

# Operational experiences with distributed PV in Australia



Gridworks  
8 Feb 2024

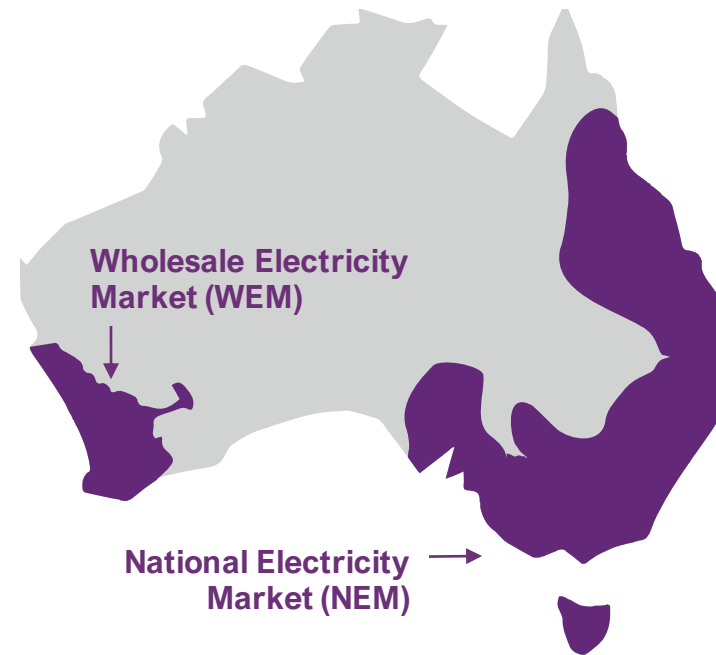


# About AEMO

- AEMO is a member-based, not-for-profit organisation.
- We are the independent energy market and system operator for the National Electricity Market (NEM) and the WA Wholesale Electricity Market (WEM), and system planner for the NEM.
- We also operate retail and wholesale gas markets across south-eastern Australia and Victoria's gas pipeline grid.



## Electricity

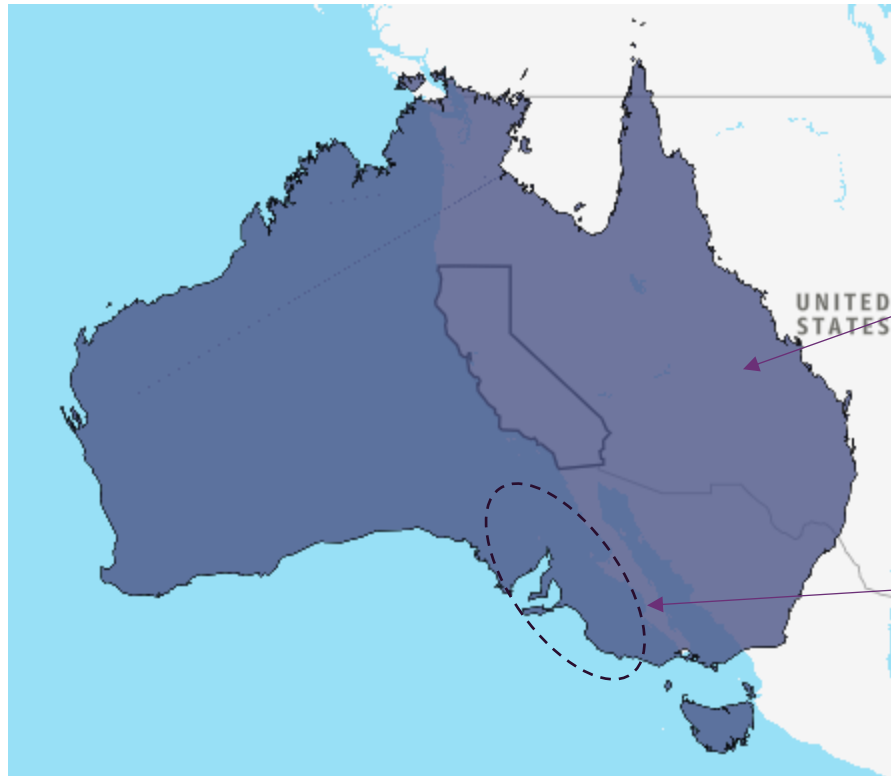


## Gas



Declared  
Wholesale  
Gas Market  
(DWGM)

Short Term  
Trading  
Market  
(STTM)  
and  
Gas Supply  
Hub (GSH)

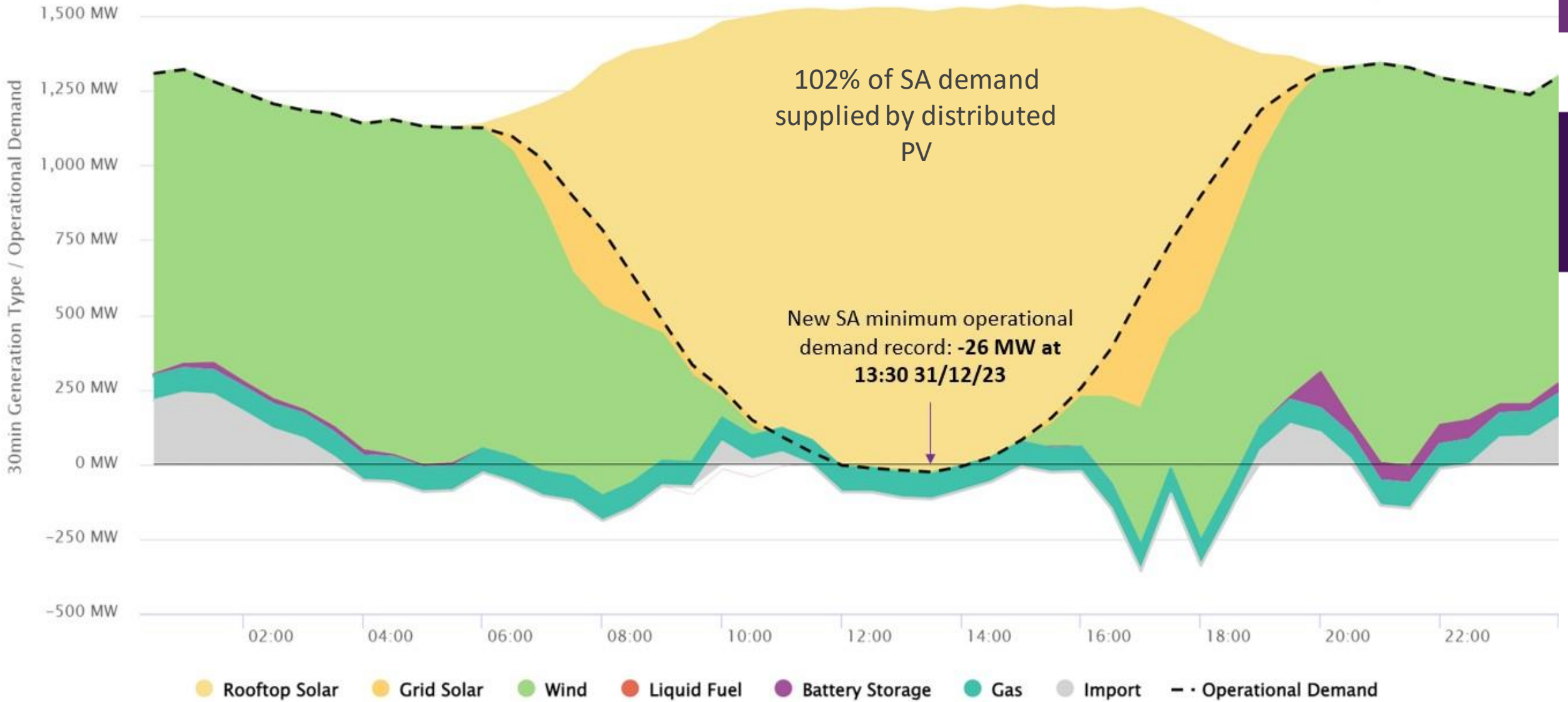


NEM  
(11-36 GW)

South Australia  
(1-3 GW)

One double circuit AC interconnector  
to the rest of the NEM

# South Australia minimum operational demand record



# Learnings to date

## Technical performance standards

- **Disturbance ride-through capabilities** – ensure suitable standards
- **Compliance** – measure & ensure suitable governance

## Dispatchability

- **Emergency backstop capability** – Early: implement simple ability to curtail active power & ensure suitable compliance
- **Integration into scheduling and dispatch** – iterate towards more sophisticated capabilities (but start simple and learn by doing)

## Visibility

- **Data** – start collecting early & ensure accurate
- **Models** – determine inputs required for development

## Roles and responsibilities evolving

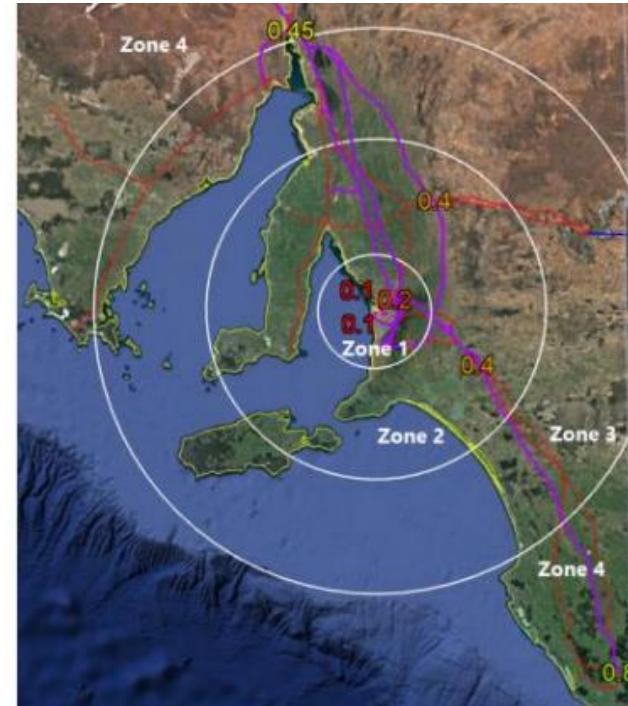
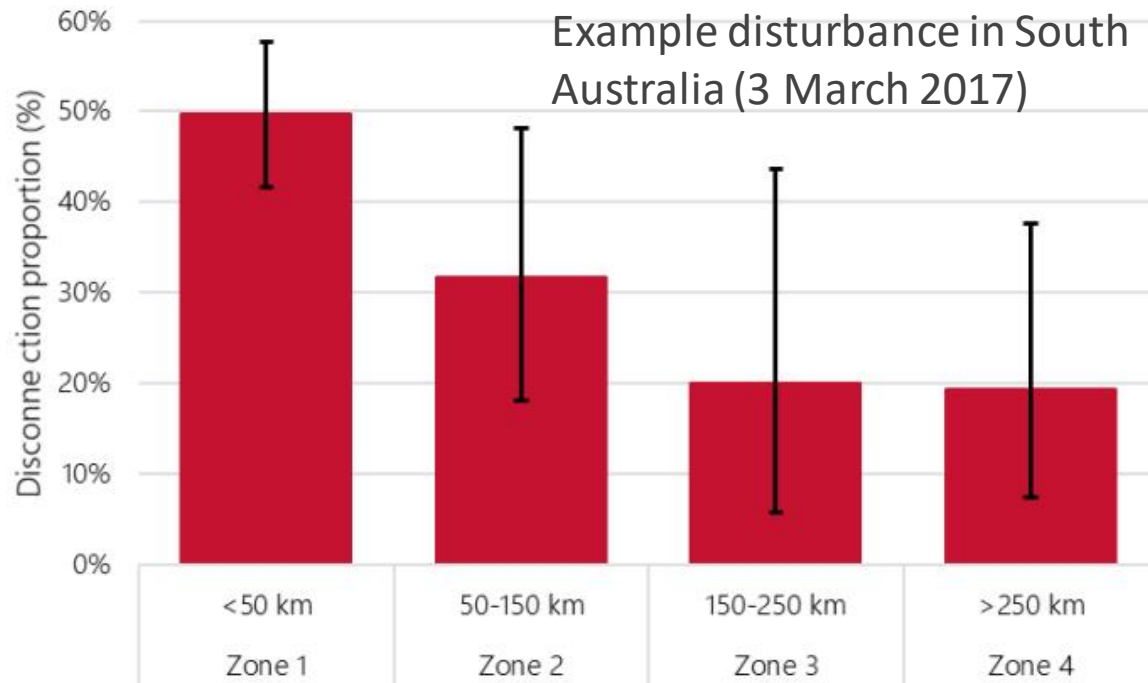
- **Original Equipment Manufacturers (OEMs)** – critically important, escalated engagement into new functions
- **Customer metering** – new capabilities? Governance challenges

## Cybersecurity

- Growing concern

# Distributed PV (DPV) shake-off

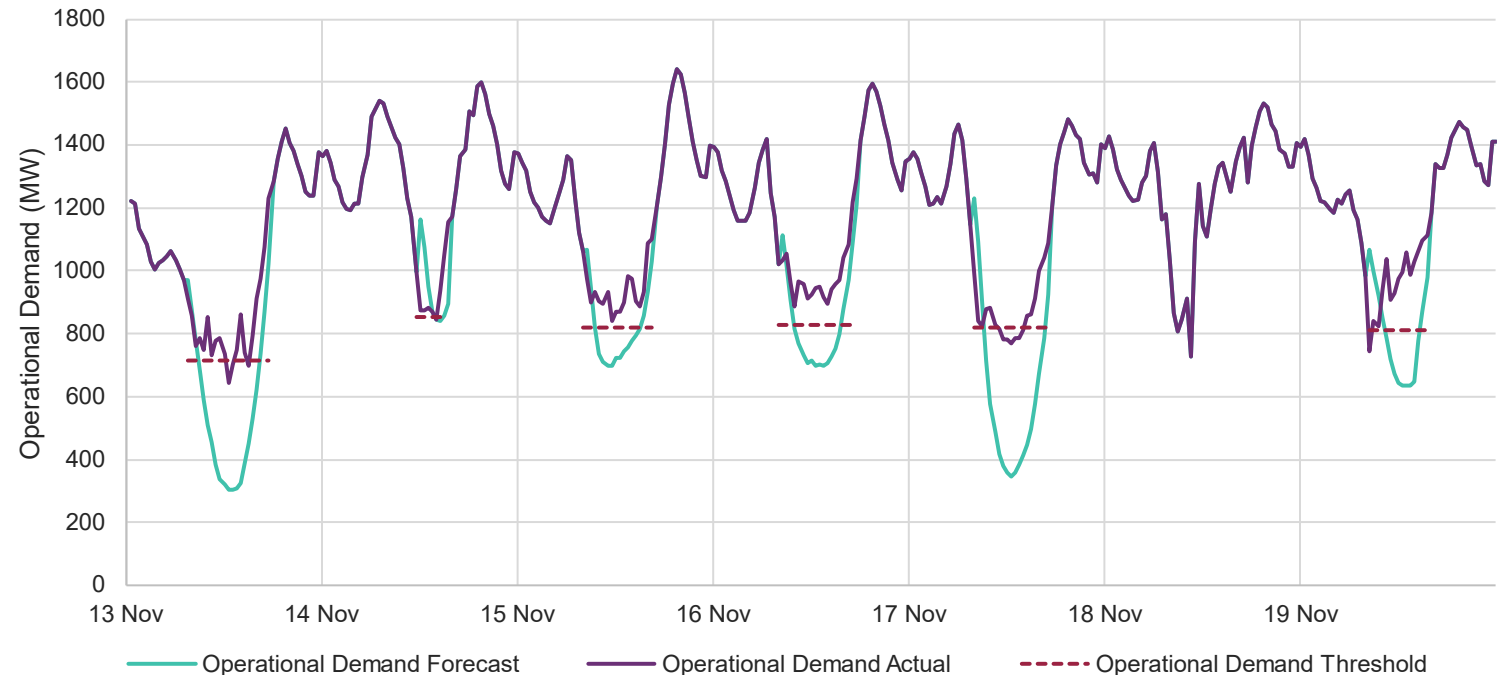
- Up to 40% of DPV in a region can disconnect in response to a fault



- If unaddressed, major security issues
- 2019-2020: Defined new disturbance ride-through requirements in standards (similar to IEEE1547-2018)
- Found only ~40% are compliant with new standards
- Have improved to ~80% by working with OEMs
- Improved governance required
- Must address very early – change is slow, and retrofit very challenging

# Incident: 12-19 Nov 2022

- 12 November 2022: Severe weather leading to synchronous separation of SA
- Operated majority of SA as an island until 19 November 2022
- Included operation through some periods of high generation from DPV
- Necessitated 400-600 MW of DPV curtailment
- Main reason was to manage frequency impacts of possible DPV shake-off in response to a fault
- ~2/3 of the response via Enhanced Voltage Management (increase distribution voltages to reduce DPV generation)
- Poor compliance with “Smarter Homes” requirements
  - Customer must appoint a Relevant Agent who can manage their DPV when required
  - Only ~40% response rate
  - Biggest erosion of response is from incorrect commissioning).
  - Working with OEMs to improve.



# Active DER management

Different kinds of active DER management required:

## Emergency backstop capability

- Used rarely, last resort
- Can be simple
- Large MW capability required
- Turn DER fully off if needed
- **Need early**



## DER market integration

- Used regularly
- More sophistication required – **iterate towards this**
- Focus on managing customer exports



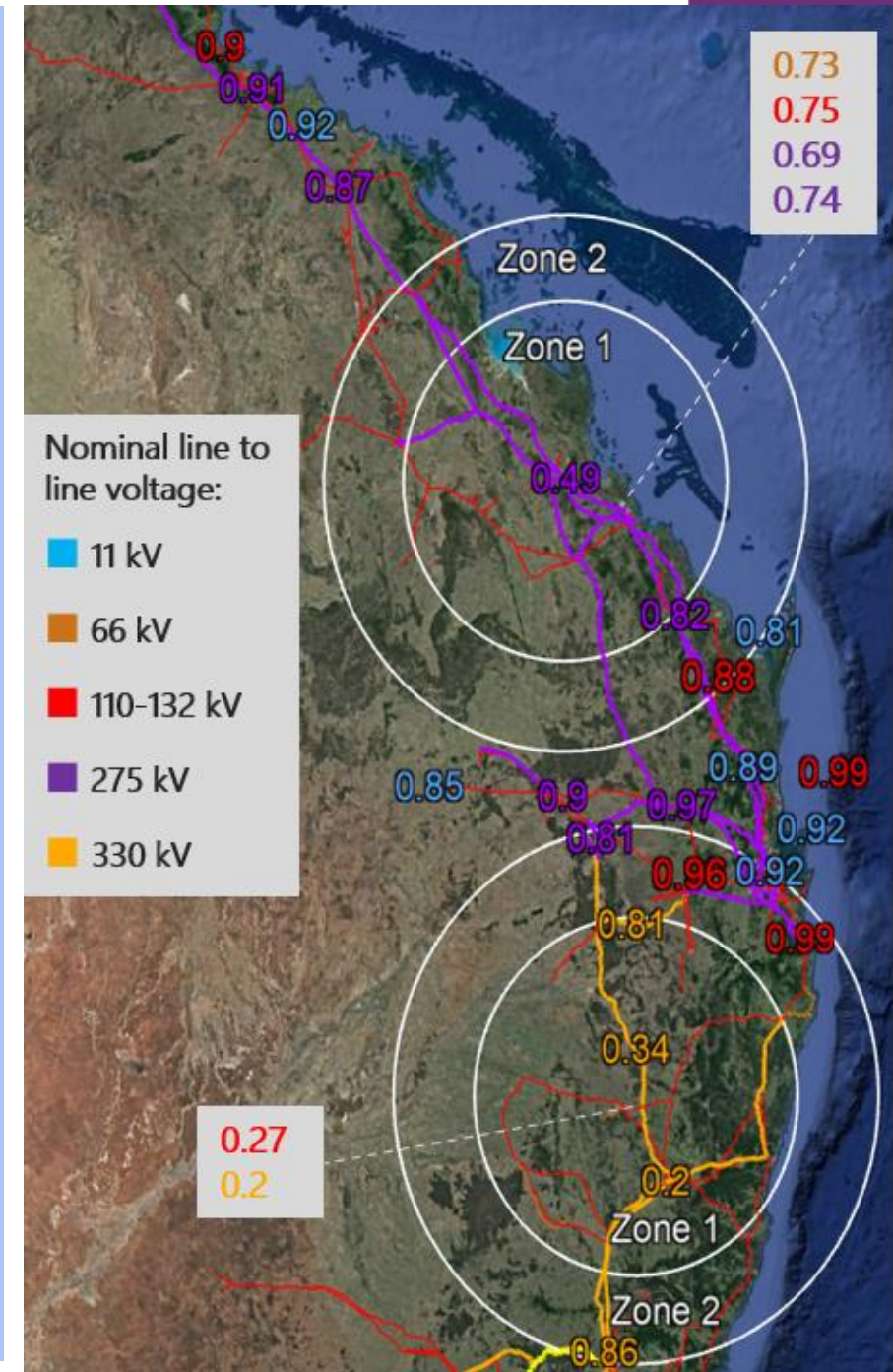
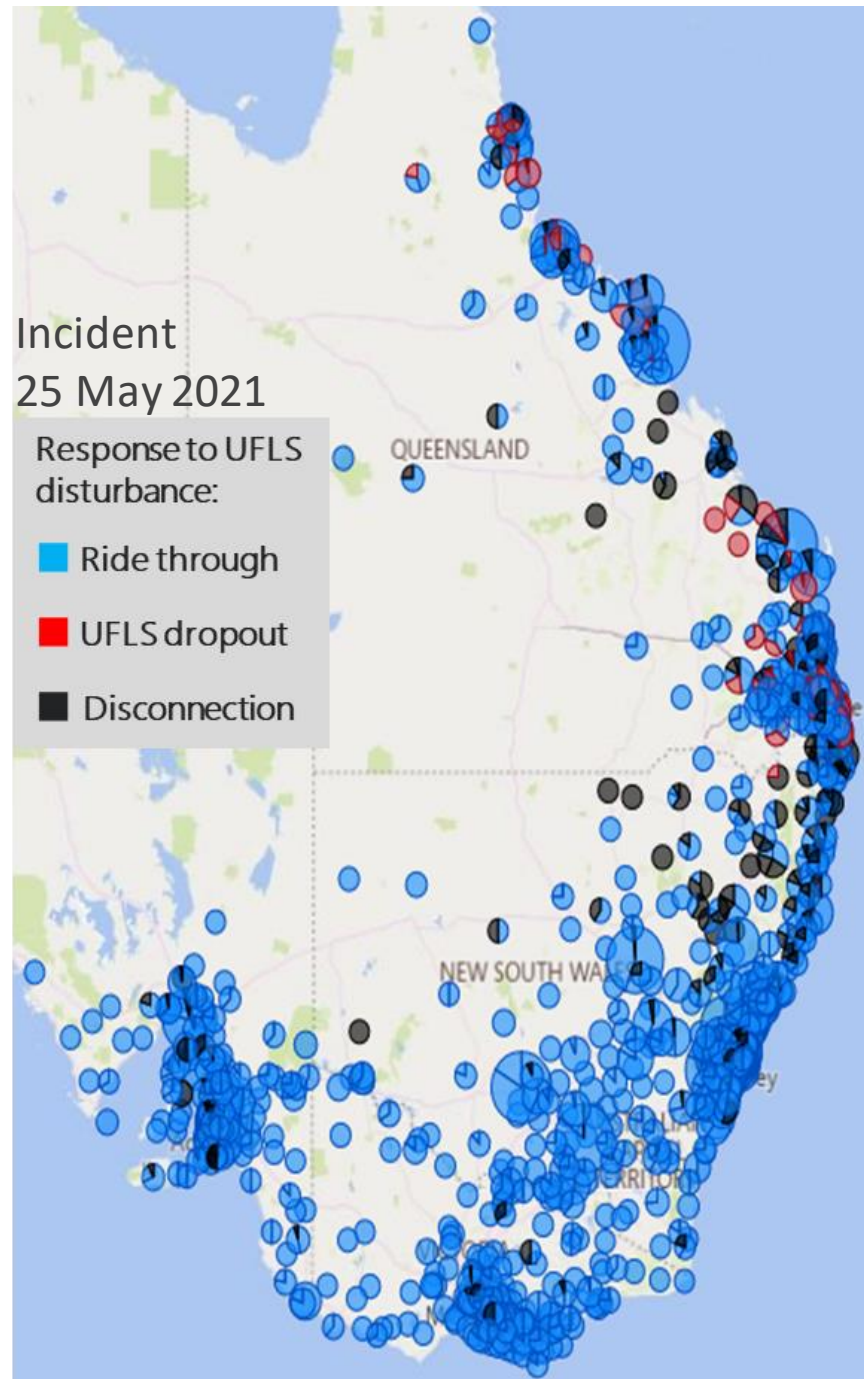


# Visibility

- Underpins model development & maintaining performance requirements
- Extensive new datasets required
  - Installed capacity of DPV at each transmission bus
  - High speed monitoring (~20ms) at a range of radial load/DPV sites in both transmission and distribution networks
  - Device-level measurements from a representative sample of devices (1-5s resolution, representative by vintage, OEM, size, location. Care on bias.)

AEMO (May 2021) [Behaviour of distributed resources during power system disturbances](#)

AEMO (Oct 2021), [Trip of multiple generators and lines in Central Queensland and associated under-frequency load shedding on 25 May 2021](#)



# For more information



<https://aemo.com.au/initiatives/major-programs/nem-distributed-energy-resources-der-program/operations>

The screenshot shows the AEMO website page for DER Operations. The page has a purple header with the AEMO logo and navigation links. The breadcrumb trail is: AEMO > INITIATIVES > MAJOR PROGRAMS > DISTRIBUTED ENERGY RESOURCES PROGRAM > DER OPERATIONS. The main content area is divided into a sidebar and a main text block. The sidebar contains a list of navigation items under the heading 'Distributed Energy Resources Program'. The main text block is titled 'DER Operations' and contains several paragraphs of text.

[aemo.com.au/initiatives/major-programs/nem-distributed-energy-resources-der-program/operations](https://aemo.com.au/initiatives/major-programs/nem-distributed-energy-resources-der-program/operations)

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⊕ Distributed Energy Resources Program

- About the DER Program >
- Markets and Framework +
- DER Demonstrations +
- DER Operations -
  - DER behaviour during disturbances →
  - Power system model development →
  - DER integration and maintaining power supply →
  - Adapting and managing Under Frequency Load Shedding at times of low demand →
- Standards and connections +

## DER Operations

The Operations workstream addresses the operational impacts of increasing levels of DER penetrating the electricity grid.

Its objectives are to ensure the operational systems are in place to maintain energy system security with regards to:

- Understanding how distributed resources behave during disturbances →
- Developing power system models of DER and load behaviour →
- Managing emerging system security challenges related to DER integration into AEMO's operations →
- Adapting Under Frequency Load Shedding at times of low demand →

Findings and references in each area are summarised in the relevant sub-page.

Work is also conducted in collaboration with transmission and distribution network service providers, state governments, DER product manufacturers and regulators, this work will benefit Australian energy consumers as they continue to access a safe, secure and reliable energy supply, generated increasingly by Distributed Energy Resources. Some key collaborations partners include:



For more information visit

[aemo.com.au](http://aemo.com.au)