Inquiry into the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019

Dated: 16 October 2019

Executive Summary

Women in Nuclear (WiN) Global is a not for profit association of women and individuals of other genders who work professionally in various fields of nuclear technology and radiological applications. WiN Australia Inc. is the Australian chapter of WiN Global. WiN Australia values its position as a professional organisation and seeks to inform this debate through expertise and neutrality rather than lobbying.

Due to the ever-increasing concern of climate change, nuclear energy should be considered to be part of New South Wales' energy mix to reduce carbon emissions. Nuclear energy also provides stable, reliable power and can be cost effective, especially when considering the lifespan of a nuclear plant. The ability to have an educated and robust discussion on nuclear power generation is restricted due to current federal and state legislation.

A full list of recommendations are provided at the end of this submission. Key recommendations made to the committee are:

a. *Current legislation regarding nuclear power should be updated to allow nuclear power to be considered as part of the energy mix for reducing New South Wales' carbon emissions.*
b. *Due to the current prohibition on uranium mining in New South Wales, the understanding and viability of uranium resources within the state is not well known.*
c. *Nuclear energy is a proven, low emissions technology.*
d. *Nuclear reactors, especially small modular reactors, would be a suitable replacement for many of New South Wales' aging fossil fuel plants.*
e. *Opportunities in uranium mining lay in the reskilling of current fossil fuel mining employees.*
f. *New South Wales has existing expertise in nuclear technologies and large construction programs that could be utilised and expanded in the event that it adopts nuclear energy.*
g. *In order to be cost effective, many small modular reactors being built is a more economically feasible option rather than a couple of large reactors.*
h. *Effective and sophisticated solutions for waste management exist. These could be applied in New South Wales.*

i. *Australians, including residents of New South Wales, want affordable, reliable, low emissions electricity into the future, and nuclear energy can fulfill this.*
j. *Ongoing, persistent, technically sound and empathetic communication with communities, and New South Wales as a whole, is the best method to engage the community.*
k. *The general population in New South Wales would benefit from increased exposure to energy production and energy markets, and how the various sectors (e.g. residential electricity, industrial electricity, fixed energy etc) contribute to greenhouse gas emissions. This would enable more meaningful discussions on nuclear energy and uranium mining.*

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1. About Women in Nuclear

Women in Nuclear (WiN) Global is a not for profit association of women and individuals of other genders who work professionally in various fields of nuclear technology and radiological applications. WiN has over 35,000 members from 110 countries. One of the aims of WiN is to promote understanding and public awareness of the benefits of peaceful nuclear and radiological applications, including nuclear energy, especially amongst women and young people.

WiN Australia Inc. is the Australian chapter of WiN Global. Membership of WiN Australia includes individuals working professionally in many areas including research, nuclear operations, security, medicine and health care, waste management, regulatory authorities, mining, nuclear and radiation safety, industry, policy and communications. WiN Australia values

its position as a professional organisation and seeks to inform this debate through expertise and neutrality rather than lobbying.

1.1 WiN's Position on Nuclear Energy

The global WiN community sees nuclear energy technology as a key part of the solution in the fight against climate change. In 2015, WiN Global produced a document known as the *"Women in Nuclear Declaration for the Earth Climate"*. The document acknowledges:

- that the world's population should reach 10 billion people and electricity demand should double by 2050, and
- that if the world is to limit global warming to a maximum of 2°C by 2050, over 80% of electricity will need to come from all available low carbon technologies (Intergovernmental Panel on Climate Change, IPCC)

The Declaration calls for immediate steps to reduce carbon emissions that include nuclear energy as an option, as agreed by the IPCC, Organisation for Economic Co-operation and Development (OECD) and many other organisations.

WiN Australia also acknowledges the UN Sustainability Development Goals and understands that sustainable and reliable energy is a key part of meeting these goals. With around a billion people worldwide still without access to electricity, there is still much work to be done. As poverty, natural disasters, climate change and inequality inadvertently affect women and children the most, WiN Australia supports the move away from fossil fuel energy generation towards sources that will improve the lives of the world's poorest and those that will be most impacted by climate change.

1.2 ***Recommendation:*** *Nuclear energy is a proven, low emissions technology. It is recommended that the Committee considers not only the potential benefits of nuclear power to New South Wales' and Australia's national interest but also to the international community, in particular to women and children and those nations most affected by climate change across the globe.*

2. Why nuclear energy is feasible and suitable for New South Wales

Nuclear energy is an important part of the energy mix to meet New South Wales' growing need for reliable, affordable and clean power. Nuclear energy is a solution to the energy trilemma.

Nuclear energy offers the densest energy solution available and is technologically advanced. Small modular reactors and Generation IV reactors provide highly capable, scalable power solutions with an increased focus on accident resistance and a reduced threat to nuclear security. These reactors are able to service cities through to small remote towns with a reliable power supply on a reduced footprint in comparison to other energy forms, therefore allowing precious land to be salvaged for agriculture, industry, population growth or for wildlife and green areas.

Innovation is a key pillar within the nuclear industry. Nuclear energy offers significant opportunities to decarbonise not only the electricity sector but also the transport and fixed energy sectors. In the absence of significant hydropower, no other technology has so far demonstrated it can decarbonise electricity let alone other sectors.

If New South Wales is to remain competitive in the manufacturing and technology spheres, we need energy abundance, not energy deficiency. Nuclear offers reliability and abundancy with low carbon emissions, unlike other technologies that are intermittent and often rely on fossil fuels for backup.

3. Response to questions outlined in *Uranium Mining and Nuclear Energy in New South Wales*

3.a. Energy in New South Wales

3.a.1. Does the 'Energy Trilemma' framework of security, equity and environmental sustainability capture the key energy issues facing New South Wales? What other factors should be considered?

The energy trilemma framework as outlined by the World Energy Council covers the key factors affecting energy issues facing New South Wales. Another factor that should be considered is health and safety.

The World Health Organization estimates that at least 7 million people die annually from air pollution, and that 9 out of 10 people breathe air containing high levels of pollutants

(https://www.who.int/airpollution/en/). Nuclear energy can play a major role in reducing these statistics.

Electricity generation and health (2007) by Markandya and Wilkinson outlined that nuclear causes the lowest number of fatalities of any major electricity source, over 100 times less than coal and natural gas. There are unfortunately many myths around death tolls from nuclear accidents associated with nuclear energy. Due to these myths and the scrutiny of safety and accidents in the nuclear industry, the global nuclear industry has a strong safety culture through the World Association of Nuclear operators (WANO) where best practice in safety is shared and exchanged globally.

Nuclear accidents are very rare. The World Health Organization determined that the major impacts of Chernobyl and Fukushima were not caused by radiation exposure, but were due to psychological and socio-economic factors resulting from misconceptions and fears about radiation. (Fukushima: https://www.who.int/ionizing_radiation/a_e/fukushima/faqs-fukushima/en/ Chernobyl: https://www.who.int/mediacentre/news/releases/2005/pr38/en/)

3.a.1.1. ***Recommendation:*** *In addition to the energy trilemma framework, health and safety also be included for consideration when discussing New South Wales energy mix. As a very low emissions technology with advanced safety management, the types of nuclear reactors under construction in the world today align with Australia's high standards and expectations for health and safety.*

3.a.2. What mix of current technologies will best meet the key energy opportunities and challenges in New South Wales? How might this change with future technological developments?

Nuclear energy can provide sustainable and reliable power, that can work alongside other low carbon technologies. Not all areas in New South Wales will be viable location for nuclear power generation. Therefore the energy mix needs to consider other zero and low carbon emission energy sources suitable per location including hydro, solar and wind. Each of these technologies come with their own challenges in regard to waste, power production, land usage,

intermittency and power storage requirements. Nuclear power supports and produces sustainable and reliable power through use of advanced reactor technologies.

Small Modular Reactors (SMR) increase the flexibility of nuclear energy therefore allowing nuclear power to be used in more locations and for a greater range of purposes, like remote townships or providing offshore humanitarian assistance for example. There are approximately 50 SMR designs and concepts globally in various development stages, some nearing operational use. Nuclear reactors, especially SMRs, would be a suitable replacement for many of New South Wales' aging fossil fuel plants as they can be constructed to produce a similar energy output to the fossil fuel plants they would replace and can utilise the same infrastructure, e.g. poles and wires.

Advanced reactors like high temperature and fast reactors increase the efficiency of nuclear energy therefore reducing waste. Fast reactors could increase the available fuel resource by about 60 times according to the World Nuclear Association i.e. todays used fuel could be reused, resulting in 60 times more energy than using the fuel just once. Fast reactors are already in operation including the Russian BN-800 which is used to dispose of weapons grade plutonium through its use as a fuel, reducing global proliferation risks.

Advanced Technological Fuels (ATF) allow for materials technology to produce fuel types that reduce waste but more importantly are able to stabilise and slow down reactions in the event of a nuclear accident. These advancements in fuel technologies will allow for reactors already operational to utilise fuels that improve safety and security standards.

3.a.2.1. ***Recommendation.*** *Any discussion on New South Wales pursuing use of nuclear energy as part of a wider energy mix needs to consider the advancement in nuclear energy reactor designs and fuel designs in order to ensure New South Wales is armed with the most up to date, safe and secure technology and avoids making decisions based on 1960's-1980's reactor technology.*

3.a.2.2 ***Recommendation.*** *Nuclear reactors, especially SMRs, would be a suitable replacement for many of New South Wales' aging fossil fuel plants as they can be constructed*

to produce a similar energy output to the fossil fuel plants they would replace and can utilise the same infrastructure, e.g. poles and wires.

3.b. Uranium mining and nuclear energy

3.b.1 What are the economic, social and environmental opportunities and risks association with uranium mining in New South Wales?

Due to the immense energy density of uranium, the amount of uranium needed for energy generation is a tiny fraction of the amount of mining required for fossil fuels. Australia has the world's largest known reserves of uranium, predominately in South Australia, Western Australia, the Northern Territory and Queensland. New South Wales may have significant resources however this is unknown as current state legislation prohibits uranium mining. Therefore, Australia is well placed to provide a reliable source of fuel for reactors if New South Wales chooses to pursue nuclear energy. The environmental impact of uranium mining is no different to the environmental impact of mining other heavy metals, such as rare earths and other elements used in solar panels or wind turbines. For an equivalent energy output, according to "Metals for a low-carbon society", Olivier Vidal, Bruno Goffé & Nicholas Arndt, Nature Geoscience volume 6, pages 894–896 (2013), "solar and wind facilities require up to 15 times more concrete, 90 times more aluminium, and 50 times more iron, copper and glass than fossil fuels or nuclear energy". The environmental consequences from mining for nuclear energy, therefore, are substantially less than other forms of energy generation.

Uranium mining, if feasible in NSW, could provide the benefits of current mining operations in NSW. The NSW Minerals Council, which represents the state's mining industry, provides data on the impacts of mining in NSW on its website http://www.nswmining.com.au/

Uranium mining activities can contribute greatly to local and national government revenues through royalties, taxes and foreign exchange benefits. Uranium mining can also foster improvements in social conditions both in local communities and further afield including direct creation of employment with the resulting income and wealth accumulation. Uranium mining has the potential to provide additional benefits to stakeholders through investment in social services such as health and education in mining regions. Pre-job training and transferable skills provide opportunities beyond the mine. Construction of infrastructure including roads and railways as

well as operation of the uranium mine can provide direct and indirect benefits as well as economic stimulus into regional areas. This has the potential to increase or sustain regional employment and facilitate indirect employment through the lifetime of the uranium mine as part of its supply chain. Uranium companies globally have invested in the past in community infrastructure in local impact communities, as part of local or national government lease agreements or as part of the mine company's corporate social responsibility strategy.

Mining may also have a positive impact on environment e.g rehabilitation of previously disturbed land, monitoring of environmental conditions.

3.b.1.1. ***Recommendation:*** *Opportunities in uranium mining lay in the reskilling of current fossil fuel mining employees, namely coal, to enable a sustainable and already skilled workforce to have job security into the future.*

3.b.2 Under what conditions would uranium mining be viable in New South Wales?

Viability for uranium mining in New South Wales will be dependent on the type and location of uranium deposits and if the price of uranium went up. According to Geosciences Australia *Australian Uranium Resources* map of September 2010, there was only one known potential uranium deposit in mid North West New South Wales named Toongi. Toongi is a paleozoic uranium deposit associated with an alkaline intrusive. There is also an established and operational uranium mine site along the New South Wales / South Australia Border being Honeymoon mine site. This is in the vicinity of a large cenozoic uranium deposit.

3.b.2.1. ***Recommendation:*** *Due to the current prohibition on uranium mining in New South Wales, the understanding and viability of uranium resources within the state is not well known. The removal of the prohibition would allow for investigation and prospecting to occur.*

3.b.3 What are the economic, social and environmental opportunities and risks associated with nuclear energy in NSW?

Economic opportunities and risks:

Nuclear energy is affordable and nuclear plants are valuable assets. Current operating nuclear power plants produce low-cost power and support stable electricity prices. Nuclear power plants are reliable and capable of operating 24/7 and are resilient to extreme weather events. The operation, maintenance and fuel costs at United States nuclear plants are approximately one-third cheaper than for fossil steam power generation ($24.4/MWh compared to $35.4/MWh) (*World Nuclear Association,* Talking Points, The nuclear industry communication handbook 2019). As well as reducing overall energy provision costs, nuclear power plants are valuable long-term assets with a lifespan of 60 years operations or longer. Therefore, while capital upfront costs are considered significant, the operational longevity of the power plants make them cost effective. In the European Union, the nuclear sector supports over 1 million jobs and generates 500 billion euros in economic impact (*World Nuclear Association,* Talking Points, The nuclear industry communication handbook 2019).

Reduction to capital costs can be made through building multiple units of the same design and following international best practice on tried and tested technology. Small Modular Reactors are currently in testing phase and in time will provide tried and tested technology to complement the fleet of nuclear energy solutions. This allows for an established supply chain to reduce initial costs as well as the ongoing maintenance and supply through the lifetime of the reactor.

3.b.3.1. *Recommendation.* *The committee acknowledge the nuclear industry performance across the United States and Europe has demonstrated reductions in capital costs and nuclear plants providing long term valuable assets that over their operational lifetime produce reduced energy costs in comparison with fossil fuel power generation.*

Social opportunities and risks:

Due to current legislation, it is difficult to have an educated discussion with the community on nuclear energy. Demand for reducing carbon emissions and taking action on climate change exist across the New South Wales population. Therefore, it is appropriate that we allow for nuclear to be included in the discussion on reducing carbon emissions.

The nuclear industry is committed to improving public outreach. Lack of effective communication in the early stages of the nuclear industry left gaps that were filled by persistent myths. In countries where nuclear power plants operate, there is good public support (*World Nuclear Association,* Talking Points, The nuclear industry communication handbook 2019). Organisations like Women in Nuclear (WiN) Global were established for community engagement. Originally, WiN was established to provide women in communities information and education around nuclear power providing safe, cheap and reliable energy to families.

Due to current legislation, it is difficult to have an educated discussion with the community on nuclear energy. The demands for reducing carbon emissions and taking action on climate change are there from a wide Australian community. Therefore, it is appropriate that we allow for nuclear to be included in the discussion on reducing carbon emissions.

3.b.3.2. ***Recommendation:*** *In order to allow for an educated community engagement and public debate, current legislation regarding nuclear power should be updated to allow nuclear power to be considered as part of the energy mix for reducing New South Wales' carbon emissions.*

Environmental opportunities and risks:

Electricity generation in Australia accounts for approximately one third of the country's greenhouse gas emissions. Nuclear energy has a small environmental footprint. In 2014, the IPCC analysed hundreds of scientific papers examining the carbon dioxide equivalency (in gCO_2e/kWh) of different energy sources (IPCC Working Group III – Mitigation of Climate Change, Annex III, Table A.III.2), with the results shown in Table 1.

Energy Source	**Lifecycle Emissions Median Value gCO_2eq/kWh**
Coal	820
Gas - combined cycle	490
Hydropower	24
Concentrated solar	27
Solar PV – rooftop	41
Solar PV – utility	48
Wind onshore	11
Wind offshore	12
Nuclear	12

Table 1: Carbon dioxide equivalency of common sources of electrical generation

Nuclear energy offers an opportunity to greatly reduce emissions from not only electricity generation, but also from the transportation and fixed energy sectors. Nuclear energy requires much less land use than other forms of low emissions electricity generation. Compared to fossil fuels, nuclear energy requires significantly less fuel. Compared to all other forms of energy, nuclear requires less mining, transport and material consumption. Furthermore, nuclear energy manages 100% of its waste, which can be efficiently stored and largely recycled.

The freshwater usage requirements of a nuclear plant are slightly larger than a conventional fossil fuel plant, but not large enough to discount nuclear energy due to this factor alone. While large amounts of water are used for cooling, 99% of this water is returned to the environment, only a few degrees warmer and free of contaminants as the cooling water is circulated through heat exchanges and is never exposed to radioactive material.

It is acknowledged that no form of energy generation is perfect from an environmental standpoint. Although there are some environmental impacts associated with nuclear energy, they are either of an equivalent magnitude or substantially reduced when compared to other forms of energy generation.

Greenhouse gas emissions

Nuclear energy offers an opportunity to greatly reduce greenhouse gas emissions across electricity generation, transportation and fixed energy sectors. Nuclear fission does not produce any carbon dioxide or other greenhouse gases. The emissions from other parts of the fuel cycle (e.g. mining of uranium and enrichment of uranium) are less than 2% of those from using coal for electricity generation (Nuclear Energy in the 21st Century, Ian Hore-Lacy).

The open source project, Electricity Map - http://www.electricitymap.org - provides live data on carbon emissions for many parts of the world based on how the electricity is being generated, including New South Wales. Data is drawn from publicly available sources, published by electricity grid operators, official agencies and others. Greenhouse gas emissions are then calculated for each electricity source based on emissions intensities derived by the IPCC (Table 1), and the live carbon intensity in gCO_2eq/kWh displayed. The data from Electricity Map is clear – areas with very low emissions either have abundant hydropower resources (e.g. Tasmania, Norway, Sweden) and/or significant nuclear resources (e.g. France, Sweden, Ontario). Areas with significant 'renewables' installed, such as wind and solar, whilst having lower carbon emission than those areas relying mostly on fossil fuels, can swing wildly in their emissions due

to the intermittency of these technologies and the reliance on fossil fuel backup (e.g. Germany, South Australia, California). If the world is to achieve deep decarbonisation, ie. at least an 80% drop in carbon emissions to remain within the 2°C scenario, then large scale adoption of stable, reliable, high capacity factor sources of electricity generation, such as hydro and nuclear, are needed. Australia is not fortunate to have abundant hydro resources, hence nuclear appears to be the next best option if the goal is very low carbon emissions.

At 1232h on 08 October, New South Wales was producing 650g carbon intensity (gCo_2eq/kWh) with only 16% of power produced from low-carbon (hydro) and 16% by renewables (wind and solar). Therefore, there are many more opportunities for New South Wales to improve its carbon emissions through an increase of low-carbon energies. (electricitymap.org)

Land footprint

One of the significant benefits of nuclear energy is that it requires less land than every other form of electricity generation. For example, a solar farm requires 450 times more land to produce the same amount of energy as a nuclear power plant ("Why renewables can't save the planet", Michael Shellenberger, Quillette, Feb 27, 2019). An important aspect of preventing climate change will be returning as much land as possible back to its 'wild state' i.e. a lot of trees and wildlife. Nuclear energy is particularly well suited to this because of its high energy density and small land usage requirements.

Water use

One criticism that is often quoted about nuclear energy is that it uses a lot of water. The freshwater usage requirements of a nuclear plant are slightly larger than that of a conventional fossil fuel plant but are not large enough to discount nuclear energy due to this factor alone. In addition, due to the small amounts of fuel used for nuclear energy compared to gas or coal, there is greater flexibility in the location of nuclear reactors. Hence reactors on the coast could desalinate water to cool themselves (or provide drinking water to communities) whilst at the same time generating electricity.

3.b.3.3. ***Recommendation:*** *That the Committee become familiar with the open source project, Electricity Map - www.electricitymap.org. If New South Wales' goal is to decarbonise its electricity sector, and potentially other sectors, then Electricity Map clearly indicates that the technologies that have demonstrated they can meet the challenge are hydropower and nuclear power.*

3.b.3.4. ***Recommendation:*** *Due to nuclear energy's low mining, resource and land use requirements, high energy density and extremely low greenhouse gas emissions, nuclear energy is a feasible and suitable technology for New South Wales in terms of its low environmental impacts.*

3.b.4 Under what conditions would nuclear power generation be viable in New South Wales?

The overarching current restriction to nuclear power generation in New South Wales is the federal and state prohibitions on nuclear power generation. Should this legislation be changed, the key to establishing a viable nuclear power industry will be through the establishment of a workforce.

A nuclear power plant program would require a large skilled workforce and hence would introduce a new sector with a substantial number of well-paying jobs and growth. There is already nuclear capability in Australia in the form of government organisations, such as the Australian Nuclear Science and Technology Organisation (ANSTO), Australian Safeguards and Non-proliferation Office (ASNO) and Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) providing the backbone to establish a stand-alone nuclear regulatory body. These bodies are largely nationally focused, therefore opportunity exists to establish state regulatory bodies and organisations for the safe, secure and peaceful use of nuclear power generation. Alternatively, the states could fall under a national system of regulation for nuclear power generation, which is common practice worldwide.

Nuclear expertise could be scaled up commensurate with the magnitude of the program. In addition, international expertise could also be utilised in the initial years until domestic expertise is appropriately established.

New South Wales already has broad experience in large construction and infrastructure projects to provide support and skills to be used in nuclear power plant construction and could draw on this workforce. Both the Australian National University (ANU) and University of New South Wales (UNSW) offer masters level nuclear courses, nuclear physics and nuclear engineering respectively, therefore already providing technical skills and knowledge into the current

Australian workforce. The expansion of these courses to form undergraduate nuclear engineering programs could increase and develop a skilled workforce within Australia. Last but not least, nuclear energy would be particularly viable economically if there were incentives in place for low carbon technologies.

3.b.4.1. ***Recommendation:*** *New South Wales has existing expertise in nuclear technologies and large construction programs that could be utilised and expanded in the event that it adopts nuclear energy. Adoption of nuclear energy would generate jobs and growth, making it a suitable option for New South Wales' future.*

3.b.5 What is the optimal investment model to create a nuclear energy industry in NSW? How does the return on investment compare with other energy options?

Industry Super Australia released a *Modernising Electricity Sectors* report that outlined cost comparisons for overall energy production. Overall cost for nuclear power plant generation is not just reliant on the physical plant itself, but also the supply chain required. Table 2 outlines the cost comparison of six different power generation facilities:

Serial	Energy Generation type	Location	Cost / GW output	Comment
1	Solar (photovoltaic)	Darlington point, NSW, Australia	$AU 5.8Bn	
2	Solar (Thermal)	Ivanpah System, California, USA	$US 21Bn	
3	Wind	Dundonnel, Victoria, Australia	$AU 4.2Bn	
4	Nuclear	Olkiluoto, Finland	$US 6-7Bn	Most expensive option
5	Nuclear	UAE	$US 4.5Bn	Average cost option
6	Nuclear	China (Generation IV reactor)	$US 1.8-2.6Bn	Cheapest cost option

Table 2: Electricity plant cost comparison (Industry Super Australia, 2019)

As demonstrated above, small modular reactors and generation IV reactors, with their small footprint significantly reduce the overall cost for energy production. However, for these costs to be realised, there needs to be a reliable and effective supply chain associated. China has been able to do this due to the large number of big and small reactors being built across the entire country.

3.b.5.1. ***Recommendation.*** *In order to be cost effective, many small modular reactors being built is a more economically feasible option rather than a couple of large reactors.*

3.b.6 Are private sector financial organisations interested in financing nuclear power projects in New South Wales should current prohibitions be repealed?

As a not-for profit organisation, WiN Australia is not in a position to comment on private sector investments in nuclear power projects.

3.b.7 How would radioactive waste from nuclear power generation be managed?

The volume of waste generated from nuclear energy is significantly less than the volumes generated from other forms of energy. Used fuel assemblies are over 95% recyclable, which also greatly reduces the lifetime of the waste. New South Wales has the land mass, as well as the geotechnical and hydrological conditions necessary for long term safe and secure storage and disposal of radioactive wastes. Radioactive wastes are a small price to pay compared to the imminent and potentially devastating effects of climate change.

Unlike other toxic wastes, the principle hazard associated with nuclear waste is radioactivity, which diminishes over time. Used nuclear fuel loses 99.9% of its radioactivity in the first 40 years, making is easier to handle and manage. Storage underwater and in dry casks is common international practice. Sweden and Finland (both of whom have chosen an “open fuel cycle”, i.e. to not reprocess/recycle their used fuel) are building deep underground facilities to dispose of their waste. Perceptions that there is no effective solution to manage radioactive waste are incorrect. There are a number of countries with well-established policies for waste disposal. Used fuel can also be seen as a valuable resource as the uranium, plutonium and, in future, minor actinides, can be recycled and reused in nuclear fuel.

Reprocessing of used nuclear fuel is the Australian government's current approach to managing the used fuel that has and will arise from the country's three research reactors (HIFAR, MOATA and OPAL). Should New South Wales decide to develop nuclear energy technology, WiN Australia encourages reprocessing of used nuclear fuel due to the benefits reprocessing bring in terms of recycling and sustainability, waste volumes and waste lifespan.

Transportation of used nuclear fuel and vitrified waste (the waste after reprocessing of used fuel) is a common practice around the world and has been done in Australia on many occasions to date without incident. Unlike many other dangerous goods that are transported by sea, rail or road as a liquid or gas, used nuclear fuel and waste is transported as a solid material in purpose-built casks that are designed for extreme conditions. Australia has the expertise and knowledge to transport these materials reliably and securely.

3.b.7.1. ***Recommendation****: Effective and sophisticated solutions for waste management exist. These could be applied in New South Wales. We recommend that the Committee considers the relatively small risks associated with radioactive waste management, transportation and storage arising from nuclear power technology, compared to the imminent and potentially devastating effects of climate change.*

3.b.8 What is the current level of support amongst the New South Wales public for uranium mining and nuclear energy?

Australians, including residents of New South Wales want affordable, reliable, low emissions electricity. It is in the New South Wales Government's interest to provide a long-term strategy that meets the needs of the people and industries in New South Wales. Nuclear energy can provide a feasible, suitable, low carbon solution to New South Wales' future energy needs. Any long-term plan or initiative requires broad political support for its long-term success. This is no different for a nuclear power program in a democratic society such as Australia.

The most recent poll on nuclear energy in Australia (to the author's knowledge) resulted in a 44% support, 40% oppose, outcome (Essential Poll June 2019). NIMBYism was identified as a potential issue in this poll. Nuclear energy, like many other forms of energy, will likely never have 100% support in Australia. However, given the opportunity, such as through the removal of

the federal and New South Wales state nuclear energy ban, the benefits of nuclear energy could become widely disseminated. Through also addressing myths and incorrect popular culture perceptions, support for nuclear energy as a powerful, reliable, safe, secure and low emissions technology could be intensified.

The Roy Morgan poll conducted in September 2019 Australia wide indicated an increase in the support for Australia to develop nuclear power to reduce Australia CO2 emission. Although not broken down by state, a majority of 69% of Australians support the refining and exporting of radioactive materials mined in Australia for use in the health services industry compared to only 12% who do not.

3.b.8.1. ***Recommendation:*** *Australians, including residents of New South Wales, want affordable, reliable, low emissions electricity into the future, and nuclear energy can fulfill this. While understanding of nuclear energy amongst the general public is typically low, an education campaign could greatly enhance this.*

3.c. Regulatory frameworks

3.c.1. If a nuclear energy industry were to be allowed in NSW, what are the optimal regulatory settings to ensure that safe and secure operation of:

- **Uranium mining** – Current mine site regulation and licensing through the New South Wales Department of Planning and Environment would be adequate. Safeguards regulations surrounding the processing and transport of uranium resources would need to be managed in accordance with current federal legislation overseen by the Australian Safeguards and Non-Proliferation Office (ASNO).
- **Nuclear power generation** – The ARPANS Act currently prohibits the building of nuclear power plants in Australia. However, it could readily be modified and expanded to include the necessary conditions to allow and regulate nuclear power. A single national regulatory body for nuclear safety and radiation protection would provide an avenue for reactor safety practices, polices and innovation to be shared openly and honestly across the sector within Australia as well as linking in with regional and international partners to share best practice for nuclear power reactors.

- **Nuclear waste disposal** – The Australian Government has established the National Radioactive Waste Management Facility (NRWMF) project (industry.gov.au/strategies-for-the-future/managing-radioactive-waste) which, as an organisation will outline requirements for the national waste facility forecast for South Australia. Should New South Wales plan a nuclear energy program, it would need to work with the federal government or adopt its own waste disposal facility.

3.c.1.1. ***Recommendation:*** *The global nuclear industry is subject to one of the most stringent regulatory regimes of any industry. Should New South Wales embark on a nuclear power regime and commence mining uranium, a sensible combination of state and national regulation/legislation would need to be implemented.*

3.c.2. Should uranium mining continue to be prohibited in New South Wales?

3.c.2.1. ***Recommendation:*** *In order to allow for investigation on uranium deposits and their viability for extraction to be an addition to the New South Wales economy, the current prohibition on uranium mining should be lifted.*

3.c.3. Should nuclear power generation continue to be prohibited in NSW?

3.c.3.1. ***Recommendation:*** *In order to allow the New South Wales population to have a complete, informed and robust discussion on the viability of nuclear power generation in New South Wales, the current prohibition on nuclear power generation should be lifted.*

3.d. Community engagement

3.d.1 In addition to the community engagement concepts discussed above (eg. Social impact), what other factors are relevant to decisions about uranium mining and nuclear energy in New South Wales?

Education and demystifying myths and propaganda surrounding uranium mining and nuclear energy are key. This allows for the community to be involved in an educated discussion on the pros and cons of the technology by removing emotion from the argument. Engaging the nuclear

community to support this communication and education strategy will allow for this information to be disseminated. The first milestone is including nuclear energy as a part of the clean and sustainable energy debate.

Addressing the common concerns of environmental and health impacts of uranium mining should be part of the education process. The Organization for Economic Co-Operation and Development (OECD) Nuclear Energy Agency publication 2014 publication “Managing Environmental and Health Impacts of Uranium Mining” (Reference OECD 2014 NEA Publication No 7062) would be a useful document to reference. The report provides a factual account of leading practices in order to inform public debate on uranium mine development and to provide policy makers with a framework of approaches that should be undertaken to ensure that uranium mining is conducted in a safe and environmentally responsible manner.

The report indicates that “ Key components in achieving this goal include the establishment of an appropriate regulatory framework, planning for closure before the mine begins production, requiring financial assurance from companies to cover the costs of closure and remediation, application of leading practices to minimise radiation exposure of workers and the public, protection of water resources and the safe, long-term disposal of tailings and problematic waste rock. Public consultation and information sharing, environmental impact assessment and environmental monitoring throughout the life cycle of the mine facility are also shown to be crucial components of this framework.”

3.d.1.1. ***Recommendation:*** *In order to allow the New South Wales population to have a complete, informed and robust discussion on the viability of uranium mining and nuclear power generation in New South Wales, education and communication is vital.*

3.d.2. What model of community engagement should be used to include the New South Wales public in decisions about uranium mining and nuclear energy?

The topic of nuclear energy can be polarising due to myths and misinformation. For this reason, it is important that the community is given access to reliable, factful information that will enable discussions on the key issues of concern.

Community consultative committees with the inclusion of organisations like WiN Australia can provide a good community engagement forum for issues to be presented and debated.

3.d.3. What is the best method of including community in decisions about:

- **Location of nuclear reactor and nuclear waste disposal** – Once appropriate sites have been determined, the communities surrounding these locations should be informed on the potential impacts and engaged on their concerns and requirements through a consultative forum. Ongoing, persistent, technically sound and empathetic communication with communities, and New South Wales as a whole, is the best method to engage the community.
- **Nuclear non-proliferation –** Nuclear energy does not increase the risk of proliferation of nuclear weapons. While enrichment and reprocessing facilities can be dual purpose and used in the production of weapons, Australia is committed to the Nuclear Non-Proliferation Treaty (NPT) and is a good global citizen abiding and supporting the International Atomic Energy Agency's (IAEA's) safeguards programs which are effective at policing proliferation activities. If New South Wales introduced nuclear power into its energy mix, then it could provide more technical support to the IAEA's safeguard program within the region. In addition, nuclear technologies in reactor and fuel design are working towards fuel and waste products that are not proliferation risks. Nuclear security also provides a workforce in physical power plant and radioactive waste facility security through a robust and multi-layered approach. This includes physical barriers, well trained guards and information security just to name a few. While at present most reactors run on analogue systems, cyber security also presents a challenge for the industry.

3.d.3.1. ***Recommendation:*** *Ongoing, persistent, technically sound and empathetic communication with communities, and New South Wales as a whole, is the best method to engage the community.*

3.d.3.2. ***Recommendation:*** *Nuclear security is an important consideration and the people of New South Wales should be informed on the opportunities associated with nuclear security and support to nuclear non-proliferation activities.*

3.d.4. What are the other key decisions on uranium mining and nuclear energy that require community engagement?

One of the key decisions for nuclear energy that requires community engagement is plant location. Community support for siting is vital and would require significant engagement. There are a number of sites throughout the state that may be more willing to explore the possibility of nuclear energy, e.g. those sites with existing coal fired power generation. However, the ongoing threat of climate change, energy security and affordability, and the opportunity for well-paying and stable employment, may encourage other communities to want to site a nuclear energy facility.

Many countries throughout the world are setting the goal to be net carbon neutral by 2050. If Australia also chooses this target, community consultation can help to establish the path Australia takes to achieve the target. There seems to be a lack of understanding as to the magnitude of change required to achieve deep decarbonisation. For example, a solar panel on the roof of a house may lower electricity prices for the homeowner but will do little to help deep decarbonisation of industry, transport, fixed energy, agriculture - every other sector other than residential electricity use. The community needs a better understanding in general of energy generation and energy markets to be able to grasp how nuclear energy and uranium mining could actually help Australia achieve a net neutrality goal.

3.d.4.1. ***Recommendation:*** *The general population in New South Wales (and Australia) would benefit from increased exposure to energy production, supply and demand, and how the various sectors (electricity, transport, fixed energy, agriculture etc) contribute to greenhouse gas emissions. This would enable more meaningful discussions on nuclear energy and uranium mining.*

4. Conclusion and recommendations

Due to the ever-increasing concern of climate change, nuclear energy should be considered to be part of New South Wales' energy mix to reduce carbon emissions and ensure ongoing reliability of energy supply. WiN Australia is committed to provide technical and honest feedback to the community in regard to nuclear related issues. The ability to have an educated and robust

discussion on nuclear power generation is restricted due to current federal and state legislation. The following recommendations are made for consideration by the committee:

i. *Nuclear energy is a proven, low emissions technology. It is recommended that the Committee considers not only the potential benefits of nuclear power to Australia's national interest but also to the international community, in particular to women and children and those nations most affected by climate change across the globe.*
ii. *In addition to the energy trilemma framework, health and safety also be included for consideration when discussing New South Wales energy mix. As a very low emissions technology with advanced safety management, the types of nuclear reactors under construction in the world today align with Australia's high standards and expectations for health and safety.*
iii. *Any discussion on New South Wales pursuing use of nuclear energy as part of a wider energy mix needs to consider the advancement in nuclear energy reactor designs and fuel designs in order to ensure New South Wales is armed with the most up to date, safe and secure technology rather than making decision based on 1960's-1980's reactor technology.*
iv. *Nuclear reactors, especially SMRs, would be a suitable replacement for many of New South Wales' aging fossil fuel plants as they can be constructed to produce a similar energy output to the fossil fuel plants they would replace and can utilise the same infrastructure, e.g. poles and wires.*
v. *Opportunities in uranium mining lay in the reskilling of current fossil fuel mining employees, namely coal, to enable a sustainable and already skilled workforce to have job security into the future.*
vi. *Due to the current prohibition on uranium mining in New South Wales, the understanding and viability of uranium resources within the state is not well known. The removal of the prohibition would allow for investigation and prospecting to occur.*
vii. *The committee acknowledge the nuclear industry performance across the United States and Europe has demonstrated reductions in capital costs and nuclear plants providing long term valuable assets that over their operational lifetime produce reduced energy costs in comparison with fossil fuel power generation.*
viii. *In order to allow for an educated community engagement and public debate, current legislation regarding nuclear power should be updated to allow nuclear power to be considered as part of the energy mix for reducing New South Wales' carbon emissions.*

ix. *That the Committee become familiar with the open source project, Electricity Map - www.electricitymap.org. If New South Wales' goal is to decarbonise its electricity sector, and potentially other sectors, then Electricity Map clearly indicates that the technologies that have demonstrated they can meet the challenge in the electricity sector are hydropower and nuclear power.*

x. *Due to nuclear energy's low mining, resource and land use requirements, high energy density and extremely low greenhouse gas emissions, nuclear energy is a feasible and suitable technology for New South Wales in terms of its low environmental impacts.*

xi. *New South Wales has existing expertise in nuclear technologies and large construction programs that could be utilised and expanded in the event that it adopts nuclear energy. Adoption of nuclear energy would generate jobs and growth, making it a suitable option for New South Wales' future.*

xii. *In order to be cost effective, many small modular reactors being built is a more economically feasible option rather than a couple of large reactors.*

xiii. *Effective and sophisticated solutions for waste management exist. These could be applied in New South Wales. We recommend that the Committee considers the relatively small risks associated with radioactive waste management, transportation and storage arising from nuclear power technology, compared to the imminent and potentially devastating effects of climate change.*

xiv. *Australians, including residents of New South Wales, want affordable, reliable, low emissions electricity into the future, and nuclear energy can fulfill this. While understanding of nuclear energy amongst the general public is typically low, an education campaign could greatly enhance this.*

xv. *The global nuclear industry is subject to one of the most stringent regulatory regimes of any industry. Should New South Wales embark on a nuclear power regime and commence mining uranium, a sensible combination of state and national regulation/legislation would need to be implemented.*

xvi. *In order to allow for investigation on uranium deposits and their viability for extraction to be an addition to the New South Wales economy, the current prohibition on uranium mining should be lifted.*

xvii. *In order to allow the New South Wales population to have a complete, informed and robust discussion on the viability of nuclear power generation in New South Wales, the current prohibition on nuclear power generation should be lifted.*

xviii. In order to allow the New South Wales population to have a complete, informed and robust discussion on the viability of uranium mining and nuclear power generation in New South Wales, education and communication is vital.

xix. Ongoing, persistent, technically sound and empathetic communication with communities, and New South Wales as a whole, is the best method to engage the community.

xx. Nuclear security is an important consideration and the people of New South Wales should be informed on the opportunities associated with nuclear security and support to nuclear non-proliferation activities.

xxi. The general population in New South Wales (and Australia) would benefit from increased exposure to energy production, supply and demand, and how the various sectors (electricity, transport, fixed energy, agriculture etc) contribute to greenhouse gas emissions. This would enable more meaningful discussions on nuclear energy and uranium mining.

WiN Australia thanks the committee for considering the submission into the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019.