HOUSE STANDING COMMITTEE ON THE ENVIRONMENT AND ENERGY
ANSWERS TO QUESTIONS ON NOTICE
PREREQUISITIES FOR NUCLEAR ENERGY
16 October 2019

REFERENCE: Questions on notice (Hansard 16 October 2019, Page 2-3)

QUESTION:
CHAIR: In looking at the GenCost analysis, obviously, when we're looking at the topic of this inquiry, there is a need to compare it across other sources of energy. I see that even the life span for a black coal plant is listed as 25 years, with large-scale solar and solar thermal also 25 years. That's from the same page that lists the assumption of $16,000.
Dr Hayward: I'll have to look into that for the black coal plant, because normally they are 50 years, I think. I'll have a look at that. Certainly in the modelling we assume it's 50 years.
CHAIR: Okay. This is on page 54.

ANSWER

The source of life span data in the GenCost report is the report authored by GHD which provides two estimates of plant life: economic life and technical life. Economic life is the period over which the plant will be financed and this is also the period over which the plant will be required to deliver its return on investment. Technical life is longer and is the period from first commissioning, until decommissioning.

CSIRO uses the economic life, which is 25 years for most plants, to calculate the levelised cost of electricity. This is appropriate since the levelised cost of electricity is the total cost of the generation plant including financing costs. However, when we use our global electricity model we use the technical life, which for coal plant is 50 years, because in that case we need to know the full life of each generation plant in order to keep track of generation plant build and retirement dates.

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REFERENCE: Questions on notice (Hansard 16 October 2019, Page 3)

QUESTION:
Mr ZIMMERMAN: Can you unpack that a little bit more? It sounds remarkably vague, in the sense that GHD has relied on a website, and, when you've sought to fact check that website, you can't find the $16,000 yourself, but then you talk about a range. It doesn't sound like a massively thorough process, if I can put it that way. I'm interested in your response to that. It sounds highly vague. Basically, you're relying on a third party, who's relying on a website, and you haven't been able to fact check that information yourself. It doesn't seem to provide the certainty—I know it's speculative, but you'd certainly be relying on it if you're making decisions about a significant investment in a new form of energy.
Dr Hayward: It is a tough one because it is so speculative. We have these stakeholder workshops where be put the numbers to them. We actually invite about 100 stakeholders, and we get about 20 to 30 to 40 coming along. We've interrogated those numbers with the stakeholders, and they seem to think that it's a perfectly reasonable number given the range of uncertainties out there.
Ms STEGGALL: Who are the stakeholders?
Dr Hayward: We could probably provide you with the list, I think.
Mr ZIMMERMAN: That would be helpful**.**

ANSWER

During the development and consultation process for the GenCost 2018 report, the following stakeholder organisations were invited to take part in workshops and comment on draft material. The organisations were selected for their knowledge and diversity. However, we also allow any organisation to join on request. As such the list represents a combination of invited participants and those who have requested to participate.

All of the listed organisations were sent the draft material and they were invited to provide feedback, even if they did not attend the workshops.

Acil Allen Consulting

AGL

ANLEC R&D

ARENA

Aurecon

Australian Energy Council

Australian Energy Market Commission

Australian Energy Regulator

Australian National University

Australian Nuclear Science Technology Organisation

Australian PV Institute

Beyond Zero Emissions

Canadian Solar

Clean Energy Council

Clean Energy Finance Corporation

Climate Change Authority

CO2CRC

Deloitte Australia

Department of Environment and Energy

Department of Industry, Innovation and Science

Electranet

Energeia

Energy Australia

Energy Networks Australia

Energy Users Association of Australia

Engie

EY

First Solar

Frontier Economics

Gamma Energy Technology

GE

Global CCS Institute

Grattan Institute

Hydro Tasmania

Infigen Energy

ITP Australia

Jacobs

Minerals Council of Australia

Monash University

NSW Department of Planning, Industry and Environment

Pacific Hydro

Powerlink

Redflow

Snowy Hydro

Southern Cross Venture Partners

Tesla

Tilt Renewables

TransGrid

University of New South Wales

University of Technology Sydney

University of Queensland

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QUESTION:
Mr BURNS: To follow up on Mr Zimmerman's question, is that an accurate statement? CSIRO has relied on GHD, who's got a number from a website. Is that correct?
Dr Hayward: It's the World Nuclear Association—
Mr BURNS: I'm aware of the association.
Dr Hayward: so it's a reputable source.
Mr BURNS: But in terms of a thorough analysis and reliability—we are looking to make recommendations, decisions based on some of this information. It just doesn't sound terribly thorough.
Jane Coram: If I may, the difficulty in any modelling is that usually you're trying to predict something that you don't understand particularly well, so we're frequently forced into using ranges and picking a number within a range. At CSIRO we do source our figures in as much detail as we possibly can, but frequently when we're exploring new scenarios we don't necessarily have a definitive source of information. We can certainly provide the justification for the figures that have been used. But they have not been plucked out of the air. They've been justified as comprehensively as we can.
Mr HOGAN: Just to come back to that statement, why wouldn't CSIRO utilise someone who did know what they were doing?
CHAIR: Is that a question or a statement?
Mr HOGAN: It's a question.
Jane Coram: Could we possibly get back to you with the basis for the figures—the comprehensive basis—because it has been done as comprehensively as we can within the time frames. There is limited information to draw upon.

ANSWER

In 2018 AEMO commissioned GHD to update information on the current cost and performance of electricity generation technologies if they were built in Australia. The GHD report is the source of Small Modular Reactor (SMR) capital costs in CSIRO's GenCost 2018 report and is published on the AEMO website.

At the time, there was no commercial scale SMR plant that had completed construction in Australia or anywhere else in the world. Consequently, there was and remains no real project data on the cost of building SMR in Australia. In the absence of real project data, our expectation was that GHD would review literature and use their judgement on general generation plant building costs to provide an estimate. The estimate they provided of $16,000/kW is consistent with an expected high cost of first of a kind plant. That is, where there is limited international and local experiencing in building that plant type then it is generally accepted that costs will be high.

GHD's cost estimate is also consistent with the generally accepted view that building plants smaller is more costly. The SMR cost estimate is around twice the cost of building large scale nuclear in Australia. We acknowledge that there is an expectation that it will be possible to build SMR in a modular way such that manufacturing costs will be able to be reduced. However, cost reductions from large scale modular manufacturing are not expected to be possible until the 2030s and so it was appropriate that GHD did not include this potential in current cost estimates.

SMR cost data will remain highly uncertain until we see greater evidence worldwide of published costs of actual completed projects. Until such data is available, we are of the view that GHD's estimate remains reasonable given the infancy of the SMR technology supply chain at present.

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REFERENCE: Questions on notice (Hansard 16 October 2019, Page 4)

QUESTION:
Dr GILLESPIE: And the other thing is the overnight costs of nuclear reactors versus this assumed completed cost is often influenced greatly by the finance behind it. Do you account for that, given that some of the models that have been presented assume discount rates of nine or 10 per cent?—which is just price-gouging by the people providing the energy, as opposed to what realistic discount rates would be in the current world interest rate cycle. You could halve the cost of a project just by changing the financial assumptions—not the engineering cost bill, but just the costs of your borrowing.

Dr Hayward: Sorry; I'd have to check how it was done for the levelised costs, but in the modelling we assume a discount rate of seven per cent in the GALLME model, for everything.

ANSWER

CSIRO has used a 7% cost of finance for all levelized cost of electricity estimates.

House of Representatives
Standing Committee on the Environment and Energy
Prerequisites for Nuclear Energy

Question on Notice received on 1 November 2019

Many of the submissions and presenters have referenced the CSIRO's GenCost Report 2018, and debate has been heated around the calculations for the levelised cost of energy. Could the CSIRO please provide the underpinnings of those calculations and outline how in the approach they have factored in the different technologies' attributes and outline the gaps in knowledge or unknowns as they relate to specific technologies that could possibly influence the outcome of those calculations.

CSIRO response:

The methodology for calculating the levelized cost of electricity is well understood by stakeholders and subsequently is not published in the GenCost 2018 report. However, should the committee require an explanation of the formula it is published on page 38 of this CSIRO report: https://publications.csiro.au/publications/#publication/PIcsiro:EP141067.

The formula is applied by using the data in Apx Tables B.1 through to B.3 together with a discount rate or cost of capital of 7% (which we note at the bottom of Apx Table B.3). These tables capture all of the different technology's attributes in so far as levelized cost of energy (LCOE) calculations are concerned. LCOE should be understood as a simple screening tool and is not a substitute for detailed project financial cash flow analysis which would include more detailed consideration of plant cost and performance attributes over time.

In terms of calculating LCOEs for technologies in the year 2020 there are very few gaps in knowledge with respect to technologies that are presently being built such as gas, wind and solar photovoltaic generation plant. The existence of recently completed or under construction projects of these technologies means that there is hard data on their costs and performance in the public domain or in the internal data holdings of the engineering firms involved in their construction. This is the motivation for using engineering firms such as GHD to provide updates to the GenCost project on current cost and performance of generation plant.

Where a type of generation plant has never been built at commercial scale in Australia the knowledge gaps are larger. These include for example commercial scale carbon capture and storage plants, nuclear small modular reactors (SMRs) and solar thermal with storage. In such cases we would tend to rely on costs of projects completed overseas and seek to convert those costs to Australian currency and conditions (e.g. local engineering labour costs).

The knowledge gaps and unknowns are the largest where there is no information about international generation plant project costs. SMRs fall into this category. While one plant is close to commissioning in Russia, and China and Argentina each have plant under construction, no public

cost information is yet available. In lieu of hard data, estimates are only available from potential vendors or from applying engineering principles. Past experience has indicated that vendor based estimates are often too low. Constructing first-of-a-kind plant includes additional unforeseen costs associated with lack of experience in completing such projects on budget. SMR will not only be subject to first-of-a-kind costs in Australia but also the general engineering principle that building plant smaller leads to higher costs. SMRs may be able to overcome the scale problem by keeping the design of reactors constant and producing them in a series. This potential to modularise the technology is likely another source of lower cost estimates. However even in the scenario where the industry reaches a scale where small modular reactors can be produced in series, this will take many years to achieve and therefore does not impact estimates of current costs.

Therefore, while noting that the source of GHD's estimated cost for SMR was not clearly stated in their report the direction of their estimate is correct. Until we see hard data on the costs of SMR, we should assume that a first of a kind plant in Australia will be more costly than large scale nuclear and more costly than vendor estimates or estimates of costs under ideal manufacturing conditions.

However, estimates of costs for SMR in future years should recognise the potential for significant costs reductions. Our methodology for projecting future cost reduction is to model the global electricity system in a 13 region model of the world. In this model we include the widely observed observation that costs of emerging technologies decrease by a constant percentage rate for each doubling of capacity deployed, referred to as the learning rate. In particular, emerging technologies tend to have higher learning rates. A table of learning rate assumptions is published in Apx Table A.1 of the GenCost 2018 report.

The GenCost 2018 projection modelling did not model SMRs as a technology separate from large scale nuclear. This is not unusual as we also do not model the variants of other technological categories to keep the model size manageable. However, we recognise that not modelling SMR as a separate technology category contributed to the fact that we did not project significant changes in future SMR costs in GenCost 2018. A second factor that contributed to this outcome was the lack diversity in the global scenarios modelled. The two climate change policy scenarios modelled in GenCost 2018 led to very similar outcomes across most technologies whereas we would expect there is a wider range of plausible outcomes.

To address these issues, CSIRO ran a workshop with stakeholders in August 2019 to design new global scenarios that would result in more diverse technology cost outcomes. Secondly, CSIRO has modified its projection model to include SMR as a separate technology category. New modelling results will be made available for public consultation in November 2019. Preliminary results for one of the new scenarios are showing a significant reduction in the cost of SMR around 2030. This reduced cost level is consistent with the lower cost estimates promoted by some vendors and with cost reductions expected to be achievable under ideal manufacturing conditions.