plants which failed to gain social licence and never, or almost never operated (e.g. Bataan in The Philippines, Lungmen in Taiwan, Shoreham and Summer in the US). Bi-partisan support has often been cited as a prerequisite for nuclear power in Australia. Without it, a colossal amount of money could be wasted on nuclear power plants for nothing.
[5] 'Hinkley Point C nuclear power station', *Wikipedia* (viewed 25 October 2024)
https://en.wikipedia.org/wiki/Hinkley_Point_C_nuclear_power_station
[6] Adam Morton, 'Does the Coalition's case for nuclear power stack up? We fact check seven key claims', *The Guardian*, 24 June 2024
https://www.theguardian.com/australia-news/article/2024/jun/20/does-the-coalitions-case-for-nuclear-power-stack-up-we-factcheck-seven-key-claims

but automatically shut down the next day, connection to grid expected by the end of 2024.[7,8]
Olkiluoto 3 (EPR, Finland) – commenced construction 2005, commenced commercial operations 2022.[9]
Vogtle 3,4 (AP1000, USA) – applied for early site permit 2006, commenced construction 2009, Westinghouse (plant maker) filed for bankruptcy 2017, Unit 3 commenced commercial operation 2023, Unit 4 commenced commercial operation 2024.[10]

These examples are all from countries with a long history of nuclear power. Based on their experience, construction alone could take 15 years. If the time for planning and approvals is included, 20 to 25 years is a realistic estimate. It could easily take longer for Australia, given that we have no experience with nuclear power and don't even have a regulatory framework in place. Clare Savage, Chair of the Australian Energy Regulator, has already told this Committee that it could take 8 to 10 years to develop a regulatory framework.[11]

Regarding the proposed 2035 operational date for small modular reactors (SMR), there can be no objective basis for this estimate, because no SMRs exist. Presumably it is based on the promises of the prospective vendors' salespeople. These are the same people who promised timely and cheap large nuclear plants, which in fact were plagued by delays and ended up costing many times more than the original estimates.

There are a couple of SRs (without the 'M') in China and Russia, but no one is suggesting Australia should purchase reactors from either of these countries. Claims that SMRs will be cheap are premised on the 'M' for modular construction, but there is no prospect of modular construction in the near future. Modular construction could not occur without massive investment in the supply chain and that is unlikely to be forthcoming until a few successful examples have been built. If the Coalition wants a 2035 startup date, Australia would have to pay a premium for a prototype reactor, with all the teething problems that that entails. Even then, that date ignores the fact that construction couldn't begin until the regulatory framework is in place.

b. fuel supply, and transport of fuel

We expect fuel would be supplied by foreign fuel fabrication companies. It is unlikely that it would be feasible for Australia to develop a nuclear fuel fabrication industry of its own in the foreseeable future. Two inquiries led by strongly pro-nuclear people produced reports that were generally sceptical about the possibility of Australia developing a nuclear fuel fabrication industry: the UMPNER Report (2006)[12] and the Report of the South Australian Nuclear Fuel Cycle Royal

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[7] ibid.
[8] 'France's newest nuclear reactor shuts itself down', *News Wires*, 5 September 2024
https://www.france24.com/en/live-news/20240905-new-french-nuclear-reactor-enters-automatic-shutdown
[9] 'Olkiluoto Nuclear Power Plant', *Wikipedia* (viewed 25 October 2024)
https://en.wikipedia.org/wiki/Olkiluoto_Nuclear_Power_Plant
[10] 'Vogtle Electric Generating Plant', *Wikipedia* (viewed 25 October 2024)
https://en.wikipedia.org/wiki/Vogtle_Electric_Generating_Plant
[11] Colin Packham, 'Slow nuclear reaction: Decade before any power plant construction, inquiry is told', *The Advertiser*, 25 October 2024
[12] Commonwealth of Australia 2006, *Uranium Mining, Processing and Nuclear Energy — Opportunities for*

Commission (2016)[13].

The nuclear fuel fabrication industry is dominated by four companies, Areva, Global Nuclear Fuel (GNF), TVEL and Westinghouse. According to the World Nuclear Association,

> "Most of the main fuel fabricators are also reactor vendors (or owned by them) … Currently, fuel fabrication capacity for all types of LWR fuel throughout the world considerably exceeds the demand. It is evident that fuel fabrication will not become a bottleneck in the foreseeable supply chain for any nuclear renaissance. The overcapacity is increased by countries such as China, India and South Korea aiming to achieve self-sufficiency."[14]

c. uranium enrichment capability

Australia has a history of research into uranium enrichment, including gas centrifuge enrichment technology and laser enrichment technology. The former is no longer being actively pursued in Australia. Australian company Silex Systems is still involved in the development of the latter technology. Silex Systems is the inventor of SILEX laser enrichment technology and majority owner of Global Laser Enrichment (GLE), which is developing a pilot laser enrichment facility in North Carolina. GLE hopes initially to re-enrich Department of Energy (DOE) depleted uranium at a facility in Paducah, Kentucky and to commercialise the technology in the United States.[15]

Both the UMPNER Report and the Report of the South Australian Nuclear Fuel Cycle Royal Commission were sceptical about the possibility of Australia developing a uranium enrichment industry. Since those reports were written, Russia's invasion of Ukraine has impacted the global uranium enrichment industry. Russia is still a major supplier of uranium enrichment services, including to Europe and the US, although they are trying to reduce their dependence. Another significant development is a predicted increase in the demand for HALEU (High-Assay Low-Enriched Uranium – above 5% and below 20% enrichment) for new reactor models. Europe and the US don't currently have the infrastructure to supply the HALEU market and are reliant on Russia.

There is no reason to assume that these developments will create an opening for Australia to develop a uranium enrichment industry. Such a scenario would face major technical and political hurdles. The predicted increased demand for HALEU assumes full-scale use of SMRs, but since none currently exist, it could turn out to be that a shortage of HALEU and HALEU fuel fabrication capacity becomes just another obstacle blocking their uptake.

Silex has managed to stay engaged in uranium enrichment, but is still at the pilot plant stage. Furthermore, its focus is on the US. It is not obvious how this will lead to a uranium enrichment

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Australia?, Report to the Prime Minister by the Uranium Mining, Processing and Nuclear Energy Review Taskforce, December 2006

[13] Kevin Scarce, *Nuclear Fuel Cycle Royal Commission Report*, May 2016

[14] World Nuclear Association, 'Nuclear Fuel and its Fabrication', last updated 13 October 2021 https://world-nuclear.org/information-library/nuclear-fuel-cycle/conversion-enrichment-and-fabrication/fuel-fabrication

[15] Global Laser Enrichment: https://www.gle-us.com

industry in Australia. A Treaty between the US and Australia specifically dealing with SILEX Technology states:

> "Cooperation under this Agreement within the territory of Australia shall be limited to research on and development of SILEX technology, and shall not be for the purpose of constructing a uranium enrichment facility in Australia unless provided for by an amendment to this Agreement."[16]

The other big obstacle is that uranium enrichment is a proliferation-sensitive technology. Uranium enrichment is associated with nuclear weapons programs in Pakistan and North Korea and possibly Iran. A few non-nuclear weapon states have uranium enrichment facilities, but the US in particular has tried to limit the spread of this technology. Laser enrichment is said to be an even greater proliferation risk than centrifuge enrichment.[17] In fact, that is a major reason why Silex is working in the US rather than Australia, as can be seen from the abovementioned Treaty. (Refer also section m. part (iii) below.)

d. waste management, transport and storage

All countries with nuclear energy programs have experienced serious difficulties dealing with their radioactive waste. Nearly 80 years since the first atomic bomb test and 70 years since the world's first nuclear power station commenced operation, no country in the world has succeeded in disposing of its civilian or military spent nuclear fuel and other high-level radioactive waste. Finland is the most advanced, with construction of a repository nearing completion. Most countries have not even reached the stage of selecting a site. It would be more accurate to say that Finland has found a political solution than that it has found a technical solution. A site that received broad local acceptance was selected (Onkalo geologic repository located near the Olkiluoto nuclear power plant) and a repository was built, but we won't know if it was a technical success for over 100,000 years. That's how long the repository has to keep the long-lived radioactive isotopes isolated from the environment.

Australia too has failed in its attempts to select a site for a disposal facility for its radioactive waste, even though the waste in question is only low-level and intermediate-level. As former Senator Rex Patrick points out, "Australia has been searching for a site for a National Radioactive Waste Management Facility (NRWMF) site since the 1970s; and after 50 years, it still hasn't found a spot on which to safely establish such a repository."[18] Several attempts have been made, but they have been opposed by the Traditional Custodians, as well as the wider public. Some State and Territory governments have laws or policies opposing the disposal of nuclear waste in their jurisdictions.[19]

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[16] *Agreement for Cooperation between the Government of Australia and the Government of the United States of America concerning Technology for the Separation of Isotopes of Uranium by Laser Excitation [SILEX Agreement], 2000*, Article 2.3
http://www.austlii.edu.au/au/other/dfat/treaties/2000/19.html
[17] R. Scott Kemp, 'SILEX and proliferation', *Bulletin of the Atomic Scientists*, 30 July 2012
https://thebulletin.org/2012/07/silex-and-proliferation/
[18] Rex Patrick, 'Nuclear waste. Fifty years of searching, still nowhere to dump it.' *MichaelWest Media*, 15 December 2023
https://michaelwest.com.au/nuclear-waste-fifty-years-of-searching-still-nowhere-to-dump-it/
[19] Emily Gibson, 'Current prohibitions on nuclear activities in Australia: a quick guide', Parliamentary Library, 30

In the early days of nuclear power, it might have seemed reasonable to build the nuclear reactors first, in the expectation that the radioactive waste problem could be solved later. Clearly this approach has failed. In the light of this troubled history, it would be irresponsible to commence a nuclear power program without first finding a solution for the waste. Any solution to the radioactive waste problem must not ride roughshod over the wishes of the local people, the people along the transport routes, or the Traditional Owners of the land. The principle of 'free, prior and informed consent' is fundamental. The United Nations Declaration on the Rights of Indigenous Peoples states:

> States shall take effective measures to ensure that no storage or disposal of hazardous materials shall take place in the lands or territories of indigenous peoples without their free, prior and informed consent.[20]

This principle has not been followed in the search for a National Radioactive Waste Management Facility[21] and there is no indication the Federal Government intends to follow this principle in its plans to store and dispose of radioactive waste from nuclear submarines. We are concerned that the Coalition is taking for granted that it will be able to impose a dump on unwilling communities for the radioactive waste from its proposed nuclear reactors.

e. water use and impacts on other water uses

As with coal fired and gas fired power plants, nuclear power plants require large amounts of water for cooling. Some plants recirculate water through cooling towers, while others have a once through system where water is extracted from rivers, lakes, or the sea then discharged back as warm water. The former system loses more water through evaporation, while the latter faces temperature restrictions. If the discharged water is too warm, it damages the environment.

> "Any nuclear or coal-fired plant that is normally cooled by drawing water from a river or lake will have limits imposed on the temperature of the returned water (typically 30°C) and/or on the temperature differential between inlet and discharge. In hot summer conditions even the inlet water from a river may approach the limit set for discharge, and this will mean that the plant is unable to run at full power."[22]

Although nuclear proponents promote nuclear energy as a solution to climate change, in fact, it will become more and more unreliable as global warming becomes more and more severe. In France, for example, restrictions on nuclear output are a recurring problem during summer because

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May 2024
https://www.aph.gov.au/About_Parliament/Parliamentary_departments/Parliamentary_Library/pubs/rp/rp2324/Quick_Guides/NuclearActivitiesProhibitions

[20] *United Nations Declaration on the Rights of Indigenous Peoples*, Article 29.2.

[21] End of Mission Statement by the UN Special Rapporteur on Toxics and Human Rights, Marcos A. Orellana, on his visit to Australia, 28 August to 8 September 2023
https://www.un.org/sites/un2.un.org/files/eom_-_08_sep_2023_-_final_.pdf

[22] World Nuclear Association, 'Cooling Power Plants', Updated 1 October 2020
https://world-nuclear.org/information-library/current-and-future-generation/cooling-power-plants

of high river temperatures. This problem is likely to become worse as temperatures rise due to climate change. The French Court of Auditors warned that "such events are set to become three to four times more frequent by 2050 … [and] recommended not to commission the six planned EPR2 reactors without significant technological improvement and a cooling system that uses less water".[23]

f. relevant energy infrastructure capability, including brownfield sites and transmission lines

As explained in our response to question a. above, nuclear power plants are unlikely to be ready within the timeline suggested in the Coalition's policy. Even if they were, the coal-fired power plants they are slated to replace would close down too soon for new nuclear reactors to pick up the slack. AEMO's 2024 Integrated System Plan forecasts

> "...the retirement of 90% of Australia's remaining 21 gigawatts of coal generation by 2034-35, with the entire fleet retired by 2038...
> "AEMO notes the departure of coal from the grid could be faster still, pointing to higher operating costs, reduced fuel security and high maintenance costs as well as more competition from renewable energy in the wholesale market."[24]

That is "the lowest-cost way to supply electricity to homes and businesses as Australia transitions to a net zero economy".[25] So coal-fired power stations are not closing down just because of government policy. They are "old and tired" and expensive to run. According to Alison Reeve, Deputy Program Director, Energy and Climate Change at the Grattan Institute,

> "Australia's coal-fired power stations are old and unreliable – that's why their owners want to shut them down. To keep plants open means potentially operating them at a loss, while having to invest in repairs and upgrades."[26]

Certainly, there are transmission lines from existing coal-fired power plants. These could also be used by solar and wind plants. The Coalition claims that under the ALP's plan, 28,000 kilometres of new transmission lines will be needed, but that figure is misleading. In fact, "AEMO's 2024 plan suggests close to 10,000km of new transmission lines will be needed to deliver this least-cost system by 2050."[27] Reeve says,

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[23] Mihajlo Vujasin, 'Climate change, water scarcity jeopardizing French nuclear fleet', *Balkan Green Energy News*, 24 March 2023
https://balkangreenenergynews.com/climate-change-water-scarcity-jeopardizing-french-nuclear-fleet/
[24] Dylan McConnell, 'Coal will be all but gone by 2034 under Australia's latest energy roadmap', UNSW Newsroom, 15 Dec 2023
https://www.unsw.edu.au/newsroom/news/2023/12/coal-will-be-all-but-gone-by-2034-under-australias-latest-energy
[25] AEMO, *2024 Integrated System Plan*, 26 June 2024
https://aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2024-integrated-system-plan-isp
[26] Alison Reeve, 'Dutton's nuclear plan would mean propping up coal for at least 12 more years – and we don't know what it would cost', *The Conversation*, 25 September 2024
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
[27] Dylan McConnell, op. cit.

> "[E]ven if the Coalition's nuclear plan became a reality, new transmission infrastructure would be needed.
> "Australia's electricity demand is set to surge in coming decades as we move to electrify our homes, transport and heavy industry. This will require upgrades to transmission infrastructure, because it will have to carry more electricity. Many areas of the network are already at capacity."

Based on the above, we don't expect 'brownfield sites' to facilitate a smooth transition from coal-fired to nuclear power. Existing coal-fired power plants will be shut down before the nuclear power plants are ready to begin generation. Some jobs might be retained, but, on the assumption that no nuclear construction starts before a regulatory framework is in place (refer response to question a. above), most coal-related redundancies will occur before new jobs are created. If towns wait around for nuclear jobs, they will miss out on jobs that could have been created by shifting quickly to renewable energy, energy storage and energy efficiency.

In fact, some of the proposed sites already have other plans which would generate jobs sooner than a nuclear power plant. Port Augusta City Council noted,

> "[T]he proposed site for the nuclear power plant is privately owned and has been considered for other projects, including the development of an export port. The success of these potential projects, which could greatly contribute to the economic development and prosperity of the region, may be jeopardised if the exploration of the nuclear power plant proposal casts doubt on the future use of the old power station sites."[28]

In regard to grid inertia and grid reliability, Adi Paterson presented alarmist scenarios during this inquiry's 28 October public hearing. A much more optimistic perspective is presented by the National Renewable Energy Laboratory (US DoE):

> "Historically, nearly all grid capacity has been provided by synchronous generators. These rotating generators have stored kinetic energy, and this stored kinetic energy (inertia) provides the grid the time needed to respond to declines in system frequency that result from contingencies and other imbalances….
> "The combination of inertia and mechanical frequency response can be replaced to a large extent with electronic-based frequency response from inverter-based resources and fast response from loads, while maintaining system reliability. Given these solutions, reduced inertia is not an inherent barrier to increased deployment of wind and solar energy. Our reliance on inertia to date results largely from the legacy use of synchronous generators."[29]

We recommend that the committee seek alternative views from renewable energy experts with specialist expertise in this area: for example, the authors of a report into this issue produced for the Australia Institute in 2023.[30]

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[28] Port Augusta City Council, 'Nuclear Power Plant Announcement for Port Augusta: Mayor Linley Shine Responds', 20 June 2024

[29] Denholm, Paul, Trieu Mai, Rick Wallace Kenyon, Ben Kroposki, and Mark O'Malley, *Inertia and the Power Grid: A Guide Without the Spin*, National Renewable Energy Laboratory. NREL/TP-6120-73856, May 2020 https://www.nrel.gov/docs/fy20osti/73856.pdf

[30] Bruce Mountain & Steven Percy, *Inertia and System Strength in the National Energy Market: A report prepared for The Australia Institute*, VEPC, Melbourne, March 2023

g. Federal, state, territory and local government legal and policy frameworks

Nuclear energy is currently illegal under federal law and also state law in several states.[31] In order to change federal law, legislation would have to pass both the House of Representatives and the Senate. Unless the Coalition wins an absolute majority in both Houses, with Labor, the Teals and the Greens likely to oppose any legislation permitting nuclear energy, there is no prospect of introducing nuclear energy after the next federal election. All that the Coalition's nuclear policy can do is delay the transformation to a green electricity system and prolong the burning of fossil fuels. Some commentators believe that is the aim.[32]

h. risk management for natural disasters or any other safety concerns

In its publicity, the nuclear industry encourages people to believe that nuclear energy is safe and getting safer. It promulgates what is referred to in Japan as the 'safety myth', which is recognised as being a leading cause of the Fukushima nuclear disaster (2011 – 3 reactors at the Fukushima Daichi Nuclear Power Station had meltdowns).[33,34] The Japanese public was told repeatedly that a serious accident couldn't happen. Even after many smaller accidents, near misses and scandals, the nuclear industry continued to promote the 'safety myth'. It chose to prioritise its bottom line over taking precautionary action. For example, it chose not to raise the height of the Fukushima nuclear power plant's seawall, despite clear warnings from scientists that the site could be hit by a much larger tsunami than it was designed to withstand.

Now the nuclear industry claims that new generation reactors, including SMRs, are inherently safe. This claim is disputed by nuclear experts such as Ed Lyman (Union of Concerned Scientists).

> "[T]he so-called passive safety features that SMR proponents like to cite may not always work, especially during extreme events such as large earthquakes, major flooding, or wildfires that can degrade the environmental conditions under which they are designed to operate. And in some cases, passive features can actually make accidents worse … In any event, regulators are loosening safety

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https://australiainstitute.org.au/wp-content/uploads/2021/03/VEPC-system-security-report-FINAL.pdf

[31] Emily Gibson 2024 op. cit.

[32] For example,

(a) Tim Buckley & John Hewson, 'Coalition claims of a nuclear power renaissance in UK further expose its shameless policy con', *RenewEconomy*, 10 October 2024
https://reneweconomy.com.au/coalition-claims-of-a-nuclear-power-renaissance-in-uk-further-expose-its-shameless-policy-con/#google_vignette

(b) Sophie Vorrath, '"Gas Trojan horse:" Coalition nuclear push slammed as fossil wedge aimed at renewables', *RenewEconomy*, 19 August 2024
https://reneweconomy.com.au/gas-trojan-horse-coalition-nuclear-push-slammed-as-fossil-wedge-aimed-at-renewables/

[33] The author of this submission was living in Tokyo at the time of the Fukushima nuclear disaster and working as the International Liaison Officer for the Tokyo-based Citizens' Nuclear Information Centre
http://cnic.jp/english/

[34] Norimitsu Onishi, ''Safety Myth' Left Japan Ripe for Nuclear Crisis', *The New York Times*, 24 June 2011
https://www.nytimes.com/2011/06/25/world/asia/25myth.html

> and security requirements for SMRs in ways which could cancel out any safety benefits from passive features … It is also considering further changes that could allow SMRs to reduce the numbers of armed security personnel to protect them from terrorist attacks and highly trained operators to run them. Reducing security at SMRs is particularly worrisome, because even the safest reactors could effectively become dangerous radiological weapons if they are sabotaged by skilled attackers … Considering the cumulative impact of all these changes, SMRs could be as—or even more—dangerous than large reactors."[35]

By downplaying the risks, the nuclear industry hopes to deflect criticism. It also hopes to reduce its costs.

> "Another way that SMR developers try to reduce capital cost is by reducing or eliminating many of the safety features required for operating reactors that provide multiple layers of protection, such as a robust, reinforced concrete containment structure, motor-driven emergency pumps, and rigorous quality assurance standards for backup safety equipment such as power supplies. But these changes so far haven't had much of an impact on the overall cost…"[36]

Suggestions that nuclear power plants could operate for 60, or 80, or even 100 years add another element of risk. Owners of existing reactors hope that by extending the operating life, they will be able to delay the costs and other problems associated with licencing and constructing replacement reactors. On the other hand, when nuclear proponents predict long operating lives for yet-to-be-constructed plants, their motivation is to use this as an argument for reducing lifetime cost estimates, thus making their proposals sound more economically attractive (refer section k. below).

In fact, the oldest operating reactor in the world is 55 years old (Beznau 1, Switzerland), so anything beyond that is entering uncharted territory. One problem that is not fully understood, but which could lead to severe accidents in aging nuclear reactors, is irradiation embrittlement of pressure vessels. In a worst case scenario, this could result in "[d]estruction of a reactor pressure vessel due to neutron irradiation embrittlement ... If the pressure vessel breaks, there is almost no way of preventing a runaway chain reaction."[37] So it is not just a matter of plucking a number out of the air. Running aging reactors involves risk-taking with potentially serious consequences.

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[35] Ed Lyman, 'Five Things the "Nuclear Bros" Don't Want You to Know About Small Modular Reactors', Union of Concerned Scientists, 30 April 2024
https://blog.ucsusa.org/edwin-lyman/five-things-the-nuclear-bros-dont-want-you-to-know-about-small-modular-reactors/
See also:
Ed Lyman, *"Advanced" Isn't Always Better: Assessing the Safety, Security, and Environmental Impacts of Non-Light-Water Nuclear Reactors*, Union of Concerned Scientists, 18 March 2021
https://www.ucsusa.org/resources/advanced-isnt-always-better
Ed Lyman, *Small Isn't Always Beautiful: Safety, Security, and Cost Concerns about Small Modular Reactors*, Union of Concerned Scientists, September 2013
https://www.ucsusa.org/sites/default/files/2019-10/small-isnt-always-beautiful.pdf

[36] Ed Lyman 2024 op. cit.

[37] Hiromitsu Ino, 'Aging Nuclear Power Plants focusing in particular on irradiation embrittlement of pressure vessels', *Nuke Info Tokyo*, No. 148 and No. 149, May/June 2012 and July/August 2012
http://www.cnic.jp/english/newsletter/nit148/nit148articles/irradiation_embrittlement.html
http://www.cnic.jp/english/newsletter/nit149/nit149articles/06_aging.html

Unfortunately, regulators don't always act on the side of caution.[38]

Besides internal risks, nuclear power plants also face external risks: for example, earthquakes, tsunamis, floods, cyclones, bushfires, aeroplane crashes, acts of terror and acts of war. It has been said that nuclear reactors are pre-positioned nuclear weapons. Russia's war on Ukraine demonstrates how real that threat can be.[39] Nuclear power plants can be engineered to reduce these risks, but that does not completely eliminate the risks, and it comes at a cost. As discussed above, the nuclear industry is keen to minimise costs, even at the expense of safety, and regulators can't always be relied on to enforce the highest safety standards.

When all else fails, there are emergency response plans. The Fukushima nuclear disaster showed how inadequate these can be. Emergency response zones are designated for planning purposes, with labels such as 'Precautionary Action Zone' (PAZ) and 'Urgent Protective Action Zone' (UPZ). These zones are mapped in concentric circles around nuclear sites. But the severity of the impact does not decrease in concentric circles as you get further from the accident site. In the case of Fukushima, the direction of the prevailing winds meant that most of the radioactivity was blown eastward out to sea, but the wind changed direction and, a few days after the earthquake, rain and snow dumped a large amount of radioactive material on the village of Iitate, about 45 kilometres to the north-west. It then took over a month for the evacuation of Iitate to be ordered, because most of Iitate was outside the concentric circles designated for emergency responses.[40] The evacuation order for Iitate was partially lifted in 2017, with the remainder not lifted until 2023, but most of the residents will never return.[41]

For the benefit of those who seek to downplay the Fukushima nuclear accident, it is worth noting that it was not the worst case scenario. As mentioned above, most of the radioactive fallout was blown out to sea. The impact would have been much worse if the wind had blown the radioactive contamination over the land. It would also have been far worse but for a remarkable stroke of luck. The Unit 4 spent fuel pool narrowly avoided boiling dry due to an unplanned extension of maintenance work just before the earthquake and tsunami devastated the plant. That extension meant the reactor cavity was full of water (contrary to the normal situation) and that water was able to flow from the reactor cavity into the spent fuel pool (contrary to design expectations) and prevent it from boiling dry.[42] At the time, Shunsuke Kondo, Chairman of the Japan Atomic Energy Commission, advised then Prime Minister Naoto Kan that if the spent fuel pool boiled dry, causing the stored spent fuel to melt, it could be necessary to evacuate Tokyo.[43,44]

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[38] Ibid.

[39] Mary Glantz, 'Russia's New Nuclear Threat: Power Plants as Weapons', United States Institute of Peace, 24 August 2022
https://www.usip.org/publications/2022/08/russias-new-nuclear-threat-power-plants-weapons

[40] FoE Japan, 'Urgent Request concerning Planned Evacuation Zone Classification of Iitate Village and surround areas', 17 April 2011
https://www.foejapan.org/en/news/110511.html

[41] 'Evacuation order lifted in last of 6 impacted Fukushima areas', *Kyodo News*, 1 May 2023
https://english.kyodonews.net/news/2023/05/5a30f5566ae8-evacuation-order-lifted-in-last-of-6-impacted-fukushima-areas.html

[42] 'The Yoshida Testimony, The Fukushima nuclear accident as told by plant manager Masao Yoshida – Epilogue: Water is there!', *The Asahi Shimbun*,
http://www.asahi.com/special/yoshida_report/en/epilogue.html

[43] "A decrease in the water level could have caused exposure and overheating of the nuclear fuel and a massive

Nuclear accidents can result in radiation exposure for the public, but everyday operation of nuclear reactors also leads to radiation exposure for workers. Epidemiological studies have shown that even low levels of exposure can have deleterious health effects. The INWORKS (ionising radiation in workers) studies followed a cohort of "309,932 workers with individual monitoring data for external exposure to ionising radiation" in France, the United Kingdom, and the United States. They concluded,

> "The summary estimate of excess relative rate solid cancer mortality per Gy is larger than estimates currently informing radiation protection, and some evidence suggests a steeper slope for the dose-response association in the low dose range than over the full dose range."[45]

In other words, the current radiation protection standards are inadequate. While the study supports a "linear association between protracted low dose external exposure to ionising radiation and solid cancer mortality" (the standard view accepted by the International Commission on Radiological Protection, which assumes a linear relationship between radiation dose and risk[46]), there is some evidence that effects of radiation exposure could be proportionally larger for lower doses. That is bad news for workers.

There is also evidence that the routine operation of nuclear power plants is associated with clusters of childhood leukaemia in the surrounding communities, although a cause of this association has not been definitively established. Radiation expert Ian Fairlie says,

> "It is undeniable that there is a clear and strong pattern of increased child leukaemia rates near NPPs around the world … However, few scientists agree on what causes the cancers … But a new study has put forward a detailed explanation for the cancers."[47]

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discharge of radiation and radioactive substances. That would not only have made the entire Fukushima No. 1 nuclear plant inaccessible, but also could have led to the abandonment of the Fukushima No. 2 plant and other nuclear power plants located nearby.
"Worst-case scenarios envisaged by the governments in Tokyo and Washington involved the evacuation of residents from the Tokyo metropolitan area."
Toshihiro Okuyama, 'Fukushima No. 4 reactor saved by upgrade mishap', *The Asahi Shimbun*, 8 March 2012

[44] Yuri Kageyama, 'Japan official faults nuke design, defends secrecy', *Associated Press*, 14 February 2012
https://www.nrc.gov/docs/ML1209/ML12093A090.pdf

[45] David B Richardson et al, 'Cancer mortality after low dose exposure to ionising radiation in workers in France, the United Kingdom, and the United States (INWORKS): cohort study', *The BMJ*, 16 August 2023
https://www.bmj.com/content/bmj/382/bmj-2022-074520.full.pdf

[46] International Commission on Radiological Protection, *ICRP Publication 99: Low-dose Extrapolation of Radiation-related Cancer Risk*, 2005
https://www.icrp.org/publication.asp?id=ICRP%20Publication%2099

[47] Ian Fairlie, 'Infant Leukaemia near Nuclear Power Stations', Campaign for Nuclear Disarmament, October 2014
https://cnduk.org/resources/infant-leukaemia-near-nuclear-power-stations/
Ian Fairlie, 'Childhood Leukemias Near Nuclear Power Stations: new article', 25 July 2014
https://www.ianfairlie.org/news/childhood-leukemias-near-nuclear-power-stations-new-article/
Ian Fairlie, 'A hypothesis to explain childhood cancers near nuclear power plants', *Journal of Environmental Radioactivity*, Volume 133, July 2014, Pages 10-17
https://www.sciencedirect.com/science/article/abs/pii/S0265931X13001811

i. potential share of total energy system mix

So far, the Coalition has named seven proposed sites, but it hasn't yet given a clear answer to the question of how many nuclear reactors or how much nuclear generation it proposes to introduce. Ian Lowe makes the following assessment, based on one reactor per site, with the qualification that the idea that any could be operating by 2035 is "pure fantasy":

> "The media release[48] claims "90 per cent of baseload electricity, predominantly coal fired power stations, is coming to the end of life over the next decade". The clear implication is that the proposed nuclear power rollout would replace those plants. In fact, we now have about 21 gigawatts of coal-fired electricity. Three of the 15 power stations – Eraring and Vales Point B in New South Wales and Callide B in Queensland – are certainly scheduled to close by 2034 and take with them about five gigawatts of generating capacity. If a future Coalition government were to build its proposed seven nuclear power stations, that would roughly replace the three units that are certain to close. If 90 per cent of the capacity does actually retire, as the media release said, the proposed nuclear program would replace only about 30 per cent of the removed generation."[49]

Professor Lowe addresses the question of the share of total energy system mix, at the same time as criticising the Coalition's claim that its nuclear plan would be less expensive than Labor's renewable plan.

> "[T]he comparison is totally invalid. It compares an inflated estimate of the cost of providing enough renewables to meet all our needs with the unknown figure of the price of seven reactors. If they were ever to be built, they would provide about six gigawatts of generating capacity. Our installed capacity now is about nine times that much. A serious emissions reduction program will mean replacing petroleum transport fuels and gas heating with electricity. That will require doubling our capacity over the next decade. The Coalition is comparing apples with watermelons. They contrast the still-unrevealed cost of nuclear reactors to meet about 5 per cent of our needs with an inflated estimate of the cost of building enough renewables to supply our total demand."[50]

Bill Grace of The University Of Western Australia suggests an even smaller percentage of Australia's electricity demand: "According to analysis by the Smart Energy Council[51] the Coalition's proposed seven nuclear reactors would only provide 3.7% of Australia's electricity demand by 2050."[52] Grace goes on to point out that nuclear energy would be competing directly with renewables. More renewables constrains the potential for nuclear and vice-versa because inflexible nuclear is a poor fit with variable renewables. He draws attention to a paradigm shift that has occurred (about which nuclear proponents of nuclear and coal are still in denial), namely that "'always on' baseload power is no longer necessary or commercially viable."

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[48] Peter Dutton, David Littleproud & Ted O'Brien, 'Media Release: Australia's Energy Future', The Liberal Party of Australia, 19 June 2024
https://www.liberal.org.au/latest-news/2024/06/19/australias-energy-future
[49] Ian Lowe, 'Peter Dutton's nuclear lies', *The Saturday Paper*, August 10–16, 2024, No. 512
https://www.thesaturdaypaper.com.au/2024/08/10/the-opposition-leaders-nuclear-lies#mtr
[50] Ibid.
[51] Smart Energy Council, 'Nuclear Fallout: $116-$600 billion to build 7 nuclear reactors', 22 June 2024
https://smartenergy.org.au/articles/nuclear-fallout-116-600-billion-to-build-7-nuclear-reactors/
[52] Bill Grace, 'No room for nuclear power, unless the Coalition switches off your solar', *The Conversation*, 15 July, 2024
https://theconversation.com/no-room-for-nuclear-power-unless-the-coalition-switches-off-your-solar-234156

j. necessary land acquisition

There will undoubtedly be local opposition to any proposal to build a nuclear power plant. Such a proposal will inevitably create divisions within the local community, as have proposals to site nuclear waste dumps. Promises of jobs and subsidies will be made. Some people might be persuaded, others will be sceptical, while others will worry about the risks and be unwilling to accept a nuclear power plant no matter how much the government offers to pay them.

The Coalition has indicated that it would be willing to compulsorily acquire the necessary land, regardless of the will of the local residents, state and local governments, or Traditional Owners. However, in the absence of a social licence to proceed, there is a possibility the project will be abandoned before it is completed, as has happened in other countries.[53] Even if a determined Coalition government was willing to over-ride local opposition, it has a duty to dispassionately assess whether the project is able to withstand political vicissitudes over the long term, including future changes of government.

k. costs of deploying, operating and maintaining nuclear power stations

All estimates based on real life experience show that nuclear energy is much more expensive than renewable energy. Final costs of nuclear power plants have invariably come in many times higher than the original estimates of project proponents and the plants were completed many years behind schedule. Refer Appendix 1 for details of costs and construction times for the most recently constructed nuclear power plants in Europe and the United States. Appendix 2 provides evidence that SMRs, although no actual examples exist, are unlikely to fare much better.

CSIRO's *GenCost 2023-24* compared life-cycle costs of various forms of electricity generation, including SMRs and large-scale nuclear.[54] SMRs were found to be significantly more expensive than the other alternatives considered, while large-scale nuclear was considerably more expensive than solar PV and wind with firming and even more expensive than solar thermal. The Coalition and the Murdoch press have not missed an opportunity to attack the *GenCost* reports on grounds such as *GenCost*'s assumptions regarding economic life and capacity factor. They don't acknowledge the distinction drawn by CSIRO between 'economic life' and 'operating life', besides which the historical record casts doubt on the Coalition's preferred 'operating life' of 60 years.[55] As for capacity factor, figures in the 90 percents, as proposed by nuclear proponents, would require prioritisation of nuclear at the expense of variable renewables and other generators with lower marginal costs.

The Coalition has not released its official cost estimates, but when it states that nuclear power is

[53] Refer examples in footnote 4.
[54] Paul Graham, Jenny Hayward and James Foster op. cit.
[55] Mycle Schneider & Antony Froggatt, *The World Nuclear Industry Status Report 2024*, pp. 64-49 https://www.worldnuclearreport.org/IMG/pdf/wnisr2024-v1.pdf

cheap it typically refers to claims by vendors,[56] or quotes cheaper electricity prices in countries with nuclear power plants. We deal with electricity prices in the next section. As for vendors' estimates, these are not a credible basis for estimating costs for Australia. Paul Graham, Chief Economist, Energy for CSIRO made the following comment to the Senate Environment and Communications Legislation Committee on 15 May 2023:

> "When we track down new reports that come out around nuclear power, everything that we've seen in the last few years traces back to a vendor estimate. So, there'll be a report by Steve Wilson or by someone else—many of the people that you've heard this morning—but when you trace down what data they used to see if there is any new data here that we can use to bring in to GenCost, invariably it just traces back to another vendor estimate. We regard vendor estimates as the lowest quality data."[57]

The repeated experience of final costs coming in multiple times higher than the vendors' original estimates backs up Mr Graham's criticism.

Another source for the Coalition's claims that nuclear is cheap is the Australian Nuclear Science and Technology Organisation (ANSTO). The poor quality of ANSTO's advice is explained in the following extended quote from economics professor at the University of Queensland, John Quiggin.

> [I]t may have come as a surprise to hear shadow energy minister Ted O'Brien cite ANSTO as the source for an estimate that a small modular reactor (SMR) could be constructed in three to five years, and a large reactor in eight to 12 years.
> Appearing on the ABC's 7:30 report in mid-March, O'Brien stated "that is the advice from ANSTO. That is the advice of the Albanese government's nuclear agency". In view of the fact that widely publicised advice from an extensive study undertaken by CSIRO yields much less optimistic conclusions, that seems like a surprising claim….
> In a submission to the Senate standing committee on environment and the communications inquiry into the environment and other legislation amendment (Removing Nuclear Energy Prohibitions) Bill 2022, ANSTO stated that SMRs "have the potential to reduce build costs using a variety of strategies, including reducing plant build times from six to eight years for large reactors to two and a half to four years for SMRs via the use of series-production methods"….
> A natural response from an interested member of the public would be to visit the ANSTO website to get more detailed information on the assessment of nuclear technology. This leads us to a webpage titled "What are small modular reactors and what makes them different?", which leads with the claim "the USA is expected to have its first SMR operating by 2026" and includes the timeframe of three to five years for construction.
> A note hastily added in the last week states: "Please note that this content was current at the time of publishing (July 2020), and the projected construction time of SMRs (three to five years) is referenced from a University of Leeds research paper. In November 2023, NuScale announced it was discontinuing its SMR project in Idaho."

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[56] "Peter Dutton has pledged that if elected, the Coalition could deliver the first small modular reactors into the grid by the mid-2030s, with British manufacturer Rolls-Royce understood to be able to deliver them at an estimated $3.5bn to $5bn each."
Simon Benson, 'Cheap power bills in nuclear backyard: Dutton', *The Australian*, April 5, 2024
https://www.theaustralian.com.au/nation/politics/peter-dutton-vows-to-bring-small-nuclear-reactors-online-in-australia-by-mid2030-if-elected/news-story/eaf9eaf2084916fa118fbeebf2ed72c9

[57] Inquiry into Environment and Other Legislation Amendment (Removing Nuclear Energy Prohibitions) Bill 2022

> Even in 2020, this research was out of date. The NuScale project, originally projected to be delivering power in 2023, had already pushed its target past 2026 by then….
> The University of Leeds paper is more interesting. It turns out to be a literature survey covering the period 2004-19. The three- to five-year estimate for the construction time for SMRs is taken from a non-peer-reviewed 2016 report by consulting firm Ernst and Young (which worked with one of the authors on the University of Leeds study). The information used to compile the report is even older, going back to 2014 or earlier. To put it bluntly, this is worthless.
> Rather than complying with its legal obligation to keep abreast of nuclear power technology and inform the public of its findings, ANSTO has relied on decade-old, unverified claims, made by a consulting company. This sloppy treatment of an issue that should be a central focus of ANSTO analysis contrasts sharply with the careful assessment undertaken by CSIRO.[58]

l. the impact of the deployment, operation and maintenance of nuclear power stations on electricity affordability

The Coalition and the pro-nuclear media cite electricity prices in countries with nuclear power plants and attempt to show that Australian prices are comparatively high.[59] In contrast, the Institute of Energy Economics and Financial Analysis (IEEFA) "found that electricity bills would need to rise in order for nuclear costs to be recovered ... The average bill increase was AUD665/year."[60]

IEEFA's report debunks claims by nuclear proponents that electricity prices in countries with nuclear power plants are cheaper than Australia, showing how these claims are misleading. The examples quoted by nuclear propagandists in the Murdoch press 'forget' to point out that low prices are (a) applicable to nuclear power plants that have already been paid for (i.e. not applicable to Australia which would be building new plants with large upfront costs), (b) artificially low due to government subsidies, and (c) artificially low because the government had to rescue the operators from insolvency due to disastrous nuclear investments. Comparing these electricity prices to the electricity prices in Australia is like comparing apples and pears.

It is worth quoting IEEFA at length to show just how misleading these electricity price comparisons are.

> "[I]n almost all cases around the world, the cost of nuclear power plant construction and financing is not fully reflected in market prices for power. This is because either nuclear power plants are very

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[58] John Quiggin, 'On nuclear, Coalition prefers the optimism of misleading, decade-old, unverified claims', *Crickey*, 20 March 2024
https://www.crikey.com.au/2024/03/20/coalition-nuclear-power-ansto-csiro-small-modular-reactors/

[59] "We could be like Ontario, where they've got 60 or 70 per cent nuclear in the mix, and they're paying about a quarter of the price for electricity that we are here in Australia."
Peter Dutton. 'Leader of the Opposition – Transcript – Joint Doorstop Interview with the Hon Barnaby Joyce MP and Cr Steve Reynolds, Muswellbrook 24 July 2024'
https://www.peterdutton.com.au/leader-of-the-opposition-transcript-joint-doorstop-interview-with-the-hon-barnaby-joyce-mp-and-cr-steve-reynolds-muswellbrook/

[60] Johanna Bowyer and Tristan Edis, 'Nuclear in Australia would increase household power bills', Institute of Energy Economics and Financial Analysis, September 2024
https://ieefa.org/resources/nuclear-australia-would-increase-household-power-bills

old and their costs are largely depreciated, or governments have acted to recover the costs either through taxpayers, or via levies which are independent of electricity markets – for example in France, the UK and Ontario, Canada. In other jurisdictions, such as a number of US states including Georgia where the Vogtle power plant is located, there isn't actually an electricity market in operation, with consumers instead served by a regulated monopoly without any competitive choice." (pp. 8-9)

"The Coalition has cited Ontario, Canada, as a state with lower power prices in a high nuclear grid (59% nuclear). However, Ontario's lower retail electricity bill costs are largely a function of low network costs and government power price subsidies. Ontario consumers pay for network costs via a charge which is separate to their kWh price charges and is denoted on the bill as "delivery", whereas in Australia network fees make up a large proportion of kWh price charges.
"More importantly, disastrous blow-outs in the cost of Ontario's nuclear build program aren't fully reflected in current power prices. In fact, Ontario was forced to undertake a major restructure of its electricity sector in the 1990's due to the fact that the state-owned utility had accumulated unsustainable debts of CAD38.1 billion (as at 1999) due to large cost blow-outs in its nuclear build program and poor utilisation of these assets. Under this restructure, CAD20.9 billion (1999 Canadian dollars) of Ontario Hydro's debt was declared by the Ontario Electricity Financial Corporation as stranded debt which 'cannot reasonably be serviced and retired in a competitive electricity market.'" (p. 28)

m. any other relevant matter

(i) Climate

Nuclear power is variously promoted as being 'zero emissions', 'clean', 'sustainable' and so on. In fact, it is none of these.

The production of nuclear energy leads to carbon emissions at each stage in the chain from cradle to grave. Nuclear power plants emit minimal carbon dioxide during the electricity generation phase (none from the fission reactions), but uranium mining, conversion, enrichment, fuel fabrication, construction, decommissioning and waste disposal all produce large quantities of carbon dioxide.[61] It has been estimated that lifecycle greenhouse gas (GHG) emissions from nuclear energy could be about six times that of hydro-electricity, maybe twice as much as wind, and about 30% higher than solar. That is not to deny that nuclear results in much lower GHG emissions than fossil fuels (maybe 7 - 10 times less than natural gas and 15 times less than coal).[62,63] These are ball-park figures subject to many assumptions. But they don't qualify nuclear as being 'clean' or 'green' or 'environmentally sustainable'. Instead of GHGs, nuclear energy produces radioactive waste.

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[61] US Energy Information Administration, 'Nuclear explained: Nuclear power and the environment', Last updated: 7 November 2022
https://www.eia.gov/energyexplained/nuclear/nuclear-power-and-the-environment.php

[62] Daniel Nugent & Benjamin K. Sovacool, 'Assessing the lifecycle greenhouse gas emissions from solar PV and wind energy: A critical meta-survey', *Energy Policy* 65, 2014, p. 241
https://www.sciencedirect.com/science/article/abs/pii/S0301421513010719

[63] Manfred Lenzen, 'Is nuclear power zero-emission? No, but it isn't high-emission either', *The Conversation*, 21 May 2015
https://theconversation.com/is-nuclear-power-zero-emission-no-but-it-isnt-high-emission-either-41615

Importantly, a large portion of the GHGs associated with nuclear power will be emitted before any electricity is generated. The construction of new nuclear power plants for Australia will actually push up our GHG emissions before any reductions are realised, which is a major problem given that emissions reductions are needed urgently now. Furthermore, while we wait for nuclear power plants to come on line, the Coalition plans to continue to rely heavily on coal and gas. Former Australian Chief Scientist Dr. Alan Finkel, by no means an opponent of nuclear energy, said, "Any call to go directly from coal to nuclear is effectively a call to delay decarbonisation of our electricity system by 20 years."[64] Meanwhile, the director-general of the UN's International Renewable Energy Agency recently wrote,

> "According to the Intergovernmental Panel on Climate Change, accelerating renewables coupled with energy efficiency measures are the most realistic means to reduce global emissions by 43 percent by 2030 and at least 60 percent by 2035.
> "Due to lower cost and higher efficiency, the IPCC has stated that renewables, particularly solar and wind, are ten times more effective at cutting carbon dioxide emissions than nuclear."[65]

(ii) Need for demand-side strategies

In our quest to transform the energy system, we must place just as much emphasis on demand as on supply. Policies aimed at energy efficiency and demand response are essential if we are to create a sustainable energy system.

One reason why electricity demand is projected to grow is the increasing electrification of the energy system. Heating and transport, which traditionally used fossil fuels, are increasingly shifting to electricity. This creates challenges, but it also creates opportunities by increasing the potential for demand management. For example, if consumers are incentivised to shift their consumption so that it more closely matches the availability of electricity from renewable resources such as wind and solar, it is possible to reduce the total generating capacity that is required. According to a report prepared for ARENA by the University of Technology Sydney's Institute for Sustainable Futures,

> "As flexible demand involves using existing assets more efficiently to match supply, it is generally lower cost than building new supply to match demand and enhances the reliability of the electricity grid."[66]

Unfortunately, there are only

> "… a small number of Flexible Demand (FD) government or regulator programs currently in operation in Australia, which relative to leading international jurisdictions are less well

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[64] Dr Alan Finkel, 'Here's why there is no nuclear option for Australia to reach net zero', *The Guardian*, 22 Mar 2024 https://www.theguardian.com/commentisfree/2024/mar/22/heres-why-there-is-no-nuclear-option-for-australia-to-reach-net-zero

[65] Francesco La Camera & Paul Dorfman, 'Compelling Economics of Renewables Unmask Fossil Fuels and Nuclear', *DC Journal*, November 7, 2024
https://dcjournal.com/compelling-economics-of-renewables-unmask-fossil-fuels-and-nuclear/

[66] Briggs, C., Roche, D., Ibrahim, I. 2024, *Flexible Demand – the Current State of Play in Australia*, Institute for Sustainable Futures, UTS, Report prepared for ARENA, p.5
https://arena.gov.au/assets/2024/06/UTS-Flexible-Demand-State-of-Play-in-Aust-Report.pdf

> developed."[67]

It is also important to increase energy efficiency.

> "…energy efficiency action is the unambiguous first and best response to simultaneously meet affordability, supply security and climate goals." International Energy Agency (IEA), 2022 [68]

This can be achieved without loss of amenity by designing dwellings, factories and cities that are inherently low-energy. Unfortunately, Australia's current energy efficiency standards are not ambitious enough.

> "Australia is currently ranked as the worst developed major energy user for energy efficiency policy and practice."[69]

(iii) Nuclear proliferation

While in the short to medium term Australia is unlikely to use a nuclear energy program as a cover for a push to develop nuclear weapons, it would be remiss to ignore this central problem, which is inextricably connected with nuclear energy.

In the 1950s and 60s Australia seriously considered acquiring nuclear weapons. "It was not until 1973, when Australia ratified the NPT, that the country finally renounced the acquisition of nuclear weapons."[70] Although acquisition of nuclear weapons might not be on the agenda now, that doesn't mean there aren't influential people keen to keep our options open. These people are particularly keen for Australia to develop capabilities in 'sensitive' components of the nuclear fuel cycle, such as uranium enrichment. Rod Lyon of the Australian Strategic Policy Institute put it this way.

> "True, an Australian enrichment capability would also be a strategic signal. It would constitute a hedge against any sharp deterioration in the regional security environment—a hedge similar to that enjoyed by a range of other countries around the world and in all likelihood one we'll never need, because we're already protected by US nuclear weapons under the ANZUS alliance. Still, the 21st century strategic order hasn't yet unfolded in Asia. Keeping options open is no bad thing."[71]

The existence of these dangerous ideas is arguably the strongest reason for Australia not to acquire nuclear power plants. If Australia commits to nuclear power, the calls for a uranium enrichment

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[67] Ibid. p.13

[68] International Energy Agency 2022, *Energy Efficiency 2022*, IEA, Paris. Quoted in Murray-Leach, R. 2023, *Clean Energy, Clean Demand, Energy Efficiency Council*, Melbourne. Version 1.0, p.7
https://www.eec.org.au/uploads/Projects/EEC%20Clean%20Energy%20Clean%20Demand%20-%202023.pdf

[69] American Council for an Energy Efficient Economy 2022 *International Energy Efficiency Scorecard 2022*, ACEEE, Washington DC. Referenced in Murray-Leach, R. 2023, *Clean Energy, Clean Demand, Energy Efficiency Council*, Melbourne. Version 1.0, p.9

[70] Jim West, 'Surprise Down Under: the secret history of Australia's nuclear ambitions', *The Nonproliferation Review*, Fall 1997
https://www.nonproliferation.org/wp-content/uploads/npr/walsh51.pdf

[71] Rod Lyon, 'Australia and the enrichment option', *The Strategist*, The Australian Strategic Policy Institute, 5 Nov 2015
https://www.aspistrategist.org.au/australia-and-the-enrichment-option/

industry will become louder, camouflaged by talk of ‘value-adding’ to our uranium mining industry. What these calls overlook is that one person’s ‘hedge’ is another person’s threat perception. It leads to a ‘hedge race’, which eventually leads to an arms race.

Rather than escalating regional tensions in this way, Australia will be more secure if it works to build trust within the Asia-Pacific region and within international institutions, by acting as an honest broker, eschewing ‘strategic signals’ of the type mentioned in the above quote. A good start would be to follow the lead of our regional neighbour Indonesia and sign and ratify the Treaty on the Prohibition of Nuclear Weapons.

Rebuilding regional trust has become even more important in light of the Australian Government’s unfortunate decision to purchase nuclear powered submarines, a decision which in itself puts pressure on the existing nuclear non-proliferation architecture, including the Nuclear Nonproliferation Treaty and the Treaty of Rarotonga. We have argued this case in submissions to the Senate Foreign Affairs, Defence and Trade Legislation Committee’s inquiry on the *Australian Naval Nuclear Power Safety Bill 2023*, and the Joint Standing Committee on Treaties’ inquiry into the *Agreement among the Government of Australia, the Government of the United Kingdom of Great Britain and Northern Ireland, and the Government of the United States of America for Cooperation Related to Naval Nuclear Propulsion*.

Philip White
On behalf of Friends of the Earth Adelaide

Appendix 1: Costs and construction times for recently constructed European and US nuclear power plants

Finland, Olkiluoto (EPR)

Platts Nuclear News Flashes, ‘TVO installs new reactor pump impellers at Olkiluoto-3 nuclear unit in Finland’, 7 February 2023

> “Olkiluoto-3 is more than 12 years behind its original scheduled start date and the unit's cost has also ballooned from the original estimate of just over Eur3 billion ($3.24 billion) to over Eur11 billion, according to the latest estimates from TVO.”

Wikipedia, ‘Olkiluoto Nuclear Power Plant’, Viewed 25 October 2024
https://en.wikipedia.org/wiki/Olkiluoto_Nuclear_Power_Plant

> “Commercial operation, originally scheduled for May 2009, began on 1 May 2023.”

France, Flammanville (EPR)

Giles Parkinson, ‘French nuclear giant scraps SMR plans due to soaring costs, will start over’,

RenewEconomy, 2 July 2024
https://reneweconomy.com.au/french-nuclear-giant-scraps-smr-plans-due-to-soaring-costs-will-start-over/

> "The Flammanville project in France was announced in 2004 with a budget of €3 billion and a deadline of 2012. It is still not in operation and its costs have soared at least four-fold to €13.2 billion."

UK, Hinkley Point (EPR)

Tim Buckley & John Hewson, 'Coalition claims of a nuclear power renaissance in UK further expose its shameless policy con', *RenewEconomy*, 10 Oct 2024
https://reneweconomy.com.au/coalition-claims-of-a-nuclear-power-renaissance-in-uk-further-expose-its-shameless-policy-con/

> "With a 2029-2031 commissioning date, Hinkley is running around 15 years late from its original targeted completion date of 2017.
> "It has a rapidly rising estimated construction cost of £41.6-47.9 billion, or A$80-93 billion."

Giles Parkinson, 'French nuclear giant scraps SMR plans due to soaring costs, will start over', *RenewEconomy*, 2 July 2024
https://reneweconomy.com.au/french-nuclear-giant-scraps-smr-plans-due-to-soaring-costs-will-start-over/

> "The Hinkley C project in the UK has been an even bigger disaster. EdF had promised in 2007 that it would be "cooking Christmas turkeys" in England by 2017, at a cost of £9 billion, but is already delayed to 2031 with a spiralling cost of £48 billion when inflation is taken into account, or $A93 billion."

United States, Vogtle (AP1000)

Patty Durand, Kim Scott & Glenn Carroll, 'Plant Vogtle: the true cost of nuclear power in the United States', May 2024
https://gcvedfund.org/plant-vogtle/

> "In 2009, Georgia Power began construction for the second set of reactors at Plant Vogtle. The initial budget was $14 billion, and new Westinghouse AP1000 reactors 3 and 4 were scheduled to be completed in 2016 and 2017, respectively. However, reactor 3 was completed in July 2023, and reactor 4 was completed in April 2024, taking 15 years to construct. The cost of construction for both reactors exceeds $36.85 billion."

Appendix 2: Problems encountered by SMRs in Europe and the US

United States, Nuscale
Giles Parkinson, 'Coalition's nuclear SMR poster boy cancels flagship project due to soaring costs', *RenewEconomy*, 9 November 2023
https://reneweconomy.com.au/coalitions-nuclear-smr-poster-boy-cancels-flagship-project-due-to-soaring-costs/

> "NuScale is often cited as the company with the most advanced plans on nuclear SMRs – a technology that does not actually exist in the commercial market – and had planned to build six such 77 MW reactors in Utah under a much vaunted proposal.
> "But the contract has been cancelled because its proposed customers – mostly municipal based utilities – refused to pay the target price for nuclear power, which had already jumped earlier this year by 53 per cent to $US89 a megawatt hour ($A139/MWh), despite a $US30/MWh subsidy from the US government…
> "NuScale is the only developer of SMRs to have received a licence from US nuclear regulators."

France, Nuward

Giles Parkinson, 'French nuclear giant scraps SMR plans due to soaring costs, will start over', *RenewEconomy*, 2 July 2024
https://reneweconomy.com.au/french-nuclear-giant-scraps-smr-plans-due-to-soaring-costs-will-start-over/

> "The French investigative outlet L'Informé reported on Monday that EdF had scrapped its new internal SMR design – dubbed Nuward – because of engineering problems and cost overruns."

UK, Rolls Royce

Josh Lamb, 'Rolls-Royce mini nuke arm posts wider £78mln loss', *proactive*, 9 October 2024
https://www.proactiveinvestors.co.uk/companies/news/1057968/rolls-royce-mini-nuke-arm-posts-wider-78mln-loss-1057968.html

> "Rolls-Royce Holdings PLC (LSE:RR.)'s mini nuclear reactor business has posted a £78 million loss for last year as news on government support for the industry is awaited.
> "The small modular reactor (SMR) business saw losses climb from £61 million a year earlier, as research and development spending grew from £78 million to £115 million."