Integration of DER

Operational Impacts

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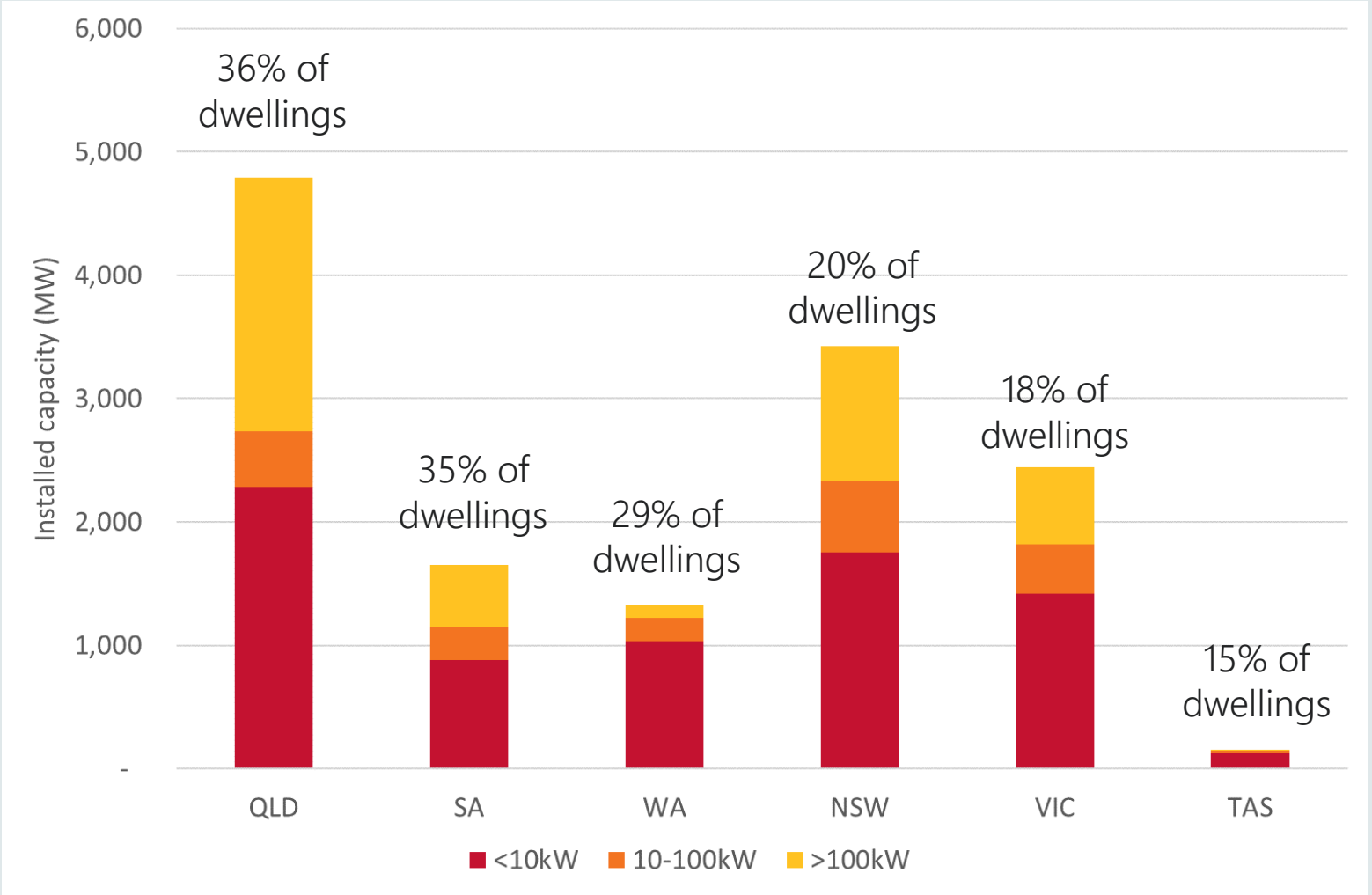
Principal, Operational Analysis & Engineering

PV installations



South Australia:

- Installations at 185MW/year (2018-19)
- Minimum operational demand record: 458 MW

APVI Institute, https://pv-map.apvi.org.au/historical#4/-26.67/134.12

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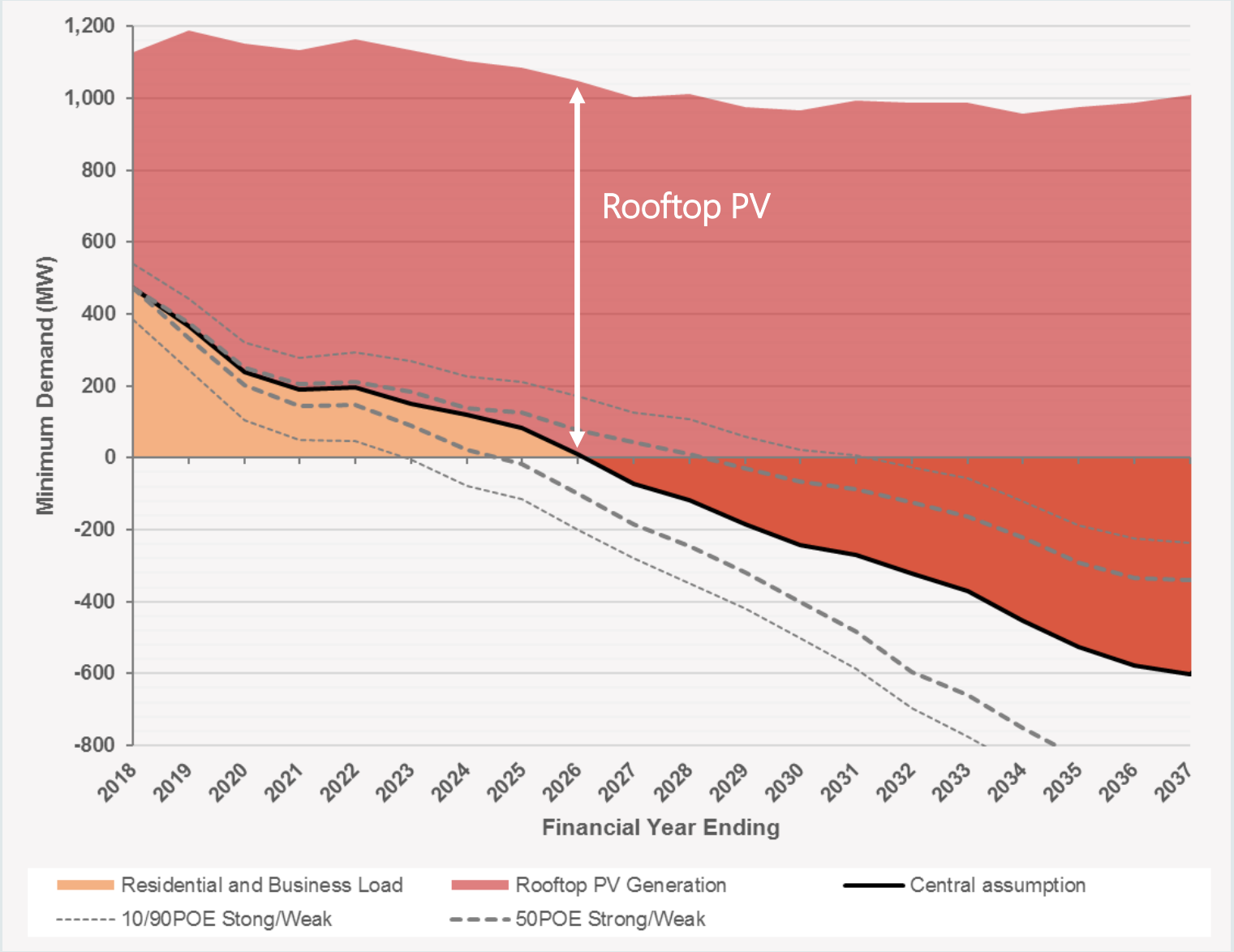
Context

DER generation will soon match entire demand in South Australia.

- What will this mean for the power system?
- How do we affordably maintain security and reliability for customers throughout this transition?
- What actions do we need to take?

Minimum demand in South Australia:



Technical challenges

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DER behaviour during disturbances

- DER may disconnect during power system disturbances
- Widespread disconnection could exacerbate a disturbance and increase the risk of system black
- Disturbance ride-through is essential for maintaining power system security
- Addressed via appropriate performance standards
  - Must implement early (before DER installation)
  - Long lead-times (changing standards can take years)
- Questions:
  - What types of behaviour have we observed?
  - What is the scale and nature of the risk?
  - Where do standards require review?

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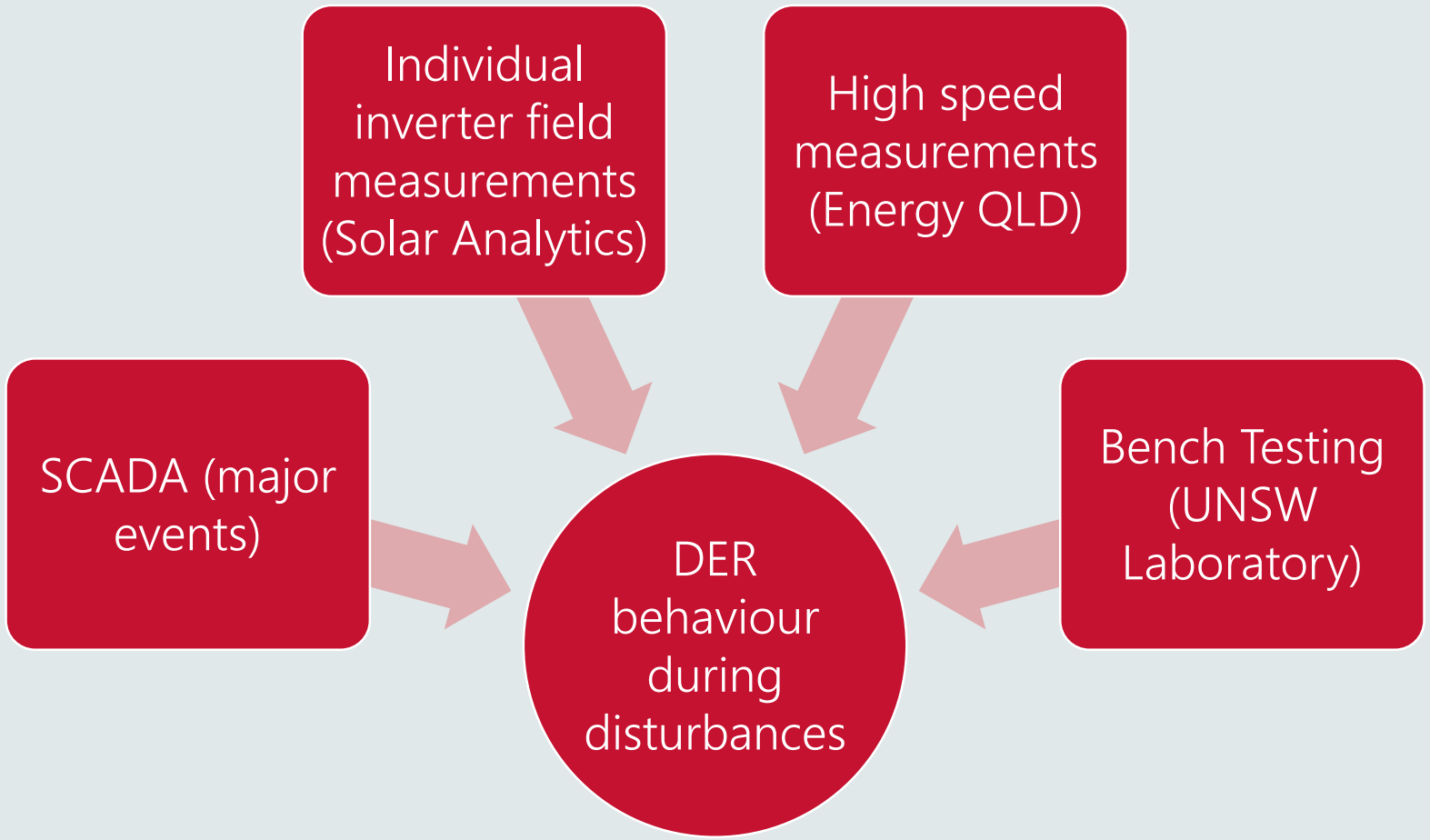
DER behaviour during disturbances



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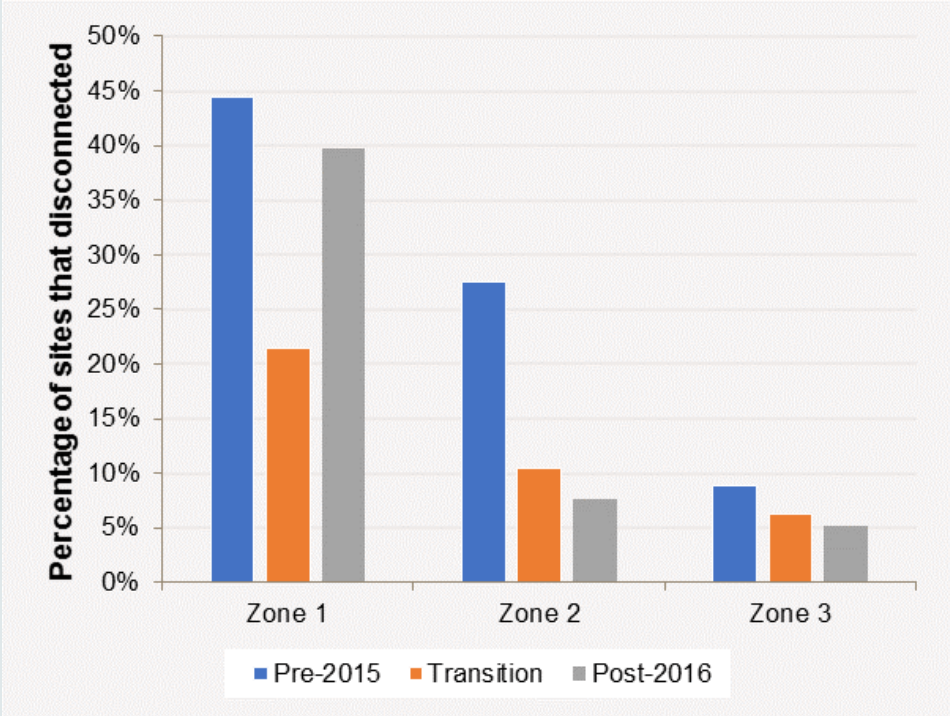
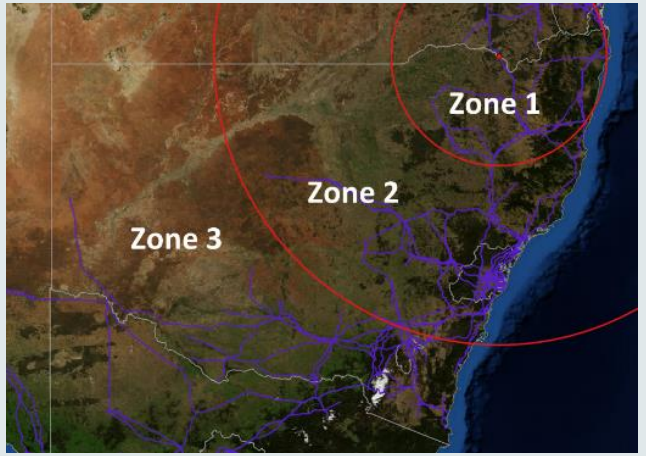
Distributed PV disconnections

25 August 2018: NSW





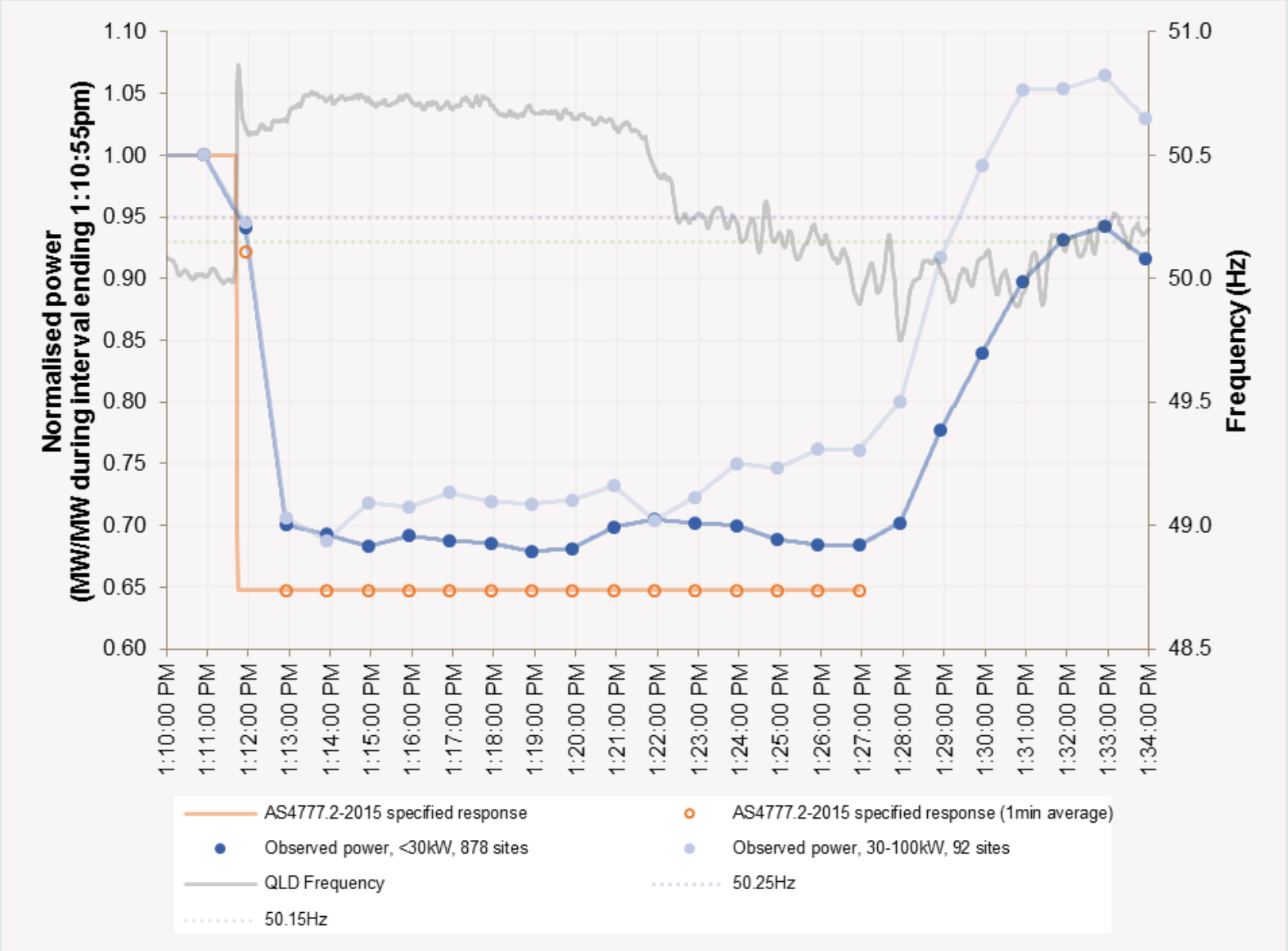
- Post 2016 inverters should not disconnect (but this behaviour is observed in around half inverters tested under laboratory conditions)

Analysis by Naomi Stringer, UNSW Sydney
Data from Solar Analytics

Compliance challenges

- At least 30% of inverters in QLD (and 15% in SA) did not respond

QLD: 25 August 2018



Analysis by Naomi Stringer, UNSW Sydney
Data from Solar Analytics

DER performance standards

Disturbance ride through

- Extend
- Multiple voltage disturbances
- Phase angle jump
- RoCoF ride through

Grid support

- Volt-Var and Volt-Watt enablement, refine settings
- Over-frequency response times
- Under-frequency response from curtailed inverters or storage

Other

- Compliance
- Interoperability
- Cyber security
- Coverage (loads?)
- System restart behaviour

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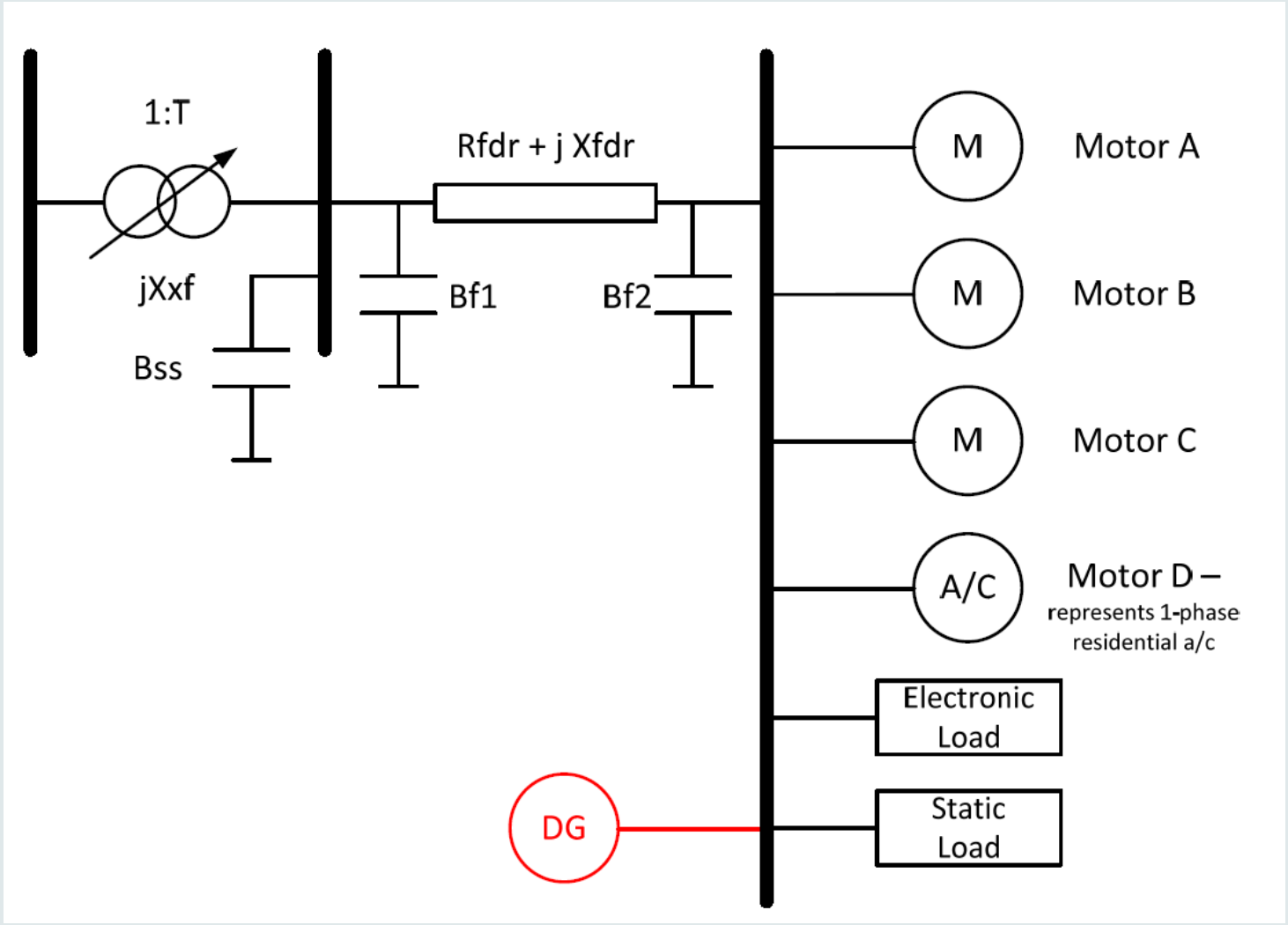
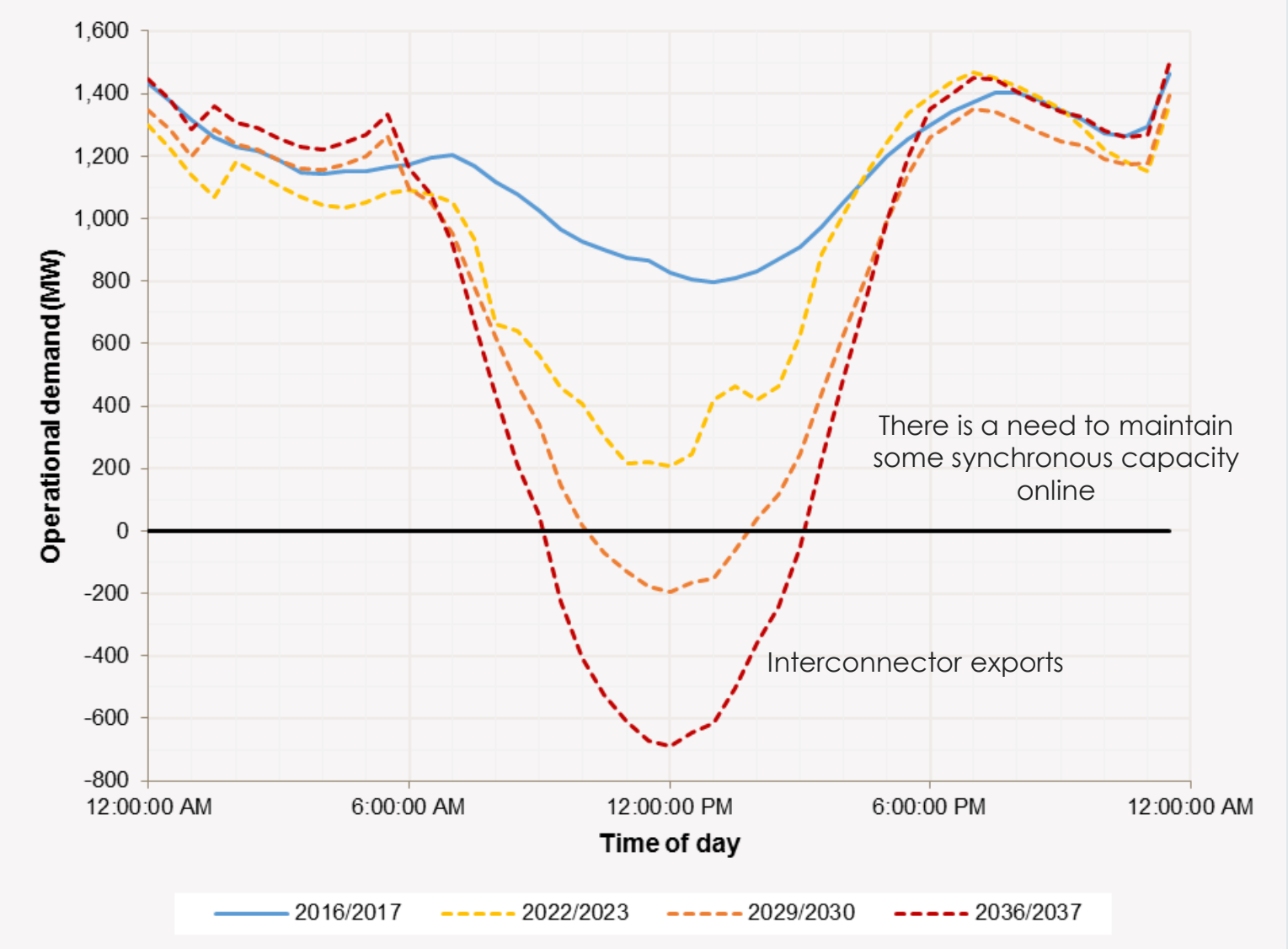
Dynamic model development

DER is now influential in power system disturbances. It is essential that this new complexity is represented in AEMO's models



Dispatchability

South Australia:



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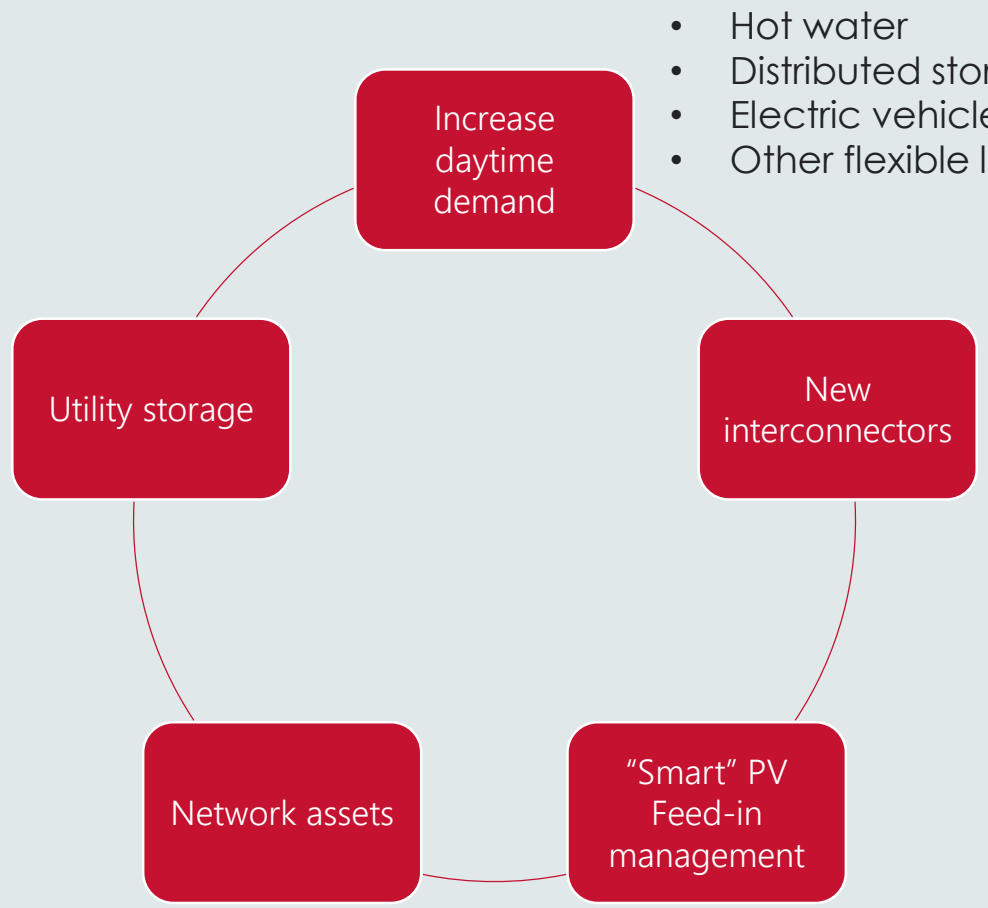
Options



- Hot water
- Distributed storage
- Electric vehicles
- Other flexible loads

- Voltage control
- Synchronous condensers

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"Smart" PV feed-in management

EPRI report for AEMO (2018), "International Review of Residential PV Feed-in Management".

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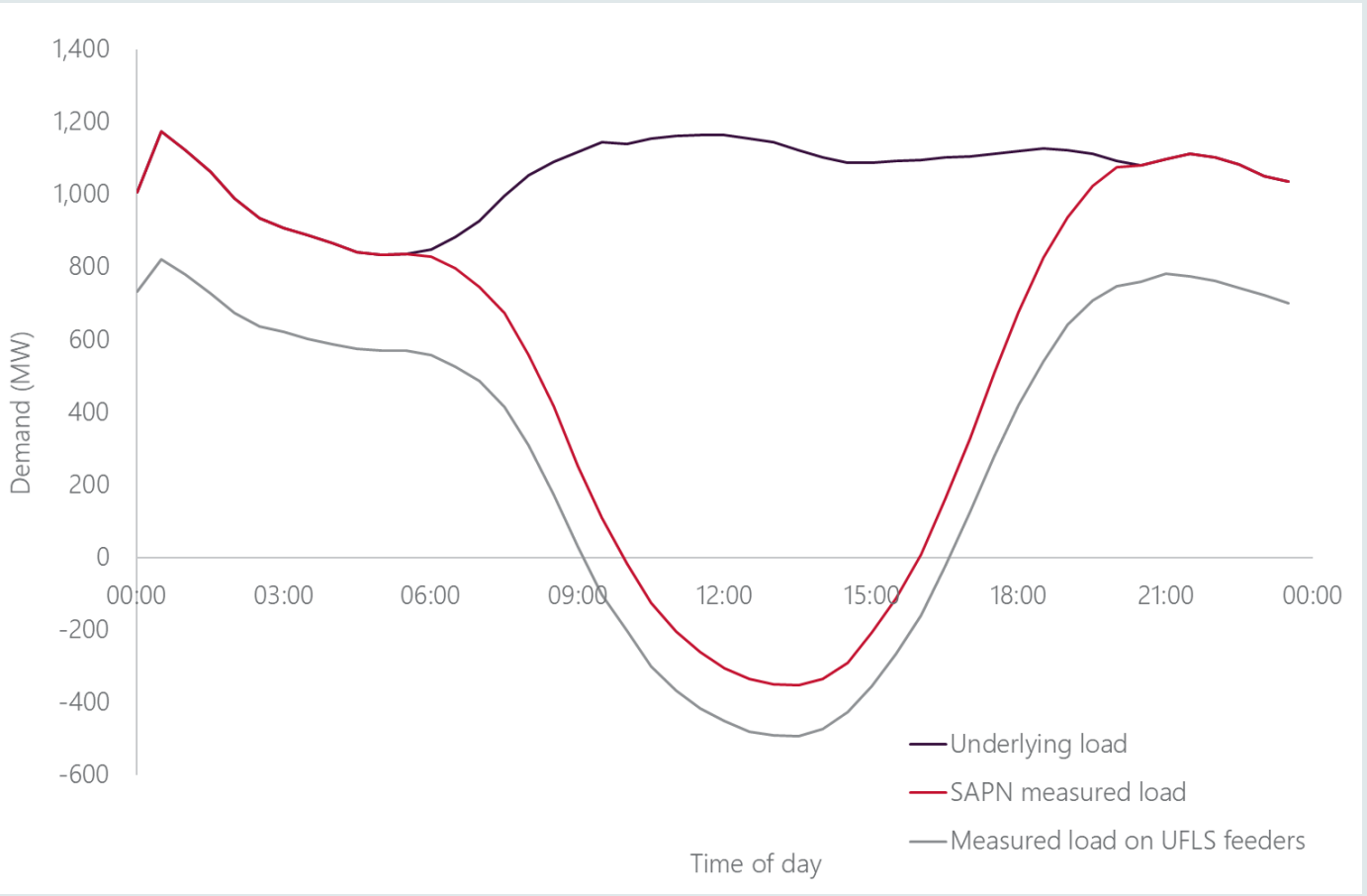
Under Frequency Load Shedding (UFLS)

- UFLS trips load as a last resort to stabilise the power system in the event of a major disturbance
- Net load is reducing

Mitigation:
- Add load to UFLS
- Constraints to minimise contingency sizes
- Dynamic arming of relays
- Alternative sources of under-frequency response

South Australia, Projection (2023-24), linear growth in PV at historical rates:



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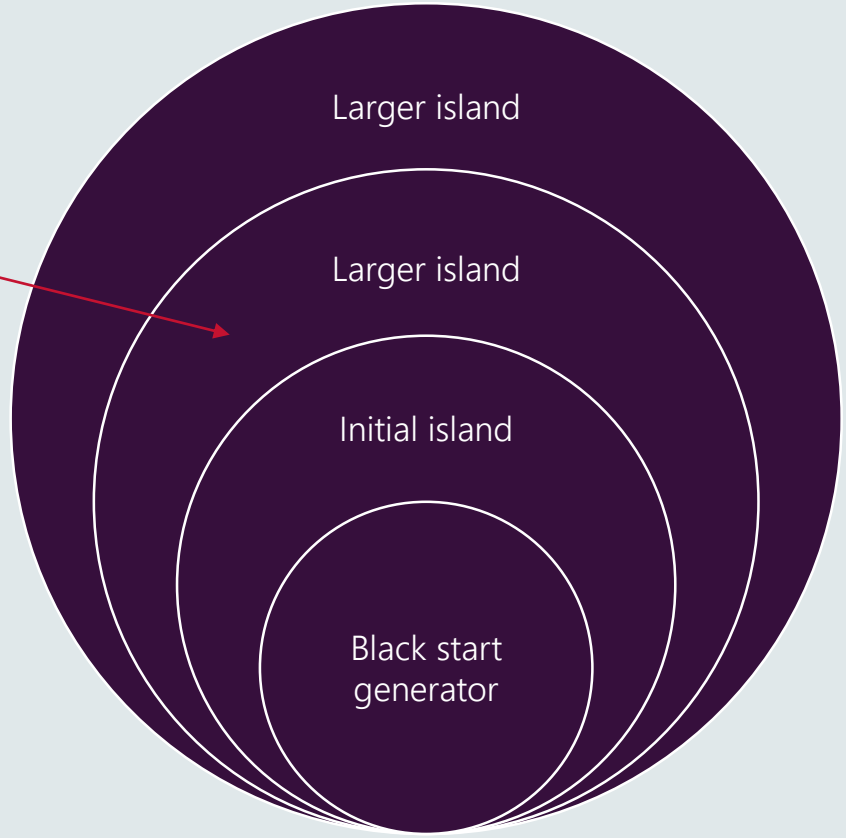
System Restoration

System black events are rare, but system operators must have resources available to restart and restore the system as safely and quickly as possible.

Load must be progressively added to the island in a controlled manner



With large quantities of uncoordinated DER, it may become increasingly difficult to anticipate the quantity of load being added to the island.

Feed-in management offers a solution, if suitably designed.

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Integrating DER to maximise consumer value

	DER Workstream	Network incentives	Data visibility	System & Market framework	Technical standards & connections	Operational process	Industry-wide collaboration
Workstream objectives		Network regulation & pricing facilitate DER and better customer service offerings.	Visibility of DER for operational, forecasting, planning, and market (incl settlement) functions. A consistent access regime for all market participants within the confines of customer consent and privacy.	Integrate DER into energy, ancillary and reserve markets. Market arrangements recognise non-retailer models, including third-party/aggregator concepts. Evolve market arrangement to a distributed market model.	Where appropriate, a nationally consistent approach to DER connections and develop DER technical standards.	To better understand operational challenges and DER capabilities to inform operational processes and tools.	Industry working together to deliver outcomes for consumers
Enablers	Pilot programs						
	Cyber security						
	Digital & Technology Strategies						

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In closing

- DER represents a significant transition for the electricity industry
- The impact of DER on power system security must be considered as a priority
- By identifying challenges early, we can implement the measures required to affordably maintain security and reliability for customers throughout this transition

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