Senate Standing Committee on Environment and Communications
Legislation Committee
Answers to questions on notice
Environment and Energy portfolio

Question No: 201

Hearing: Budget Estimates

Outcome: Agency

Program: ARENA

Topic: Cost of solar plus storage by 2025

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Question Date: 23 May 2017

Question Type: Spoken

Senator Ludlam asked:

Senator LUDLAM: I understand the distinction you are making. Could you provide us, again on notice, with your best estimate as to the cost of solar plus storage by 2025, either PV plus battery or CST plus some kind of storage medium? Can you have a crack at that for us?
Mr Frischknecht: Yes, we will have a crack at that. But bear in mind that taking PV plus battery is not quite the same as saying you have got PV or other variable renewables that are effectively balanced by the entire grid, which allows you to use many different mechanisms, which at different times different ones will be cheaper or more available—demand management, pumped hydro, batteries, interconnections to other regions. We will try to give you both numbers.

Answer:

- ARENA's internal estimate of today's costs based on cost estimates available to ARENA in 2017, is as follows:
    - 100 MW of solar PV would cost approximately $200m and have an LCOE (PPA breakeven price) of approximately $80/MWh based on ARENA's recent competitive round (2017 prices)
    - Adding 100MW/100MWh of battery storage would add a further cost of $85-120m (subject to significant uncertainty based on 2017 price estimates available to ARENA). This level of storage is one hour of peak production.
    - Therefore the breakeven PPA price would increase by approximately 40% to 60% compared to a standalone PV farm resulting in an LCOE of $112/MWh - $128/MWh.
    - The breakeven price for a CST project with 8 - 15 hours storage is estimated by industry proponents to be around $150/MWh
- Projected costs in 2025 are less certain and depend on factors such as technical innovation and cost reductions through deployment experience and global manufacturing scale.
- The Low Emissions Technology Roadmap provides projected costs for 2020 and 2030, drawing on numerous sources, with estimates for PV, lithium-ion batteries and concentrating solar thermal recorded in the table below. We note price data from ARENA's large-scale solar PV round suggests today's costs are already below the upper end of the projected range for 2020, and industry estimates of today's costs for

CST are already below the projected range for 2020. Cost estimates have also been published in modelling work for the independent review into the future security of the national electricity market, also shown below. The marginal cost of additional storage is relatively low for solar thermal compared to battery storage.

Technology	2020 estimated cost	2030 estimated cost	Source
Large-scale PV	$75-$90 per MWh of production (LCOE)	$55-$70/MWh	CO2CRC, 2015
	Average $91/MWh	Average $61/MWh	Adapted from Jacobs 2017, *Report to Independent Review into the Future Security of the National Electricity Market*
Utility-scale lithium-ion batteries	$80-$100/MWh (LCOE)	$60-$70/MWh	Brinsmead, Graham, Hayward, Ratnam, & Reedman, 2015
Concentrating solar thermal - tower system	$170-$210/MWh of production (LCOE)	$160-$200/MWh of production (LCOE)	CO2CRC, 2015
	Average $172/MWh	Average $109/MWh	Adapted from Jacobs 2017, *Report to Independent Review into the Future Security of the National Electricity Market*

- An overall reliable supply from the electricity grid with high shares of renewable energy can be achieved through a combination of approaches, such as geographic diversity (allowing temporary low output in one location to be met by production from other locations); excess capacity; storage, such as pumped hydro or batteries; and other forms of flexible capacity such as demand response, concentrating solar thermal, biomass and gas peaking plant.
- A combination of generation, storage and system security technologies is likely to be beneficial in future - batteries, PV, solar thermal and other technologies may well be complementary.
- The ANU published a study in February 2017 estimating the levelised cost of balancing (which accounts for a combination of costs) as $26-$48/MWh for a theoretical system with 100 percent renewable energy.
- ARENA is funding the ANU STORES study which aims to produce a costing tool for pumped hydro energy storage, which will enable more detailed modelling of costs associated with this form of storage, which in turn can be used as an input to estimates of the overall cost of an electricity system with high shares of renewable energy.