Distributed Energy Resources: Integration in the Australian NEM

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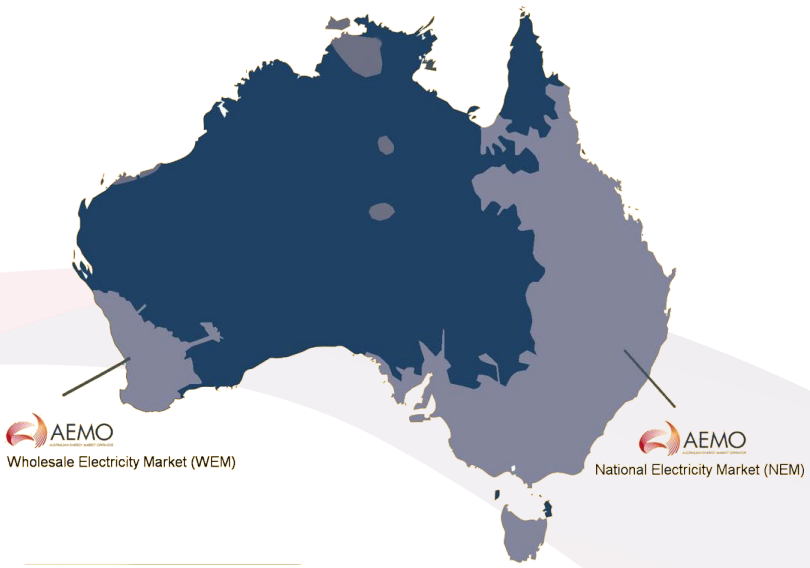
About AEMO



We operate Australia's National Electricity Market and power grid in Australia's eastern and south-eastern seaboard, and the Wholesale Electricity Market and power grid in south-west WA.

Both markets supply more than 220 terawatt hours of electricity each year.

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

Collectively traded more than A$20 billion in the last financial year.

Ownership

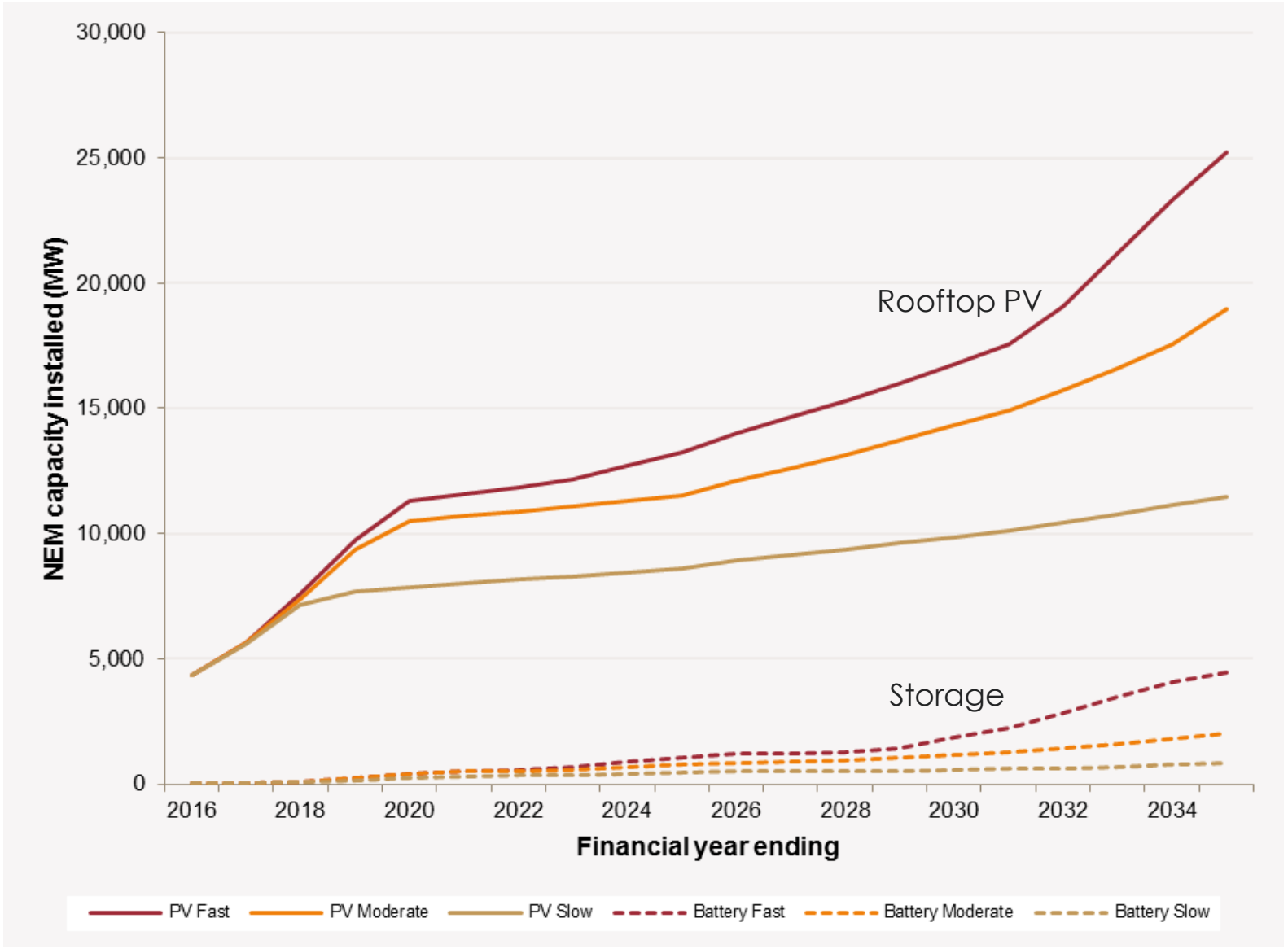
40% Market participants

60% Governments of Australia

Growth in DER

- Distributed Energy Resources (DER) are growing rapidly
- The transition to decentralised resources could represent the most significant power system transformation since it was established

AEMO's forecast for the NEM:



- 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?

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Power System Requirements

Summarises the technical and operational needs of the power system.

Provides a foundation for exploring power system impacts, and identifying emerging challenges.

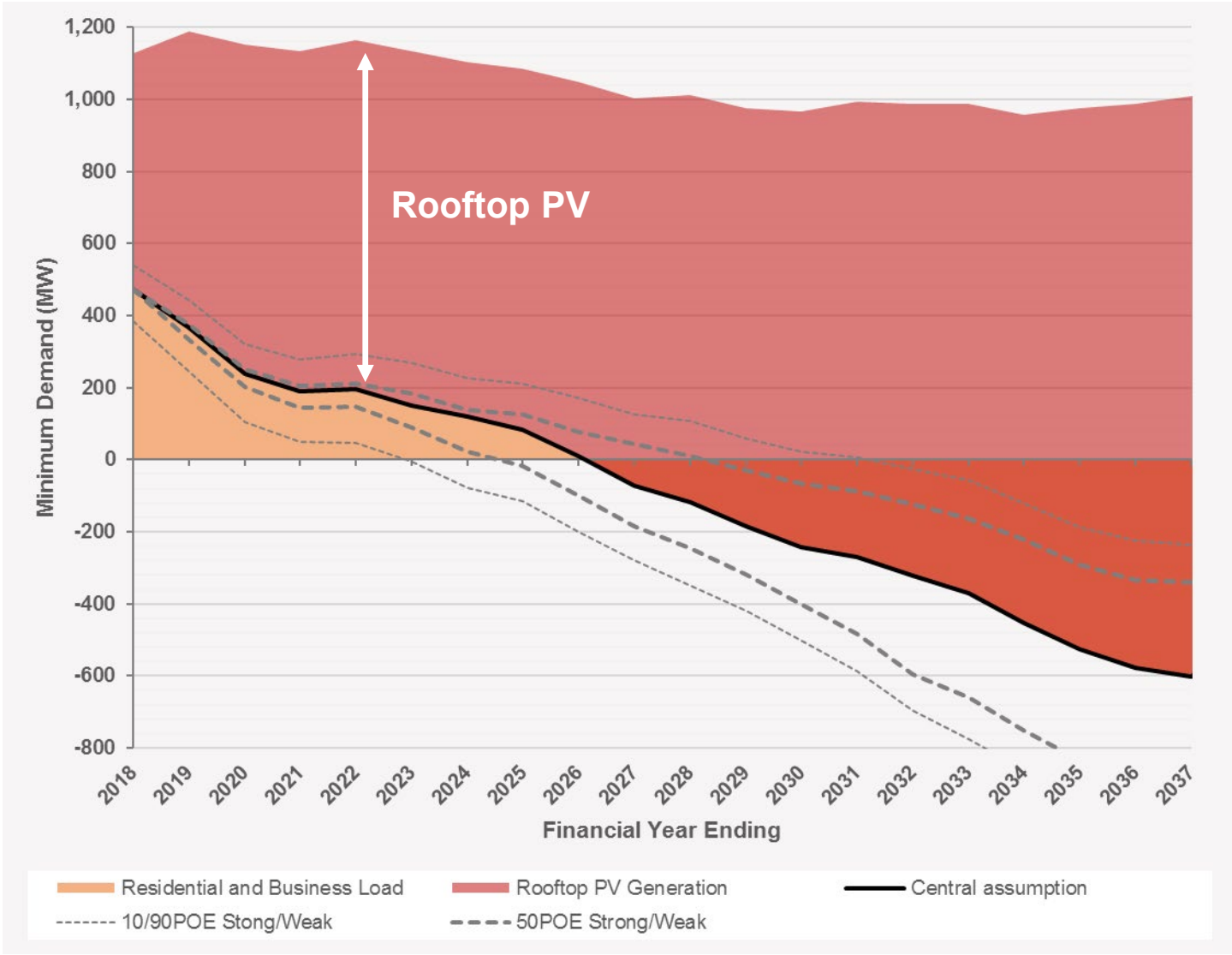
Dispatchability

System flexibility at times of minimum demand is reducing.

At present, there is no mechanism implemented for active management of rooftop PV.

Rooftop PV has the potential for "smart" active management to provide the necessary levels of flexibility.

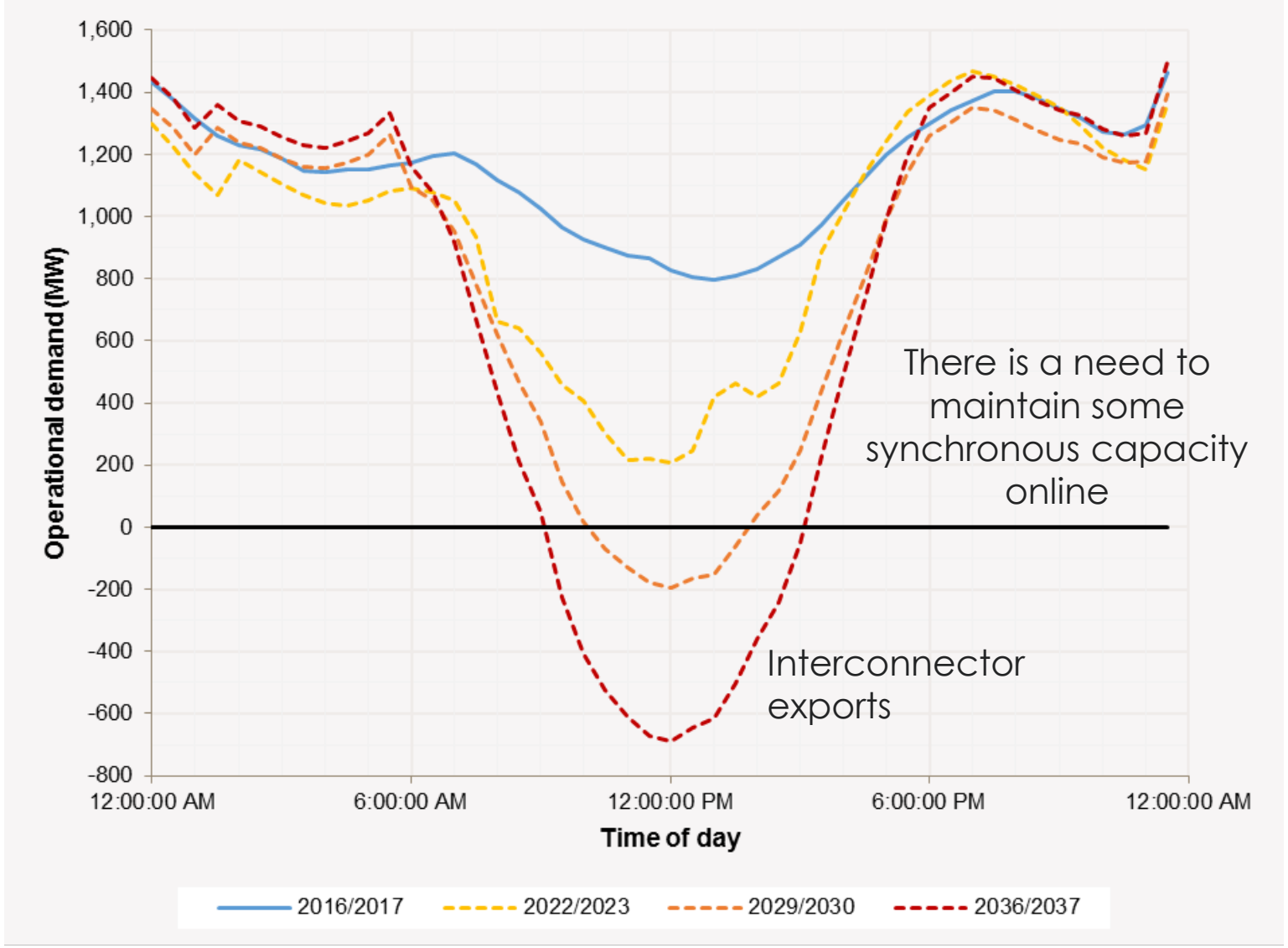
Minimum demand in South Australia:



By as early as 2023, passive rooftop PV could supply all demand in South Australia in some periods

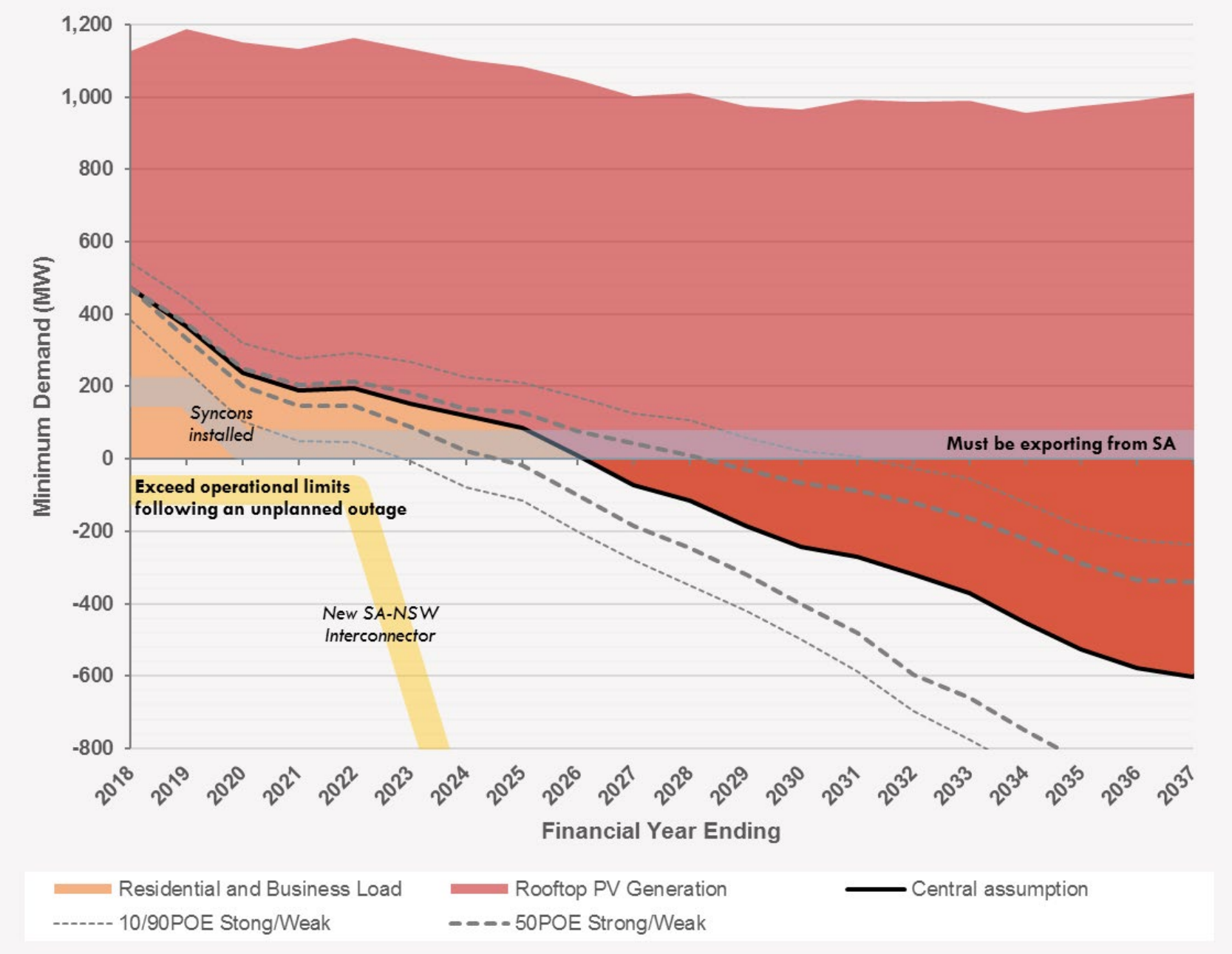
Dispatchability

Operational demand in South Australia:



Dispatchability

During the next decade, challenges are mostly associated with operation during "emergency conditions" (bushfires, severe weather, network outages), when flows on the network must be reduced to remain secure. This occurs rarely.



Dispatchability

- Timing of challenges: **Oct/Nov/Dec:**

(number of days affected in forecast)

	January	February	March	April	May	June	July	August	September	October	November	December
2017	5	3	3	1	0	0	0	2	2	14	12	8
2016	5	3	4	5	0	0	0	1	8	13	12	7
2015	6	1	8	4	1	0	0	2	9	7	7	10
2014	7	3	4	6	0	0	0	2	6	8	9	8
2013	5	3	3	1	1	0	0	2	7	11	14	10
2012	2	2	7	2	0	0	0	2	4	12	9	10
2011	8	3	5	6	1	0	0	2	3	12	13	12
2010	9	3	3	5	2	0	0	2	6	14	7	16

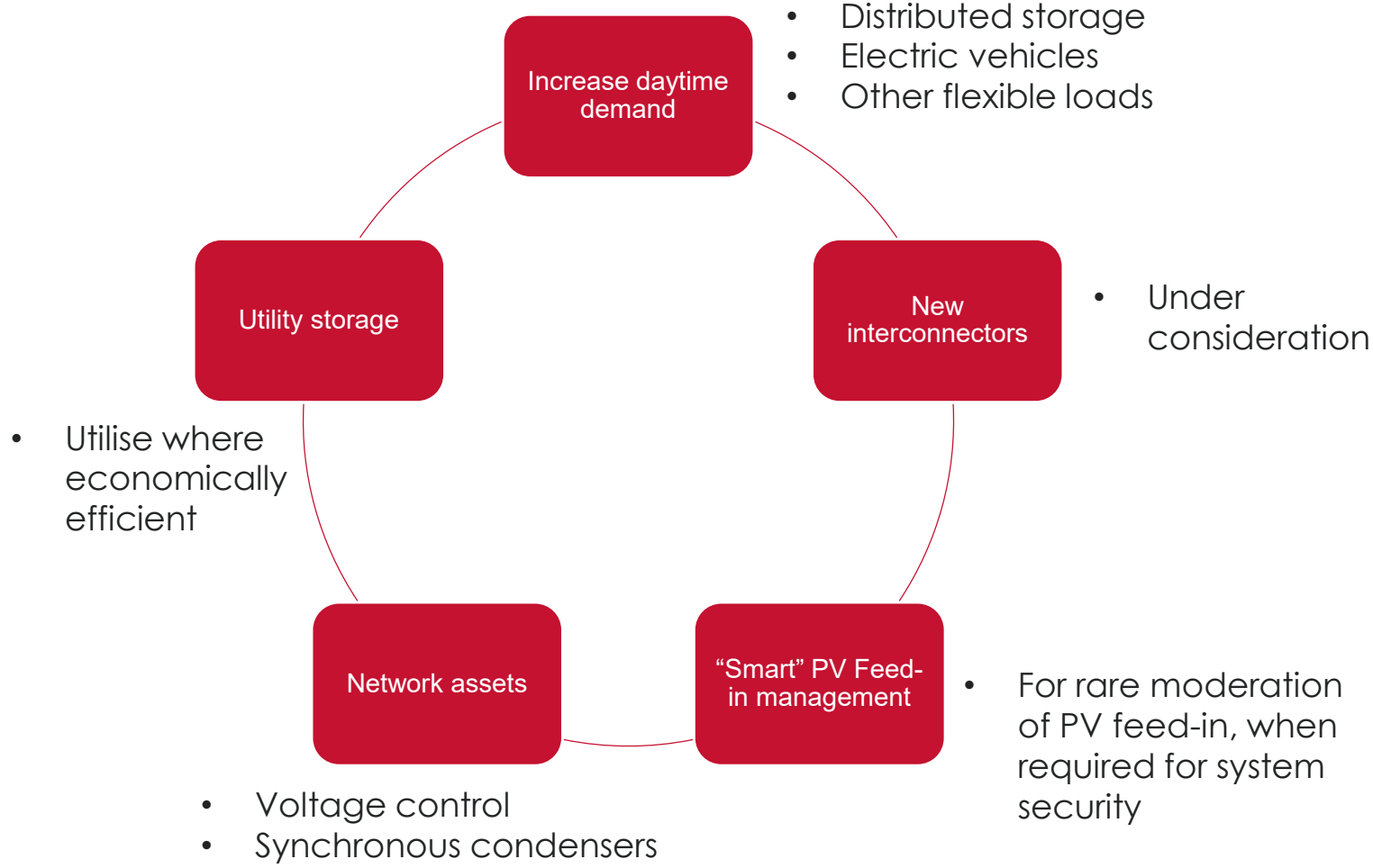
On weekends:

	SUN	MON	TUE	WED	THU	FRI	SAT
2017	14	5	1	5	5	6	14
2016	23	0	2	4	4	7	18
2015	20	3	0	6	1	4	21
2014	21	4	2	0	2	4	20
2013	20	5	3	3	4	6	16
2012	24	6	2	4	2	1	11
2011	27	8	4	7	2	5	12
2010	25	4	4	3	4	9	18

- Challenges occur primarily during Oct/Nov/Dec (low demand and high PV generation)
- Primarily on weekends

Options

A suite of technical options can be implemented in parallel



"Smart" PV feed-in management

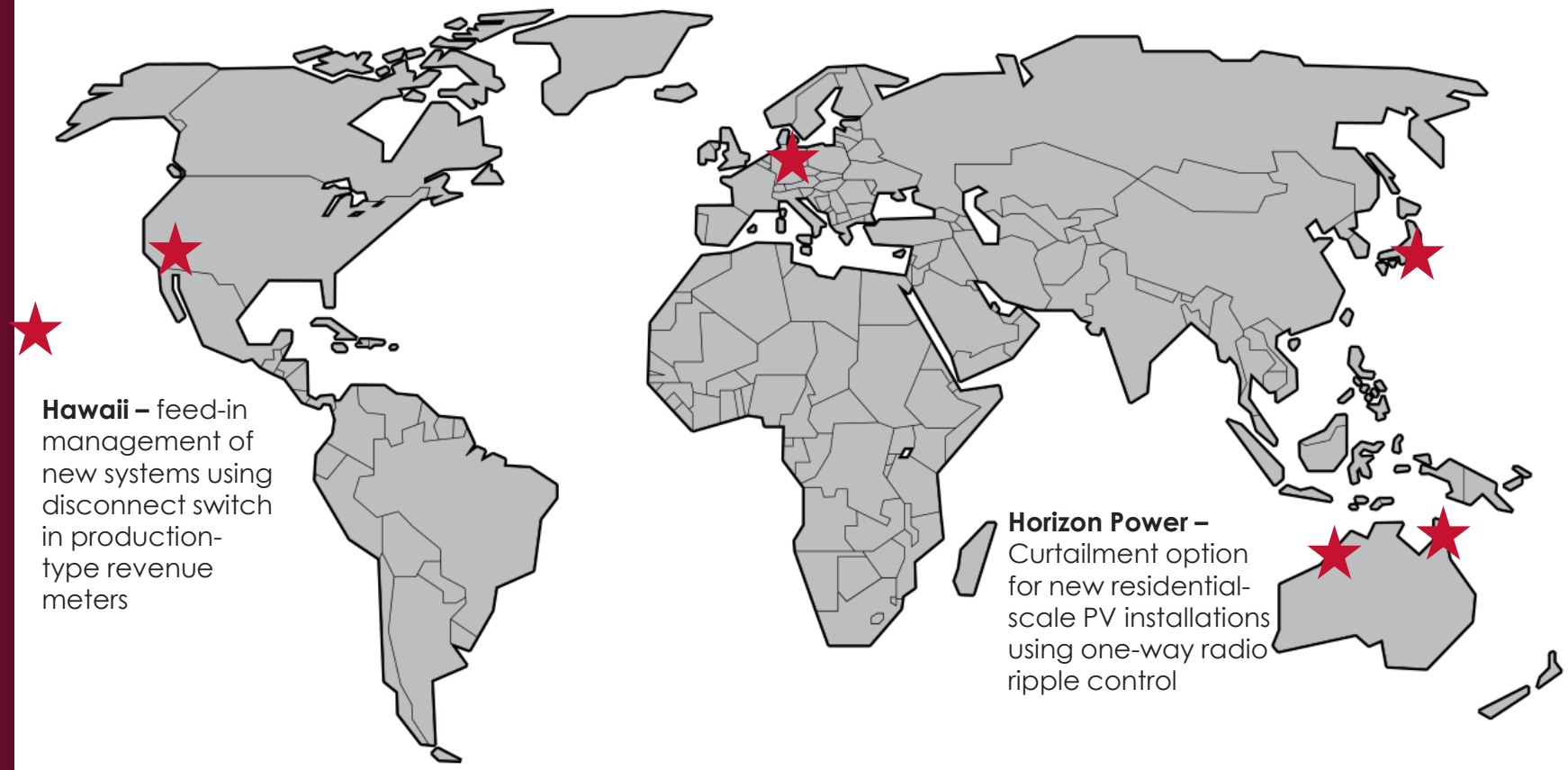
PV feed-in management has been demonstrated at scale.

Australia is one of a few countries that face the need for small-scale PV feed-in management, arising earlier than most.

Arizona – Pilot project involving 1,600 utility-owned residential PV inverters to demonstrate management of real and reactive power functionalities

Germany – Curtailment option for new residential-scale PV installations using one-way radio ripple control

Japan – multiple pilot projects testing curtailment of PV using internet communication pathways



Hawaii – feed-in management of new systems using disconnect switch in production-type revenue meters

Horizon Power – Curtailment option for new residential-scale PV installations using one-way radio ripple control

Energy QLD – Lockhart River Pilot project on a standalone microgrid investigating automated control of four PV systems using a programmable logic controller to respond to dynamic limits at the central diesel generating station

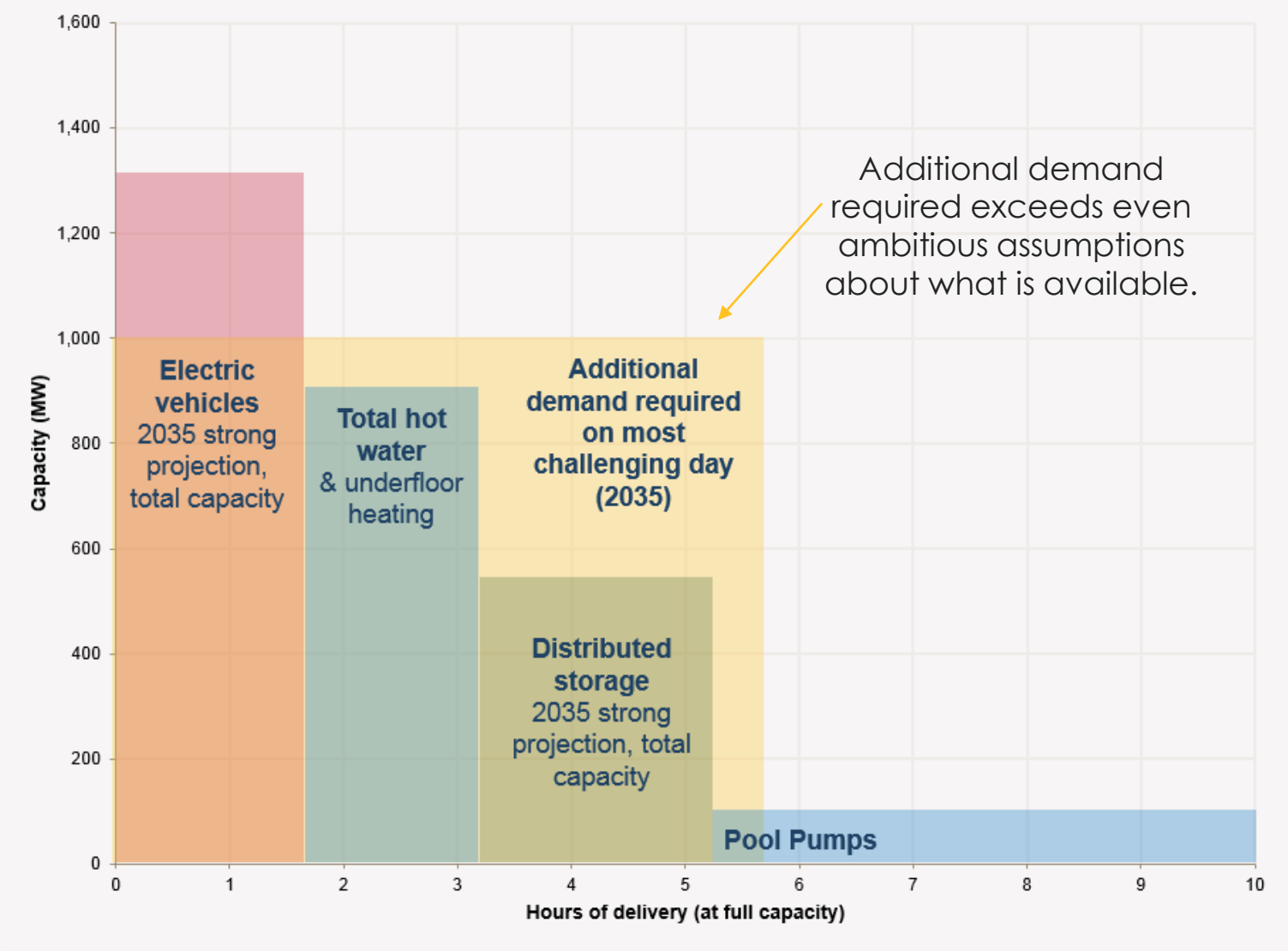
EPRI report for AEMO (2018), "International Review of Residential PV Feed-in Management".

Demand management

The amount of excess energy from rooftop PV is very large.

There is a need for "smart" capabilities, even with extensive demand response.

Maximum demand response potential in SA from a range of sectors:



Other challenges

A suite of other challenges related to DER have been identified

A program of work is underway to investigate the timing and nature of the challenge, and determine appropriate actions.

Performance standards

- Need for review of performance standards for DER to ensure they adequately support system security needs

Predictability

- AEMO's dynamic models do not accurately capture the behavior of load and DER during disturbances

Frequency management

- Emergency Frequency Control Schemes and special protection schemes may no longer operate successfully under high rooftop PV conditions

System restoration

- Unmanaged DER operation may interfere with progressive restoration of load during a system restart process

Other challenges

A suite of other challenges related to DER have been identified

A program of work is underway to investigate the timing and nature of the challenge, and determine appropriate actions.

Voltage management

- Emerging challenges managing transmission & distribution voltages at times of low operational demand

Visibility

- Need for collection of standing data on DER installed for forecasting, system planning, and stability studies

VPP management

- Unmanaged rapid movement of large VPPs could cause demand forecast errors, increased need for frequency control, and system security challenges

Orchestration

- Need for coordination between AEMO and DNSPs in DER dispatch

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						

Key activities in train

- DER Visibility – establishment of DER register. Consider granular visibility as part of Open Energy Networks
- Connections & technical standards – working with ENA and Standards Australia, and international counterparts. Informed by trials.
- Market access – working with AEMC on DER access to energy, ancillary and reserve.
- AEMO/ENA Open Networks consultation
- Market trials – i.e. Virtual Power Plant trial and distributed markets
- Cross industry through Distributed Energy Integration Program (DEIP)

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- DER represents a significant transition for the electricity industry
- The impact of DER on power system security must be considered as a priority
- A coordinated and collaborative work program is required
- 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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Thank you

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