How Much Energy Storage Does Australia NEM Need?

THE UNIVERSITY of ADELAIDE

Electrical and Electronic Engineering

Background & Motivation

Australia is committed to transition its electricity generation from fossil fuels to 100% renewable energy. However, production from renewable energy sources is not as reliable as fossil fuels because of their availability and intermittency.

To ensure the electricity generation from renewable energy sources is meeting the demand supply, it is important to to develop an Energy storage system which is large enough to meet the demand supply in case of non-availability of renewable sources.

Project Aim

The aim of this project is to gain perspective on how much energy storage is needed to ensure demand supply balance due to the intermittency of renewable energy sources.

Project approach

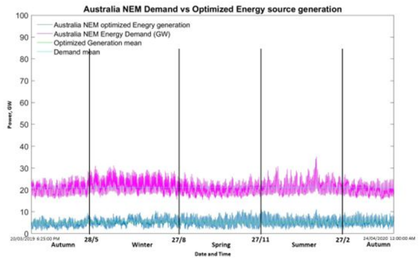
- Collecte electricity generation and demand data from AEMO website.
- Determine the storage requirements for today's Renewables
- Determine how much renewable energy is required to retire all fossil fuel generation
- Determine the minimum amount of storage required to ensure demand-supply balance at all times. Consider various scenarios:
  - ■minimum renewable energy supply
  - ■Multiples of this minimum level with excess energy producing fuels.

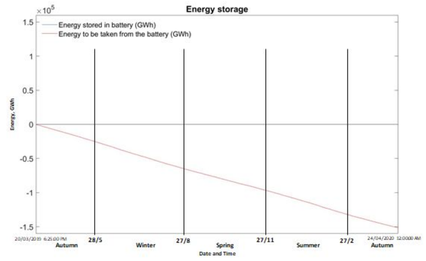
Methodology

- Generate a graph to compare Total Power generation(GW) versus Power demand(GW) from March 2019 to April 2020
- Calculate and plot Net power(GW) graph, such that Net power (GW) = Power generation(GW) - Power demand(GW), for each time interval
- Integrate the Net power (GW) graph, in order to obtain Energy storage required (GWh) graph for each time interval
- The highest value in Energy storage required (GWh) graph is the battery capacity that is needed to meet the power demand and avoid power outage.

Result and Discussion

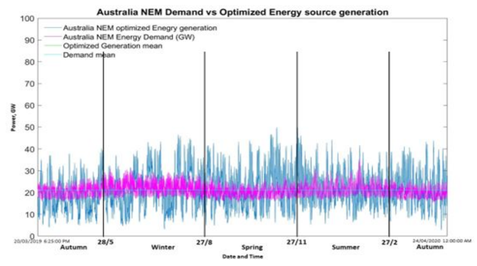
a) Baseline case

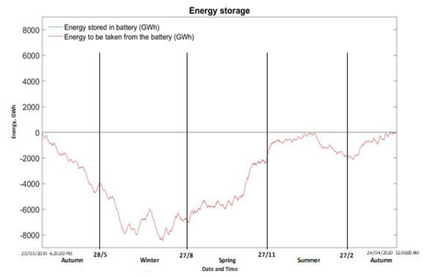




Storage required = 151700 GWh
= 783979 Hornsdale battery
= 433 Snowy hydro 2.0
= 32.2 Gordon Dam (Tasmania)

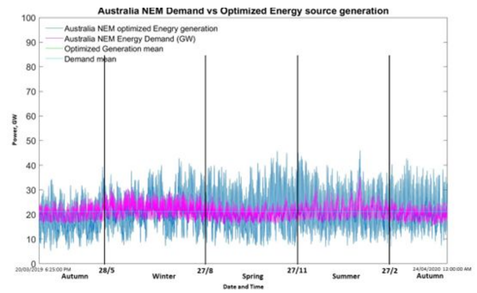
b) 7*wind + 7.7*solar + 1*rooftop PV + 1*hydro

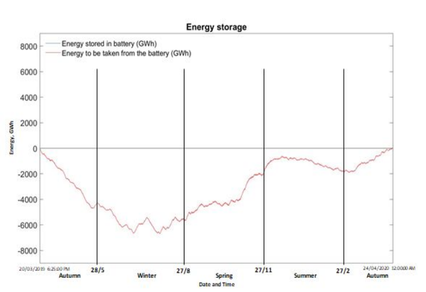




Storage required = 8440.4 GWh
= 43620 Hornsdale battery
= 24 Snowy hydro 2.0
= 1.8 Gordon Dam (Tasmania)

c) (Wind + solar + rooftop PV + hydro)*4.1308





Storage required = 6687.1 GWh
= 34559 Hornsdale battery
= 19 Snowy hydro 2.0
= 1.4 Gordon Dam (Tasmania)

Conclusion

According to our finding, the transition of Australia's electricity from fossil fuel to 100% renewable energy source requires at least 4 times of current renewable energy generation to meet the electricity usage demand. However, in order to overcome the intermittency of renewable energy source, 6687.1 GWh of battery capacity is needed if each energy source is multiplied by 4.1308. This storage capacity is equivalent to 19 times of Snowy hydro 2.0, 1.4 times of Gordon Dam storage capacity in Tasmania and also 8.07 x 10^12 KG of water mass in a 300 Meters height of pumped hydro storage.
Further research should be carried out in order to justify if case B is more practical in term of economy.

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