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australian taxpayers' alliance
fighting tax, regulation & waste

STANDING COMMITTEE ON THE ENVIRONMENT AND ENERGY: INQUIRY INTO THE PREREQUISITES FOR NUCLEAR ENERGY IN AUSTRALIA

SUBMISSION OF THE AUSTRALIAN TAXPAYERS' ALLIANCE (ATA)

16 September 2019

1 The Australian Taxpayers' Alliance (ATA) thanks the committee for the opportunity to provide comments to the abovementioned inquiry.

2 The ATA is a 75,000+ member national grassroots taxpayers' advocacy group which stands for the principles of individual freedom, minimising government waste and rolling back inefficient or ineffective regulatory barriers which impede the progress and prosperity of Australia's economy and the welfare of taxpaying individuals and businesses.

3 The ATA supports the legalisation of nuclear power generation in Australia within an appropriate regulatory framework based on international best practice that ensures the safe disposal of waste, the safe operation of reactors, the mitigation of any negative environmental impacts, the cost-efficient generation of energy, and a private investment-driven sector with the necessary conditions needed to mitigate sovereign risk and the need for corporate welfare or subsidy.

4 The ATA adopts this position due to the effects of high electricity prices in Australia on taxpaying individuals and businesses whereby these prices effectively amount to a tax on investment, jobs and economic growth which erodes the living standards of Australians and makes our businesses less competitive against our counterparts overseas. For example, Australian families often pay twice as much for their electricity than counterparts in the United States, and our businesses pay as much as three times what American businesses pay.[1] This has already damaged or decimated business and investment in Australia.[2]

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[1] CME, Electricity Prices in Australia: An International Comparison, July 2016 http://cmeaustralia.com.au/wp-content/uploads/2013/09/160708-FINAL-REPORT-OBS-INTERNATIONAL-PRICE-COMPARISON.pdf

[2] Some examples: family-run recycling company Plastic Granulating Services was forced to close its doors for good last year, leaving 35 employees out of work after nearly 4 decades in operation due to crippling electricity costs. Council of Small Business Australia CEO Peter Strong, recently described electricity price hikes as the "biggest business crisis I've seen in my lifetime."

Australia's almond industry, which suffered a 50% increase in its energy bills since 2012. The country's largest producer, Olam International, incurs 15% of its costs through electricity bills. Olam CEO Sunny Verghese, recently described Australia as the most expensive nation where Olam operates due to our 'broken' electricity system.

5 While the ATA acknowledges that substantial start-up costs may be involved in the establishment of nuclear power and that private investment may not immediately materialise depending on conditions in the nuclear energy sector, it is the ATA's position that a competitive energy market which delivers value for consumers and businesses is contingent upon access to all possible options- especially where rapidly innovating fields with high potential such as nuclear power are concerned. The ATA therefore supports lifting the moratorium on nuclear power generation in Australia in order to lay the groundwork for encouraging private investment with the right regulatory framework in place. The ATA notes that while the lifting of the moratorium and the introduction of an appropriate regulatory framework may not immediately reduce electricity prices or immediately result in the introduction of new generation, it is nonetheless important in laying the conditions for this to be possible in the future as Australia will be better equipped to take advantage of innovations taking place throughout the world.

6 The ATA further notes that nuclear power plants produce a fraction of the greenhouse gas emissions of solar or wind farms, according to the UN Intergovernmental Panel on Climate Change.[3] It is therefore submitted that Australia's current and easily reversible moratorium on nuclear power is not only an act of economic vandalism, but of environmental vandalism which stymies innovations in the climate policy space.

7 This is especially concerning given that the Australian government's current and historic policy strategy of facilitating a transition away from fossil fuel-based energy has been to allocate taxpayer-funded subsidies for renewable energy such as wind and solar. Unlike nuclear, these sources, due to their inherent intermittency and the inadequacy of current battery storage technology and battery storage technology in the foreseeable future, end up locking in fossil fuel use as coal or increasingly expensive natural gas must be relied upon to provide the necessary backup and baseload power.[4] The results of this policy have included the expenditure of billions of dollars in taxpayer-funded corporate

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Sydney-based hardware manufacturer Alchin Long Group, which was forced to reconsider plans to shift jobs back to Australia from China in 2017 due to a doubling of its electricity bills.

Australia's aluminium smelting industry, which was forced to drastically cut production last year due to electricity price hikes – placing thousands of jobs at risk. Boyne Smelters, a subsidiary of Rio Tinto, was forced to shed 100 jobs.

[3] Schlömer, S., Bruckner, T., Fulton, L., Hertwich, E., McKinnon, A., Perczyk, D., ... & Wiser, R. (2014). Annex III: Technology-specific cost and performance parameters. *Climate change*, 1329-1356.

[4] Brook, Barry W., et al. "Why nuclear energy is sustainable and has to be part of the energy mix." *Sustainable Materials and Technologies* 1 (2014): 8-16.
https://www.sciencedirect.com/science/article/pii/S2214993714000050

welfare for energy companies,[5] as well as volatile and high electricity prices for Australian homes and businesses due to economic distortions in the energy generation market due to the premature retirement of more cost-efficient yet non-subsidised fossil fuel-fired generators upon which renewable power remains reliant for backup.[6] It is submitted that nuclear power must at least be available as a legal option for private investors and entrepreneurs in order to facilitate the range of avenues which can facilitate any inevitable decarbonisation of energy generation given its superiority to taxpayer-funded wind and solar energy due to the ability to deliver reliable electricity supply without fossil fuel backup.

a) Waste Management, Transport & Storage

b) Health & Safety

8 Although no technology is risk-free, "*Nuclear power has fewer health and safety impacts than current technology fossil fuel-based generation and hydro power*."[7] Notably, innovations already exist which dramatically reduce and virtually eliminate both the risks of producing nuclear energy as well as the waste products generated. **Molten salt reactors**, for example, can be built on a smaller scale, can run on uranium or thorium and produce a small fraction of the radioactive waste generated by conventional nuclear reactors such as that which is currently deployed at Lucas Heights near Sydney, NSW and have a decay time of only 300 years. This technology is already under development in many leading economies including China, USA, Canada and the UK. Notably, the USA, Canada and UK are developing the technology substantially through private investment due to market interest.[8] This can be contrasted with wind and solar energy which are currently heavily reliant on government subsidy paid for by consumers through higher electricity bills or through taxpayers who pay higher taxes.

9 Australia is geologically stable and most of the continent is not prone to seismic activity or exposed to potential tsunami activity. The 2006 Australian government review found that several sites in Australia were suitable for the disposal of

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[5] Mark Ludlow, "Renewable energy subsidies to top $2.8b a year up to 2030" *Australian Financial Review* 13 March 2017. https://www.afr.com/politics/renewable-energy-subsidies-to-top-28b-a-year-up-to-2030-20170313-guwo3t

[6] Isaac Orr and Fred Palmer, "How the Premature Retirement of Coal-Fired Power Plants Affects Energy Reliability, Affordability" *The Heartland Institute* February 2018 https://www.heartland.org/publications-resources/publications/how-the-premature-retirement-of-coal-fired-power-plants-affects-energy-reliability-affordability

[7] 'League Table: Coal Power Finance,' Rainforest Action Network, Sierra Club, BankTrack, The End of Coal: Coal Finance Report Card 2015, Chapter 6.

[8] World Nuclear Association – Molten Salt Reactors (updated: August 2017) http://www.world-nuclear.org/information-library/current-and-future-generation/molten-salt-reactors.aspx

moderate and high-level radioactive waste, [9] and that even then-current technology allowed for safe disposal.[10] South Australia alone, can take over 13% of the world's nuclear waste with no material risk to communities.[11] France, Germany and the USA have all approved nuclear generators even in areas near population centres after thorough environmental assessments.

10 Conversely, electricity generated by nuclear power between 1971 and 2009 is estimated to have prevented the deaths of 1.84 million people due to air pollution through the replacement of capacity which would otherwise have been occupied by alternative power sources.[12] The case for legalising nuclear power generation within an appropriate regulatory framework is therefore strong on safety and public health grounds as well as environmental grounds.

11 **Case Study: Fukushima**

12 The purported risks of nuclear power and radiation are often overstated. Caution towards nuclear power rose in the wake of the Fukushima disaster in Japan in 2011. Notably, a number of factors instrumental to that incident do not apply to Australia. Japan is located close to a tectonic fault-line and lacks Australia's geological stability due to its earthquake-prone nature. Furthermore, the Fukushima reactor was located close to the coast where it was subjected to a tsunami which ultimately triggered the incident.

13 Moreover however, the fallout and ongoing effects of Fukushima demonstrate that even in a worst-case scenario such as that incident, the risks are far outweighed by the potential benefits of nuclear power.

14 A 2016 study found that "The accident at Fukushima Daiichi nuclear power plant contaminated the soil of densely populated regions in Fukushima Prefecture with radiocaesium, which poses risks of internal and external exposure to the residents. However, extensive whole-body-count surveys have shown that internal exposure levels of residents are negligible. In addition, data from personal dosimeters have shown that external exposure levels have decreased, so the estimated annual external dose of the majority of people is <1 mSv in most areas of Fukushima."[13] The study further noted that while problems remained in Fukushima, a majority of these issue are psychosocial rather than radiological, indicating that the purported

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[9] Switkowski, Z. (2006). Uranium mining, processing and nuclear energy: Opportunities for Australia? *Issues*, (77), Chapter 5.

[10] Ibid.

[11] Latika Bourke, "Julie Bishop reopens nuclear debate as route to cut carbon dioxide emissions" *Sydney Morning Herald* 30 November 2014.

[12] Kharecha, P.A.; Hansen, J.E. Prevented mortality and greenhouse gas emissions from historical and projected nuclear power. *Environmental Science and Technology* **2013**, *47*, 4889-4895.

[13] Hayano, R. (2016). Measurement and communication: what worked and what did not in Fukushima. *Annals of the ICRP*, *45*(2_suppl), 14. http://journals.sagepub.com/doi/full/10.1177/0146645316666493

or expected ill impact of the Fukushima disaster and fear of radiation extends far beyond the actual magnitude of risks.[14]

15 Cited and discussed in the abovementioned paper,[15] is a previous 2016 study which measured the radiation exposure experienced by French high school students from Paris who visited the Fukushima area and radiation zone in Japan.[16] The students wore decimeters (Geiger counters) that measured their radiation exposure throughout their trip. The study found that radiation exposure spiked when the students passed through security screening at Paris and Tokyo airport as well as when they passed through the French embassy screening. By contrast, the increase in radiation exposure upon visiting various towns in the Fukushima area, including Tomioka which was directly exposed to the radiation plume, was relatively low.

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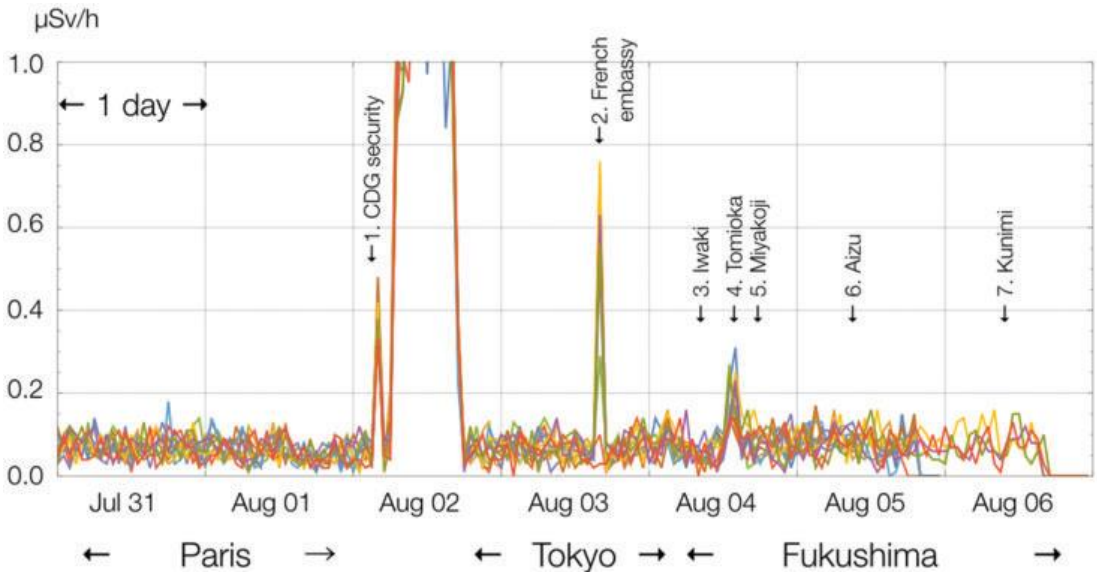


c) Environmental Impacts

17 Nuclear power plants produce a fraction of the greenhouse gas emissions of solar or wind farms, according to the UN Intergovernmental Panel on Climate Change.[17]

[14] Ibid.

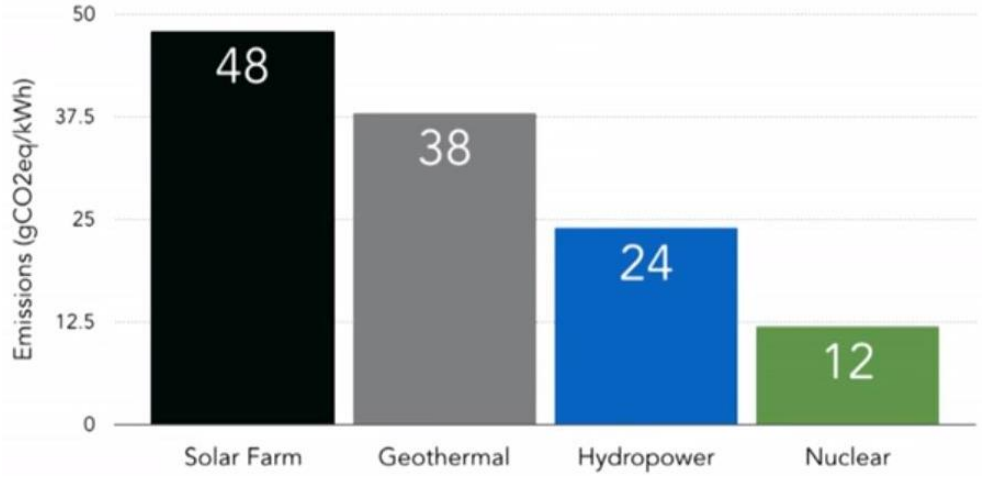
[15] Ibid p. 18-22.

[16] Adachi, N., Adamovitch, V., Adjovi, Y., et al., 2016. Measurement and comparison of individual external doses of high-school students living in Japan, France, Poland and Belarus – the 'D-shuttle' project. J. Radiol. Prot. 36, 49–66.

[17] Schlömer, S., Bruckner, T., Fulton, L., Hertwich, E., McKinnon, A., Perczyk, D., ... & Wiser, R. (2014). Annex III: Technology-specific cost and performance parameters. *Climate change*, 1329-1356.

Both the IPCC and the IEA have recognised nuclear power as a key technology for lowering carbon emissions.[18] [19]

18 A 2006 Australian government report found that Australia's greenhouse gas emissions could be cut by 8-17% if nuclear power were incorporated into our energy mix.[20]



19 "*Nuclear power is a low-emission technology. Life cycle greenhouse gas emissions from nuclear power are more than ten times lower than emissions from fossil fuels and are similar to emissions from many renewables*."[21] France relies on Nuclear energy for a substantial proportion of its energy needs and pollutes at substantially lower rate than Australia, with Australians producing, on average, 15.8 Tonnes of carbon per capita as opposed to France's 4.32 Tonnes per capita.[22]

20 Nuclear power-generated electricity produced between 1971 and 2009 has avoided an estimated 64 gigatons of carbon dioxide emissions by replacing electricity that would otherwise have been generated by alternative sources.[23] It is

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[18] IEA, 2014. The way forward: five key actions to achieve a low-carbon energy sector.

[19] IPCC, 2014. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change https://www.researchgate.net/publication/274897242_Transport_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?el=1_x_8&enrichId=rgreq-47e281b9f0b29fc5aa374b2ec39b1f3d-XXX&enrichSource=Y292ZXJQYWdlOzI5Mjk2NDA0NjtBUzozMzMxMDU4NDUwMzA5MTJAMTQ1NjQzMDAzMDM2MQ==

[20] Switkowski, Z. (2006). Uranium mining, processing and nuclear energy: Opportunities for Australia? *Issues*, (77), 45.

[21] Switkowski, Z. (2006). Uranium mining, processing and nuclear energy: Opportunities for Australia? *Issues*, (77) Chapter 7.

[22] Cole Latimer, "Australia has missed the boat on nuclear power" *The Age* 11 January 2018.

[23] Kharecha, P.A.; Hansen, J.E. Prevented mortality and greenhouse gas emissions from historical and projected nuclear power. *Environmental Science and Technology* **2013**, *47*, 4889-4895.

submitted that legalising nuclear power generation in Australia will therefore be greatly beneficial in mitigating Australian greenhouse gas emissions.

d) Energy Affordability & Reliability

e) Economic Feasibility

21 With a complete combustion or fission, approximately 8 kWh of heat can be generated from 1 kg of coal, approximately 12 kWh from 1 kg of mineral oil and **around 24,000,000** kWh from 1 kg of uranium-235. **Uranium-235 contains two to three million times the energy equivalent of oil or coal**.[24]

22 Although nuclear energy generation is characterised by high start-up costs and constructing and rendering a reactor operational will take between 10-15 years, it is a cost-effective and cheap option in the long-term and will pay for itself.

23 The start-up capital and construction cost of new nuclear reactors vary significantly between countries. This is because of significantly different material factors, including, to a large extent, regulatory burdens which vary substantially between jurisdictions. For example, the cost of constructing a new reactor in the USA varies from $6 billion to $10 billion USD. [25] This is primarily due to significant expansion in America's regulatory regime pertaining to nuclear reactors over time. By contrast, the costs of building reactors in South Korea have significantly decreased over time and continue to do so.[26] Overall, from the first reactor in Korea in 1971, costs declined by 50%, or 2% per year cost decrease for the whole Korean nuclear construction history.[27] Factors which promote lower and more stable costs include design standardisation of new plants and reactors,[28] as well as building reactors consistently in pairs or larger sets at the same time.[29] Any regulatory regime applicable to nuclear power must be cogent of these factors.

24 In the case of South Korea,[30] the country entered into nuclear power development in the 1970s, decades after the United States, France and Japan. As a result, they were able to benefit off imported designs from these countries in the initial stages

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[24] European Nuclear Society https://www.euronuclear.org/info/encyclopedia/f/fuelcomparison.htm

[25] Lovering, J. R., Yip, A., & Nordhaus, T. (2016). Historical construction costs of global nuclear power reactors. *Energy Policy*, *91*, 371-382.

[26] World Nuclear Association website (Updated: December 2017) http://www.world-nuclear.org/information-library/economic-aspects/economics-of-nuclear-power.aspx

[27] Lovering, J. R., Yip, A., & Nordhaus, T. (2016). Historical construction costs of global nuclear power reactors. *Energy Policy*, *91*, 378.

[28] Lévêque, F., 2014. The Economics and Uncertainties of Nuclear Power.

[29] Lovering, J. R., Yip, A., & Nordhaus, T. (2016). Historical construction costs of global nuclear power reactors. *Energy Policy*, *91*, 379.

[30] Ibid.

of nuclear power development. Subsequent plants were then modelled off a standardised local design which was developed based on the experience of previous imported designs. Notably, the downward trend in costs continued over this time and can be contrasted with upward trends in cost seen in France, the United States, and Japan (where cost trends were similar to the United States albeit with a lag of approximately 5 years). It is submitted that South Korea's experience and regulatory framework should be referenced and utilised as a model for an Australian nuclear power regulatory framework as it represents best practice by contrast to the escalating costs seen in France and the United States as well as Japan. It is noted that despite the relatively smaller cost increases seen in South Korea with the development of that country's regulatory framework, South Korean plants continue to function effectively within strong safety and environmental requirements.

25 Though there are typically high capital costs for building the first several plants, costs tend to fall for each additional plant built as the supply chains develop and the regulatory processes improve. Ongoing costs such as fuel, operational, and maintenance costs are relatively small components of the total cost. The long service life and high productivity of nuclear power plants allow sufficient funds for ultimate plant decommissioning and waste storage and management to be accumulated, with little impact on the per unit price of electricity generated.

26 Current developments in nuclear technology and newer generators/plants show a move towards smaller, more efficient and cheaper plants which will offset the expected costs. For example, Terra Power is a venture partly funded by Bill Gates which has been in operation since 2012 and aims to downscale nuclear power production.[31]

27 Costs are likely to decline further as global technological developments and innovations continue.

28 It is noted that even in the case of rising costs, researchers note the potential trade-offs between higher-cost reactors and better performance,[32] as well as the potential for costs to fall after a period of increase which has been seen in other greenhouse gas mitigating technologies such as wind and solar,[33] and which

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[31] Graham Lloyd, "Nuclear Power the alternative for Australia none dare name" *The Australian*, September 17, 2017.

[32] Berthélemy, M., 2012. What drives innovation in nuclear reactors technologies? An empirical study based on patent counts. CERNAWORKING PAPER SERIES 2012-01. https://www.researchgate.net/publication/254418341_What_drives_innovation_in_nuclear_reactors_technologies_An_empirical_study_based_on_patent_counts

[33] Rubin, E.S., Yeh, S., Antes, M., Berkenpas, M., Davison, J., 2007. Use of experience curves to estimate the future cost of power plants with CO2 capture. Int. J. Greenh. Gas Control 1, 188–197. https://www.researchgate.net/publication/222552026_Use_of_experience_curves_to_estimate_the_future_cost_of_power_plants_with_CO2_capture

researchers have found to be applicable to nuclear power innovation and development as well.[34]

29 In 2017, Australian National University research studied trends in innovation and costs involved in nuclear power generation and summed up the historical record across the majority of countries (whereby South Korea was the outlier) as follows: "*Learning rates and deployment rates changed in the late-1960s and 1970s from rapidly falling costs and accelerating deployment to rapidly rising costs and stalled deployment*."[35] The researchers concluded that if learning and deployment rates had continued along the same rates seen in the early period, then the cost of nuclear power would be 10% of what it is today, and that nuclear power could have cost-effectively replaced 100% of fossil fuel-generated power by 2015.[36] They further noted that these previous rates can be achieved today and in the future with appropriate policy frameworks.[37]

30 **Cause of cost increases and the negative consequences of overregulation**: A substantial body of research has identified the likely primary cause of the cost increases in nuclear power generation seen in most countries worldwide since the 1960s as political and regulatory responses driven by anti-nuclear lobbyists and activists citing safety concerns.[38] [39] [40] [41] While the increase in regulation may indeed have contributed to increased safety, the effects of this on cost increases of nuclear power generation and plant construction as well as stymied innovation have in turned caused more expensive and less accessible electricity (and lower living standards as a result), significantly higher worldwide greenhouse gas emissions and millions of avoidable air pollution-related deaths.[42] It is submitted that risk-proportionate regulations which are objectively and rationally developed based on international best practice and scientific reality, rather than unduly influenced by alarmism or fear-mongering, can ensure the potential of safe and environmentally

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[34] Lovering, J. R., Yip, A., & Nordhaus, T. (2016). Historical construction costs of global nuclear power reactors. *Energy Policy*, *91*, 379.

[35] Lang, Peter. "Nuclear Power Learning and Deployment Rates; Disruption and Global Benefits Forgone." *Energies* 10.12 (2017): 2169. https://www.mdpi.com/1996-1073/10/12/2169/pdf

[36] Ibid.

[37] Ibid.

[38] Cohen, B. Costs of Nuclear Power Plants–What Went Wrong? In *Nuclear energy option*, Plenum Press: New York:, 1990.

[39] Grubler, A. The costs of the French nuclear scale-up: A case of negative learning by doing. *Energy Policy* **2010**, *38*, 5174-5188.

[40] Daubert, V.; Moran, S.E. *Origins, Goals, and Tactics of the U.S. Anti-Nuclear Protest Movement.*; Rand Corporation: Santa Monica, CA, 1985.

[41] Lovering, J. R., Yip, A., & Nordhaus, T. (2016). Historical construction costs of global nuclear power reactors. *Energy Policy*, *91*, 379.

[42] Lang, Peter. "Nuclear Power Learning and Deployment Rates; Disruption and Global Benefits Forgone." *Energies* 10.12 (2017): 2169. https://www.mdpi.com/1996-1073/10/12/2169/pdf p. 13-16.

friendly power which is cost-effective and to the betterment of Australia's economy and human development.

31 **Flow-on Economic Benefits:** The economic benefits of legalised nuclear power would transcend the production of cheap, clean energy. Nuclear waste management itself is a prosperous industry that would attract foreign investment. In 2006, the Australian Government's report found that "*Downstream steps of uranium conversion, enrichment and fuel fabrication could add a further $1.8 billion of value annually if all Australian uranium was processed domestically."*[43] These economic benefits will overwhelmingly flow to regional communities, revitalising the regional economy and providing high-quality, well-paid jobs.

g) Workforce Capability

32 The **United Arab Emirates**, like Australia, has a low population base and far, far less nuclear expertise than what we have, yet they have built 5.6 GW of reactors in 5 years. The UAE government recently awarded a $20.4 billion contract to a South Korean consortium to build four 1400 MWe reactors by 2020. They are under construction and on schedule with the first two units due to begin operation in 2018.

33 The UAE relies on skilled immigration in order to fill gaps in its ability to produce adequate expertise and knowhow from amongst its own population. It is submitted that skilled immigration, under specialised visas or otherwise, can ensure that any workforce capability gaps in Australia can be moderated until such a time as local expertise can be made available alongside adequate education and training programs.

h) Security Implications

34 Strict controls which prevent the development of nuclear weapons are already in place under the Non-Proliferation Treaty (NPT) to which Australia is a signatory.[44] The development of civilian nuclear energy in Australia then is unlikely to result in any negative geopolitical implications as it would not raise concerns about nuclear weapons proliferation given Australia's longstanding international reputation and transparency.

35 It is submitted that Australia's vast landmass offers the advantage of far greater choice in where nuclear power stations can be set up to eliminate or minimise any national security concerns arising from the potential targeting of these facilities in

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[43] Switkowski, Z. (2006). Uranium mining, processing and nuclear energy: Opportunities for Australia? *Issues*, (77), 45.

[44] Hubbard, C. (2004). From Ambivalence to Influence: Australia and the Negotiation of the 1968 Nuclear Non-Proliferation Treaty. *Australian Journal of Politics & History*, *50*(4), 526.

a war event. By contrast, several countries which already make significant use of nuclear energy, such as France, the UK and South Korea, do not have such an advantage. Nonetheless, these nations have taken security implications into account whilst constructing and maintaining nuclear power plants.

f) Community Engagement

i) National Consensus

36 Consistent opinion polling shows growing support for and openness towards nuclear power generation in Australia. The latest survey from Essential (June 2019) found that 44% of those polled support nuclear power plants, with approximately 40% opposing them.[45]

37 It is submitted that the concerns of those who oppose nuclear power can be addressed through sensible regulatory frameworks and increased awareness about the latest scientific innovations and the role of nuclear energy in climate policy as recognised by the UN IPCC will further shore up public support.

38 It is further submitted that an ongoing trend in increasing public support is attested by polling data over the decades which also supports the role of public information and education.

39 McNair Gallup polling[46] conducted across Australia shows that outright support for nuclear power is capable of rising rapidly in recent years, going from 41% to 49% between 2007 and 2009. Outright opposition also fell sharply from 53% to 43% over the same time.

40 It is submitted that the latest polling shows only a slight decrease in outright support, supplemented with a small decrease in outright opposition, since then despite the high-profile Fukushima event which is discussed above in this submission and a renewed push by anti-nuclear campaigners and lobbyists.

41 The results of a 2014 independent South Australian poll similarly show significant and growing public support connoting a strong trend towards public consideration of nuclear power, with 48% total support, 32.6% opposition, and a 19.5% rate of neutral responses.[47] Notably, that poll found that a vast majority of neutral respondents offered conditional support contingent on the addressing of concerns and/or the provision of further information. It is therefore submitted that

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[45] Katharine Murpy "Australians' support for nuclear plants rising – but most don't want to live near one" *The Guardian* 18 June 2019. https://www.theguardian.com/australia-news/2019/jun/18/australians-support-for-nuclear-plants-rising-but-most-dont-want-to-live-near-one

[46] "More Aussies Back Nuclear Power: Poll" *Sydney Morning Herald* 13 October 2009. https://www.smh.com.au/national/more-aussies-back-nuclear-power-poll-20091013-gu7r.html

[47] South Australian Chamber of Mines & Energy URANIUM and NUCLEAR ATTITUDES SURVEY, April 2014. http://www.sacome.org.au/images/UAS_Results_summary_final.pdf

leadership and advocacy on the part of Australia's political class backed by the science will shore up national consensus for nuclear power generation in Australia given the evidence in support of nuclear power.

42 The lifting of the moratorium on nuclear power has also been supported by the South Australia Nuclear Fuel Cycle Royal Commission.[48] South Australia holds a majority of Australia's Uranium and would greatly benefit from legalised nuclear power as the state is currently home to some of the world's highest electricity prices,[49] unstable electricity supply including blackouts driven in significant part on overreliance on wind and solar energy without sufficient baseload power,[50] and one of Australia's highest unemployment rates.[51]

j) Other Relevant Matter: Nuclear Power Plants Under Construction Worldwide

43 **Argentina** has three operating reactors and nascent plans for two units to be constructed by China National Nuclear Corporation (CNNC).

44 In **Armenia** construction is planned to start on a new reactor in 2018 following government approval in May 2014.

45 **Bulgaria** is planning to build a large new reactor at Kozloduy.

46 In **Brazil** construction of the country's third unit is ongoing following the signing of an agreement with CNNC in September 2017.

47 In **China**, now with 38 operating reactors on the mainland, the country is well into the growth phase of its nuclear power program. There were eight new grid connections in 2015, and five in 2016. 20 more reactors are under construction, including the world's first Westinghouse AP1000 units, and a demonstration high-temperature gas-cooled reactor plant. Many more units are planned, including two largely indigenous designs – the Hualong One and CAP1400. China aims to have more nuclear capacity than any country except the USA and France by 2020. It is projected that the combined nuclear generation capacity in China will be 60 GW by 2030 which is equivalent to Australia's TOTAL electrical generation capacity.

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[48] Ibid.

[49] Charis Chang, "South Australia has the highest power prices in the world" *News.com.au* 9 August 2017.

[50] Nick Harmsen, "AEMO releases final report into SA blackout, blames wind farm settings for state-wide power failure" Australian Broadcasting Corporation, 28 March 2017.

[51] Peter Jean, "South Australia's unemployment rate has jumped to 6.1 per cent after the Holden factory closure" *Adelaide Now* 14 December 2017.

48 In the **Czech Republic** the government remains strongly committed to new nuclear capacity. Talks were held in early 2017 with parties interested in constructing new units in the country.

49 In **Finland**, construction is under way on a fifth, very large reactor which is expected to come online in 2019, and plans are progressing for another large one to follow it.

50 **France** is building a similar 1600 MWe unit at Flamanville, for operation from 2019.

51 **India** has 22 reactors in operation, and six under construction. This includes two large Russian reactors and a large prototype fast breeder reactor as part of its strategy to develop a fuel cycle which can utilise thorium. Nineteen further units are planned, and proposals for more – including western and Russian designs – are taking shape following the lifting of nuclear trade restrictions.

52 In **Iran** a 1000 MWe PWR at Bushehr began commercial operation in September 2013, and further units are planned.

53 **Japan** has two reactors under construction.

54 **Pakistan** has two Chinese ACP1000 reactors under construction.

55 **Romania**'s second power reactor started up in 2007, and plans are being implemented for two further units to be built there.

56 In **Russia**, several reactors and two small ones are under construction, and one recently put into operation is a large fast neutron reactor. About 25 further reactors are then planned, some to replace existing plants. This will increase the country's present nuclear power capacity significantly by 2030. In addition about 5 GW of nuclear thermal capacity is planned. A small floating power plant is expected to be commissioned by 2019 and others are expected to follow.

57 **Slovakia** is completing two 440 MWe units at Mochovce, to operate from 2018.

58 **South Korea** plans to bring a further three reactors into operation by 2019. All of these are advanced PWRs of 1400 MWe. These APR1400 designs have evolved from a US design which has US Nuclear Regulatory Commission (NRC) design certification, and four have been sold to the UAE (see below).

59 In the **UK**, 11 units are planned, including four 1670 MWe EPR units, four 1380 MWe ABWR units and three 1135 MWe AP1000 units.

60 In the **USA**, there are plans for two new reactors, beyond the two under construction now. Small to Medium Reactor (SMR) designs are gaining traction. One of these, NuScale, has successfully managed to attract private funding, first from Fluor to the tune of about $220 million then from the municipal utilities conglomerate UAMPs for $450 million. UAMPs owns the poles and wires in 6 states on the West coast of the US (minus California). Along with the initial DOE (Dept. of Energy) grant of $220 million, matched by $220 million from Fluor and $450 million from UAMPs - This $1 billion or so is being used to build the first of a kind NuScale 50MWe SMR in Idaho National Labs by 2026. The NuScale SMRs are designed to be

deployed in batches of 12 in a common pool containing 80 Olympic pools worth of water which takes care of reactor decay heat after the reactor is shutdown. UAMPs has a plan to massively roll out these passively safe reactors as brownfield replacements for their aging coal fired power plants. They are also testing the NuScale reactor's load following capability with the HorseButte windfarm next to Idaho National Labs. This SMR design is particularly conducive to integration with renewables, as discussed in a recent paper.[52] These developments have occurred despite strong competition from cheap and widely available natural gas and a strict regulatory environment.

61 **Belarus** is building two large new Russian reactors at Ostrovets.

62 Other emerging countries with committed plans for nuclear include: Lithuania, Turkey, Bangladesh, Jordan, Poland and Egypt.

Pros, Cons & Recommendation/Conclusion

63 Despite the many advantages, a number of difficulties remain in establishing nuclear power projects in Australia. Firstly, the absolute moratorium on new projects coupled with political uncertainty about rules imposed by future governments have been and are a deterrent for the private sector to establish a business case.

64 High start-up costs for large-scale reactors may also deter many investors and these difficulties are compounded by the existence of subsidies for wind and solar energy that make it more difficult for nuclear energy to compete without subsidy on the wholesale market. An environmental case therefore exists for these subsidies to be cut and diverted to nuclear energy instead in reflection of the significantly lower carbon footprint of nuclear power generation. However, it is submitted that allowing rapidly innovating technologies such as wind, solar and nuclear to compete on equal footing without subsidy will be sufficient and desirable from the standpoint of taxpayers and electricity consumers.

65 The high start-up costs and difficulties of competing with subsidised wind and solar energy have driven the UK government to provide public financing to ongoing projects such as the Hinkeley reactor. Although public financing is undesirable from the perspective of taxpayers, analysts including Steve Thomas, Professor of Energy Studies at the University of Greenwich in the UK, note that the cost of equity, that is companies using their own money to pay for new plants, is usually higher than the cost of debt and that "*once large amounts of money have been arranged at low interest rates … the money can then be lent out at higher rates of return.*"[53] Hence

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[52] Ingersoll, D. T., et al. "Integrating nuclear and renewables." (2016): 37-39. https://www.researchgate.net/publication/295114246_Integrating_nuclear_and_renewables

[53] The Doomsday Machine, Cohen and McKillop (Palgrave 2012) 199.

a loan provided to a private entity is likely to result in long-term returns to the taxpayer in the form of interest.

66 Although large-scale reactor proposals may be deterred by high financing costs and potential need for government support, there is significant potential for smaller-scale reactors in Australia. Although nuclear scientist Ziggy Switkowski has expressed scepticism for large-scale reactors, he notes that smaller, modular nuclear reactors could play a part in the future energy mix, and could support regional centres.[54]

67 The moratorium on new nuclear reactors, in place since 1998, has stifled open debate about nuclear power and its economic potential and potential for climate change management in Australia. It is submitted that this moratorium should be lifted regardless of whether the government is approached with a business case. Rapid innovations mean that the costs of nuclear power and hence the difficulties of establishing nuclear projects in Australia, will decrease over time with the removal of the moratorium supplying the catalyst for proposals and research in the longer-term.

68 It is unlikely that lifting the moratorium on nuclear power generation will result in immediate private investment in nuclear energy projects or short-term reductions in electricity prices. However, it is nonetheless a crucial step in ensuring that Australia is ready to take advantage of this rapidly innovating technology in which we have a comparative advantage when the time comes. Although lifting the moratorium may not provide sufficient certainty for private investors by itself, it is a pre-condition for ensuring commercial certainty.

69 **The Australian government should lift the moratorium on nuclear power by amending the *Environment Protection and Biodiversity Conservation Act* and the *Australian Radiation Protection and Nuclear Safety Act* to make nuclear fuel fabrication, power, enrichment or reprocessing facilities legal.**

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[54] Cole Latimer, "Australia has missed the boat on nuclear power" *The Age* 11 January 2018.