Renewable Integration Study 101

An introduction to the RIS

Presenters

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About AEMO

AEMO is the independent system and market operator for the **National Electricity Market** (NEM) and the WA **Wholesale Electricity Market** (WEM).

We also operate **retail and wholesale gas** markets across south-eastern Australia and Victoria's gas pipeline grid.

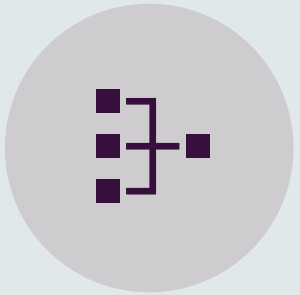
Ownership

40% Market participants

60% Governments of Australia

Today's Webinar

AEMO is planning for change



What did the RIS study?

Outcomes of the RIS

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AEMO is planning for change

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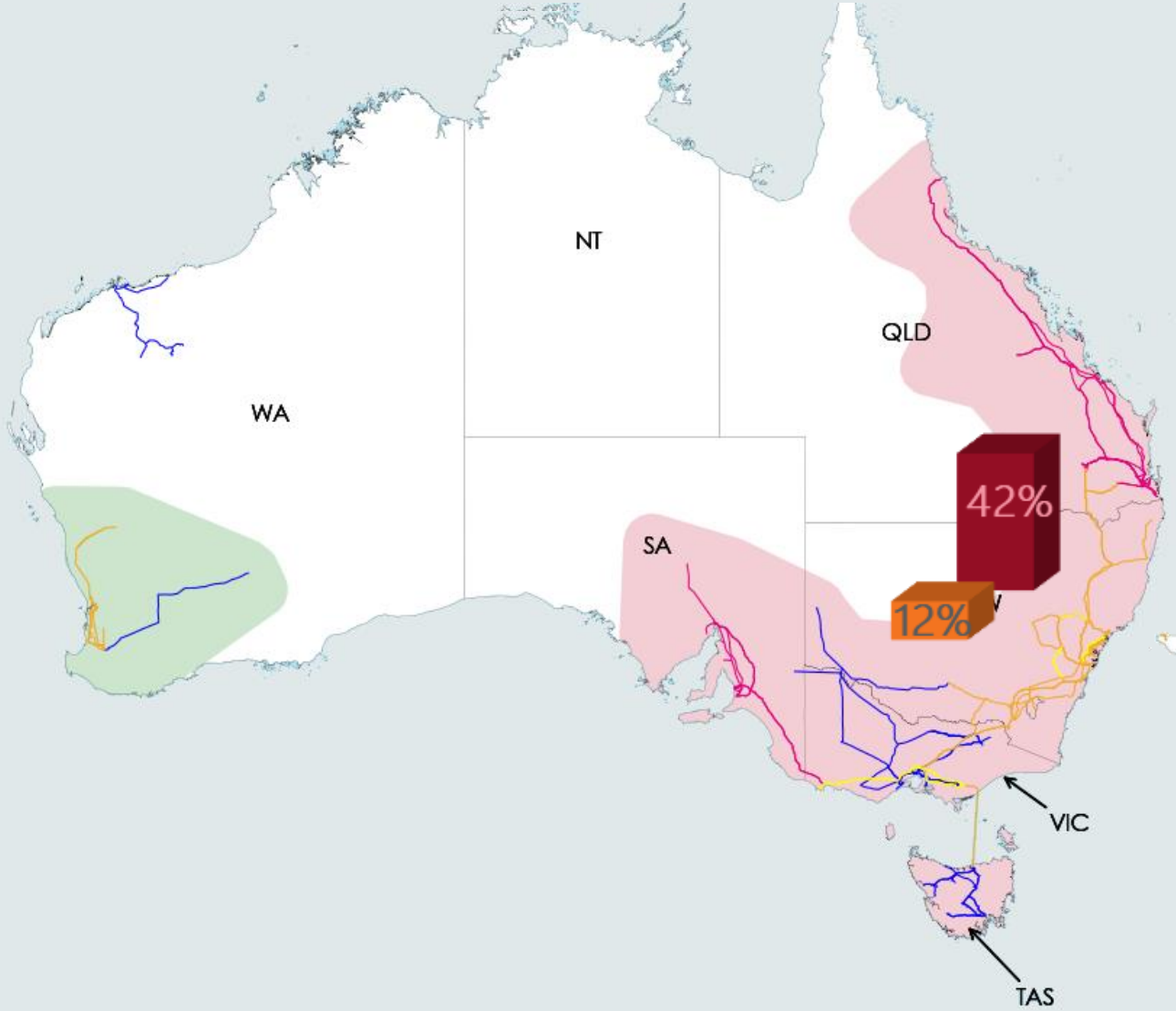
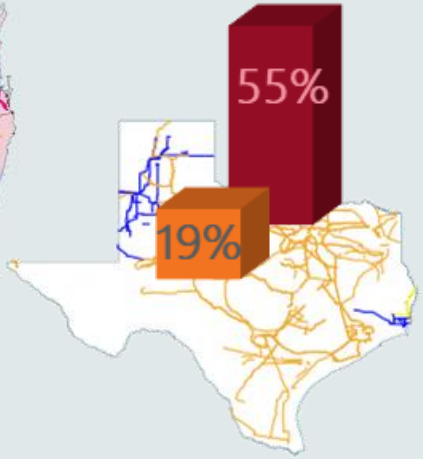
What has been happening?

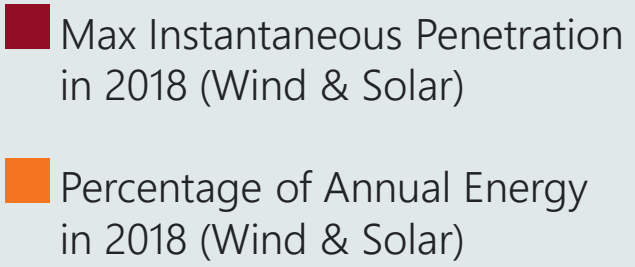


Penetration of wind and solar can be measured as a percentage of total energy in a year, or instantaneously as a percentage of the generation at any point in time.

The RIS focuses on **instantaneous penetration**.

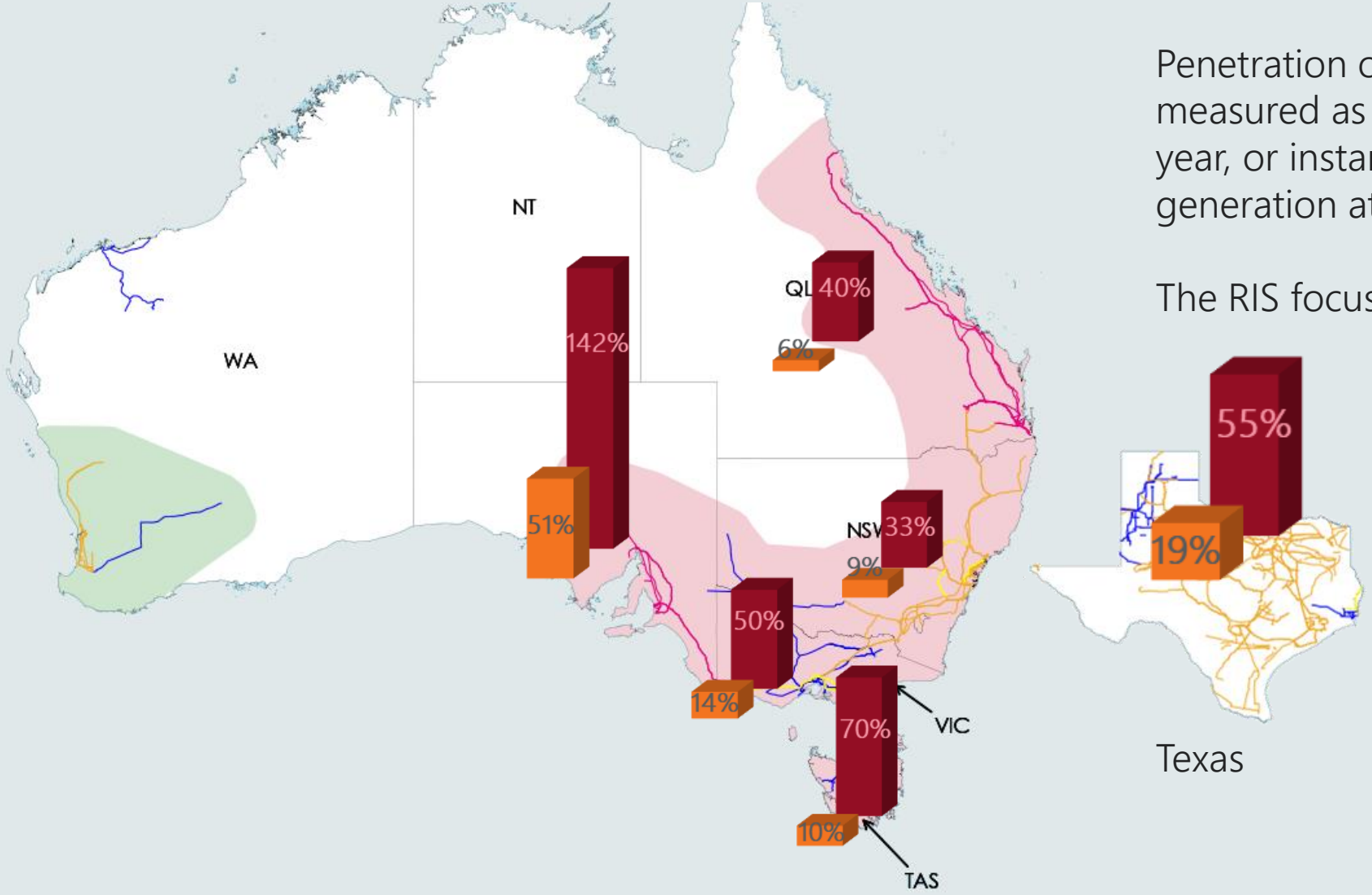


Texas



RIS International Review: https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/future-energy-systems/2019/aemo-ris-international-review-oct-19.pdf?la=en

What has been happening?



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Texas

- Max Instantaneous Penetration in 2018 (Wind & Solar)
- Percentage of Annual Energy in 2018 (Wind & Solar)

RIS International Review: https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/future-energy-systems/2019/aemo-ris-international-review-oct-19.pdf?la=en

By 2025 …

Installed wind and solar generation

Increase by **50 – 100%**

Distributed PV installed generation capacity

could **more than double**

Available wind and solar in the NEM

75 – 100% of demand at times

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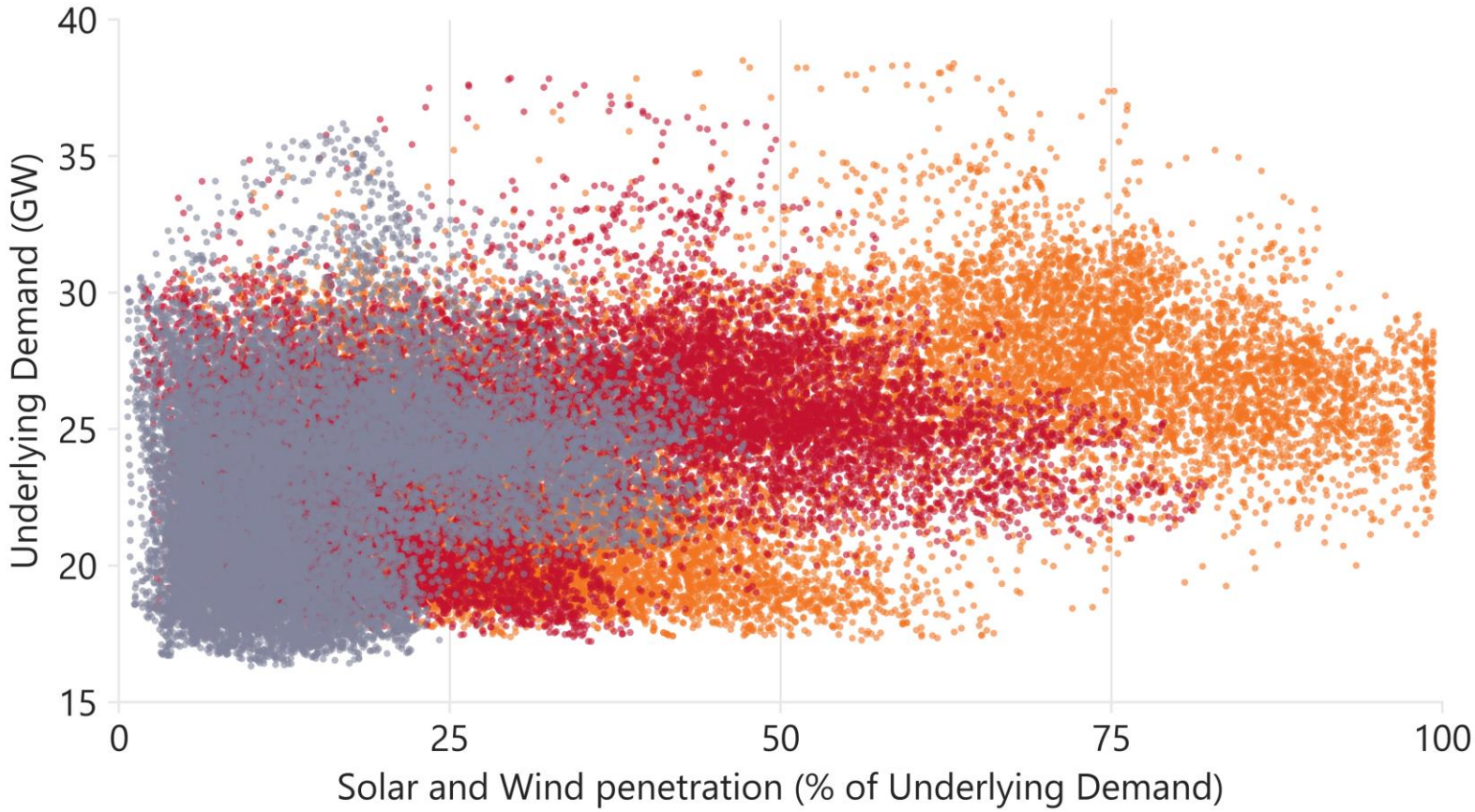
Increasing wind and solar



- In 2019 the **instantaneous penetration of wind and solar generation in the NEM** was just **under 50%**
- By 2025, this could reach:
  - **75%** under the ISP **Central** scenario
  - **100%** under the ISP **Step Change** scenario

Notes: Actual 2019 penetration includes all lost energy; 2025 projections only include network congestion but do not include system curtailment or participant spill.

What is AEMO's role?

We ensure that Australian consumers, businesses and industry have access to **secure and reliable energy at all times**

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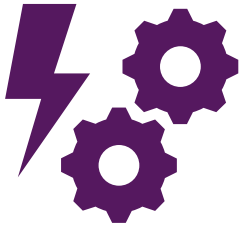
We do this by managing:

Supply and demand balance

Uncertainty and variability

Frequency



System strength and voltage

What did the RIS study?

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Changing power system characteristics

	Conventional	Wind and Solar	RIS Analysis
Location	Centralised	Centralised and Decentralised	Distributed PV

Distributed PV

What is it?

This includes residential, commercial and industrial solar systems, which AEMO doesn't have visibility or controllability, like with other large generators.

Today

DPV has reached **25%** instantaneous NEM demand

Collectively DPV is now the largest generator

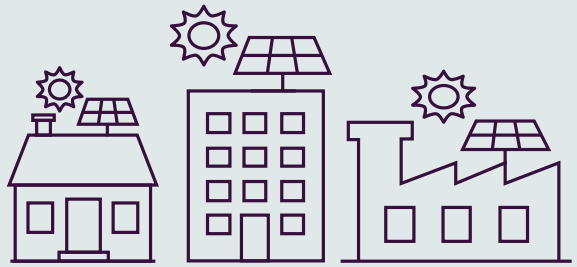
2025

Installed DPV could be **>26x the largest coal generator** in the NEM

DPV to reach **37 – 50%** instantaneous NEM demand

Why is this important?

- While **individually small, in aggregate DPV systems have a big impact.**
- AEMO **cannot see where these systems are.** This makes it harder to balance supply and demand.
- DPV systems have **varying capabilities**. Some settings can cause issues for system security.
- Increasing the capability of these devices will **unlock consumer** value and help **support the broader community.**



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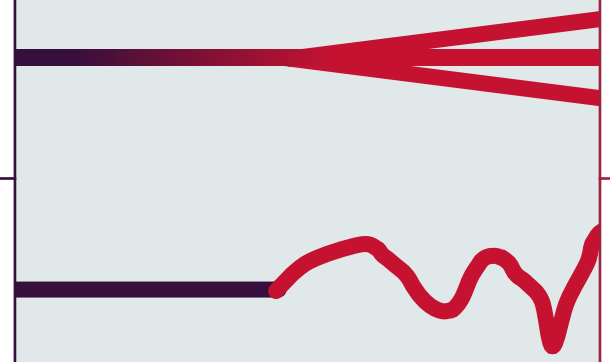
Changing power system characteristics

	Conventional	Wind and Solar	RIS Analysis	
Location	Centralised	Centralised and Decentralised	Distributed PV	Operability
Energy Source	Firm	Variable	Variability and Uncertainty	



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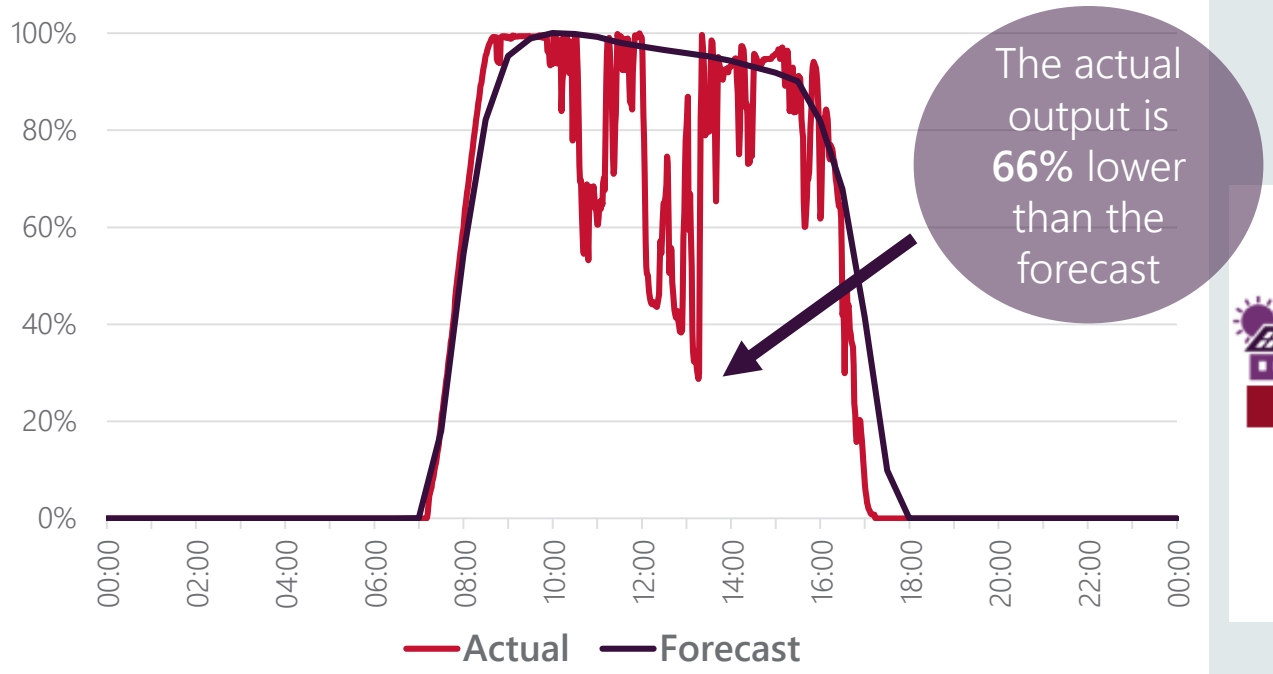
Variability and uncertainty

What is it?

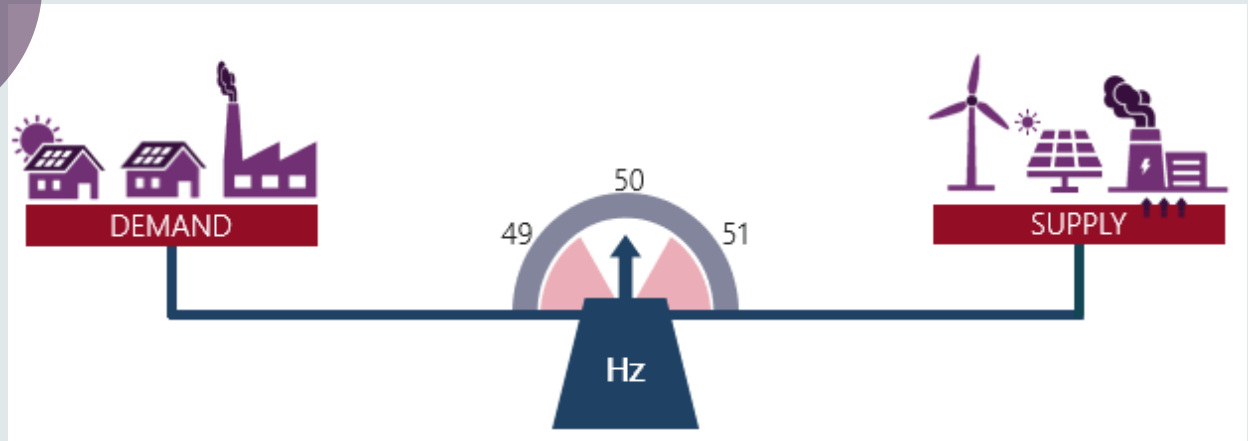
The **movements up and down** in demand or resource availability and how well these movements can be **forecast**.

Example: daily large-scale solar farm generation



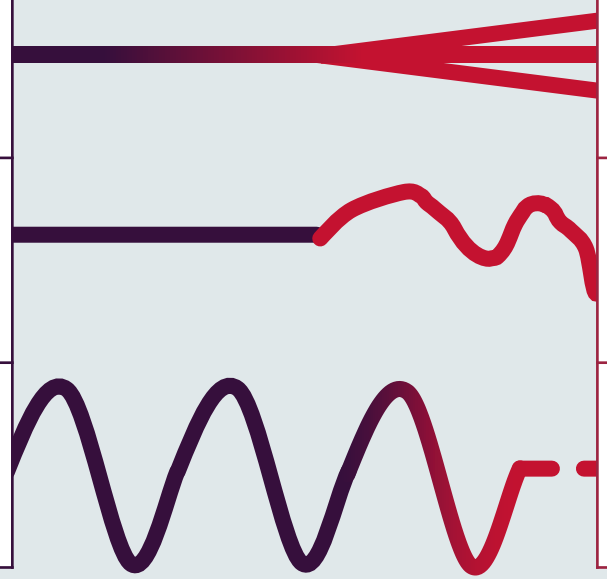
Why is this important?

- Supply and demand are **constantly and instantaneously balanced.**
- To ensure supply to meet demand we need to know **what resources are available and when.**
- Variability and uncertainty **impact the ability to effectively balance supply and demand.**



Changing power system characteristics

	Conventional	Wind and Solar	RIS Analysis	
Location	Centralised	Centralised and Decentralised	Distributed PV	Operability
Energy Source	Firm	Variable	Variability and Uncertainty	
Technology	Electro-Mechanical (Synchronous)	Power Electronic (Inverter Based or Asynchronous)	Managing Frequency (& System Strength)	



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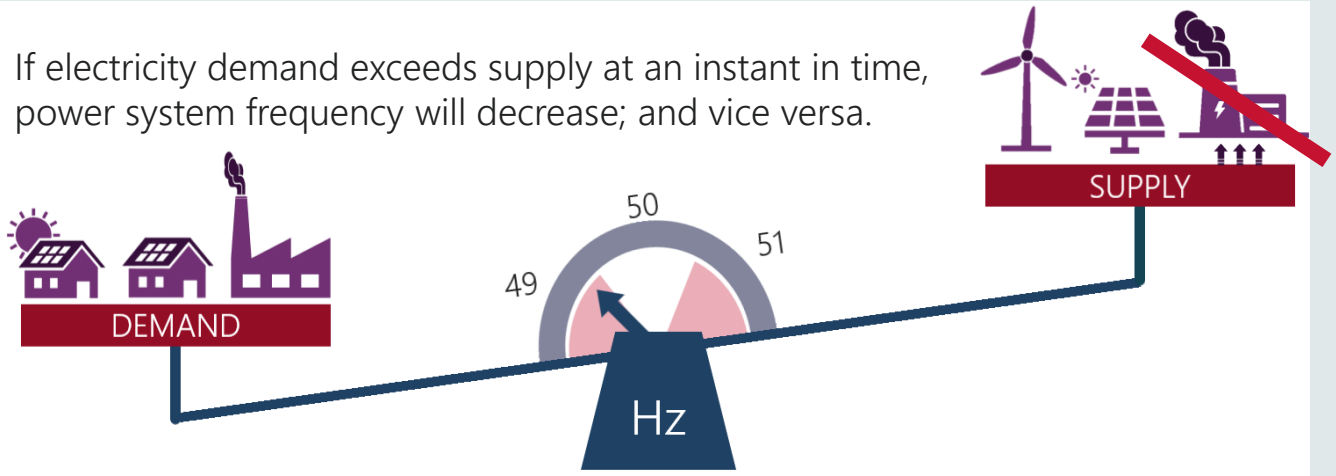
Frequency

What is it?

Frequency is the **heartbeat of the power system** that ensures everything is in sync. It tells us information about the electricity supply and demand balance in real time.

If electricity demand exceeds supply at an instant in time, power system frequency will decrease; and vice versa.



Why is this important?

- Frequency can change too quickly or go outside the technical limits under sudden loss of supply or demand on the system. Without frequency control services, **equipment or devices can be damaged**.
- As wind and solar penetrations increase, synchronous machines are online less often, **reducing the frequency control services** traditionally provided by these machines.
- New technologies respond differently to frequency introducing **new risks to the system**.

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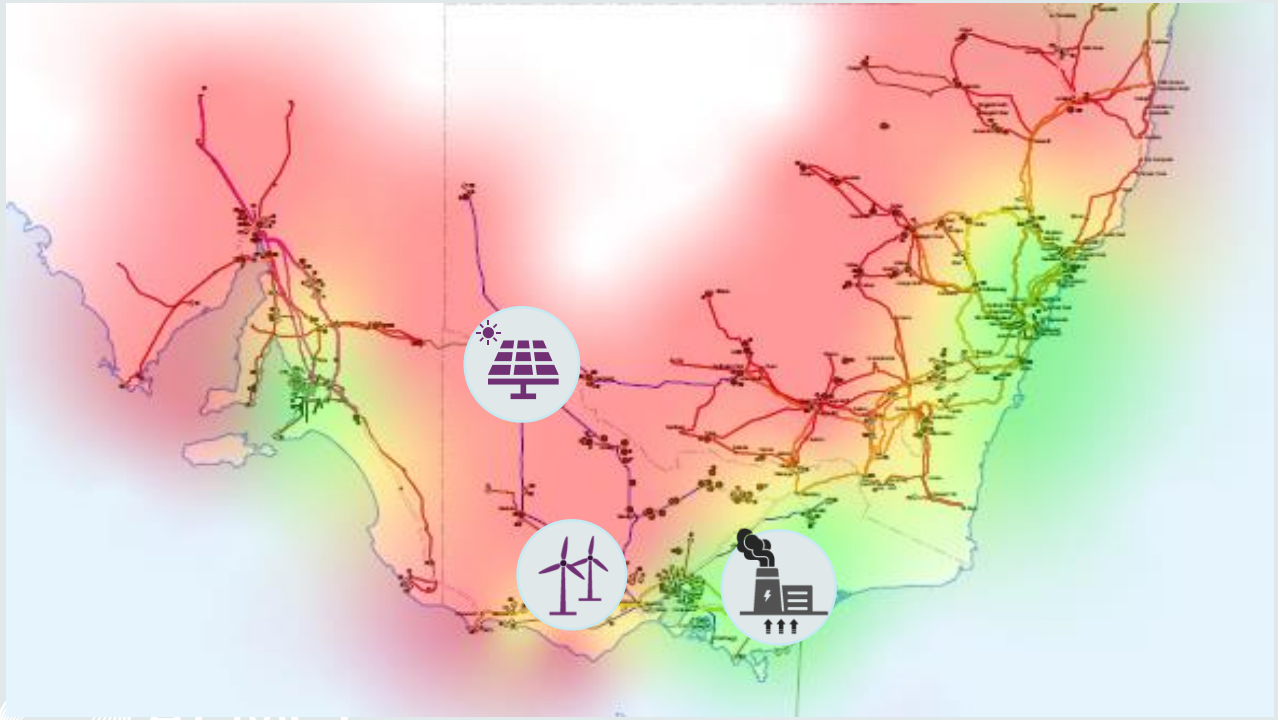
System strength

What is it?

The ability of the power system to **maintain and control the voltage waveform** at any given location in the power system, both during steady state operation and following a disturbance.



Why is it important?

- Historically provided as a by-product when energy was **produced by large synchronous machines** and was **abundant across the network**
- Wind and solar are asynchronous (inverter-based)
- As wind and solar penetrations increase, there is **displacement of synchronous machines**. This weakens the grid
- A weak grid is exposed to many **technical issues impacting grid performance and operational stability**, for example there is more likely to be a blackout following a disturbance
- **Australia is at the forefront** of solving system strength issues.

Outcomes of the RIS

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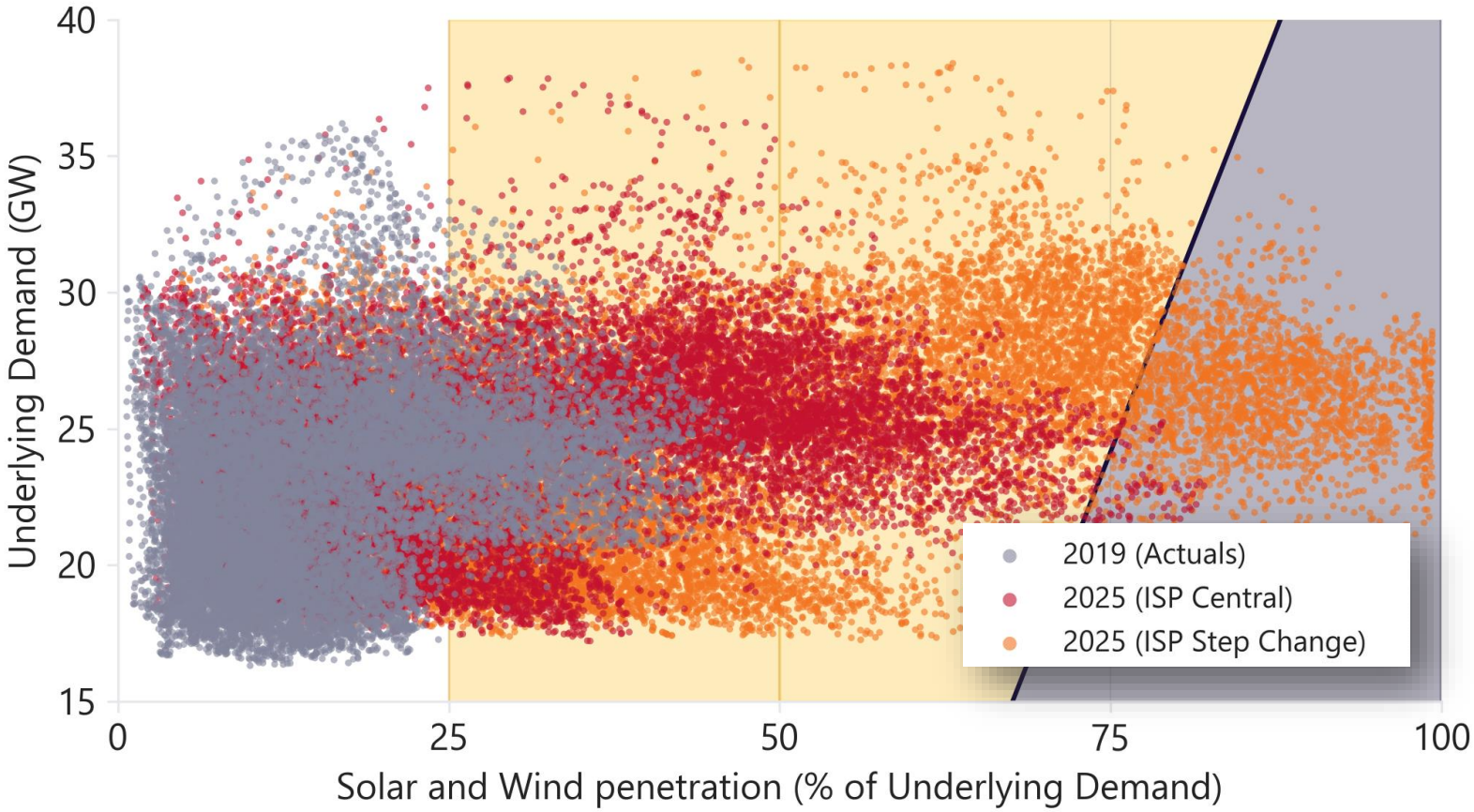
Key findings



- From **25% penetration onwards**, we are starting to see impacts of changing characteristics.
- The Renewable Integration Study provides a workplan to reach **75% instantaneous penetration** at any point in time.
- If action is not taken to manage **distributed PV, variability and uncertainty, frequency and system strength**, wind and solar penetrations could be limited.
- From a technological perspective, **it is possible to go beyond 75% in future.**

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Going forward

Significant **system transformation possible** in the next 5 years

Cost benefit analysis to **maximise value to end consumers**

Strategic construction of **new network capability (poles and wires)**

Ongoing reforms for the rule that govern electricity supply

Opportunity to lead the world in demonstrating the successful operation of a large power system with high levels of wind and solar

Watch the whole series

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RIS series available at: https://www.aemo.com.au/energy-systems/Major-publications/Renewable-Integration-Study-RIS


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