Increasing wind power production in Australia plays a critical role to achieve the government’s target of 20% of electricity supply by renewables by 2020. The presence of carbon tax and projected falling costs of building a wind power plant attract more investment in large-scale wind generation in Australia.

Grid integration cost is divided into three components: additional system capacity & balancing costs, system grid connection cost, and grid reinforcement/extension cost (applied system cost top-down approach from GreenNet EU-27 project).

Empirical data of 5’ dispatch interval of NEM load and wind generation for 15 years (1999-2014) is used to estimate capacity cost & balancing cost. Grid connection and reinforcement costs are estimated using findings from the literature. Capacity credit of wind power is about 35% and balancing reserves accounts for 28% of installed capacity in Australian NEM.

To quantify the economic impacts of fluctuation of wind power on the Australian NEM by:

- Estimating capacity credit of wind generation and balancing reserves in the Australian NEM; and
- Quantifying the costs of grid integration of large-scale wind generation in the Australian NEM in 2013-2020.

**Objectives**

To quantify the economic impacts of fluctuation of wind power on the Australian NEM by:

- Estimating capacity credit of wind generation and balancing reserves in the Australian NEM; and
- Quantifying the costs of grid integration of large-scale wind generation in the Australian NEM in 2013-2020.

**Key impacts of wind integration**

- Wind speeds vary over time
- Matching demand and supply requires reduced reserve capacity
- Wind farms are located geographically
- Forecast errors are usually localized
- Wind output varies seasonally
- Cost of connection and reinforcement are required
- Balancing reserves are affected by disturbance reserve

**Capacity Credit of Wind Power**

- Capacity credit: a measure of the amount of load that can be served on an electricity system by adding intermittent generation with no increase in the capacity deficit
- Capacity credit is determined in 3 steps (Soder & Amelie, 2008)
  1. Identify capacity deficit without wind power (numbers of hours that load could not be met)
  2. Identify capacity credit with wind power by adding wind power production to available capacity curve
  3. Calculate the amount of capacity of thermal generation required to return capacity deficit to the previous level

**Method**

- Grid integration cost is divided into three components: additional system capacity & balancing costs, system grid connection cost, and grid reinforcement/extension cost (applied system cost top-down approach from GreenNet EU-27 project).
- Empirical data of 5’ dispatch interval of NEM load and wind generation for 15 years (1999-2014) is used to estimate capacity cost & balancing cost. Grid connection and reinforcement costs are estimated using findings from the literature.

**Findings**

- Capacity credit of wind power is about 35% and balancing reserves accounts for 28% of installed capacity in Australian NEM.
- Integrating additional 8.8GW of wind energy into the NEM grid by 2020 will cost Australia from $32-$37/MWh equivalent to about $400 million of investment.
- Grid reinforcement and extension costs account for the largest portions, followed by capacity & balancing costs; and grid connection cost.
- If wind farms are located in a wide area to capture fluctuation in wind flows, the integration cost will be reduced.
- Integration costs vary due to seasonal effect (capacity credit of wind generation in winter is lower than in summer).

**Conclusions**

- Wind power will be competitive only if system LCOE of wind technology is fallen below these of conventional resource.
- Accounting for integration costs makes wind generation in Australian NEM become less attractive to investors.
- A range of measures from Government is required to reduce integration costs (interconnection, demand side management, wide area of wind farm location).
- Wind power is overvalued which leads to overproduction in wind generation in Australian NEM (Q0). Research work is needed to identify the optimal portfolio of generation technologies and the optimal wind penetration rate in NEM (Q*).