House of Representatives Standing Committee on the Environment and Energy

ANSWERS TO QUESTIONS ON NOTICE

CSIRO

Inquiry into the current circumstances, and the future need and potential for dispatchable energy and storage capability in Australia.

11 08 2021

Question 1

How much of a need is there currently for dispatchable generators to be available at times of peak demand? Is there a strong evidence base? Has CSIRO provided any advice to Government on the need for dispatchable generation?

Every electricity system requires a mix of low-cost, slow responding generation capacity for the bulk of electricity supply as well as faster responding, higher-cost flexible generation for load following at peak times or responding to generation outages. The Australian Energy Market Operator (AEMO) calculates future changes in the shape of the electricity load curve with particular focus on peak demand and minimum demand. It also monitors the rate of generator outages. Therefore, the evidence base is strong for the ongoing need for flexible technologies to meet these needs. CSIRO supports AEMO in these functions by providing projections of the adoption of technologies such as rooftop solar, batteries and electric vehicles which may impact the future shape of the electricity load curve.

As the electricity system transitions towards using less fossil fuel and more variable renewable energy sources, the type of flexible generation that will be deployed to meet peak demand or cover generation outages will change. Gas and diesel-based generation have historically been the preferred flexible generation technologies. However, our analysis of the cost of storage technologies such as batteries and pumped hydro indicate that they will be competitive with gas and diesel in the future. The analysis is available through CSIRO's GenCost publication.

GenCost also includes hydrogen and biogas based flexible generation options. Hydrogen and biogas provide low emission alternatives to using gas and diesel where a fuel-based technology is preferred to storage. The advantage of any fuel-based technology over a storage technology is that they can generate indefinitely for as long as they can access fuel supply. However, storage technologies can no longer generate once their finite storage capacity is consumed. Consequently, we still see a role in the future for fuel-based technologies for supporting long periods of low renewable generation that exceed the likely capacity of storage technologies (which is not more than a day or two based on current technologies).

Additionally, as noted in CSIRO's written submission to this inquiry:

Page 7: *In terms of future need it is expected that, by 2030, four of Australia's states will be achieving at least 50 per cent electricity generation from renewables. This means energy storage will be critical to continue Australia's emissions reduction journey. A range of different and complementary energy storage solutions with capacity that can meet the timescales of energy demands and maintain grid stability will be needed.*

Page 8: *To date, the need for off grid dispatchable power has typically been met by diesel generators. The domestic market for rental diesel generators is up to $600 million and spans a range of sectors including mining, agriculture, and defence. Despite the maturity of the technology, there are inherent limitations; not only is there the capital cost associated with the generators but also an ongoing cost associated with fuel and maintenance, and in remote areas the supply of fuel may be uncertain.*

Evidence for these statements is provided in the list of scientific, peer-reviewed publications and reports in the appendix of CSIRO's submission. This information cover topics including electricity networks and systems, battery and chemicals storage, hydrogen, printed solar films, concentrated solar thermal, natural gas and offshore renewable energy systems.

GenCost Reference: Graham, P., Hayward, J., Foster J. and Havas, L. (2021) *GenCost 2020-21: Final report*, Australia. https://www.csiro.au/-/media/EF/Files/GenCost2020-21 FinalReport.pdf

Question 2

During the hearing you were asked about the potential cooling issues with batteries and what would happen if cooling fails. Has CSIRO done a comparative assessment of the reliability of other dispatchable energy technologies? For example, looking at the comparison between batteries, pumped hydro, concentrated solar thermal, coal fired generation, gas peaker plants etc. looking at breakdowns/major malfunctions, maintenance, and efficiency.

As an essential part of the GenCost project, each year CSIRO partners with AEMO to update the current and future cost and performance characteristics of all relevant generation and storage technologies. This information is needed by AEMO to do system planning and is generally used by CSIRO and the broader electricity modelling community as they study electricity futures.

The GenCost project commissions an engineering company to provide an update on current technical abilities of each technology. Included in their report are the following data for each generation technology which is relevant to comparing reliability:

- **Summer capacity rating**
  The power available from many thermal technologies is reduced as ambient temperatures rise
- **Average forced outage rates**
  Based on average performance of the fleet of that technology type
- **Average planned maintenance**
  Number of days generation is offline due to planned maintenance
- **Maintenance costs**
- **Energy efficiency**
- **Ramp rates**
  The rate at which they can increase or decrease output

The report and data are available on the AEMO 2021 Integrated System Panning web pages:

1. https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/isp/2021/aurecon---cost-and-technical-parameters-review-2020.pdf?la=en
2. https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/isp/2021/aurecon---cost-and-technical-parameters-review-2020---workbook.xlsb?la=en