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Submission to

**Environment and Planning Committee, Legislative Council,
Parliament of Victoria**

Inquiry into Nuclear Prohibition in the Nuclear Activities (Prohibitions) Act 1983

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Summary

There is no justification for continuing the historic prohibitions of uranium mining and nuclear facilities in Victoria. These selective prohibitions are to the detriment of regional communities that could benefit from the jobs and investment in uranium mining and nuclear power, and to the broader Victorian community that could benefit from increased economic activity, reliable and affordable electricity and reduced carbon emissions.

Nuclear energy is widely used in many countries where it provides security of supply as well as reduces carbon emissions and other air pollution.

The International Energy Agency analysed different electricity technologies and found that nuclear energy is competitive in terms of the levelised cost of electricity (LCOE) with fossil fuels and renewables firming with storage. In any case, assumptions on the cost of nuclear energy are no reason to maintain legislative prohibitions. Nuclear power plants will not be built unless they are economic.

The Australian Nuclear Association strongly recommends repeal of the historic prohibitions against uranium mining and nuclear facilities in the Nuclear Activities (Prohibitions) Act 1983.

Repeal of these legislative prohibitions does not imply that uranium mining and or nuclear facilities including power plants will necessarily be introduced in Victoria. However, removing the prohibitions will allow these activities to be considered on their merits as part of the Victorian resource and energy future.

1. AUSTRALIAN NUCLEAR ASSOCIATION

The Australian Nuclear Association is an independent incorporated scientific institution with members from the professions, business, government and universities with an interest in nuclear science and technology. Many of our members are professional scientists and engineers with considerable experience and expertise in nuclear issues.

2. URANIUM MINING

Removing the Victorian prohibition on uranium and thorium exploration and mining could contribute to reducing global low carbon dioxide production (Terms of Reference 1), provide economic and social benefits to Victoria (Terms of Reference 2) and enable Victoria to participate in the nuclear fuel cycle (Terms of Reference 3)

Currently exploration for and mining of uranium ores is legal in South Australia, Western Australia and the Northern Territory. Removing the prohibition on exploring and mining uranium in Victoria will benefit regional centres by allowing uranium mines to be developed where proposals meet the already stringent mining regulations and licensing processes.

Most of the risks, hazards and environmental impacts of uranium mining are similar to those of other mines already regulated and licenced in Victoria. A uranium mine would also need to meet the existing Victorian radiation safety regulations which would apply to the workers at the mine and the public. Radiation regulations needed for mining uranium are very well established and already applied in industries managing radioactive materials and in mines with significant naturally occurring radioactivity. Experience and knowledge relating to the successful and effective regulation and licensing of uranium mines can be supplied by other States and countries.

The modern uranium mining industry has a good safety record in both radiation and general safety. Radiation dose records are compiled by major mining companies under the scrutiny of regulatory authorities. Aside from radiation, the occupational health and safety hazards of modern uranium mining are no greater than, nor distinct from, other comparable mining operations.

The current selective prohibition of uranium mining is to the detriment of regional communities that could benefit from the jobs and investment in uranium mining and to the broader Victorian community that could benefit from the increased economic activity.

Nuclear power plants produce clean electricity with very low carbon emissions. Removing the prohibition on uranium exploration and mining will contribute to the world supply of uranium is an economic uranium ore body is found in Australia.

The Australian Nuclear Association recommends repeal of the prohibition on uranium and thorium exploration and mining so that Victoria can benefit from the international trade in uranium and contribute to the global production of clean energy.

3. NUCLEAR POWER PLANTS

The Victorian Nuclear Activities (Prohibitions) Act 1983 prohibits certain nuclear activities in Victoria including the construction and operation a nuclear reactor or a nuclear power reactor. Removing the prohibition against nuclear power plants could provide economic, environmental and social benefits for Victoria (Terms of Reference 2) and provide opportunities for Victoria to benefit from participation in the nuclear fuel cycle (Terms of Reference 3).

Nuclear power plants are major generators of electricity in most advanced and many developing countries. Although nuclear energy has a very good record overseas for supplying reliable, affordable and low carbon electricity, Victoria has maintained historic prohibitions from 1983 that prohibit the construction or operation of nuclear facilities including nuclear power reactors.

Repealing the prohibition against nuclear facilities would allow proposals for nuclear facilities, including nuclear power plants, to be considered on their merits as part of Victoria's clean energy future.

Based on the overseas experience, adding nuclear power to Victoria's energy system would increase reliability and affordability, as well as greatly reduce carbon emissions. Nuclear power plants in regional locations would be a major long-term employer. Nuclear power could enhance the health and welfare of people in Victoria and improve the environment by reducing emissions.

Nuclear electricity is a very well-established technology with over 17,000 nuclear power plant-years of commercial operation since the first commercial nuclear power plants started in the 1950s.

As of January 2020, there were 447 nuclear power plants in service in 30 countries, and 52 nuclear power plants under construction¹. In 2018 nuclear generated approximately 10% of the world's electricity, and about 18% of the electricity of OECD countries².

Nuclear power plants are very reliable operating at a high capacity factor – in 2018 the global average capacity factor was 79.8%³ - providing dispatchable electricity 24 hours per day. This figure would be even higher if it wasn't for the fact that more and more nuclear power plants are being used for load following. The very low carbon emissions of nuclear power greatly assist these countries in meeting international carbon emission commitments.

Uranium is a very energy dense fuel. This means for example that while a 1000 MWe coal plant would consume about 2.6 million tonnes of coal per year, the equivalent nuclear plant would consume only 25 tonnes of uranium. Partial refuelling of pressurised water reactors takes place every 18 to 24 months.

Nuclear power plants generate low carbon clean electricity. The demand for electricity for private and industrial use, including transport and the developing electric vehicle market, will only increase. Nuclear energy plays a key role in lowering carbon emissions from the energy sector in many countries. The carbon emissions for the whole nuclear fuel cycle are very low and of the order of 40 grams CO₂/kWh. This low carbon emission is similar to emissions from wind and hydro per unit of electricity produced⁴ and slightly less than solar PV. This comparison assumes that methane from hydro is not significant and ignores the emissions from any storage or backup generators required for firming wind and solar generators.

In 2018, nuclear power plants around the world produced 50% more clean electricity than wind and solar combined⁵. In the European Union and USA, nuclear produces more low carbon electricity than hydro⁶.

The use of nuclear power plants enables countries to achieve low carbon emissions from electricity generation. For example, nuclear supplied 72% of electricity in 2016 in France

¹ IAEA Database on Nuclear Power Reactors, <https://pris.iaea.org/pris/> Accessed on 29th January 2020.

² *Nuclear Energy Data 2019 Edition*, OECD Nuclear Energy Agency 2019

³ *World Nuclear Performance Report 2019*. World Nuclear Association, 2019

⁴ *Emissions of selected electricity supply technologies (gCO₂eq/kWh)*. Table A.III.2, Annex III: Technology-specific cost and performance parameters. In: *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*

⁵ *Electricity Information Overview*, International Energy Agency 2019. Page 4.

⁶ IEA 2019b *Nuclear Power in a Clean Energy System*, International Energy Agency May 2019

which had an electrical generation carbon emission intensity of 58 grams CO₂/kWh compared to 440 grams CO₂/kWh for its neighbour Germany, which has a similar sized electricity grid and is closing nuclear plants⁷.

Nuclear energy is a large-scale generator, which can be a coal replacement technology. As well as reducing carbon emissions, nuclear power plants also benefit the environment by reducing other air pollution. Installing either larger nuclear power plants or the emerging small modular reactors (SMRs) could maximise the use of our existing power resources such as the grid, transport systems, cooling resources and most importantly the existing work forces. The construction and operation of nuclear power plants can help to ensure stable regional communities and local economies for many decades.

In many countries, the costs of nuclear electricity are competitive with fossil fuels and with renewables firmed with storage or backup.

The International Energy Agency analysed different electricity technologies and found that nuclear power is competitive in terms of the levelised cost of electricity (LCOE) with fossil fuel and renewables. The construction cost of nuclear power plants depends on many factors including the type of plant and the vendor, whether it is first or n-th of a kind and the country where the nuclear power plant is being built. The long potential operating life and low operating costs of nuclear offset the high construction costs⁸.

However, LCOE analysis does not include system costs in a grid operating with significant variable renewable energy (VRE) such as solar and wind. Adding a low cost VRE to the grid requires backup generators or storage available for the times when the VRE is not producing electricity. In addition to this, as greater reductions in carbon intensity are made, every element of a VRE grid will be operating at steadily reducing capacity factors.

The time to build a nuclear power plant has a major bearing its cost. Although recent construction of some first-of-a-kind power plants in Finland, France and the USA have cost more than planned, the overall conclusion of the International Energy Agency study stands - in most countries nuclear is economically competitive as a generator of electricity.

The construction times of the EPR and AP1000 nuclear power plants already built and operating in China were much shorter and at lower cost than the first-of-a-kind plants of same design built in Europe and the USA.

The median construction time for nuclear power plants completed between 2011 and 2017 was 68 months from first pouring of concrete to the connection of the unit to the grid⁹.

A recent OECD report on the costs of decarbonisation highlighted the impact of the variability of wind and solar have on electricity system costs and the cost of the extra backup generators, costly transmission lines and excess capacity required¹⁰.

Decarbonising our electricity system will need an optimum economic mix of low carbon technologies to work together. Because of their intrinsic variability, the overall system cost of

⁷ EEA 2019. *CO₂ Emission Intensity Electricity Generation*. European Environment Agency.

⁸ IEA 2015. *Projected Costs of Generating Electricity*, International Energy Agency, Nuclear Energy Agency, Organisation for Economic Co-operation and Development Sept 2015

⁹ IAEA 2019. *Nuclear Power Reactors in the World*. International Atomic Energy Agency, Vienna, May 2019

¹⁰ OECD 2019. *The Costs of Decarbonisation: System Costs with High Shares of Nuclear and Renewables*, Nuclear Energy Agency, Organisation for Economic Co-operation and Development, OECD June 2019 NEA No 7299.

adding large amounts of wind and solar are larger than the sum of their individual plant level costs.

In particular, the OECD 2019 study concludes that:

“... diversity of energy sources drives down total costs of energy in a low-carbon system, whereas taking options off the table – such as nuclear – creates extra costs to society”.

It also indicates that:

“... the impacts of decarbonisation targets on the optimal investment policies are not linear and some targets may yield a share of a particular technology e.g. wind, that under a more stringent target may not be present in the optimal mix”.

For modelling Australia’s energy future, it is vital that nuclear energy be included in the options. It is important that the legislative prohibitions be removed so that nuclear can be properly assessed. The costs of electricity from nuclear power plant in Australia will only be known when vendors can make proposals for modern plants destined for Australia.

Even though nuclear energy is economic for many countries, the cost of a nuclear power plant in Australia will not be known until there is a firm proposal. Assumptions about possible costs are no basis for the prohibition of nuclear power technology. Nuclear power plants will only be built if nuclear energy is economic.

Modern nuclear power plants are safe.

The Chernobyl accident is the only accident in the history of nuclear power generation in which deaths have occurred from radiation. It is important to note that the Chernobyl nuclear power plant type would not have been licenced outside the former Soviet Union.

The Fukushima nuclear accident caused great economic loss and evacuation of large numbers of people. Nevertheless, there is no clear evidence of any deaths attributable to the emission of radiation from the accident that occurred at Fukushima. Radiation doses to the public were ten times lower than the dose at which any direct health impacts become evident.

As with the aircraft industry nuclear power plant designs are continually being improved based on the operating experience of current nuclear power plants. The nuclear risk and safety of all operating nuclear plant and new designs were reassessed following the Fukushima accident and where necessary upgraded.

The most significant design improvements in modern large-scale 1 GWe nuclear power plants and Small Modular Reactors (SMRs) are the introduction of safety features which enable these reactors to automatically shut down and remove decay heat using passive controls. This means that modern reactors remain safe without external power supply or human intervention for an extended time.

SMRs, rated from 10 MWe to 300 MWe, are now undergoing regulatory assessment overseas. SMRs have advanced safety features, are designed to load-follow and their modularity reduces the upfront capital cost making them easier to finance and quicker to operate.

Any nuclear plant to be built in Victoria would be a modern design, Gen III, or later, that meets international standards. It will have to meet the stringent regulatory condition based on well-established international standards. Nuclear power plant designs are assessed, approved and licensed by a nuclear regulator before construction.

Nuclear power plants have the potential to increase the reliability and affordability of Victoria’s energy system and reduce carbon emissions. Consequently, the Victorian

prohibitions should be removed so that nuclear power plants can be seriously considered on their merits to be part of Victoria's energy system

4. BARRIERS TO PARTICIPATION IN THE NUCLEAR FUEL CYCLE

As well as the prohibitions in Nuclear Activities (Prohibitions) Act 1983, which should be removed, there are other barriers to gaining the benefits of nuclear energy in Victoria's energy system (Terms of Reference 4).

The regulatory regime for nuclear power plants needs to be clarified and a regulator for nuclear power plants needs to be identified.

The Commonwealth and each of Australia's eight State and Territory jurisdictions have legislation covering the use of radiation. However, of the nine pieces of primary radiation control legislation that exist in Australia, only the Commonwealth ARPANS Act 1998 specifically addresses nuclear installations and nuclear safety¹¹.

The Victorian Department of Health and Human Services regulates the use of radiation in Victoria by administering the *Radiation Act (2005)*. However, the Department has no experience or expertise in regulating nuclear facilities such as nuclear reactors.

The ARPANS Act applies to Commonwealth entities that use or produce radiation are the subject of the ARPANS Act, which includes all the nuclear installations currently in Australia.

At this time, all the nuclear installations in Australia are operated by Commonwealth entities and hence are regulated by ARPANSA, including the 20 Megawatt OPAL Research Reactor at Lucas Heights near Sydney.

In 1977, the Commonwealth and States at COAG agreed on the roles and responsibilities for the environmental responsibility and the Heads of Agreement includes the following statement related to nuclear activities¹².

6. Nuclear activities

The Commonwealth has a responsibility and an interest in relation to the assessment and approval of mining, milling, storage and transport of uranium and the development and implementation, in consultation with the States, of codes of practice as provided under the *Environment Protection (Nuclear Codes) Act 1978* for protecting the health and safety of the people of Australia, and the environment, from possible harmful effects associated with nuclear activities.

This statement provides clarification on the Commonwealth role in environmental regulation of uranium mining, but it is not clear if the agreement includes nuclear installations such as nuclear power plants.

The Federal Environment Protection and Biodiversity Conservation Act 1999 (the EPBC Act), currently under review, specifically states that the Federal Minister shall make no

¹¹ see APRPANS submission 136 to The House of Representatives Standing Committee on Environment and Energy Inquiry on "*the prerequisites for nuclear energy in Australia*".

https://www.aph.gov.au/Parliamentary_Business/Committees/House/Environment_and_Energy/Nuclearenergy

¹² <https://www.environment.gov.au/resource/heads-agreement-commonwealth-and-state-roles-and-responsibilities-environment>

declaration relating to or give approval for the construction or operation of a nuclear power plant.

International best practice requires the Government to establish a national policy and strategy and a legal and regulatory framework for safety¹³. A legal and regulatory framework is essential to provide a basis for assessing any proposal for a nuclear power plant.

There is an urgent need to clarify responsibility for nuclear safety legislation and regulation for a nuclear power plant proposed by a company or organisation which is not a Commonwealth entity.

The Australian Nuclear Association recommends that nuclear safety be administered by an expanded ARPANSA under Commonwealth legislation. The States and Territories could continue to have a role in occupational health and safety, environmental and non-nuclear aspects of the plant. A legislative framework between the Commonwealth, States and Territories for the effective and efficient regulation of nuclear facilities including nuclear power plants.

Australia can benefit from current and emerging nuclear power plant designs as well as from the considerable international experience accumulated in regulating nuclear power plants, taking into account safety, environmental, technical, economic and social factors.

4. RECOMMENDATIONS

The Australian Nuclear Association strongly recommends

- 1. Repeal of the Nuclear Activities (Prohibition) Act 1983.**
- 2. Nuclear safety be administered by an expanded ARPANSA under Commonwealth and State legislation.**

¹³ IAEA Safety Standards Series No. GSR Part 1 (Rev. 1) *Governmental, Legal and Regulatory framework For Safety - General Safety Requirements* Feb 2016