Submission No 46

INQUIRY INTO URANIUM MINING AND NUCLEAR FACILITIES (PROHIBITIONS) REPEAL BILL 2019

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Date Received: 16 October 2019

Standing Committee on State Development
Parliament of New South Wales
Parliament House
6 Macquarie Street Sydney,
NSW 2000 Australia

Subject: Inquiry on the "Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019."

Dear Standing Committee State Development,

I am grateful for the opportunity to make a submission to this inquiry to repeal the *Uranium Mining and Nuclear Facilities (Prohibitions) Act* of 1986.

By way of background, I am a graduate of University of Queensland and Australian National University. I have previously held positions within the Queensland Public Service and since 2016 have been employed at the University of Oxford in Data Analyst roles first at Magdalen College and currently within the University Development Office.

I have developed a keen interest in energy and related matters here in Australia and globally. As such I have become an active participant in the energy discussion in Australia through several essays related to nuclear power and energy on Urbansource.com.au and Online Opinion. These include:

- Aussie nuclear power? Yes Please! (August 2019) https://www.onlineopinion.com.au/view.asp?article=20468\
- Time to go nuclear (October 2018) https://www.onlineopinion.com.au/view.asp?article=20010
- Confronting Energy Realities (February 2018) https://www.onlineopinion.com.au/view.asp?article=19559

My submission, which is enclosed below, will concentrate on nuclear energy and address the following key messages:

1. Australia is already an established nuclear nation with experience in managing and operating nuclear technology, undertaking nuclear research and is embedded in the nuclear fuel cycle.
2. Empirical evidence remains at odds with public perceptions and opposition arguments to nuclear energy based on health, safety, environmental impacts and economic feasibility.
3. With the need to act on climate change and growing concerns around energy reliability and affordability, Australians' aversion to nuclear power appears to be gradually waning.
4. The prohibition on nuclear energy in Australia at both the federal and state level remains the main inhibitor to further assessments regarding feasibility and development by both government and the private sector.

Please find enclosed with this letter my submission to the committee.

Yours sincerely,

Tristan Prasser
Oxford, United Kingdom

Overview

It is my belief that the central role of this committee is to overcome the mythology surrounding nuclear energy and uranium mining that has led to the current prohibition of both since 1986 in New South Wales (NSW). In doing so, this committee must facilitate a pathway for policy makers, industry and the public to constructively engage and consider how a nuclear energy and uranium mining industry can be implemented in NSW. Given the deepening energy woes confronting the NSW and more broadly Australia, along with the need to reduce carbon dioxide emissions to address climate change, it is becoming increasingly evident that nuclear energy is no longer an 'if' but a 'must'.

Indeed, much of the rationale that once existed in opposing nuclear energy no longer applies within the context of 21st century Australia and is increasingly a reflection of views held by a shrinking, but vocal and ideologically possessed minority. Lifting the prohibition of nuclear energy and uranium mining in NSW would enable the promise of nuclear energy to not only be considered for addressing the energy and environmental challenges of today, but also those of tomorrow. It is no longer appropriate to continue to make decisions in 2019, based on legislation passed in the 1980s, reflecting the views of the 1970s.

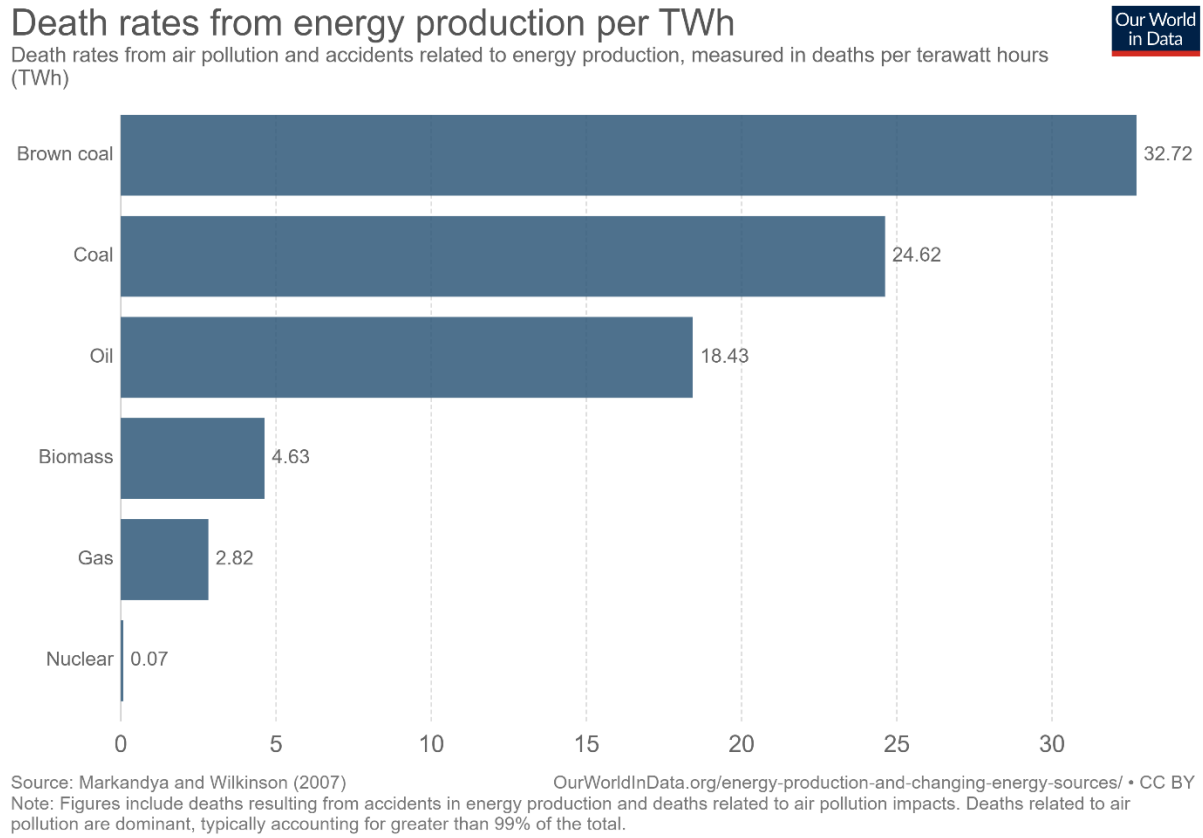
A nuclear nation:

Australia is already an established nuclear nation. Since the 1950s, Australia has had a long and positive relationship with civilian nuclear technology and research. Australia has operated three research reactors in the Sydney suburb of Lucas Heights, with the OPAL reactor being the latest iteration. This facility produces life-saving isotope medicine and enables a plethora of important scientific research.[1] Australia has developed its own solution to managing radioactive waste – Synroc[2] – which encapsulates waste in hot pressed rock matrices that will resist weathering for millennia. Australia's regulatory bodies such as Australian Nuclear Science and Technology Organisation (ANSTO) and Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) engage with the international community to ensure high standards of protection, security and operational best practice are maintained. With the largest known reserves of uranium in the world, Australia is a key supplier of uranium to the EU, China, India, Japan, South Korea and the US for use in civilian nuclear power plants to generate clean electricity to millions every year.

Myth 1 - Nuclear energy is unsafe and dangerous:

Globally, nuclear energy remains one of the safest forms of electricity generation available. Nuclear power's safety has been well documented in numerous reports and studies over the past 40 years. Markandya and Wilkinson in the medical journal *The Lancet* noted that nuclear power had "one of the smallest levels of direct health effects"[3], including the Chernobyl nuclear accident in the former Soviet Union. They determined that the death rates from energy production per Terawatt hour (TWh) from air pollution and accidents related to nuclear was 0.07, in comparison to brown coal at 32.72 and coal at 24.62[4]. This is outlined in the Graph 1 below from the economist Max Roser's website Our World in Data (https://ourworldindata.org/what-is-the-safest-form-of-energy).

Graph 1:



Hansen and Kharchea highlighted in 2013 that nuclear power provided “a large contribution to the reduction of global mortality”, calculating “a mean value of 1.84 million human deaths prevented by world nuclear power production from 1971 to 2009, with an average of 76,000 prevented deaths/year from 2000 to 2009.”[5] This is thanks primarily to the fact that nuclear power does not emit pollutants such as sulphur dioxide, nitrogen oxides, heavy metals and particulates, all of which are linked to adverse health impacts[6].

Nuclear power plant safety has improved significantly since 1990 as a result of technological improvements and a better understanding of the technology since the days of Chernobyl, Three Mile Island and more recently Fukushima. Concerns regarding another Chernobyl or Fukushima-style incident remain high in the public imagination, reinforced by popular culture references such as HBO’s *Chernobyl, The China Syndrome* and *The Simpsons*. These accidents have killed relatively few people in comparison to other sources of energy such as hydroelectricity or fossil fuels as highlighted above. No one died as a result of Three Mile Island, while there have been no radiation deaths attributed to the Fukushima accident, in comparison to the thousands who perished in the earthquake and subsequent Tsunami.[7]

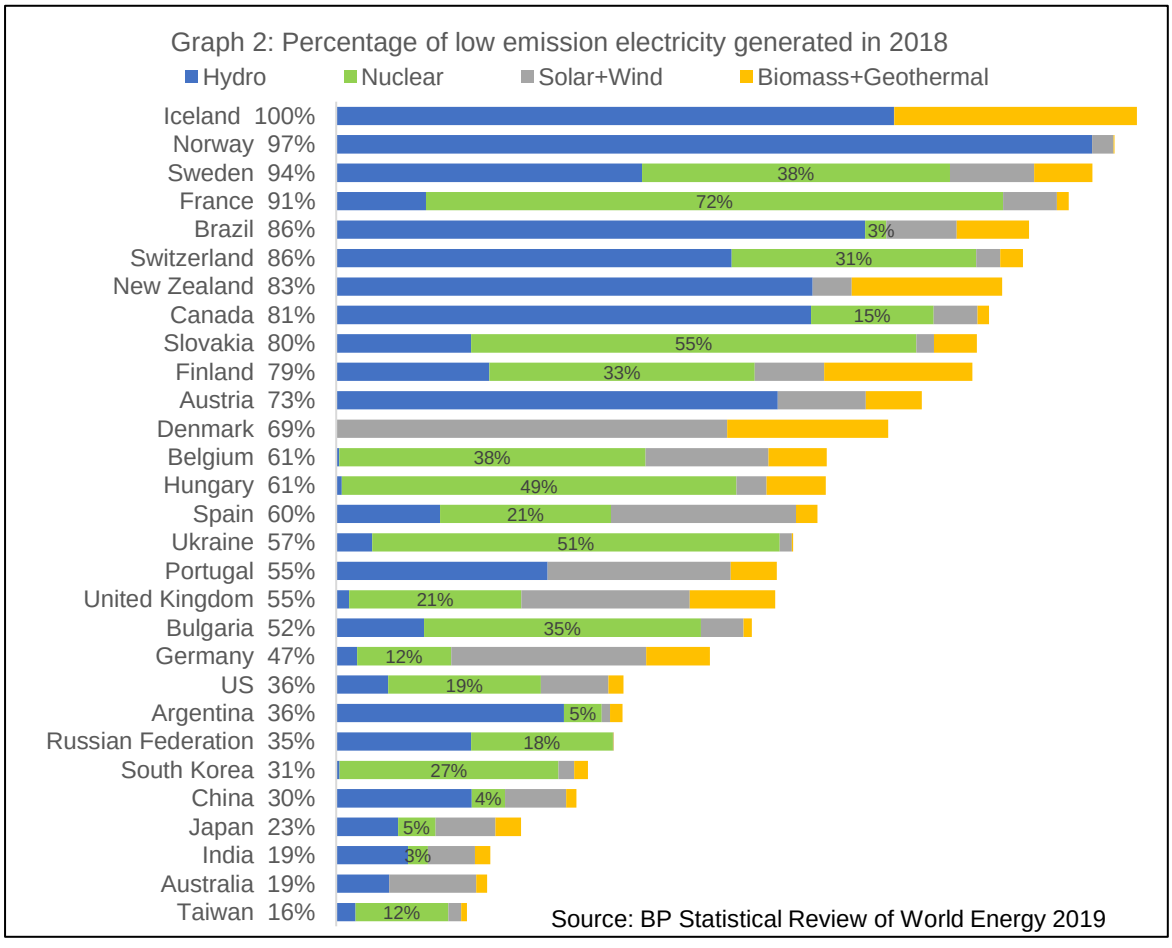
The reality is that designs connected to previous nuclear power plant accidents are no longer on the market and thus out-of-scope for consideration. Newer advanced reactor designs (such as Small Modular Reactors (SMRs)) that are coming online or in development are inherently safe as they are designed to operate on the laws of physics rather than use ‘active’ safety mechanisms.[8] This makes the possibility of a Chernobyl-style meltdown significantly reduced or simply physically impossible.

Finally, regarding the management of nuclear waste, the 2016 South Australian Nuclear Fuel Cycle Royal Commission extensively assessed and demonstrated that the management of nuclear waste is a well-developed process, backed by decades of scientific understanding and knowledge.[9] There are negligible environmental, or health impacts/risks posed by nuclear waste, as a result of nuclear energy having a closed-fuel cycle, that sees nuclear waste encapsulated, stored or recycled in purpose-built facilities.

Myth 2 – Nuclear energy harms the environment:

Carbon Dioxide Emissions: Nuclear reactors are a zero-carbon dioxide technology that have played and will continue to play a key role in reducing carbon dioxide emissions. The International Atomic Energy Agency (IAEA) notes that globally the "use of nuclear power avoids the emissions of nearly 2 billion tonnes of carbon dioxide every year – the equivalent of taking over 400 million cars off the road per year"[10]. Or the equivalent of taking 3.7 Australia's off the planet[11]. According to Hansen and Kharchea, "between 1971 to 2009 world nuclear power generation prevented an average of 64 Gigatonnes of CO2-equivalent".[12] The International Energy Agency (IEA)[13] and the Intergovernmental Panel on Climate Change (IPCC)[14] have stated that nuclear power alongside other technologies can make a significant contribution to cutting carbon dioxide emissions.

It is a proven technology that has assisted in rapidly decarbonizing electricity grids, as demonstrated by data from the BP Statistical Review of World Energy 2019. Graph 2[15] below highlights that it is predominately those countries that have a high share of nuclear power along with hydro and/or intermittent renewables such as wind and solar that generate the most amount of low-emission electricity.



Finally, it remains the only credible low-emission energy source to displace large amounts of fossil fuels outside the electricity sector. Global experience suggests nuclear power could play a major role in Australia providing process heat[16] for desalination, water treatment, synthetic fuel production (hydrogen for example) and industrial heat for steel and other manufacturing.

Other emissions: As mentioned above, nuclear energy also avoids other emissions and particulates that are produced by burning coal such as sulphur and nitrogen oxides that lead to acid rain and photochemical smog, heavy metals that harm human health and the release of radioactive elements into the surrounding environment.

Material input: Nuclear energy requires less material input (such as steel, concrete, rare earth elements and other materials) than other forms of energy production thanks to its high-power density. As highlighted in a US Department of Energy report in 2015, a conventional nuclear pressurized water reactor only requires 843 tonnes per TWh (tonnes/TWh) of materials compared to Wind's 10,260 tonnes/TWh or Solar's 14,920 tonnes/TWh.[17] Newer SMRs designs will require even less concrete and steel than current conventional reactors.

Land use: Nuclear power plants do not require as much land per megawatt as other low-emission technologies thanks to its high-power density. This was highlighted in a report into the land use of energy technologies in the US with the results shown in Table 1[18] below. Nuclear energy therefore does not suffer from the serious land use or transmissions right-of-way challenges that intermittent renewables do. Newer SMR designs aim to reduce this land use footprint even further.

Table 1 – Land use per energy sources in the US	
Electricity Source	Hectares per Megawatt Produced
Nuclear	5.14
Natural Gas	5.02
Solar	17.6
Wind	28.58
Hydro	127.56

Waste: Energy density of nuclear power's fuel means that in comparison to fossil fuels the amount of waste produced is small. For example, it is estimated that the ash produced by Australia's fleet of coal-fired power stations alone is 12 million tonnes per year[19], compared to the 400,000 tonnes of spent fuel (of which 25% is reprocessed) produced by ALL nuclear power plants ever[20]. This waste is stored securely and safely in spent fuel pools or dry casks requiring little use of land.

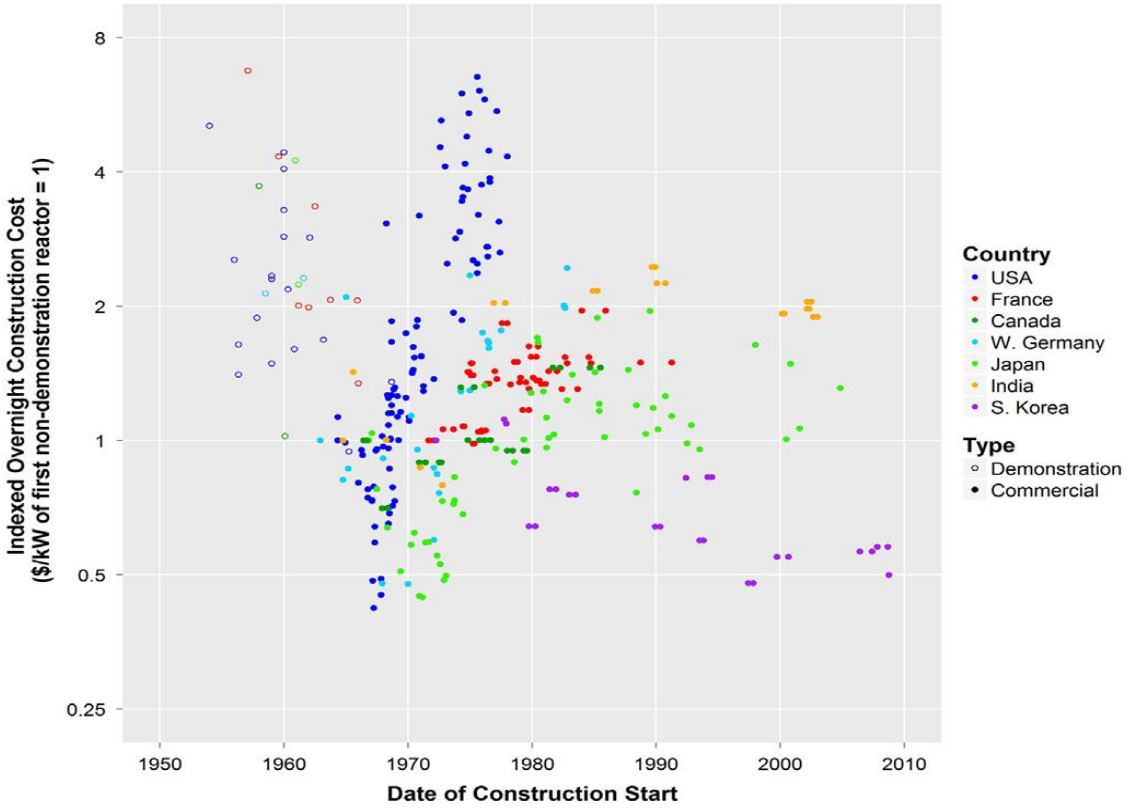
Water: Nuclear power plants would have a negligible impact on Australia's water security[21]. Indeed, Nuclear energy can only have a positive impact on ensuring Australia's fresh water is used in a more sustainable manner. Using process heat, nuclear power could assist in desalinating water sources to produce potable water for dry communities. There is well documented global experience where nuclear power plants have been used to desalinate water through reverse osmosis technology.[22]

Myth 3 – Nuclear is prohibitively expensive

Capital Costs: One of the predominate arguments brought against nuclear energy is cost – in particular, capital costs. It is acknowledged that conventional reactor builds have been characterised by high start-up and construction costs, especially in the West. The examples of Hinckley Point C (UK) and Olkiluoto (Finland) being cited as the prohibitive cost of nuclear energy. Start up and construction costs, however, vary significantly between different

countries and jurisdictions. A paper in 2016 by Lovering et al highlighted that such variance is the result of different material factors, including, to a large degree, regulation burdens, as demonstrated by the US and South Korea. While nuclear build costs have continued to rise in the US as result of its increased regulation, in South Korea construction costs have declined by 50% since the first nuclear reactor was built in 1971, or the equivalent of a 2% decrease per year, as shown in Graph 3 below.[23] Clearly in the right settings, nuclear power's capital costs can and will decline.

Graph 3 – Overnight capital costs. Lovering



In addition, it is anticipated that advanced reactor designs will address many of the construction cost issues that have long plagued nuclear projects in the West. Standardisation and modularity will assist in driving down the overnight and indirect costs, while mitigating construction risks and delays.[24] Even so, the contemporary experience of South Korea and United Arab Emirates, demonstrates that nuclear remains one of the most reasonable and affordable pathways to decarbonisation on a large-scale.

System Costs: Much of the focus of the energy debate when discussing different energy technologies focuses on the Levelised Cost of Energy (LCOE). It is a measurement used to compare different generation technologies based on the unit-cost of electrical energy over the lifetime of a generating asset. While it is a useful measure, it does not take into account the dispatch characteristics of a technology nor the full costs that will be imposed on the energy system such as transmission and other supporting infrastructure (back up and storage). LCOE is often used by opponents of nuclear energy as proof that is too costly in comparison to intermittent renewable technologies such as wind and solar and justify a transition to a 100% renewable system.

A number of studies into 100% renewable systems have shown that there is "a high degree agreement on several key features of renewable centric power systems that are likely to make these systems more costly and challenging than balanced low-carbon power systems

employing a diverse portfolio of resources." [25] This is due to the need to offset the intermittency of wind and solar energy technologies. Indeed, a recent Organisation for Economic Cooperation and Development (OECD) study highlighted that "the most efficient manner to achieve the ambitious emission objective of 50g CO_2 per Kilowatt hour (KWh) is to rely on nuclear power and hydroelectricity as dispatchable low-carbon generating solutions rather than on wind and solar PV."[26] It concluded that:

> "If OECD policy makers want to achieve such a deeply decarbonised electricity mix they must foster vigorous investment in low-carbon technologies such as nuclear energy, VRE and hydroelectric power. Where hydroelectric power is constrained by natural resource endowments, nuclear and VRE remain the principal options."[27]

Therefore, policy makers must carefully consider the full system implications and costs of an energy policy that cherry picks technological solutions based on the fashion of the day, rather than the medium to long-term needs of the energy market.

Energy security and reliability

Nuclear energy within the Australian context would offer energy diversification, grid resilience and baseload power. Just as you should never put all your savings into one stock, it is equally dangerous for a country or a state to rely too heavily on one source of energy. A transition solely towards a renewables-only model would leave NSW dangerously exposed to a) extreme weather events, b) other fuels, particularly gas-fired generation, used for back-up and c) dependence upon other states through interconnectors, as has been demonstrated in South Australia.

Energy diversification thus translates into grid resilience. Current conventional nuclear reactors only require refuelling every 18 to 24 months. Newer reactor designs such as Terrestrial Energy's Integral Molten Salt reactor will require refuelling every 7 years.[28] Nuclear power is also the only energy source that by design is immune to all extreme weather events.[29] This makes nuclear power plants significantly less vulnerable to supply disruptions (Oil shocks, gas supply issues) or significant weather events.

Nuclear energy provides baseload energy. Compared to intermittent renewables, which must be backed up with other fuels such as gas or have significant investment placed into storage, nuclear reactors provide reliable, 24/7, seven days a week, 365, always-on power.

Consensus and community engagement:

For nuclear energy to be adopted in NSW and more broadly Australia, politicians and policy makers must engage and convince the public that it is required. As Emeritus Professor of Physics Wade Allison from the University of Oxford stated, "The evidence makes plain the need for a root-and-branch cultural change in attitudes to nuclear technology."[30] There is no hiding from the fact that like any major change or reform, be it water fluoridisation, gun laws or financial deregulation, this will be at times challenging and face resistance from a vocal and ideologically motivated minority.

Yet there are indications that after years of public aversion to nuclear energy in Australia, this is beginning to wane. This observation is based on a series of polls conducted by various news and media outlets over the past 12 months[31]. This includes the recent Roy Morgan poll that demonstrated "a narrow majority of 51% (up 16% since 2011) of respondents say Australia should develop nuclear power to reduce Australia's carbon dioxide emissions."[32] Further to this industry groups are starting to seriously consider the option of nuclear energy,

as indicated by Industry Super Australia's public support earlier this year[33] and more recently the Australian Workers Union[34].

Reasons for this change may be that in the age of climate change action, electricity price hikes and reliability concerns, much of the original rationale underpinning Australians' aversion to nuclear energy no longer applies. As a result, there is scope for politicians, policy makers and industry leaders to engage further with the public on the potential of nuclear energy in NSW and Australia. This should start with discussions around lifting the current state prohibition on nuclear power and uranium mining to allow further feasibility and development assessments to progress. If successful, NSW should also lobby the Federal Government and opposition parties to reconsider its current prohibition on nuclear energy.

Removal of the prohibition on nuclear power:

NSW's current nuclear energy prohibition under the *Uranium Mining and Nuclear Facilities (Prohibitions) Act* remains the biggest barrier to the consideration and adoption of nuclear power in NSW. This prohibition continues to inhibit any further assessment on nuclear energy feasibility and development in the state and more broadly speaking Australia. It also continues inhibit further community engagement and building of national consensus on this issue. It is time for this antiquated and unjustified prohibition on nuclear energy to be lifted to allow for a true technologically agnostic approach to electricity generation and energy in NSW. Furthermore, it would provide an impetus the Federal government and other state governments to lift their current prohibitions on nuclear energy and/or uranium mining.

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