Need for visibility of DER

AEMC stakeholder forum 27 March 2018

Agenda

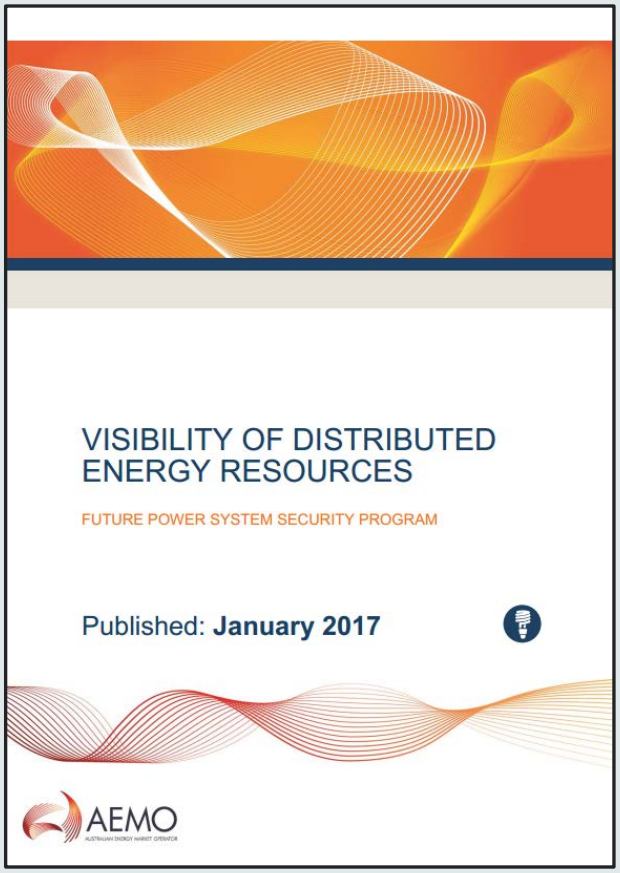
1. Impact of DER on the power system
2. Need for visibility
3. Changing load characteristics
4. Impact on power system operation
5. Impact on market efficiency
6. Questions and discussion

Impact of DER on the power system

Individually small

… but in aggregate large

AEMO Visibility of DER report



- Outlines:
  - *The need for visibility to efficiently accommodate increasing penetrations of distributed energy resources (DER) in the power system while maintaining power system security.*
  - *The potential impact of DER on market efficiency and reliability if their existence and behaviour is not visible or predictable.*
  - *Potential regulatory changes that may be required to address information gaps.*
  - *Initial options for the collection of data, recognising the need for further consideration and consultation on these.*
- Available here

Need for visibility

- Large penetrations of DER installed (under 5 MW) are currently largely invisible to AEMO.
- Lack of visibility affects AEMO's ability to quantify and manage the operational impacts of DER on the power system.
- If current information gaps on DER persist as the penetration continues to increase, this will progressively decrease AEMO's ability to:
  - Maintain power system security
  - Deliver information to support efficient market outcomes

Visibility is required to…

- Determine and revise operational bounds of system:
  - Accurately forecast demand and intermittent generation
  - Model solutions to power system congestion.
  - Real-time system stability analysis
  - Predict behaviour of the power system in response to unexpected events, and put in place mitigation measures.
  - Determine the performance standards for intending generation looking to connect to the network.
- Longer term system planning and investment

Without visibility, AEMO has less confidence in this technical envelope. This leads to:

- Conservative limits imposed to avoid insecure operation
- Market inefficiencies

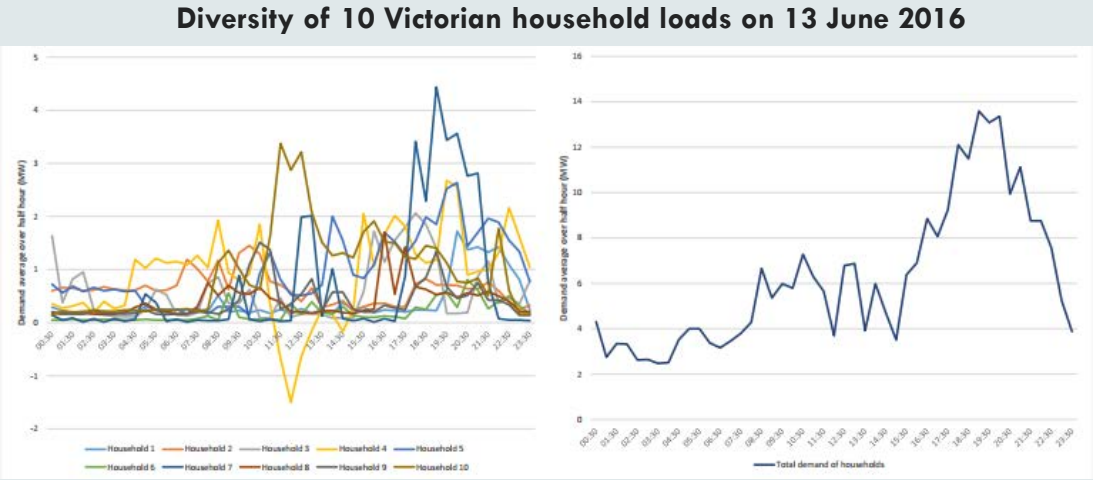
Changing load characteristics

- While many DER generate energy, if they are behind the meter they are seen by the system as a **change in load** characteristics.
- Lack of visibility impacts power system operation in two broad areas:
  1. **Prediction** of load

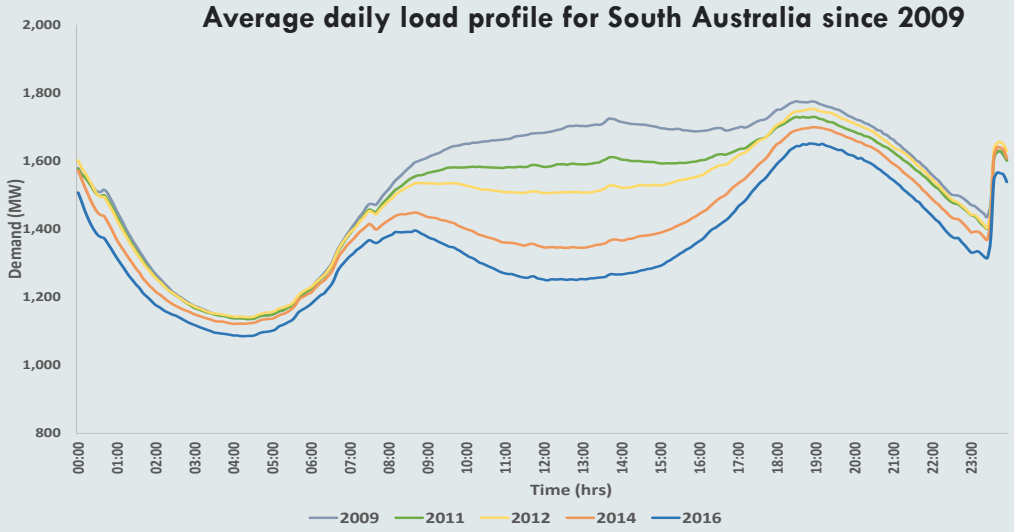
     Aggregated impact of DER on load profiles
  2. **Response** of load

     How load responds to system disturbances

Prediction of load



Traditional demand forecasting relied on **diversity** in different loads.



DER adds drivers that are locally correlated and **undiversified**.

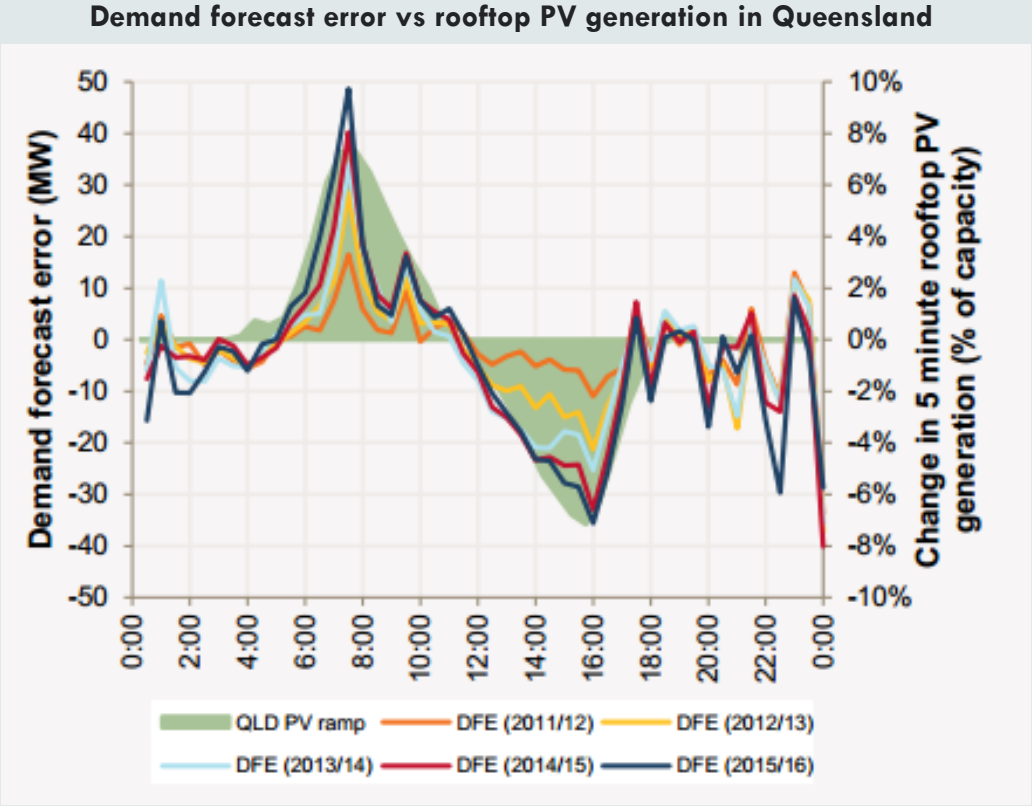
In aggregate this changes the daily load profile.

DER impacts on load forecasts

	Description	Implications without visibility
Variability and uncertainty	Underlying variability and uncertainty in many DER	Greater demand forecast error increasing regulation FCAS requirements.
Ramping	Large localised concentrations of DER can ramp up or down quickly because of their variability	Need for additional ramping resources and FCAS due to ramping events.
Performance characteristics	Each type of DER will vary in its performance characteristics.	Forecast impact on load profiles need to be calibrated against real performance to more accurately reflect the properties of the system.
Price decoupled	DER may respond to prices decoupled from the wholesale price (e.g. retail tariff) or self-optimise based on prices.	AEMO needs to forecast the behavioural investment decisions of consumers. Without visibility, it will be difficult to predict aggregate behaviour.
Measurement and telemetry	DER do not generally have associated metering or remote control.	AEMO has to estimate how much underlying demand is required to be met from grid-supplied generation.

Example – load forecasting error due to no visibility

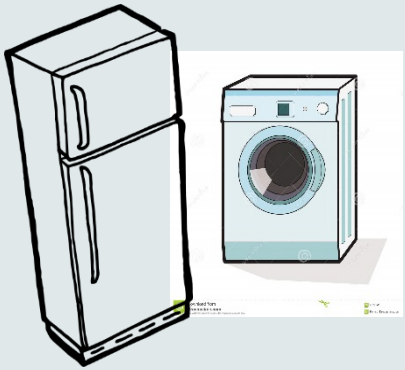
AEMO has observed increases in the demand forecast error in some regions at the times when solar generation is ramping up (increasing as the sun rises) and ramping down (decreasing as the sun sets)



Demand forecast error increasing proportionally to the change in solar generation.

Load response

- How load in aggregate will respond to system disturbances.



Traditional appliances:

- Powered by AC induction motors
- Stable response to disturbances
- They provide a "load relief" that can be estimated

DER:

- Some connected to network through inverters
- Response to system disturbance is **electrical** not **technical**
- Response is pre-set to disconnect at a certain point

- Need to know these settings to define **operating limits** and understand any **impact on emergency control mechanisms.**

Impact on power system operation

- More conservative technical operating limits due to increased uncertainty around load behaviour.
  - More stringent constraints in the dispatch process, creating market inefficiencies.
  - More challenging to plan short-term outages and network augmentation needs.
- Inability to accurately forecast the increased variability in load
  - Greater requirements for regulation FCAS.
- Uncertainty over the effectiveness of emergency control mechanisms (such as under frequency load shedding) without knowledge of inverter trip settings.
  - Undermines AEMO's ability to operate the power system within the FOS.
- Inaccuracies in medium- and long-term planning processes.
  - Risk of under- or over-investment in infrastructure.

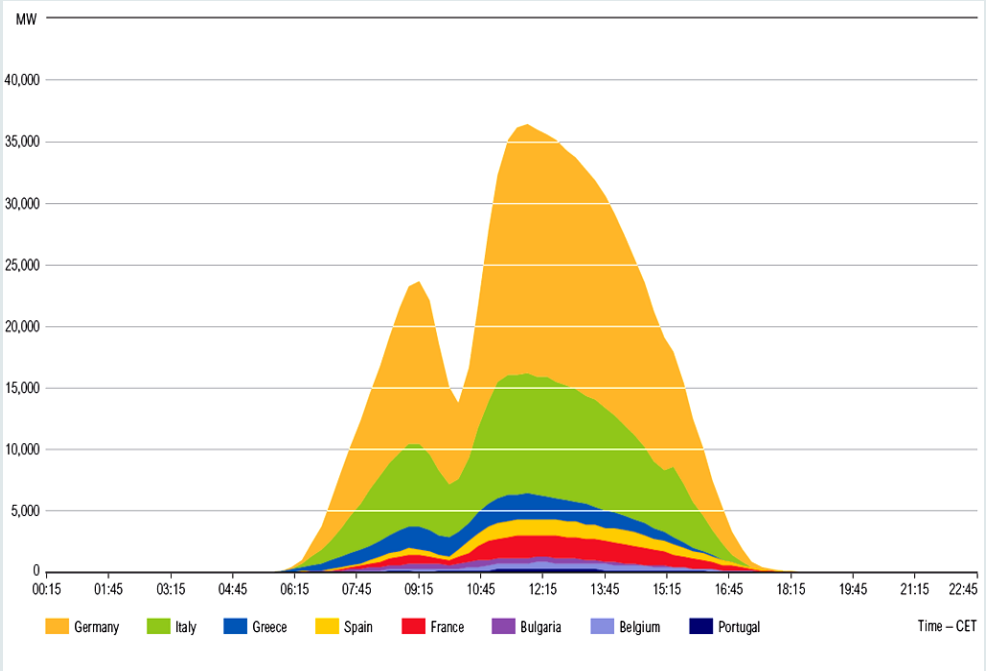
Visibility required for planning

- Lack of visibility means AEMO uncertain to how power system will respond to events.
- Small disturbances – how will unknown resources respond to frequency or voltage deviations?

Larger events: 20 March 2015 European near total solar eclipse

- 6 months planning across 23 countries with 89 GW solar
- Decrease in forecast PV output of 20 GW at start of eclipse
- Increase by ~40 GW at end
- Power system remained secure because operators had:

"A clear description of the installed PV capacity and their capabilities… [and] real time measurement of the dispersed PV generation… key for adapting the operational strategy in real-time"



Impact on market efficiency

- AEMO is responsible for providing accurate information to the market to support participants in making a range of operating and investment decisions across timeframes from pre-dispatch out to 10-20 year planning horizons, such as:
  - Quantitative positions for generators and other participants to make short-term decisions on unit availability, unit commitment, maintenance scheduling, future fuel contracts as well as trading.
  - Sending efficient signals to the market in relation to future investments such as generation to meet potential shortfalls in supply, or network needs.
- If AEMO is unable to accurately predict how the system is going to perform across all these time periods, then it will not be able to provide information needed to support market efficiency or reliability.
  - This potentially results in the power system being operated increasingly inefficiently, asset under-utilisation, less informed investment decisions, and ultimately increased costs borne by consumers.

Questions and discussion