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*A Submission by **SMR Nuclear Technology Pty Ltd** to*

The House Select Committee on Nuclear Energy 2024

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SMR Nuclear Technology Pty Ltd is an independent Australian consultancy, founded in 2012, based in Sydney.
SMR-NT's Directors have over 100 years of combined experience in power generation, including 50 years of nuclear power generating experience.

SMR-NT has been closely monitoring nuclear developments worldwide and has identified four opportunities for Australia:

1. **Large power reactors up to 1 GW electrical output for Queensland, NSW and Victoria that have sufficiently large grid systems to take this size of unit**
2. **Small Modular Reactors (normally defined as up to 300 MW electrical output) that could be deployed in any state and territory**
3. **Microreactors (up to 10 MW electrical output) for off-grid communities and mine sites**
4. **Generation IV advanced reactors to provide electricity and process heat to decarbonise industry.**

Australia's power system must be reliable, affordable and sustainable. Whilst maintaining high reliability, Australia must successfully make the transition of its power system to a more affordable system with lower emissions.

Nuclear power is the only low emissions technology that is reliable and independent of the weather.

Australia is not starting from scratch. Australia has over 60 years' experience in nuclear technology with a world -class nuclear research organisation – the Australian Nuclear Science and Technology Organisation (ANSTO) currently operating the OPAL research reactor.
Australia also already has an independent nuclear regulator (ARPANSA) and safeguards organisation (ASNO) and is a party to all the nuclear conventions.

The SMR-NT report[1] "A just Transition to Low-Emissions Technology – Repowering Coal-fired Power Stations in Australia with SMRs", June 2004 examines how Australia can take the opportunity to re-use important existing infrastructure (particularly transmission), retain jobs and maintain the life of communities by repowering the sites.

The following sections examine in detail some of the important issues.

1. Radioactive Waste Management, Transport and Storage

Radioactive Waste Management

Low Level Waste (LLW)

Routine day-to-day operations of a nuclear power plant produce only LLW.

Typical LLW comprises paper, cleaning materials, resins, filters and lightly contaminated scrap metal. LLW is sorted, and compacted into 220 litre drums and stored on site. No shielding is required as the radiation level on the outside of the drum is low. The drum provides containment. Radionuclides with half-lives of less than about thirty years are considered to be short lived. The time for LLW to decay to background levels is normally assumed to be within 300 years.

A 1,000 MWe power reactor would produce each year approximately 120m^3 (two shipping containers) of LLW that is packaged and stored in drums before being transported to a Low Level Waste repository.

The IAEA guidance for this waste is in a Near Surface Repository. This has engineered features to contain the waste for 300 years, i.e. a number of barriers to restrict release of the radionuclides to the environment.

The Tellus Sandy Ridge[2] near-surface waste repository 240 km northwest of Kalgoorlie in WA is licenced to accept low-level waste from anywhere in Australia and its exclusive economic zone.

Intermediate Level Waste (ILW)

A power reactor would produce a very small amount, ~1.5m^3/yr of ILW. This is mainly metallic waste from maintenance or refuelling operations. It is stored in a shielded cask.

[1] https://www.smrnuclear.com.au/_files/ugd/c733f6_1ea5acf3c281440fb2b9f801d512bc2b.pdf

[2] https://tellus.com.au/project/sandy-ridge/

High Level Waste (HLW)

HLW has higher activity than ILW and produces significant heat. The normally accepted definition of the heat load is > 2kW/m^3.

HLW is not produced during routine day to day reactor operations and is only associated with used fuel.

When a power reactor is refuelled, the used fuel that is removed is highly radioactive and still producing heat. Normal practice is to store the used fuel in a cooling pond close to the reactor for several years to allow the radioactivity and heat load to decay. There are then four options for used fuel management:

- interim dry storage;
- reprocessing if unburnt fissile materials are to be recycled and/or transuranic waste materials are to be removed;
- burning of recycled materials and transuranic waste in a fast neutron reactor;
- final disposal of complete spent fuel assemblies or other HLW in underground storage facilities in geologically stable locations

A 1 GW nuclear reactor would discharge an average of ~45 fuel assemblies per year which are initially stored in cooling ponds and subsequently can be stored in dry casks on site for the life of the plant.
Alternatively, the used fuel could be sent abroad for reprocessing as is the current practice for used fuel from ANSTO's research reactors. The final disposal of the small amount of waste from reprocessing or complete used fuel assemblies will be in a deep geological repository. Construction of this type of facility has been completed at Olkiluoto in Finland. The facility is now undergoing trial runs of placing canisters underground before final disposal commences. The Swedish Land and Environment Court has granted an environmental permit to allow the construction of a similar facility in Sweden. A similar project in France is also close to approval.

Transport

There is very good international agreement and standards for the transport of radioactive materials, because the whole of the nuclear fuel cycle, from ore to waste, involves transport, in many cases between countries.

The IAEA Safety Standard TS-R-1 provides the detailed safety standards and guidance. For Australia, ARPANSA has issued the *Code for the Safe Transport of Radioactive Materials*[3] based on the IAEA Specific Safety Requirements SSR-6 Rev 1 2018. Compliance with this code is mandatory.

[3] Code for the Safe Transport of Radioactive Material RPS C-2 (rev 1) March 2019

Safe transport is ensured by:

- Containment of radioactive materials
- Control of external radiation levels
- Prevention of criticality (limiting the quantity of materials to prevent a nuclear reaction)
- Packages designed to withstand a fire.

2. Health and Safety

Nuclear energy has the lowest incidence of death and accidents amongst all energy production technologies, comparable to renewables. It is many times lower than fossil fuels.

In 2013, the UK Tyndall Centre for Climate Change, in a report for Friends of the Earth, found that:

> *"… overall the safety risks associated with nuclear power appear to be more in line with lifecycle impacts from renewable energy technologies and significantly lower than for coal and natural gas per MWh of supplied energy".*

In 2016, the South Australia Nuclear Fuel Cycle Royal Commission conducted an in-depth inquiry that concluded that safety was not a basis for ruling out nuclear power in Australia.

Modern reactors are designed to be inherently safe, avoiding Chernobyl-type or Fukushima-type accidents.

SMRs can be installed below ground level. This protects them from external hazards and unauthorised access. The reactor building is able to withstand aircraft impact. The GE Hitachi BWRX-300 is an example of this type of reactor[4].

The NuScale[5] module sits in a large "swimming pool" enabling the reactor to be cooled indefinitely without attention.

Modern SMR designs have now become a game-changer for nuclear safety. Although traditional reactors are safe, SMRs take safety to a new level of "walk-away safety". For example, the NuScale SMR does not require any operator action, backup electrical supplies or water supplies and would have survived even the Fukushima accident. The passive safety systems enable the reactor to be cooled indefinitely without attention - "indefinite cooling time".

The US Nuclear Regulatory Commission (NRC) has confirmed that the NuScale plant does not require any emergency electrical generators to keep the plant safe. The NuScale SMR is the first nuclear reactor design to have achieved this accreditation.

[4] https://www.gevernova.com/nuclear/carbon-free-power/bwrx-300-small-modular-reactor

[5] https://www.nuscalepower.com/en

3. Nuclear Liability

Potential cross border consequences of a nuclear accident require an international nuclear liability regime, so national laws are supplemented by international conventions.
Australia is not a party to an international nuclear liability convention. Australia's nuclear facilities are covered by an unlimited Commonwealth Government provision.
The latest international convention, designed to modernise and enhance the legal regime, is the *Convention on Supplementary Compensation for Nuclear Damage* which came into force in April 2015. Australia has signed (1997) but not ratified this convention. Prior to the start of a nuclear power program, Australia should consider appropriate nuclear liability arrangements

4. Environmental Impacts

i) Emissions

Energy production not only has short-term health impacts relating to accidents and air pollution; there are also the long-term, environmental impacts relating to climate change. Signs of this are already starting to show, with extreme weather events, reduced rainfall, sea level rise, etc.

Australia must utilise every safe, low-emissions technology to reduce its emissions. Nuclear is a safe, low-emissions technology that should be included in the energy mix in Australia, as it is already in 31 other countries, with four new countries with nuclear power reactors presently under construction.

Nuclear power, like wind and solar, has zero operating emissions. The South Australia Nuclear Fuel Cycle Royal Commission examined in detail the whole of life cycle emissions for different electricity generation technologies. The median value for nuclear is 12kg/MWh, the same as wind. Solar is slightly higher at 18-50 kg/MWh.

In 2023, 2,602 TWh was generated by nuclear power reactors worldwide, saving over 2 billion tonnes CO2-e emissions (World Nuclear Association).

In 2023/24, Australia exported 5,742 tonnes of uranium oxide concentrate worth $1.19 billion (ASNO Annual Report 2023/24) which would have generated ~193 TWh and saved the recipient countries more than 200 million tonnes CO2-e, yet Australia does not take advantage of this valuable resource.

Australia's total emissions peaked in 2006 at 640.9 Mt CO_2-e with electricity contributing 31%. Total emissions in 2023 dropped to 442.9 Mt CO_2-e but electricity is now contributing 35%.[6]
We emphasise that no country has achieved a low level of emissions without extensive investment in nuclear energy and/or hydro.

[6] https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-gas-inventory-quarterly-update-march-2024

ii) Process Heat

Emissions reductions are required in all areas of energy production and use. Industry commonly uses coal or gas for process heating. Modern nuclear reactors can produce process heat which can reduce emissions from industry. Wind and solar cannot directly provide process heat. Nuclear power not only reduces emissions from electricity generation, but also provides a pathway to emissions reductions in many other industries.

iii) Energy Density

Renewables, for example wind and solar, are very low energy density technologies, that is, the physical quantity of plant required for a given output is very high. The amount of concrete and steel in a wind turbine is more than 10 times the quantity in a nuclear power plant for a given output.[7] The NSW Nyngan solar plant has 1,350,000 PV panels on frames supported by 150,000 posts but produces only 102 MW peak output.

iv) Land Area

Wind and solar require large areas. For example, the 150 MW Coleambally (NSW) solar plant occupies 550 hectares. This can be compared to a 1,000 MW Westinghouse AP-1000 power reactor that occupies a fenced area of only 10 hectares.
Comparing the median land use of energy sources per unit of electricity[8] for whole life-cycle assessment, which accounts for the land of the plant itself and the land used for the mining of materials used for its construction, fuel inputs, decommissioning and handling of waste:
Utility scale solar PV = 19 m^2 per MWh
Nuclear = 0.3 m^2 per MWh
Onshore wind project area = 8.4 m^2 – 247 m^2 per MWh. There can be a large environmental impact of onshore wind as we have seen in the devastation of the Great Dividing Range in Queensland.

v) Decommissioning

There is extensive experience of decommissioning nuclear power plants, with more than 140 decommissioned worldwide. After operations cease, the fuel and coolants are removed. This takes about 2 years and removes the major radiation hazards - 99% of the radioactivity is in the used fuel. The plant buildings are then dismantled and the site remediated, leaving a greenfield site that can be reused.

There is an excellent example of decommissioning a research reactor in Australia. ANSTO's Moata research reactor at Lucas Heights operated from 1961 to 1995. The used fuel was removed after shutdown and sent back to the USA. In 2009/10 the reactor was completely dismantled. The concrete shielding was cut with a diamond saw and checked for radiation levels. Most of the concrete was able to be moved to landfill as industrial waste. The cost of dismantling was $4.15m. Considering that Moata operated for 34 years and laid the foundations of nuclear research in Australia, the cost of decommissioning is clearly a small proportion of the total project cost.

[7] 2015 US DOE Quadrennial Technology Review
[8] https://ourworldindata.org/land-use-per-energy-source

vi) Noise

Nuclear and PV produce very little noise during operation. Wind turbines produce significant noise which has an environmental impact and limits their siting. The noise of nuclear cannot generally be heard outside the plant boundary.

vii) Weather-dependency

Nuclear power plants operate regardless of the weather. They are designed to continue operating in extreme weather conditions. There are many examples in the USA where nuclear power plants have continued to supply electricity in extreme weather conditions, when other electricity generators have failed. PV panels can easily be damaged by storms and particularly by hail.

Renewables, by contrast, are totally weather-dependent. The output from a wind turbine rapidly decreases as the wind drops. Although this can be forecast to some extent, the drop can sometimes be quicker than expected. For example the AEMO report into conditions on 10 February 2017 (the very hot day in NSW) identified that the wind dropped faster than forecast, leading to a shortage of supply. According to AEMO, of more concern is the total cut-off of supply from a wind turbine when the high wind protection operates. In windy conditions, the turbine can suddenly de-load without warning. South Australia has over 1,600 MW of wind turbines, but the total output can be <10% for several days during calm conditions. The total output of **all** the wind farms in the NEM was less than 20% of their installed capacity for 2,760 hours (32%) during 2017.

5. Load Following and Grid Operation

With typically 70% of the electricity generation from nuclear power, the French nuclear fleet has always had to load follow. They contribute to primary and secondary frequency control and a daily load cycle complying with the European Utility requirements of 50% - 100% rated load at 3%-5%/min.
Modern nuclear reactors are designed to “load follow” and can support weather-dependent renewables[9]. They do not need to be connected to the grid for safety. On loss of grid, the reactor can remain in operation and is then ready to contribute to re-establishing the grid. Modern reactors can quickly load follow if required by using a 100% turbine bypass.
A multi-module plant can independently vary the output of each module providing a flexible load response. For longer periods of load reduction, a module can be shutdown and quickly returned to service whilst still in a hot standby condition.
The Westinghouse AP-1000 (1,100 MWe) has industry-best load following capabilities[10] at 1 MW/sec from 15% power and step load change +/- 10% between 25% and 100% load.
The AP-1000 can also withstand a 100% load rejection to house load without a trip.

[9] https://www.smrnuclear.com.au/_files/ugd/c733f6_86ddd097b2924f33b6b823d017b90b14.pdf

[10] https://westinghousenuclear.com/media/s11prru4/ap1000-fact-sheet-nonprop3_2-pager_jul-2023.pdf

6. Cooling Water

There is a misunderstanding that nuclear reactors require more cooling water than other technologies. As in a coal-fired power station, the steam production is in a closed circuit boiler/steam generator with a small amount of water required for make-up. Any generation technology that uses a steam cycle requires a condenser to convert the steam exiting the steam turbine back to water to circulate back to the boiler. The main water usage on site is the cooling water for the condenser. Because a nuclear power station of the PWR/BWR type has a lower thermal efficiency (typically ~ 33%) compared to a coal-fired power station (~40%), for a given output the nuclear plant will require slightly more cooling water than a coal-fired power station.
If cooling water is limited, providing a coal-fired station is replaced by a PWR/BWR of not greater capacity, there will be sufficient cooling water.
The main cooling water requirement for nuclear power plants is condenser cooling water for plants that use a steam turbine to generate electricity. The exhaust steam from the turbine is condensed back into water to be recirculated to the nuclear reactor. As in any electrical generation plant that uses a steam turbine, including all coal-fired power stations, this requires separate condenser cooling water supplies. Unlike the water supplied to a boiler in a coal-fired power station or to the steam generator in a nuclear power plant, condenser cooling water does not have to be high quality and seawater/lake/river/recycled water is commonly used.

There are three condenser cooling arrangements[11]:

Direct once through cooling

Water is taken from a lake, river or the sea, passes through the condenser and is discharged back into the original water source, but at a point where it will not immediately recirculate. There are usually environment limits on the temperature of the water being returned.
Direct cooling **withdraws** more water than other condenser cooling methods but the water **consumption** is smaller. If the water source is a lake, they will be some small evaporation losses.

Indirect cooling with cooling towers

The condenser cooling water is circulated through cooling towers which discharge the heat to the air, both directly and through evaporation. This is the plume of condensed water vapour that is seen rising from a cooling tower. Tower cooling **withdraws** less water but **consumes** more. Many Australian coal-fired power stations use cooling towers, e.g. Mount Piper

Dry cooling

The condenser cooling water flows through a large radiator in a closed circuit. Fans blow air through the radiator removing the heat. Water **consumption** is very low as there is no water loss through evaporation. Dry cooling increases the house load (electricity required to operate the plant) because of the fans and hence decreases the electrical output slightly. Dry cooling also increases the cost of the cooling system.

The largest coal-fired unit in Australia uses dry cooling. Kogan Creek[12], QLD, 750 MWe supercritical located on the Western Downs consumes only 80 l/MWh, about 5% of a typical Australian coal-fired

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[11] https://www.smrnuclear.com.au/_files/ugd/c733f6_ee43fafd75ad4642a2a74fa8e1953d7a.pdf

[12] https://www.csenergy.com.au/news/blog/the-giant-radiator-keeping-kogan-creek-cool

power station.
The giant radiator has 48 fans, each 9m diameter.

Milmerran, QLD, 2 x 426 MWe supercritical coal also uses dry cooling with a consumption of ~150 l/MWh.

Summary of cooling water options

- When there are abundant cooling water supplies or adequate supplies without too restrictive environmental limitations, direct cooling is the most efficient and least cost option.
- Indirect cooling using wet cooling towers is an option when water supplies are restricted.
- Dry cooling is a more expensive and less efficient option, but enables power plants to be situated practically anywhere

Many of the advanced Small Modular Reactors and microreactors under development now do not use a steam turbine and will not require significant cooling water supplies.

7. Earthquakes

Part of the safety analysis for the siting, construction and operation licences for a nuclear power plant is the assessment of external events, including earthquakes. An earthquake must not jeopardise the safety of the plant.
All countries follow the IAEA guidance for assessing the requirements for seismic design.
IAEA Safety Standard SSR-1 *Site Evaluations for Nuclear Installations*[13]requires that the seismic hazards associated with a site for a nuclear installation be evaluated to serve as an input to the seismic design of the installation.
The site is evaluated in accordance with IAEA Safety Guide NS-G-3.6 *Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Power Plants*[14].
IAEA Safety Standard SSG-67 *Seismic Design for Nuclear Installations* [15] lists the design requirements.

Earthquakes are described by the Richter scale, which is a log scale, i.e every number increase is a factor of 10. Scale 4.0 – 4.9 (typical for NSW) are described as "light", average frequency of occurrences globally are 10,000 – 15.000 per year. Some objects may fall off shelves but they cause little damage. Scale 9.0 – 9.9 is categorised as "extreme" and will cause heavy damage and total destruction to most buildings, except nuclear power plants. The March 2011 Fukushima earthquake was 9.0, the 4th largest ever recorded. Eleven operating nuclear reactors in the area shutdown automatically. All six Fukushima Daiichi reactors survived the earthquake, all control rods inserted and the reactors shutdown safely even in this extreme event. They were only damaged by the later tsunami. Scale 9 is 100,000 times more severe than scale 4.
It is estimated that 20% of reactors worldwide are operating in areas of significant seismic activity (WNA).

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[13] https://www.iaea.org/publications/13413/site-evaluation-for-nuclear-installations

[14] https://www.iaea.org/publications/7067/geotechnical-aspects-of-site-evaluation-and-foundations-for-nuclear-power-plants

[15] https://www.iaea.org/publications/14664/seismic-design-for-nuclear-installations

Australia is not an area of high seismic activity and seismic design in accordance with international standards would be routine. The reactor has earthquake detectors in the reactor basement linked directly to the reactor protection system. The reactor trips automatically, no operator action is required.
ANSTO's OPAL research reactor at Lucas Heights was assessed for seismic hazards and has seismic detection and trips in its protection system.

8. Economics

In looking at the economics of different power generation options, it is essential to understand the distinction between capital costs and total power system costs and to take into account capacity factors, additional transmission cost and firming costs of renewable energy forms.

Electricity needs to be available on demand, 24 hours a day, 7 days a week and in all weather conditions. Nuclear meets this essential requirement and in addition provides system security and stability.
The availability of solar depends on the month and time of day. In the NEM in 2023, the capacity factor of utility solar varied between 13.4% in June and 27.5% in December, average over all months of 21.5% (WattClarity).
The availability of onshore wind also depends on the month and can be at any time of the day. In the NEM in 2023, the capacity factor of wind varied between 25.8% in April and 41.2% in June, average over all months of 30%.
Wind and solar may not be available at the times of the day when it is most required.

Although the capital costs of wind and solar equipment are lower than nuclear, the true cost to the power system is higher. This is due to:

(i) their lower capacity factor,
(ii) additional transmission costs
(iii) firming costs
(iv) lifetime.

Modelling by the Australian consultancy Electric Power Consulting of Kiama in 2018 showed that the cost of a system with 100% renewables would be more than 4 times the cost of a system where coal was replaced by nuclear [16].

A report (2019) by the OECD-NEA explains why the cost of electricity is increased by a high percentage of variable renewable energy (VRE) in the system[17].

The capital cost of a nuclear power plant built since 2000 varies between A$4,323/kW in South Korea to A$20,883 in the UK, average cost A$9,574/kW.
For comparison, the GenCost 2023-24 report Table B.9 lists the 2023 cost of a large reactor as A$8,655/kW.

[16] Electric Power Consulting https://epc.com.au/index.php/nem-model/
[17] The Costs of Decarbonisation: System Costs with High Shares of Nuclear and Renewables, NEA No7299, 2019

The wide variation in cost is due to a number of factors:

- The type of reactor – for example the very high cost in the UK is of the Evolutionary Pressurised Reactor (EPR), a very complex, very large capacity (1,720 MWe gross) reactor that would not be deployed in Australia.
- Whether the vendor has fully completed the design before construction started
- Whether the vendor has a supply chain that can deliver equipment to time and budget
- The degree of modularisation and factory build of the design
- Whether the reactor has been already built or is a First of a Kind (FOAK)
- The cost of labour and materials in the country
- The efficiency of the regulators in the country

Australia should establish a *Nuclear Energy Program Implementing Organisation (NEPIO),* as recommended by the IAEA Milestones program, which would consider all the available reactor designs and vendors and select a proven design and a proven vendor.
It would be sensible for at least the first reactors to be built on the sites of retiring coal-fired power stations to save costs by reusing the existing infrastructure (particularly the transmission connections and cooling water systems) and save the communities by retraining the coal-fired power station staff for the nuclear plant.

9. Deployment time

The deployment time consists of two parts – construction and pre-construction preparations.
The official start of construction of a nuclear power is when the first nuclear concrete is laid. From then to the completion of construction and start of operation of a large nuclear power plant of a proven design would be expected to take ~ 5 years. The construction time of an SMR could be less depending on the degree of factory construction. The GenCost 2023-24 report table B9 lists the construction time of an SMR as 4.4 years.

This would be preceded by a period of around 5 years for community consultation, site selection, feasibility studies, environmental and development approvals and arranging financial facilities, making a total deployment period of up to 10 years.

As an example of a nuclear project in Australia, the deployment time of the complex OPAL research reactor at Lucas Heights from the initial announcement by the Hon. Peter McGauran, Minister for Science and Technology, in 1997 to full power operation in 2006 was less than 9 years.

10. Workforce capability

Education is an important part of preparing for a nuclear power program. The University of New South Wales has been offering a Master of Nuclear Engineering Science (Nuclear Engineering) from 2013 and other universities include guest nuclear lectures in their energy programs. Also the Australian National University Master of Nuclear Science course was established in 2007 and includes nuclear reactors and the nuclear fuel cycle. Following the AUKUS announcement, more courses are being offered.

The construction, commissioning and operation of ANSTO's new OPAL research reactor is a good example of how staff can be recruited, trained and become an efficient workforce. In addition to staff recruited from overseas, young Australian engineering graduates were recruited and trained in nuclear operations whilst the reactor was under construction. They gained extensive operations experience during the commissioning process and Australia now has an expert cohort of nuclear engineers.

Australia is a very attractive country to live and work in. SMR Nuclear Technology Pty Ltd is regularly approached by nuclear engineers working overseas who would love to work in a nuclear program in Australia.

11. Security Implications

An important security issue is safeguards.
"Safeguards" is the total system for accounting for nuclear materials and are measures applied by the International Atomic Energy Agency (IAEA) to verify that non-proliferation commitments made by States under Safeguards Agreements with the IAEA are fulfilled. Because of our involvement in the nuclear fuel cycle and research reactors, Australia already has Safeguards Agreements in place. The Australian Safeguards and Non-Proliferation Office (ASNO), in the Department of Foreign Affairs and Trade is responsible for ensuring Australia's obligations for safeguards.

There are global and domestic security implications of nuclear power development.

At a global level, utilisation of nuclear power will reduce the vulnerability of individual countries to disruptions in oil supply and to volatility in oil prices. At a domestic level, nuclear power will not be prone to fuel supply shortages.

12. National consensus

National support for properly-regulated nuclear power as part of the energy mix would contribute to community trust of energy policy and build national confidence in Australia's own long-term energy future and as supplier to our key trading partners of China, India and Japan.

Canada has made an early start on positioning itself to be the most innovative country in the modern nuclear industry. This is demonstrated by its publication in November 2018 of *'A Call to Action: A Canadian Roadmap for Small Modular Reactors.'*

The Canadian Roadmap starts by acknowledging nuclear energy as *'a strategic asset.'* Its declared purpose is '*to chart a vision for the next wave of nuclear innovation ... [because] SMRs could help Canadians achieve a low-carbon future.'* As it explains:

'Markets around the globe are signaling a need for smaller, simpler, and cheaper nuclear energy in a world that will need to aggressively pursue low-carbon and clean energy technologies to meet climate change goals.

SMRs respond to these needs: they are smaller nuclear reactors that involve lower capital investment and modular designs to control costs; they can compete with other low-cost forms of electricity generation; they incorporate enhanced safety features; and they could enable new applications, such as hybrid nuclear-renewable energy systems, low-carbon heat and power for industry, and offset diesel use in remote communities and mine sites.'

13. Removal of the prohibition on nuclear power

The construction and operation of a nuclear power plant in Australia is presently prohibited by two Federal Acts:

- **Environmental Protection and Biodiversity Conservation Act (EPBC Act) 1999 S.140A**
- **Australian Radiation Protection and Nuclear Safety Act (ARPANS Act) 1998 S.10**

These prohibitions were put in place at a time when there was no real appreciation of the contribution that modern, safe nuclear power plants could make to energy security, affordability and emissions reduction.

In May 2016, the South Australia Nuclear Fuel Cycle Royal Commission recommended that prohibitions be removed:

> *Recommendation 8 - Pursue removal at the federal level of existing prohibitions on nuclear power generation to allow it to contribute to a low-carbon electricity system, if required.*

The legislative prohibitions preclude any serious consideration of the merits of nuclear power generation in Australia. Nuclear power plant vendors will not treat Australia as a potential market whilst the prohibitions remain.
Although government reports have repeatedly endorsed the merits of "technology neutrality" in power system planning, the legislative prohibitions have prevented its accomplishment.
System reliability, as well as affordability and lower emissions, beyond 2030 can be underwritten by including nuclear generation in the generation mix and utilising all low-emissions technologies.

14. IAEA support

The IAEA provides comprehensive guidance and support for the establishment of a nuclear power program in individual countries.

The IAEA Milestones Program[18] identifies the key infrastructure issues to be considered. Australia already has much of the infrastructure in place, for example the safeguards system, because of our involvement in the nuclear fuel cycle. A worthwhile supporting step for Australia would be the establishment of a Nuclear Energy Program Implementing Organisation (NEIPO) as recommended by the IAEA in its Milestones Program.

Some Concluding Points

In the modern era, the nuclear industry is transforming itself to meet contemporary community expectations. In particular, modern nuclear power plants are designed to be inherently safe and will provide reliable, affordable and low-emissions power for up to 80 years.

If the moratorium on nuclear power generation is lifted, nuclear power could be deployed and become a game-changer in Australian power system planning, progressively replacing obsolete power generators in the Australian power system as they close down over the next 30 years.

The development of nuclear power generation in Australian would lead to the establishment of an entire new industry with long-term environmental, technological, economic and social development benefits for the people of Australia and its internal regions. These benefits would flow on progressively to other industries.

SMR Nuclear Technology Pty Ltd has been pleased to provide this submission to the House Select Committee on Nuclear Energy and stands willing to expand on these and any other issues that the Committee may wish to raise in evidence to the Committee.

Tony Irwin
Technical Director
November 2024

[18] IAEA Nuclear Energy Series NG-G-3.1 Milestones in the Development of a National Infrastructure for Nuclear Power