Submission to the Australian Senate Inquiry into Nuclear Power 2022-23

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Abstract

Australia's existing ban on nuclear power generation and associated infrastructure restricts our ability to adopt modern technologies with considerable environmental and economic benefits. Modern nuclear reactor technologies would mitigate the standard objections to nuclear power, by enabling existing waste from overseas reactors to be used as fuel. This opens up the possibility of reducing the need to mine fuel, reducing the spread of nuclear material between countries, simplifying disposal of nuclear waste, and generating electricity with minimal greenhouse gas emissions.

1 Personal background and interest

I am a visiting research fellow at the University of Adelaide. I hold a PhD in Theoretical Physics, and therefore have considerable expertise in mathematics and science, which informs my opinions on the civilian uses of nuclear technology. I receive no funding or salary from any company or organisation in the mining, power, defence, or nuclear industries.

2 Statement addressing the benefits and risks of nuclear power

I support the proposal of the bill, to allow nuclear energy generation and the development of related infrastructure in Australia.

Nuclear power is a low-carbon energy generation technology which can play a vital role in curtailing the emission of greenhouse gases, while providing stable baseload power. Criticisms of nuclear power are frequently based up older (generation I and generation II) reactor designs and performance, and focus on several areas of concern;

- Safety
- Nuclear proliferation
- Disruption of environmentally and culturally sensitive areas related to mining fuel and waste disposal
- Construction timeframes

Modern nuclear reactor designs (Generation III/III+ and IV) as well as fuel extraction technologies can greatly reduce - or entirely overcome - all of these concerns. It is therefore important that the potential of nuclear power to mitigate against anthropogenic climate change is based upon modern nuclear technologies.

2.1 Safety

Nuclear power has an undeserved poor reputation in terms of safety. In reality, when deaths per terawatt hour of energy generated are evaluated (due to accidents and air pollution), nuclear power is just as safe as wind and solar. Wind power is responsible for 0.04 deaths per terawatt hour, nuclear for 0.03, and solar 0.02, in comparison with brown coal which accounts for 32.72 and oil at 18.43 deaths per TWh.

Perceptions of the safety of nuclear power are dominated by the Chernobyl and Fukushima nuclear accidents. However fewer than 100 deaths can be directly attributed to Chernobyl, and only one death can be attributed to radiation exposure at Fukushima. Several thousand deaths are attributed to the evacuation of civilians from the surrounding area, however it must be remembered that the area also experienced an earthquake and tsunami which made the evacuation circumstances

more challenging. It is difficult therefore to *solely* attribute these casualties to the accident at the Fukushima power plant.

It should also be noted that modern nuclear reactor designs incorporate "passive" safety systems, meaning that in the event of a mishap the laws of physics themselves cause the reactor to shut down.

2.2 Nuclear proliferation

There are understandable concerns about civilian nuclear reactors being used to create weapons-grade material which can be used for military purposes, or fall into the hands of rogue states. This can be addressed in a two-fold manner.

Firstly, would Australia produce weapons-grade material? The answer is a simple no. We can and should choose not to enrich nuclear material for military uses.

Secondly, as Australia mines and provides nuclear fuel to other countries, we can mitigate the risk of weapons being created from nuclear material mined in Australia by developing the technology to dispose of the spent fuel from foreign power stations. The potential for doing so will now be addressed.

2.3 Disposal

The disposal of existing nuclear waste presents considerable challenges around the world. Nuclear waste is radioactive because it contains unused energy. If that energy was released and fed into the power grid, the waste itself would become less radioactive. Modern nuclear reactor designs have the potential to use existing nuclear waste as fuel in this way.

Refusing to build nuclear power stations does nothing to reduce the amount of nuclear waste that already exists, **but reusing that waste as fuel renders it more inert, while generating electricity.** The residual radioactivity of any remaining nuclear waste can be sufficiently minimal that disposal would not be as difficult as for the unused waste.

In this way, Australia could act to reduce its greenhouse gas emissions and produce electricity. At the same time, by acquiring nuclear waste from foreign countries to use as fuel, Australia could reduce the risk of that waste being redirected to military purposes or rogue organisations/states. This would enable Australia to be a responsible participant in the nuclear fuel cycle, by keeping account of how much nuclear material we export, and how much we import after it has been used overseas for power generation.

2.4 Environmental and cultural considerations

There are understandable concerns around mining and nuclear waste disposal in areas of the country that have high environmental value, or cultural significance to First Nations people. These can be mitigated by the benefits of modern nuclear power technology mentioned above.

Acquiring and using nuclear waste as fuel would reduce the amount of mining necessary to meet Australia's energy needs. Furthermore since nuclear fuel contains much more energy per kilogram than fossil fuels, a transition to nuclear power and away from fossil fuels would reduce the amount of land that needed to be mined, leading to a net reduction in environmental and cultural impacts. Similarly the use of nuclear waste as fuel would, as noted above, result in residual amounts of waste which are not as radioactive as the waste one started with. This would reduce or entirely eliminate the need to store waste in geologically stable areas for several thousand years - again mitigating the environmental and cultural impacts.

In addition, small quantities of uranium exist dissolved in the world's oceans. Recent research has focussed on extracting uranium from seawater, with some success. If this technology could be scaled up it would allow useful quantities of nuclear fuel to be obtained from seawater. The fuel extracted would be replaced by uranium dissolving from rocks on the seafloor, making this an effectively inexhaustible source of fuel without any need for mining.

2.5 Construction timescale

Some opponents of nuclear power argue that it couldn't be adopted rapidly enough to mitigate climate change. This argument would need to be evaluated on a case-by-case basis for any particular infrastructure design. However it is not a good argument for maintaining a ban on nuclear technology. Even if nuclear reactors were *only* used to reduce the radioactivity of existing nuclear waste this would be worthwhile. The fact that doing so could produce usable electricity is an added bonus.

There also exist designs for so-called Small Modular Reactors, which can be rapidly produced, and scaled up by adding more SMRs to the grid as time goes by, allowing for a rapid reduction in fossil fuel use.

3 Summary

The potential use of nuclear power in Australia is a win-win scenario. Adopting nuclear technologies, especially those which reprocess existing waste into fuel, would allow us to decrease our national greenhouse gas emissions, mitigate against nuclear proliferation, reduce the impact of mining, and provide better waste disposal options than currently exist. It would also create hi-tech job opportunities which could encourage Australian students to study science and engineering at university, leading to economic benefits associated with the growth of the STEM sector.

Thank you for considering my submission to this inquiry.

Dr S. Bilson-Thompson