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Does Australia need Nuclear-Powered Submarines and a Nuclear-Power Sector?

Lindsay Hughes
Senior Research Analyst
Indo-Pacific Research Programme

Key Points

- To a very large degree, anything associated with a nuclear industry or which has a nuclear basis, whether civilian or military, is anathema in Australia.
- Such thinking impedes Australia's climate commitments, as well as its defence strategy.
- The delays and cost overruns that now hinder Australia's *Attack*-class submarines ought to provide further reason to revisit the need for a domestic nuclear sector.
- By countering some of the arguments put forward against the creation of a domestic nuclear sector, this paper attempts to restart the discussion of the advantages to be gained from one.

Summary

Australia badly needs a modern submarine fleet to replace its ageing *Collins*-class submarines in order to ensure the security of its sea lines of communication in an increasingly volatile Indo-Pacific region. Its future submarines will be required to operate further from home, including in the South China Sea.

Accordingly, then-Prime Minister Tony Abbott announced early in August 2015 that his government would bring forward defence projects worth billions of dollars, including the

Attack submarine (known at the time as the Future Submarine) project. In his estimation, doing so would safeguard thousands of Australian shipbuilding jobs and keep a large part of the estimated $40 billion that the proposed twelve new submarines would cost, in the country. His announcement reinvigorated debate on whether the Future Submarines ought to be bought off the shelf from a foreign manufacturer, designed specifically for Australia's requirements and built in conjunction with a foreign manufacturer or completely designed and built in Australia.

The debate almost automatically assumed, however, that the Future Submarines would be conventionally-powered, i.e. by diesel-electric engines. The Defence White Paper of 2009 dismissed the nuclear option as expensive to purchase and operate, requiring new skills and training, gaps in self-reliance and safety concerns. Left unstated was the fact that anything nuclear is politically dangerous to the government that proposes their acquisition and use. Nevertheless, in light of the delays and cost overruns that reportedly plague the *Attack* submarines, it may be time to revisit the nuclear-powered option and ask if Australia should also develop a nuclear power sector. To be clear, this is not to argue that Australia should create a nuclear-power sector in order to support a fleet of nuclear-powered submarines – there is no immediate connection between the two – but, rather, to show that Australia needs a nuclear sector and, if one were established, support a nuclear-powered submarine fleet that could better serve its defence requirements.

Analysis

Australia currently operates six *Collins*-class submarines. Designed in the 1980s, these submarines are plagued by failures, notably in their readiness. As one government-initiated report observed:

> The daily "two boat" material availability of the Collins Class was above 90% in FY07 and thereafter progressively worsened until December 2009 when two submarines were materially available less than 10% time. Two-submarine availability in June 2012 was around 60%, today it is well over 90%. [T]his does not mean that two Submarines were deployable for over 90% of the time.

Essentially, of the six submarines, only two are available for ninety per cent of the time, but even those two were not always readily available to carry out operational orders.

Australia eventually opted for the French-designed *Shortfin Barracuda* submarines, which became known as the *Attack*-class, the modified conventionally-powered variant of the nuclear-powered *Barracuda*. In essence, Australia opted to purchase the yet-to-be-fully-designed – let alone tested – conventionally-powered variant of a nuclear-powered submarine. To make matters worse, the cost of the project blew out to $89 billion from the initial $50 billion. That increase, coupled with the delays encountered, has reportedly led Prime Minister Scott Morrison to contemplate terminating the entire project in favour of an evolutionary redesign of the *Collins*-class submarines. The nuclear option had once again been discarded.

Australia is a signatory to the Paris Agreement on climate change, which aims to cap global warming at 1.5 degrees above pre-industrial levels. It has lagged behind its goal to reach net zero emissions, however, leading one expert to warn late last year that it has just nine years before it exceeds its commitments. That is due to a large extent on its reliance on coal-fired energy production. A full 56 per cent of Australia's electricity is generated by coal-fired power plants. While energy use for electricity generation fell by two per cent in 2018-19, despite a one per cent increase in electricity output, reflecting reduced fossil fuel generation and an increase in renewable generation, Australia's energy consumption rose by 0.6 per cent in 2018-19 to reach 6,196 petajoules. Overall, coal use accounted for 29 per cent of Australia's primary energy mix.

It takes 1,100 pounds (approximately 500 kilograms) of coal to produce one Megawatt hour of electricity. Burning that amount of coal produces around 2,100 lbs of carbon dioxide and 346 lbs of methane. As one source notes:

> Carbon dioxide (CO_2) emissions from combusting fossil fuels are the main driver of global warming. CO_2 is also the main by-product of coal combustion: nearly four grams of CO_2 are produced for every gram of carbon burnt (depending on its type, coal can contain as much as 60 to 80 percent carbon).

It adds:

> Methane (CH_4) often occurs in the same areas that coal is formed, and is released during mining activities. Methane is 34 times stronger than carbon dioxide at trapping heat over a 100-year period and 86 times stronger over 20 years; roughly 10 per cent of all US methane emissions come from coal mining.

In contrast, as a scholar noted in the mid-twentieth century:

> The respective power potential may be realised if it is considered that one pound of the isotope of uranium, U-235, if fully utilised, could release some 10 million kilowatt hours of energy, as compared to the three or four kilowatt-hours produced by the burning of one pound of coal. In other words, one single pound of uranium can generate as much power as 3,000 tons of coal, 250,000 gallons of gasoline, or 9,000 tons of high explosive TNT.

It is notable that Australia consumed 129,642,679 tons of coal in 2016, which was 11.4% of the world's consumption, placing it tenth in the list of coal-consuming countries. While the radioactive end product of the nuclear power generation process must be stored for a very long time, that cost pales in comparison to the production of greenhouse gases that have an immediate effect on the climate. Australia could meet its climate commitments by creating a nuclear-power sector and reducing its dependence on coal. While nuclear power cannot fully replace the coal-fired sector, a sufficiently large nuclear-power sector, coupled with the renewable energy sector (which grew by five per cent in 2018-19, with 50 per cent growth in solar energy and 17 per cent growth in wind energy consumption), could drastically reduce Australia's greenhouse gas emissions.

A nuclear-power sector would have the additional benefit of providing skills that could be transferred into the military domain – including nuclear-powered submarines. A nuclear-power sector would demand university graduates with skills in engineering, physics and mathematics, the same skills and skill levels that the US Navy requires to operate its nuclear submarines. Australian graduates with similar skills could be employed on Australian nuclear-powered submarines. Claims that the US would be reluctant to give away its nuclear submarine technology are countered with the fact that Washington has provided nuclear propulsion technology to the UK and Canada. The *Attack*-class submarines will, moreover, contain a significant proportion of US-made systems, including a version of the AN/BYG-1 Submarine Payload Control System.

Another advantage that nuclear-powered submarines have over conventionally-powered ones is the time spent on duty. For instance, on a ninety-day mission, a nuclear-powered submarine could spend ten days or so to get from Australia to the South China Sea but patrol there for seventy before returning. A conventionally-powered submarine, on the other hand, would not be able to remain there as long due to its physical limitations: fuel, the need to surface to recharge its batteries, etc. It was probably that experience that partially led a retired US Rear Admiral, John B. Padgett III, to state that 'it takes 2.2 to six [conventionally powered submarines] to obtain the equivalent effectiveness of a single [nuclear-powered one].' Going by that metric, Australia need only purchase six nuclear-powered submarines at most and likely fewer than that. This will have a direct effect on the costs associated with acquiring nuclear-powered submarines. The infrastructure costs that Australia will face if it acquires nuclear submarines must be balanced against the costs of catering to twelve conventionally-powered submarines.

Finally, the Australian community's concerns about nuclear safety must be addressed. US nuclear-powered ships have visited Australia since 1960 without accident. The US Navy has, moreover, 'accumulated over 6,200 reactor-years of accident-free experience involving 526 nuclear reactor cores over the course of 240 million kilometres, without a single radiological incident, over a period of more than 50 years.' The Australian Radiation Protection and Nuclear Safety Agency estimates the danger of a loss-of-coolant accident by a nuclear-powered vessel to be one in ten thousand reactor hours and the risk of an uncontained accident at one in ten million. Similarly, naval personnel aboard nuclear-powered submarines are exposed to less environmental radiation than the average background and medical radiation in the US.

Having dispensed with those concerns and, in light of Australia's climate commitments, it stands to reason that the creation of a nuclear-power sector ought to be revisited. That sector could potentially provide much of the foundational skills required to maintain and operate a nuclear-powered submarine fleet that could enhance Australia's defence several-fold.

While much deeper analysis of the matter is required, this ought to provide a preliminary indication that such analysis is almost compulsory.

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Suite 5, 202 Hampden Road, Nedlands WA 6009, Australia.
Tel: +61 8 6389 0211
Web: www.futuredirections.org.au