GenCost 2020 Consultation Submission

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ALL EVIDENCE AND SUBMITTED WORK IS MY OWN OPINION AND NOT OF MY EMPLOYER NOR COLLEAGUES. FOR FURTHER EVIDENCE AND ELABORATION PLEASE CONTACT MY PERSONAL EMAIL.

Introduction

This submission has been purposely kept simple and concise with graphs and data preferred over words. The reason is so the reviewers are able to make their own conclusions based on the data provided.

Recommendations are made at the end of each section based on the data. The subject matter takes aim at the data representing the costs of nuclear power. The numbers have been at a contrast with other studies across the globe, this report aims to correct some of these numbers and point the reviewers in the direction of supplementary material.

The majority of the data comes from the interdisciplinary study from MIT "*The Future of Nuclear Energy in a Carbon-Constrained World*", which provides expert advice from over 120 individuals, 16 reviewers, an advisory committee of 15 and a study participant group of 21 individuals. This report is exemplary in evaluating opportunities in nuclear energy, power plant costs, advanced reactor evaluations, industry business models and policies and reactor safety regulation and licensing. I implore reviewers to explore this report and its recommendations.

Comments and feedback are welcome.

Areas of inquiry

Deep decarbonisation

A noteworthy take away from the MIT report is that deep decarbonisation skews prices in a nonlinear fashion without nuclear power. As we attempt to lower CO2 emissions, the cost of increasing it with (majority) non-synchronous generators becomes exponential, along with huge capacity additions (another discussion).
See below. All assumptions of scenarios can be found in the report.

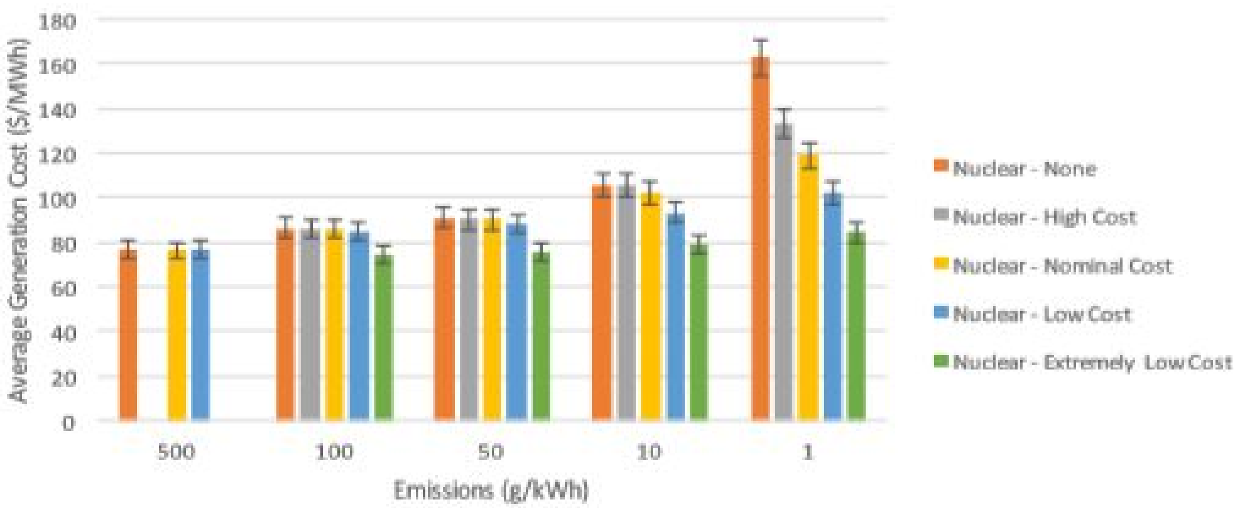

Figure 1: Texas Nuclear Average Generation Cost under different Emissions scenarios;
y-axis in $(**USD**)/kWh

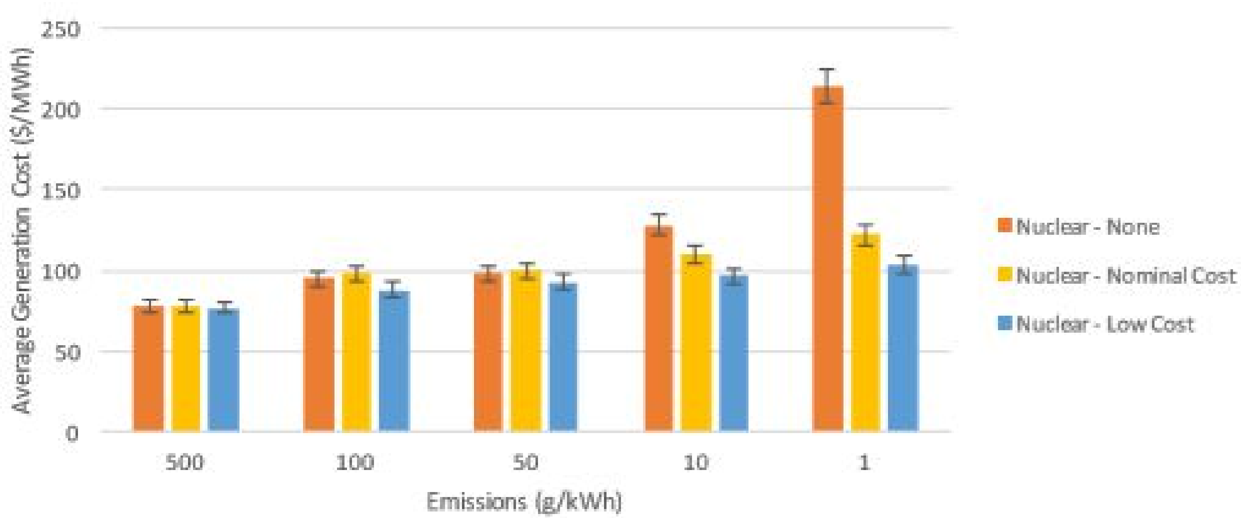

Figure 2: New England Nuclear Average Generation Cost under different Emissions scenarios;
y-axis in $(**USD**)/kWh

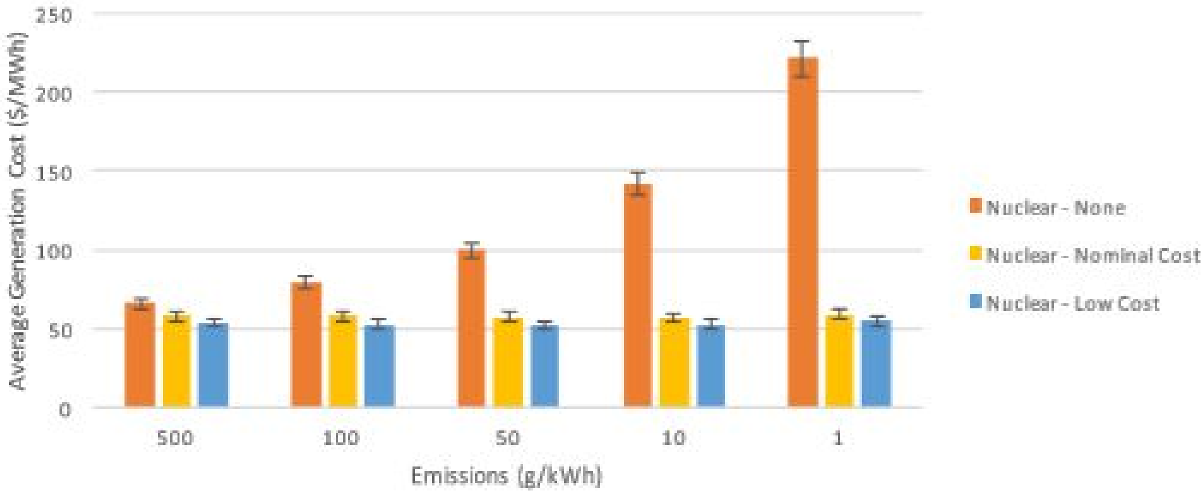

Figure 3: T-B-T Nuclear Average Generation Cost under different Emissions scenarios; y-axis in $(**USD**)/kWh

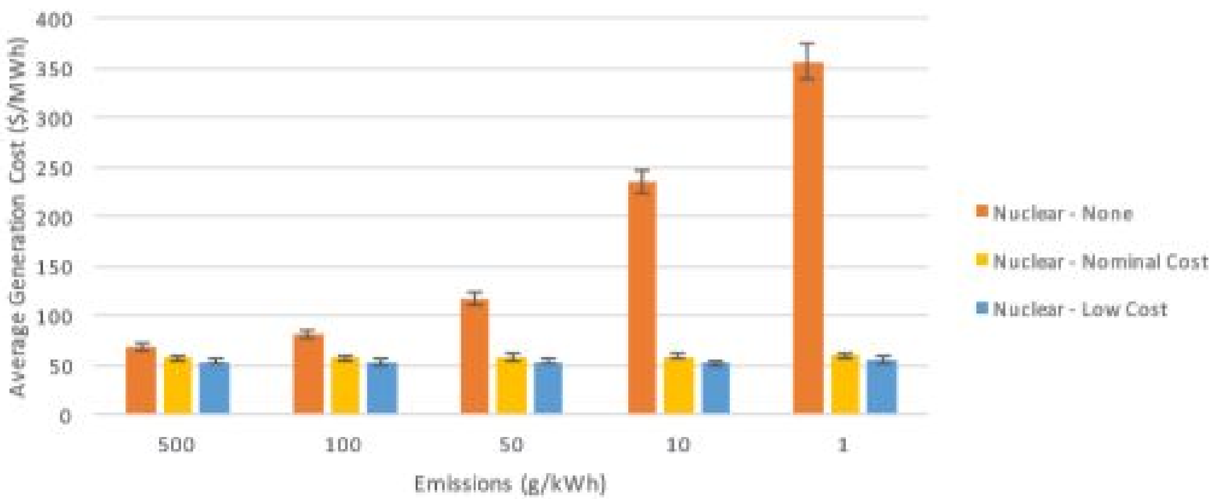

Figure 4: Zhejiang Nuclear Average Generation Cost under different Emissions scenarios; y-axis in $(**USD**)/kWh

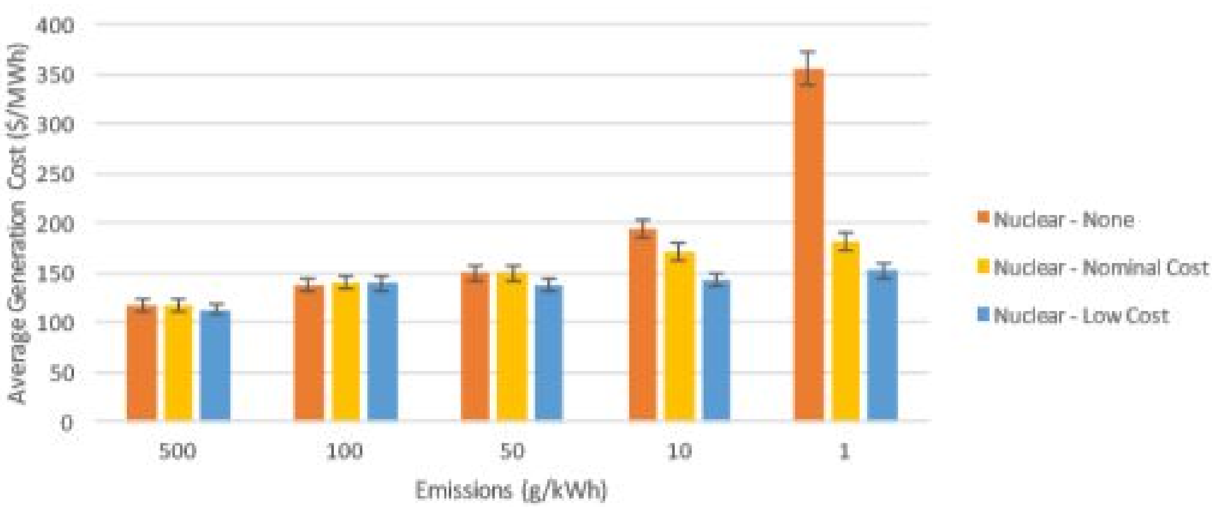

Figure 5: UK Nuclear Average Generation Cost under different Emissions scenarios; y-axis in $(**USD**)/kWh

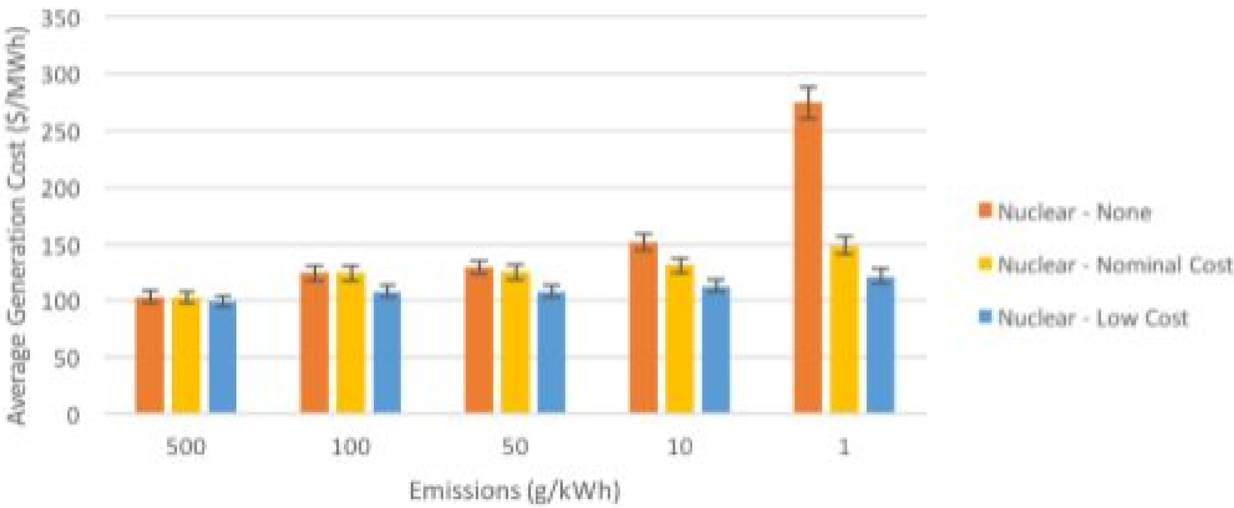

Figure 6: France Nuclear Average Generation Cost under different Emissions scenarios; y-axis in $(**USD**)/kWh

*****NB - These figures (1 - 6) are in $(USD)/MWh***

It can be surmised that different energy landscapes will bear different costs, but when deep decarbonisation is a priority, nuclear power consistently lowers the overall average generation cost. As seen in figure 5, Texas which has the perfect landscape for wind and solar generation still has the benefit in adding nuclear power, even under a high or nominal cost of generation.

It is realistic to expect that nuclear power costs will either drop or maintain the status quo. If the latter is to happen then the generators will still provide economic benefit, if the former is to happen they become quite viable.

Therefore, nuclear power could help flatten this price increase while keeping CO_2 low. For this reason it is recommended that more attention is paid to the ongoing studies, with wider sample sizes to be used, then checked against an Australian context.

LCOE Comparison

Figure 7 is a comparison of the GenCost LCOE estimate (green bars) against the U.S Energy Information Administration (blue bars) data, Lazard estimate (gold bars) and ECOFYS (European based consultancy - orange bars). It can be seen that the majority of technologies are congruent, although nuclear energy is an outlier.
**NB - ECOFYS is a 2012 dataset and therefore wind and solar are consequently higher in price.*

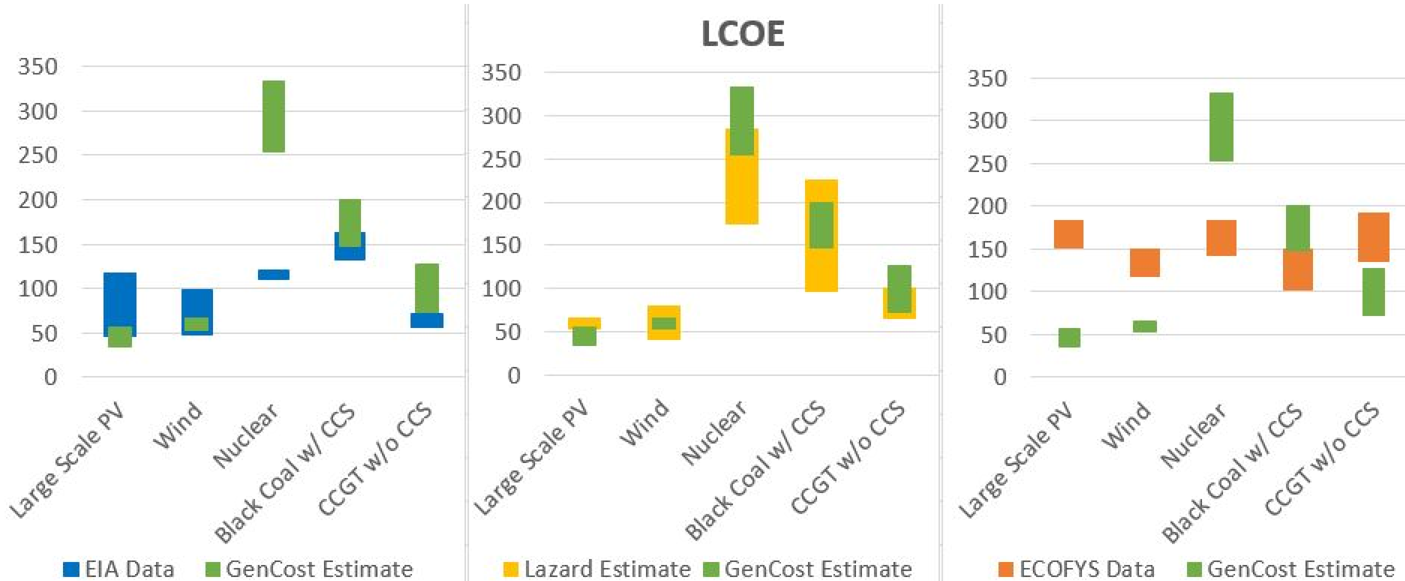

Figure 7: Varied Technologies LCOE Comparison from different data/estimates against GenCost; y-axis in $(AUD)/MWh

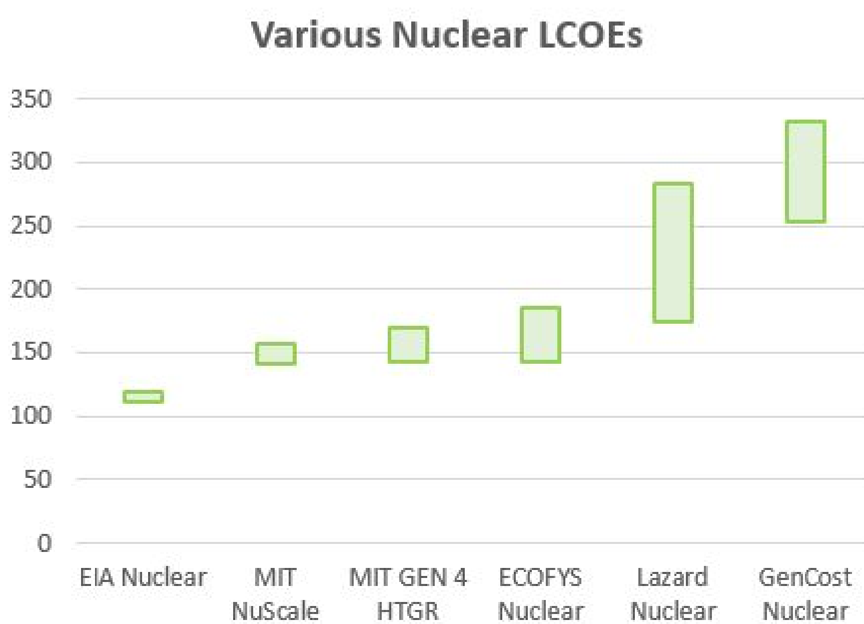

Figure 8: Nuclear LCOE Comparison from different data/estimates; y-axis in $(AUD)/MWh

Figure 8 is a comparison of various nuclear LCOEs.

The EIA data is reliant upon current large scale nuclear (>450MW) and therefore lower than an SMR estimate.

MIT NuScale estimate is included to provide a current SMR LCOE pricing, this is in stark contrast to the GenCost figure.

The MIT HTGR GEN 4 estimate is included as it is understood that the GenCost estimate relies upon a GEN 4 SMR assumption; it is shown that if Australia were to choose this type of reactor, that the GenCost price is still not representative.

The ECOFYS data is included to show an up to date European LCOE figure (including the FOAK and unique EPR plants under construction).

The Lazard estimate is shown as an authority on LCOE pricing.

The GenCost estimate is significantly higher than all of these prices.

Capital Cost Comparison

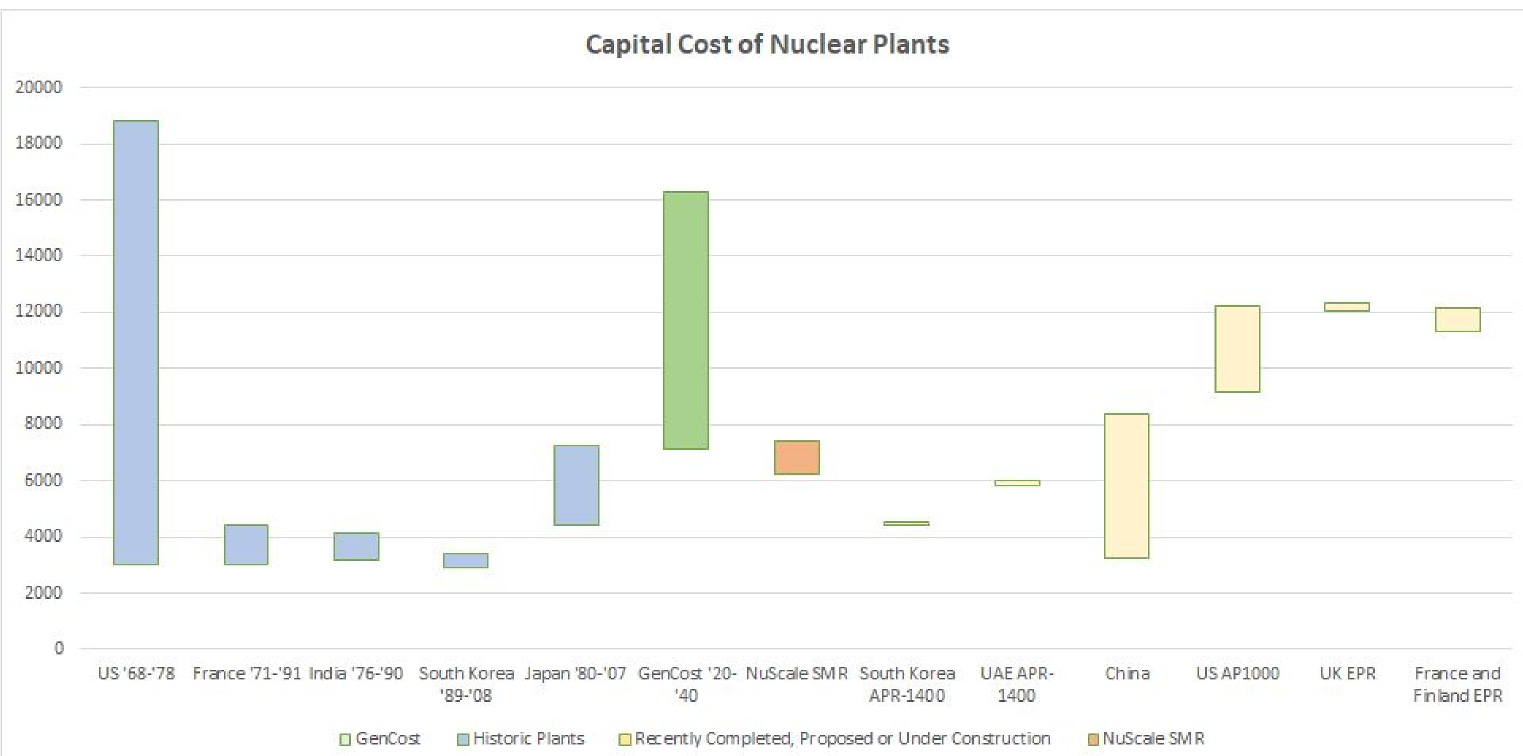

Figure 9: Nuclear Capital Cost Comparison from different estimates; y-axis in $(AUD)/kWh

Figure 9 represents the capital costs of historical nuclear power plants (blue) against recently completed, proposed or under construction plants (yellow) with GenCost (Green) and NuScale SMR (orange) in the middle.

Almost all of the builds on this figure are large reactors (>450MW), the NuScale and GenCost estimates are the only SMR data available. GenCost has estimated significantly higher capital cost pricing.

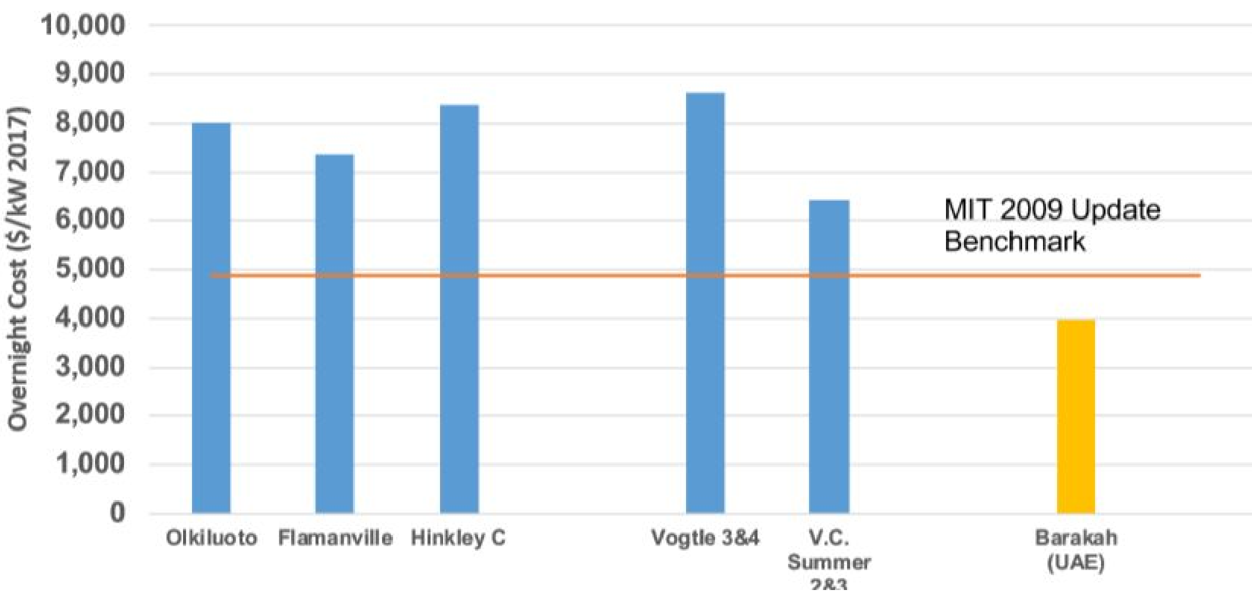

Figure 10: Nuclear Capital Cost Comparison from different estimates; y-axis in $(**USD**)/kWh

Figure 10 represents different capital costs from recent expensive builds (in USD) against a cheaper, recent UAE build (provided from the South Korean KEPCO). Although these are also large reactors, it is significant due to the fact that a new reactor build from a country with zero expertise in the nuclear field is capable of reaching such a low overnight capital cost.

The orange line “MIT 2009 Update Benchmark” represents the target benchmark that was proposed in the MIT 2009 update report before the Fukushima tragedy.

It is worth noting the GenCost figure is still marginally higher than the recent expensive builds and marginally higher than the UAE build.

Achieving a successful and stable Nuclear build

The following findings are explored in much greater detail and have been taken directly from the recent MIT report. I have included in my opinion the most pertinent recommendation (of many) from the report and most applicable in an Australian context.

Finding: Successful nuclear builds tend to have the following attributes:

a) Completion of needed portions of the design prior to start of construction

b) Development of a proven supply chain for nuclear steam supply system (NSSS) components and access to a skilled labor workforce,

c) Inclusion of fabricators and constructors in the design team to ensure that components can be manufactured and structures can be built to relevant standards,

d) Appointment of a single primary contract manager with proven expertise in managing multiple independent subcontractors,

e) Establishment of a contracting structure in which all contractors (and subcontractors) have a vested interest in the success of the project,

f) Adoption of contract administrative processes that allow for rapid and non-litigious adjustments to unanticipated changes in requirements or subcontractor performance

g) Operation in a flexible regulatory environment that can accommodate small, unanticipated changes in design and construction in a timely fashion.

Recommendation: Focus on using proven project and construction management practices to increase the probability of success in the execution and delivery of new nuclear power plants.

Conclusion

"*Government help, in the form of well-designed energy and environmental policies and appropriate assistance in the early stages of new nuclear system deployment, is needed to realize the full potential of nuclear.*"

This quote from the report is significant for Australia and for the GenCost implementation. It is not only true for nuclear power, but for our NEM at large.

GenCost feeds into the AEMO Integrated System Plan reports which sums up with other inputs to form a basis for environmental policies, if Australia is to achieve climate targets as efficiently and as cheap as possible then the policies must be sound. To secure strong, bipartisan policy we need firm agreement on numbers, of which need meticulous revision.

There are other areas I would invite the reviewers to look into, such as the regulatory success story of NuScale and what this means for nuclear power and SMRs and the sensitivities nuclear power has in regards to cost as explored in the MIT report (things such as materials, workforce, delays etc).