SMR Nuclear Technology Pty Ltd
Governor Macquarie Tower
Level 23, 1 Farrer Place
Sydney NSW 2000
ABN: 88 160 242 428
www.smrnuclear.com.au

*A Submission by **SMR Nuclear Technology Pty Ltd** to*

GenCost 2022-23 Consultation Draft

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EXECUTIVE SUMMARY

SMR-NT is concerned that the Australian Governments, Federal and State, are not receiving the complete up-to-date information to make an informed choice about the engineering and economic factors for the best mix of technologies for electricity supply.

As demonstrated by recent statements by Energy Minister Chris Bowen that SMRs will cost > $16,000/kW and are therefore too expensive to consider, Australia is neglecting a reliable, low emissions technology that is independent of the weather and is being actively considered by several countries.
Chris Bowen's statement was based on the GenCost 2021-22 report of $16,487/kW as the high figure for the capital cost of an SMR in 2030.
This inaccurate figure (adjusted to 2022) has again appeared in the GenCost 2022-23 Consultation draft and will continue to be inappropriately used to try to demonstrate that SMRs are too expensive to consider.

Source of the high figure for the capital cost of an SMR in 2030

GenCost 2022-23 Consultation draft table B.8 *Data assumptions for LCOE calculations* for Nuclear SMR in 2030 has a low figure of $7,355/kW and a high figure of $15,853/kW.

At the CSIRO GenCost 2022-23 webinar on current costs held on 20/10/2022, Aurecon showed their technology cost updates. Since this did not include SMRs, I asked the question "Which company will CSIRO contract to provide nuclear costs?" The response from Paul Graham was that they had no plans to update nuclear costs. He expected the next data would be from the IAEA project "Economic Appraisal of SMRs" in 2024.

The last year that CSIRO contracted a company to produce SMR capital costs was GHD in 2018.

The high estimate of $16,000/kW is from GHD (2018), for a Gen IV (advanced reactor) to be constructed in 2035, with the source of the $16,000/kW said to be the WNA. The GHD figure was disputed in Federal and State nuclear inquiries and denied by the WNA. It is inappropriate to use this figure and CSIRO admitted that 'the source was unclear". In the 2020-21 report CSIRO stated that the IEA *"Projected costs of electricity generation 2015 report* proposed that nuclear SMR typically costs 50% to 100% more than large scale nuclear and CSIRO claimed that using the 100% and recent nuclear costs justified the $16,000/kW figure.

The IEA updated their report in 2020 in their *Projected costs of electricity generation 2020 report.* This takes a more positive view of SMRs and instead of identifying an increase of cost of 50%-100% over large nuclear, the report now identifies that SMR costs could be lower. The IEA state this is due to:

"Simplification – passive mechanism improvements and greater design integration would reduce the number of components and result in containment building savings.

Standardisation – the lower power output of SMRs reduces the need to adapt to local site conditions, raising the level of design standardisation compared with large reactors.

Modularisation – smaller SMR size means that transporting their modules would be easier than for large reactors. In fact the degree of modularization increases considerably for power outputs of less than 500 megawatts of electrical capacity (MWe). This trend could be improved with more aggressive modularization techniques tailored to the logistical constraints and transport standards of each country. It is estimated that 60 – 80% factory fabrication levels are possible for SMRs (with power outputs below 300 MWe)(Lloyd, 2019)."

The continued use of this high figure due to a misinterpretation by GHD of an SMR project and an out-of-date IEA report is therefore now inappropriate.

CSIRO claim that this figure is also supported by the Economic and Finance Working Group SMR Roadmap EFWG 2019 Canada report.
This report surveys many countries. Table C-2: On Grid Inputs and Outputs Table for SMR-Evolutionary in 2030 has a high cost figure of CDN $9,476/kW = AUD 9,949/kW (current rate 1 CDN = 1.05 AUD).
Thus the EFWG report does not support a figure of anywhere near $16,000/kW, even with escalation and any additional allowance for Australian labour costs etc.

The Canadian report also states a 2030 low cost of CDN 4,837/kW = AUD $5,079/kW.
If CSIRO want to rely on the Canadian report, then it would be logical to use this low figure rather than the low figure of $7,355 for 2030 quoted in GenCost 2022-23 report table B.8.

I can understand that CSIRO would prefer not to use vendor estimates, but I suggest that a detailed vendor estimate backed by an associated AACE class would be more accurate than the current CSIRO estimates.
In 2020, our company, SMR Nuclear Technology Pty Ltd, a Sydney based consultancy, commissioned Fluor to produce a detailed cost estimate of deploying a SMR in Australia.
This is for a standard 12 module NuScale plant with a capacity of 924 MWeG, 884 MWeN output.
The cost is for a generic greenfield site in Australia and estimated as a first-of- a-kind (FOAK) facility.
Rates for Australian labour, concrete and international supply chain were derived from experience on multiple Fluor project bids in Australia.
The estimate includes:
Direct field costs - all plant, equipment and construction costs including commissioning
Indirect field costs - temporary construction buildings and field staff
Home office costs - detailed site specific engineering, procurement and contracts
The estimate does not include owners costs including land acquisition.
Overnight capital cost: USD 3,595,720,000. (USD 2020 costs)
884 MWe nett output, cost = USD 4,067/kW installed capacity
At the current exchange rate of 0.72, cost = **AUD 5,649/kW.**
This is a detailed bottom up AACE level 4 cost estimate. AACE class 4 is -30% to +50%.
At the +50% maximum range, this is **AUD 8,474**. Again this is far away from the >16,000/kW and I suggest this would be a more appropriate high cost figure.
This is for a FOAK plant. Because 12 modules would be built in the first plant, the learning curve for SMRs will be better than for large nuclear plants. NuScale estimate an NOAK plant built in the USA would cost USD 2,850/kW.

In January 2023, the first commercial contract for a grid-scale SMR in the Western world was signed to deploy a BWRX-300 SMR at Ontario Power Generation (OPG) Darlington site in Canada. We will soon have an actual FOAK project cost that can be used, adapted for Australia, as an SMR figure for the GenCost report. It is expected that this will be in the region of AUD 4,000/kW – AUD 5,000/kW installed capacity.

CSIRO has continued to use the $16,000/kW figure arguing that nothing has changed. What has changed is CSIRO's knowledge that the figure is not supported by evidence from any project. This figure is also not supported by any cost analysis published by any other organisation worldwide.

With regard to nuclear O&M costs, the GenCost 2022-23 draft report Apx Table B.8 Data assumptions for LCOE calculations has SMR O&M fixed $200/kW, O&M variable 5.3/MWh as the previous report.

The US EIA Feb 2021 report (Levelised costs of New Generation Resources in the Annual Energy Outlook 2021) includes O&M figures for new nuclear build in 2026:
Fixed O&M USD 15.51/MWh = AUD 22.2/MWh (rate 0.7)
Variable O&M USD 2.38/MWh = AUD 3.4/MWh (rate 0.7)

SMRs are expected to have lower costs because of the simple systems and passive safety systems requiring less maintenance.
I have previously supplied you with the NuScale O&M costs:
Fixed O&M USD 64/kW = AUD 91/kW (rate 0.7)
Variable O&M = 0
I suggest you could review your AUD 200/kW fixed O&M figure for new build.

As a more general comment, the comparison of overnight costs was appropriate when the technical capacity factor of the different technologies was not greatly different. Now that we have technologies with greatly different capacity factors, it is misleading to compare simple $/kW overnight capital costs.
For example, Figure 2-1 provides current cost estimates for electricity generation technologies. Onshore wind appears to be >50% more expensive than large scale solar, but taking into account the actual electricity produced because of the difference in capacity factor, the cost/kW is actually nearly the same.
LCOE figures are supposed to compensate for this, but it then becomes more complex due to the many variables, especially integration costs of VRE in the system.

Some Concluding Points

All Australian governments and organisations look at the CSIRO-AEMO GenCost report as the authority on the costs of available technologies for electricity generation and base the economics of their energy policies on this document.
It is therefore vitally important that the GenCost report provides the best available information for all technologies. For many years, this has not been the case for SMRs. The last year that CSIRO engaged a company to produce a cost estimate for SMRs was in 2018 and the figures produced by GHD were widely considered to be inaccurate.
SMRs may not be deployed in Australia before 2030, but policy makers are planning on a much longer timescale and need to be fully aware of all the options.

SMR Nuclear Technology Pty Ltd has been pleased to provide this submission to the CSIRO GenCost 2022-23 Consultation Draft and as in previous years would be happy to clarify any issues.

Tony Irwin
Technical Director
January 2023