

Logan Smith



### **Submission to the Victorian Enquiry into Nuclear Prohibition**

Dear Members of the Committee,

My name is Logan Smith, I hold an RMIT Bachelor of Civil and Infrastructure Engineering and a UNSW Masters in Engineering Science – Nuclear. I am currently working in the construction industry but I represent myself, and my podcast (Going Fission - [www.goingfission.podbean.com](http://www.goingfission.podbean.com)) in this submission. The Federal enquiry into nuclear power for Australia was a valuable investigation and I am confident Victoria's state level inquiry will be similarly valuable.

The future of Australia's energy transition is occurring at a time when cost, reliability and the effects of burning fossil fuels are all key parts of the political debate. Our coal fired infrastructure is aging and there is no established plan to replace it. Gas is simply another fossil fuel-and it is unlikely that renewables will be an effective replacement without a revolutionary development in storage technology along with massive redesign and augmentation of the transmission infrastructure.

Nuclear power is a mature technology which we have, to date, excluded from consideration because of outdated legislation that has been in effect longer than I have been alive. This legislation makes it very easy to simply accept handwaving arguments such as 'it's too expensive', or 'what about the waste problem?' and discourages government or industry from investigating the technology at any useful detail.

A technology, which I might add, demonstrated its ability to replace fossil fuels last century, and serves as a reliable and economical generation asset in much of the developed world.

### **Investigate the potential for Victoria to contribute to global low carbon dioxide energy production through enabling exploration and production of uranium and thorium;**

I think the investigation as stated above is focussed incorrectly. If we in Victoria are serious about contributing to global low carbon energy production, we should be developing an energy transition plan for replacing brown coal (and subsequently gas) fired power stations with nuclear and other low-carbon options, because a nuclear power station anywhere is less carbon emissions everywhere.

Granted, exploration for and mining of uranium deposits could be made possible if the legislation is changed but it is not particularly clear what Victoria holds in terms of uranium deposits. Should that come to pass, Victoria's contribution to low carbon energy production (domestically, nationally or worldwide) through mining of uranium and thorium is going to be very limited. I would expect the enquiry to reference findings of the 2016 SA royal commission<sup>1</sup> as they are relevant here. Increasing uranium production into a saturated market is unlikely to be a wise economical investment, nor will it have a significant effect on carbon emissions worldwide. This would likely be equally true if we developed uranium enrichment or fuel fabrication. The more effective course of action would be to

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<sup>1</sup> (Government of South Australia, 2016)

use uranium domestically to reduce our reliance on fossil fuels, targeting electricity generation first and subsequently, the process heat and chemical fuel sectors.

As for Thorium, it is a fascinating area of nuclear *development*, but it won't be commercialised for some time. Although many proponents of Thorium may give the impression that the fuel is somehow vastly different to uranium, it is still governed by nuclear physics. Current uranium-based technology is perfectly suitable for our needs today and should be the basis of any new nuclear power build as it can produce energy in large quantities today. If so desired, development of a thorium fuel cycle could be pursued but should not be a primary focus.

While on the topic of developing technologies, synthetic fuel deserves a mention. Hydrogen is one option, but others are possible as well. In any case, producing synthetic fuels requires a significant energy input. From where will it come? The position put forth by ARENA is that renewables will provide this primary energy<sup>2</sup>. Currently, after around 30 years of nurture renewables only account for 17% of Australia's electricity production. If renewables are unable to replace coal and gas in the electricity sector, how can one reasonably expect them to produce enough hydrogen to replace hydrocarbon use in another sector, such as transport? Nuclear power could easily provide low-carbon, primary energy for synfuel production.

One final note worth addressing is the rollout of Electric Vehicles. At the risk of repeating myself, should a significant portion of transport energy consumption shift from oil to electricity, what will service this increased demand? The status quo suggests renewables are unable meet current demand, so coal or gas infrastructure will need to expand. Alternatively, we could establish some nuclear power infrastructure.

**Identify economic, environmental and social benefits for Victoria, including those related to medicine, scientific research, exploration and mining;**

Before we speak of reaping benefits, we need to ensure that the state is capable of keeping the lights on. Victoria's coal-fired power stations, like elsewhere in the NEM, are coming to the end of their lives. Hazelwood closed in 2017, and Victoria went from a net exporter to a net importer of electricity<sup>3</sup>. While renewable generation technology has its place on grid, so too does high output, reliable generation, be that coal, gas or nuclear. Victoria should have developed a plan for replacing Hazelwood before 2010. Yallourn is due to close in 2032 and Loy Yang in 2046<sup>4</sup>. If this mistake is not to be repeated, now is the time to be planning their replacements.

Nuclear power can act as a direct replacement as it is a large thermal power station, and thus retains the benefits such as high output and capacity factors, spinning reserve and fault capacity (properties that intermittent sources such as wind and solar lack). Additionally, nuclear also benefits from the same low lifetime carbon emissions enjoyed by renewables, and promotes energy security as the fuel is energy dense, easy to transport and a small proportion of the total energy cost. A nuclear power station has more flexibility in location as it is not restricted by its fuel source, such as areas of high wind or solar irradiance or location of a coal seam. The high energy density of the uranium fuel makes it easy to transport. Availability of cooling water and existing transmission infrastructure are better suited to nuclear siting than renewables.

Regarding the non-power benefits of nuclear science, I'd like to offer the following points:

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<sup>2</sup> (Australian Renewable Energy Agency (ARENA))

<sup>3</sup> (Harrison, 2018)

<sup>4</sup> (Transgrid, 2018)

Nuclear technology can be applied to many aspects of life beyond electricity generation. Food preservation and construction foundations are two examples. Removing legislative barriers will be a step toward broader domestic access to nuclear materials required to pursue these capabilities.

Australia already has some significant expertise in nuclear science and developing a local nuclear industry would provide a valuable partner for our academic capabilities, and vice-versa.

The nuclear laboratories at Lucas Heights are world class facilities and should be more widely recognised as such by the Australian population. Detractors of nuclear technology will fearmonger about the risk presented by the existence of Lucas Heights<sup>5</sup>, and yet joyously point out the disruption to the medical isotope supply if it is offline<sup>6</sup>. The OPAL reactor is a classic example of a single point of failure. This heralds a golden opportunity for Victoria to examine the practicality and viability of a second facility to produce medical and industrial isotopes to help secure continued supply, should one facility enter a shut-down period. However, the legislative ban on such technology prevents Victoria even considering such an opportunity.

Victoria is fortunate enough to be the home to the Australian Synchrotron<sup>7</sup>. This a particle accelerator, another tool of nuclear science (the Large Hadron Collider on the French-Swiss border is another example). This is important as particle accelerators are used differently to neutron scattering beamlines. The synchrotron uses electrons (which are negatively charged) to produce beams of intense light for a number of scientific instruments. Neutron scattering experiments are also useful to nuclear science, but as neutrons have no charge, they must be sourced and propelled differently. A nuclear reactor can be used as a neutron source for such experiments. Neutrons emitted from fission events produced in a nuclear reactor can be fed into beamlines to facilitate a myriad of neutron scattering capabilities. This is one application of the OPAL reactor at Lucas Heights. As the law in Victoria prohibits nuclear reactors but not particle accelerators, we have inadvertently created legal landscape that incongruently restricts access to the various tools of nuclear science.

Nuclear is a technology where humanity has barely scratched the surface of its capability. Uranium 238 (the non-fissile component and 99.3% of all mined uranium<sup>8</sup>) can be used as fuel in a fast-neutron reactor. Although yet to be commercialised, the technology does already exist<sup>9</sup>, and Australia could become part of its development.

### **Identify opportunities for Victoria to participate in the nuclear fuel cycle;**

There is no technical reason why Victoria (or even Australia) cannot participate in the nuclear fuel cycle. For us to take part, the legislative bans at state and federal levels need to be removed and the government would need to demonstrate effective leadership to educate the public against unfounded scaremongering. We would need to carefully plan how to develop and attract appropriate talent. Australia is not as anti-nuclear as it once was, and a government (State or Federal) with a little courage would be able to demonstrate to the world that the state is open for business in the nuclear industry.

So long as electricity decarbonisation is a goal, there is absolute value in nuclear power. This is demonstrated in several locations around the world. The SA Royal Commission noted that gigawatt

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<sup>5</sup> (The Greens, 2018)

<sup>6</sup> (Cooper, 5)

<sup>7</sup> (Australian Nuclear Science and Technology Organisation, 2020)

<sup>8</sup> (World Nuclear Association, 2019)

<sup>9</sup> (World Nuclear Association, 2019)

scale nuclear reactors were not considered a good fit for South Australia; understandable, as SA constitutes only 6% of the NEM. Victoria makes up about 23%<sup>10</sup>, which suggests that larger energy infrastructure would better serve Victoria's electricity needs, particularly as replacement for the 4.5 GW of coal capacity that will need to be found when Yallourn and Loy Yang close.

The Royal Commission found that a significant profit could be realised by building a Spent Nuclear Fuel (SNF) repository, I don't see why this proposal could not be adopted by Victoria. However, the Commission overlooked what could be done with this money, which made it sound like an appeal to greed.

Its important to note what SNF actually is, as the myth of glowing green liquid is as ubiquitous as it is wrong. Nuclear fuel goes into a reactor as one of many small pellets, containing about 3-5% fissile Uranium ( $U^{235}$ , this is the fuel source) and the balance being fertile Uranium ( $U^{238}$ , essentially just filler material). When those same pellets come out of the reactor as SNF, they are still solid, retain about 1% as  $U^{235}$ , 1% Plutonium, 3% minor actinides and fission products (this is the heat and radiation producing component) and 95%  $U^{238}$ . This large portion of  $U^{238}$  is significant, as it can be used as fuel in a fast-neutron reactor.

Dr. Ben Heard and Senator Sean Edwards made a fascinating submission to the Commission which I think still deserves consideration<sup>11</sup>. It outlines a bold plan that still has the potential to be unimaginably valuable to the nation. Put simply, we could accept the worlds SNF for a fee. Then, with the capital raised by that venture (estimated at over \$100 billion<sup>12</sup>), develop a nuclear power industry including SNF reprocessing and fast-neutron reactors. Once such infrastructure is established, the worlds SNF surrendered to Australia is processed into fuel to run our nation. It is quite literally, run zero emission nuclear reactors on the reprocessed SNF that the world pays us to take back, from the uranium we originally sold.

It is an incredibly bold plan that, if successfully executed, would be certainly be a step toward Australia becoming 'the clever country' and a respected partner in the nuclear fuel cycle.

**Identify any barriers to participation, including limitations caused by federal or local laws and regulations;**

Obviously, the legislative bans at federal and state levels must be repealed in order to act on anything this inquiry is investigating. There is little incentive for international nuclear interests to engage with Australia while they are place.

The common criticisms are that nuclear is too expensive, dangerous and the waste is an intractable problem. Although easily refuted, they have become persistent myths that are often considered fact by detractors and used effectively to sway an uninformed and undecided population.

Recommendation 2, Part d) of the Federal Inquiry report into nuclear power was that an independent body be established to manage community engagement, provide advice and education and answer questions from the public, which has my support.

Australia has always had a vocal anti-nuclear movement, which is understandable, considering the history of the technology in this part of the world; clandestine British nuclear weapons tests at

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<sup>10</sup> (Department of the Environment and Energy, 2018)

<sup>11</sup> (Heard, et al., 2015)

<sup>12</sup> (Government of South Australia, 2016)

Maralinga, the troubled history of uranium mining at Ranger and Jabiluka, and the Rainbow Warrior incident in New Zealand.

Fortunately, from these incidents, Australia has learned some valuable lessons. Australia is a signatory to the Nuclear Non-Proliferation Treaty (NPT)<sup>13</sup> and continues to engage in worldwide efforts against both nuclear weapons testing and proliferation of nuclear and chemical weapons<sup>14</sup>. Indigenous rights are recognised and are considered prior to industrial development, including mining (see the Environmental Protection and Biodiversity Conservation Act 1999<sup>15</sup>).

Of course, the anti-nuclear movement still exists and it is loud, but not necessarily large. In September 2019, Roy Morgans<sup>16</sup> found a slight majority of Australians (51%) are in favour of the technology, where 34% are still opposed (the balance being undecided). However, a notable split exists between men and women (about 20%). Any public and community engagement would be well advised to identify why this is and address these concerns.

The federal enquiry made recommendations to counter these issues. They were to repeal the ban (although I do not believe this recommendation goes far enough, as it does not explicitly mention repealing the ban against other activities in the fuel cycle, such as uranium enrichment or nuclear fuel fabrication) and commission enquiries into technological, economic, regulatory and public education. Victoria should follow suit.

Indeed, the federal enquiry already found that the CSIRO GenCost 2018 report<sup>17</sup>, that estimated a ridiculously high cost of nuclear, was unverifiable. What else will be discovered as we further investigate this technology?

One very important activity that should be undertaken is developing an energy transition plan. This should consider all energy sources and related infrastructure and not be limited to nuclear. No matter how this is approached, it will be a large, complex task. Australia is overdue for such a plan, as we have procrastinated for far too long.

A common mantra is that new wind and solar is now cheaper than coal, and this is used as justification to discredit nuclear power generation without consideration. However, this is based on Levelised Cost of Energy (LCoE), a metric designed to compare traditional, on-demand forms of energy production. Relevance of LCoE is diminished when applied to wind and solar as these sources introduce intermittency, an aspect that is not quantified by the LCoE. Due to their intermittency, solar and wind must be backed up today by natural gas or other dispatchable power generation infrastructure. Because the transmission network was never designed to work with the highly distributed nature of renewables, accepting greater penetration of renewables means modifying the grid. These are costs that the LCoE does not consider.

I'm not against the implementation of renewables per se, but I am frustrated by the widely circulated claim that nuclear is 'too slow' or 'too expensive' without also acknowledging limitations facing renewables, such as the unavailability of electricity storage at scale or the costs incurred by rebuilding

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<sup>13</sup> (United Nations)

<sup>14</sup> (Australian Safeguards and Non-Proliferation Office (ASNO))

<sup>15</sup> (Australian Commonwealth Government, 2019)

<sup>16</sup> (Roy Morgan, 2019)

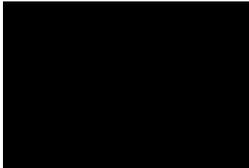
<sup>17</sup> (Commonwealth Scientific and Industrial Research Organisation, 2018)

the national grid, especially considering the rapidity of the French nuclear build in the 20<sup>th</sup> century<sup>18</sup> or the success of Ontario's replacement of coal power<sup>19</sup>.

In conclusion, I am very pleased that nuclear technology has become a topic of discussion at government level and look forward to a day when this technology can be used alongside all others in the Australian energy mix.

I am happy to assist with the enquiry with any matters in my submission.

Regards,



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<sup>18</sup> (Palfreman)

<sup>19</sup> ( Independent Electricity System Operator (IESO), 2020)

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