Lifting the Nuclear Ban in Australia

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Key Points

- Nuclear power is a zero-emissions source of electricity. Australia is the only G20 nation where this is banned.

- The increasing penetration of intermittent renewable energy in power systems is leading to higher electricity costs and is posing risks to system security. A whole-of-system, technology-neutral approach to power system planning and emissions reduction is essential, with the freedom to consider the pros and cons of nuclear power as a key part of the solution.

- Lifting the nuclear ban would not mean the immediate approval of any nuclear power development -- it would simply allow Australia to test the economic feasibility and social acceptance of a possible proposal if one eventuates. If a proposal is found tp be feasible, all necessary environmental and regulatory approvals would still need to be sought.

- Lifting the ban would also allow Australia to build its nuclear power knowledge base as a prerequisite to any future development, and be able to participate fully in global efforts to reduce greenhouse gas emissions.

Reliable, affordable energy, without harm to the environment

"Modern designs of nuclear reactors are small, hyper-efficient, and radically safe. They can't melt down, are often a tenth or less the size of conventional light-water reactors, can be manufactured in factories just like wind turbines and solar panels, and can operate at sufficiently high temperatures to provide heat and power for steel, cement, hydrogen, and fertilizer production. Like wind and solar, these reactors produce energy with zero carbon dioxide. Unlike wind and solar, they produce it 24 hours a day with high availability and reliability." [1]

Australians live in a large, fragile, continent where protection of the environment is highly valued, and radical technological change is often viewed with caution.[2] The nation's future may depend on how well it uses technology to advance its prosperity while at the same time protecting the environment.

[1] Ted Nordhaus et al of The Breakthrough Institute in 'Foreign Affairs', 24 January 2017

[2] National Academies Forum, 2010, *Understanding the Formation of Attitudes to Nuclear Power in Australia,* Canberra ACT.

Carbon dioxide is essential to life, but scientists tell us that too much is being emitted, and at a rate faster than natural 'sinks' can handle. Nonetheless, reliable, affordable energy remains essential in the modern world.

It is not straightforward, uncostly, or fast to switch to low-emissions technologies. It will be much more difficult without access to nuclear technologies which offer denser power delivery and reliable all-weather performance.

An important metric of human progress is Energy Return on Energy Invested (EROI) which measures how much energy is spent in gaining surplus energy to enable society to function. It is human ingenuity, trial-and-error, and intelligent learning that has enabled this continual improvement to take place, so as to ensure that we are not investing more and more resources to gain less and less high-quality energy. For example, the unbuffered EROI for pVsolar power has been assessed as 4 :1, with nuclear at 75 :1.[3]

Australian governments have access to this information, but the nuclear ban remains. History may judge this harshly.

Whole-of-system costs

The swing to low-carbon energy sources as a means of dealing with climate change is gathering momentum across the world. Each country has to find its own way to the mix of technologies that will best meet its needs at affordable cost.

This poses difficult challenges, as existing paradigms of generation and supply are changed from centralised, one-way power delivery, to complex combinations of distributed generation, small-scale and large-scale storage, plus two-way flow of power, together with pricing and supply information over an intelligent grid. This will represent the convergence of information technology and sophisticated power generation technology, enabling more choice for consumers, greater management and control efficiency throughout the system, all with the aim of improved affordability, reliability, and environmental protection.

This will not happen by itself ; it will require careful analysis and accurate comparison of different technology configurations to arrive at practicable and cost-effective answers. To quote from the findings of the recent SA Royal Commission : --

*"For those planning a future electricity system, and a market in which it will operate, the relevant issue is the total system cost, i.e. accounting for the cost of generation, connection, inter and intra- regional expansion of transmission and distribution networks, and grid support costs" ...*and*... "specifically, the cost of reserve generation that might be required to meet total demand when the variable renewable energy technology is not available."* [4]

This kind of analysis must occur in the early planning stages. Whole-of-system costs are critical, and must be properly allocated before technology choices are made.

The Australian National Electricity Market network extends some 4500 km across five eastern States, connected to hundreds of generators embracing coal, gas, biomass and hydro as dispatchable supply. To this is being added increasing levels of small-scale, intermittent, and unpredictable domestic solar power producers from rooftop generation,

[3] Weisa Challengbach et al, 2013, *Energy Intensities, EROIs, and Energy Payback Times of electricity generating power plants,* Nature Publishing Group, London UK.
[4] Nuclear Fuel Cycle Royal Commission Report, May 2016, Adelaide SA.

as well as an increasing number of wind farms with their variable, non-synchronous, intermittent input to the grid. The Australian Energy Market Operator (AEMO) is responsible to maintain a balance between these sources of generation and demand across the network at all times, so as to maintain strict frequency and voltage control for reliable supply.

Reducing emissions

Reducing emissions will take many years. In the USA, it is predicted that by the year 2030, fossil fuels will still provide around 64% of total fuel used for electricity generation.[5] In Australia, coal is responsible for 63% of electricity generation and gas for 21%, making a total of 84% for fossil fuels.[6] We have a long way to go.

Australia's whole-of-economy emissions in 2015 were around 545 million tonnes per year, with electricity generation accounting for about 33%. Government policy is for total emissions to be reduced to 26 - 28% below 2005 levels by 2030. Nett of already-contracted reductions under the Emissions Reduction Fund, at end 2015 this represented an effective 20% reduction from 2015 levels. This is a significant challenge to be achieved over a 15 year period.

Nuclear power might need to be in the mix beyond 2030. Nuclear power can provide emissions-free, dispatchable generation to complement renewable generation.[5] Combined with smart grid technology and energy storage, it would enable load balancing and smoothing when necessary to avoid excessive system costs.

Small Modular Reactors (SMRs) using advanced technology with high capacity factors (93 – 95%), installed underground and under water, with a 60+ year life, some producing very little waste requiring isolation from the environment for only 300 years, would be ideal for Australia. The US government has acknowledged that SMRs offer a lower initial capital investment, greater scalability, and siting flexibility for locations unable to accommodate more traditional larger reactors. They also have the potential for enhanced safety and security compared to earlier designs.[7]

Obtaining planning, regulatory and development approvals for any feasible projects, followed by development work, is likely to take around a decade,[8] which is why the legislative ban on nuclear power needs to be removed now.

A challenge for nuclear power development anywhere is up-front capital cost, but this has to be evaluated in the context of high reliability in all weathers, long life, and low operating cost. No investment in nuclear power development for Australia is worth considering while ever the legislative ban remains in place.

[5] Dr. Peter Fox-Penner, 2014, *Climate Change, the Smart Grid, and the Future of Electric Utilities,* Island Press, Washington DC, USA.

[6] Department of Industry, Innovation and Science, Australia, *Australian Energy Update 2016*

[7] Office of Nuclear Energy, US Department of Energy, *Benefits of Small Modular Reactors,* https://energy.gov/ne/benefits-small-modular-reactors-smrs (last accessed 27 January 2017).

[8] In the UK, a recent report suggests 2030 as the likely year of commissioning its first SMR; see Energy Technology Institute , *Preparing for a UK Small Modular Reactor by 2030.* Loughborough UK, downloadable from www.eti.co.uk.

Lifting the ban

In 2017, in a world struggling to find ways to advance human welfare without causing dangerous climate change, it is hard to believe that Australia still has a ban on nuclear power plants for electricity generation, enforced by two Commonwealth Acts.[9.] New South Wales, Queensland and Victoria also have certain prohibition Acts in place.

The Commonwealth ban was introduced in the context of debate in the late 1990s about the replacement of the Lucas Heights nuclear research reactor. The debate at that time was influenced by events such as the French nuclear testing in the Pacific, the Rainbow Warrior incident in New Zealand, the contentious process of siting a waste repository for Australia's medical and industrial nuclear waste, and the Chernobyl nuclear accident of 1986, none of which had any real bearing on commercial use of nuclear energy for power generation.

The following actions would seem necessary if Australia is to construct a firm pathway towards a reliable low-carbon electricity system beyond 2030 : --

(1) the pursuit of a whole-of-system, technology-neutral approach to power system planning, aiming at the optimal mix of energy sources and not arbitrarily excluding nuclear power, to deliver electricity via an intelligent grid at an affordable cost, reducing greenhouse gas emissions and providing long-term energy security to the nation ;

(2) thorough analysis and comparison to ensure that all system costs, including back-up for intermittency where applicable, are properly allocated in reaching the optimum combination of technologies, accompanied by appropriate regulatory changes to make them operationally and financially viable ; and

(3) bipartisan political commitment to remove the discriminatory ban on nuclear power, to encourage its social acceptance, to introduce appropriate safety and environmental regulation, and provide long-term policy support for private sector investment in all elements of the power system.

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About the Author

Barry Murphy *is a well-known company director, consultant and commentator on the energy industry in Australia. He has degrees in applied science and engineering , postgraduate qualifications in environmental studies, energy studies, and an MBA from UNSW. Barry worked for thirty years with Shell and Caltex in the downstream refining and marketing parts of the oil industry in Australia, America, and South-East Asia, retiring as Chairman and Chief Executive of Caltex Australia Ltd. Among other things,he has served subsequently as Managing Director and Chief Executive of the Federal Airports Corporation, Chairman of Delta Electricity, Chairman of Natural Fuels Australia Ltd., a director of the Telstra Sale Company, Chairman of the Australian Rail Track Corporation, and Independent Person on the National Operating Committee for Jet Fuel Supply Assurance.*

[9] Commonwealth of Australia, *Environmental Protection & Biodiversity Conservation Act 1999* section 140A and *Australian Radiation Protection and Nuclear Safety Act 1998* section 10.