

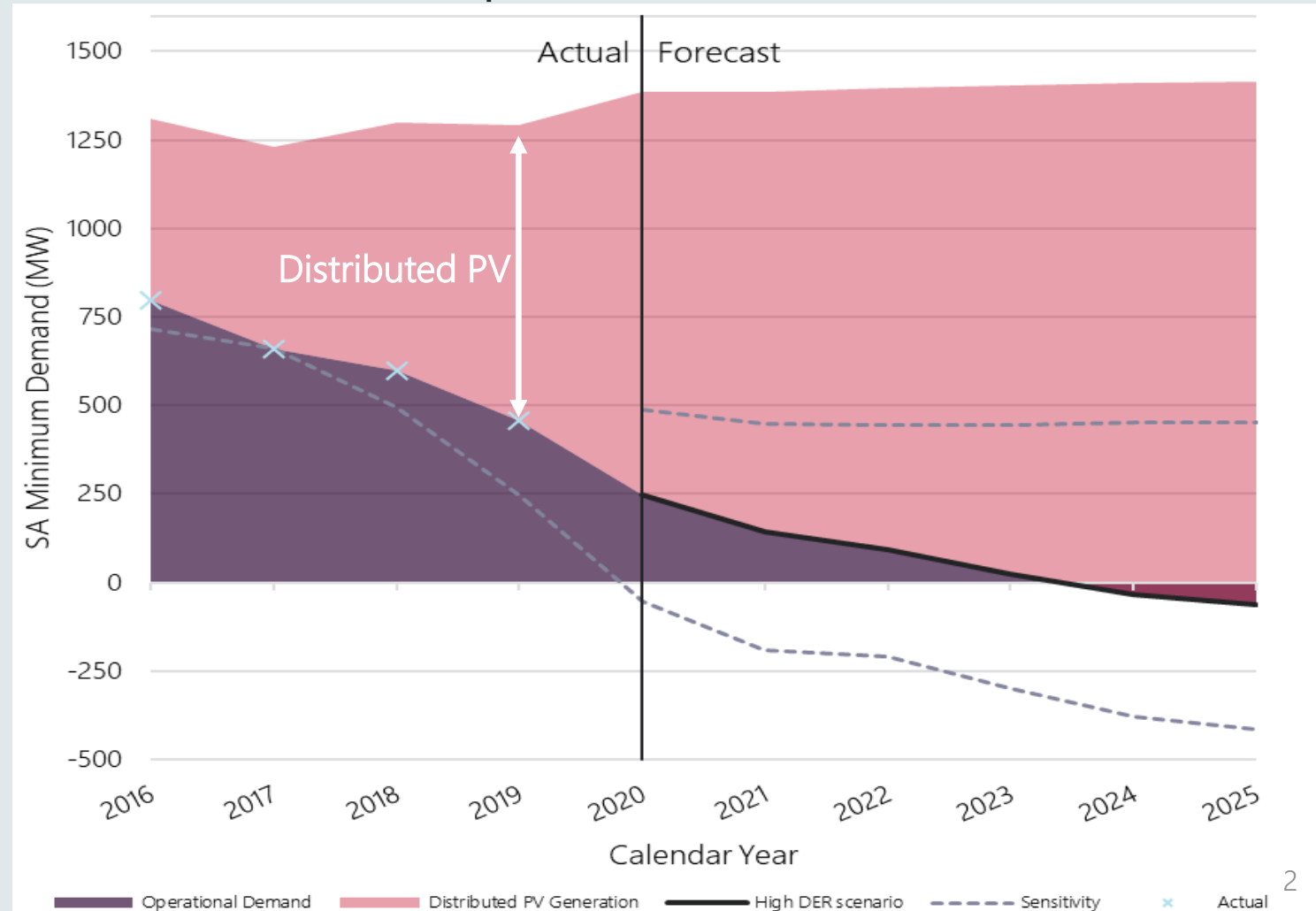
DER Integration

Emerging system security challenges in low load conditions

DER integration

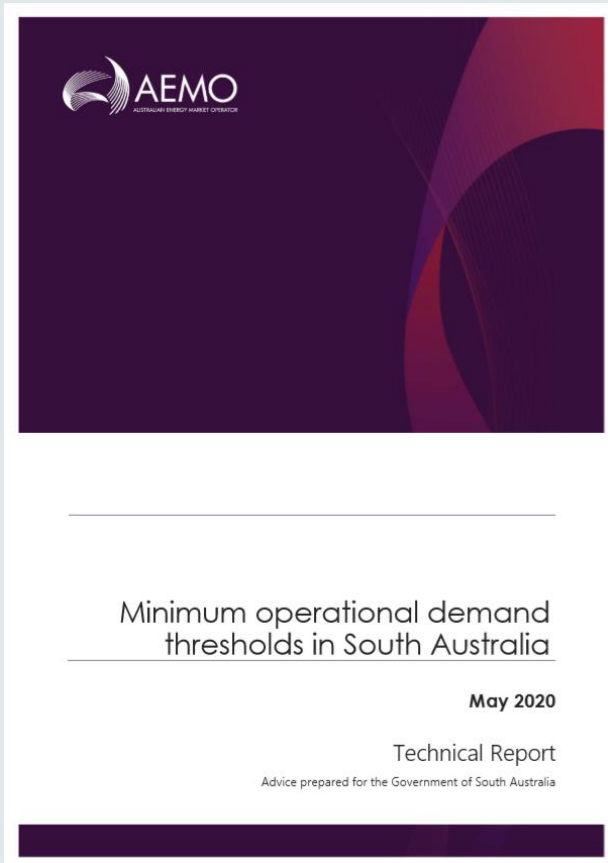
- Within 1-3 years, operational demand in South Australia could become negative.
- When and what operational challenges may arise?
- What actions do we need to take now, to ensure we can operate a secure system?

Minimum operational demand in SA

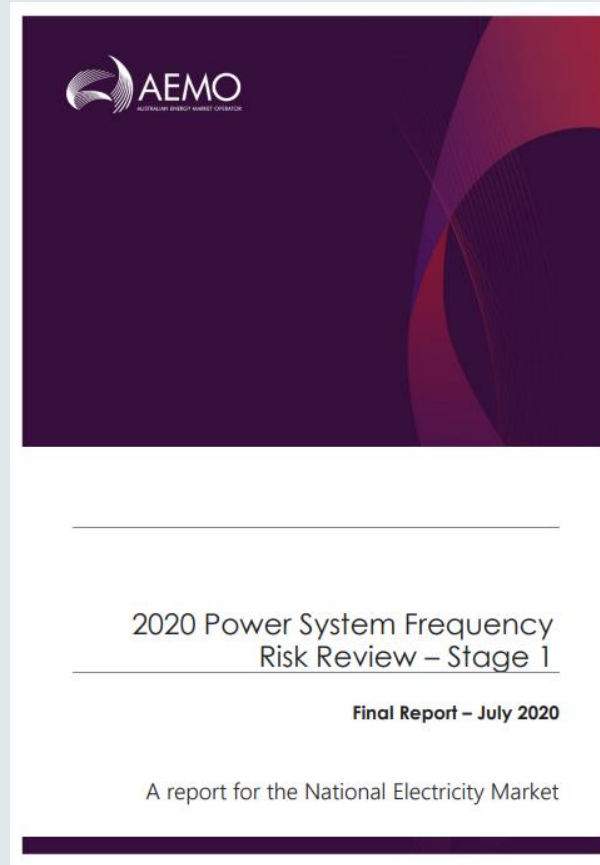


Reports

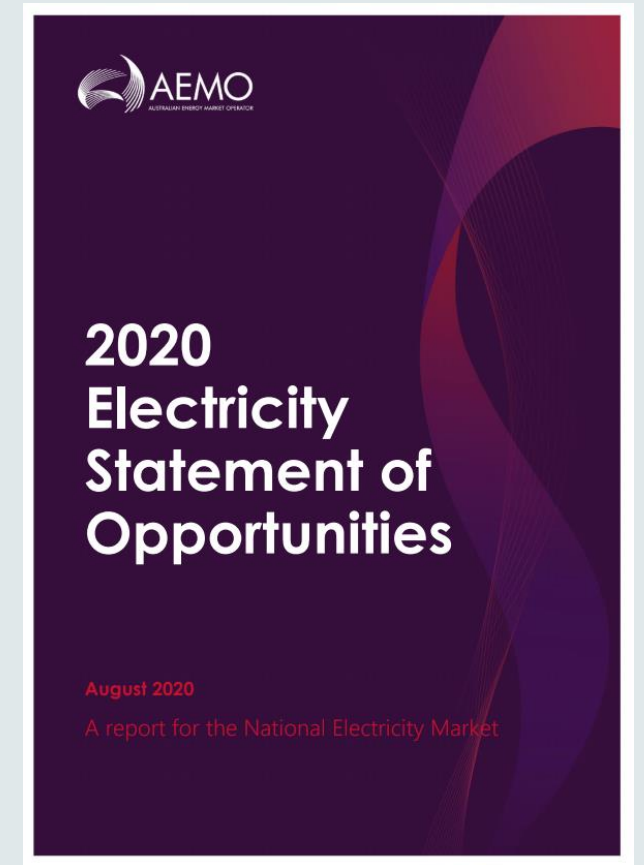
Analysis released recently:



https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/sa_advisory/2020/minimum-operational-demand-thresholds-in-south-australia-review.pdf?la=en



Appendix A, at: https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2020/psfrr/final-2020-power-system-frequency-risk-review-stage-1.pdf?la=en&hash=C1EA01AAC28C7DF0D4F69700B8FC439B



https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/nem_esoo/2020/20-electricity-statement-of-opportunities.pdf?la=en&hash=85DC43733822F2B03B23518229C6F1B2

Preliminary findings

Challenges identified:

Distributed PV disconnection

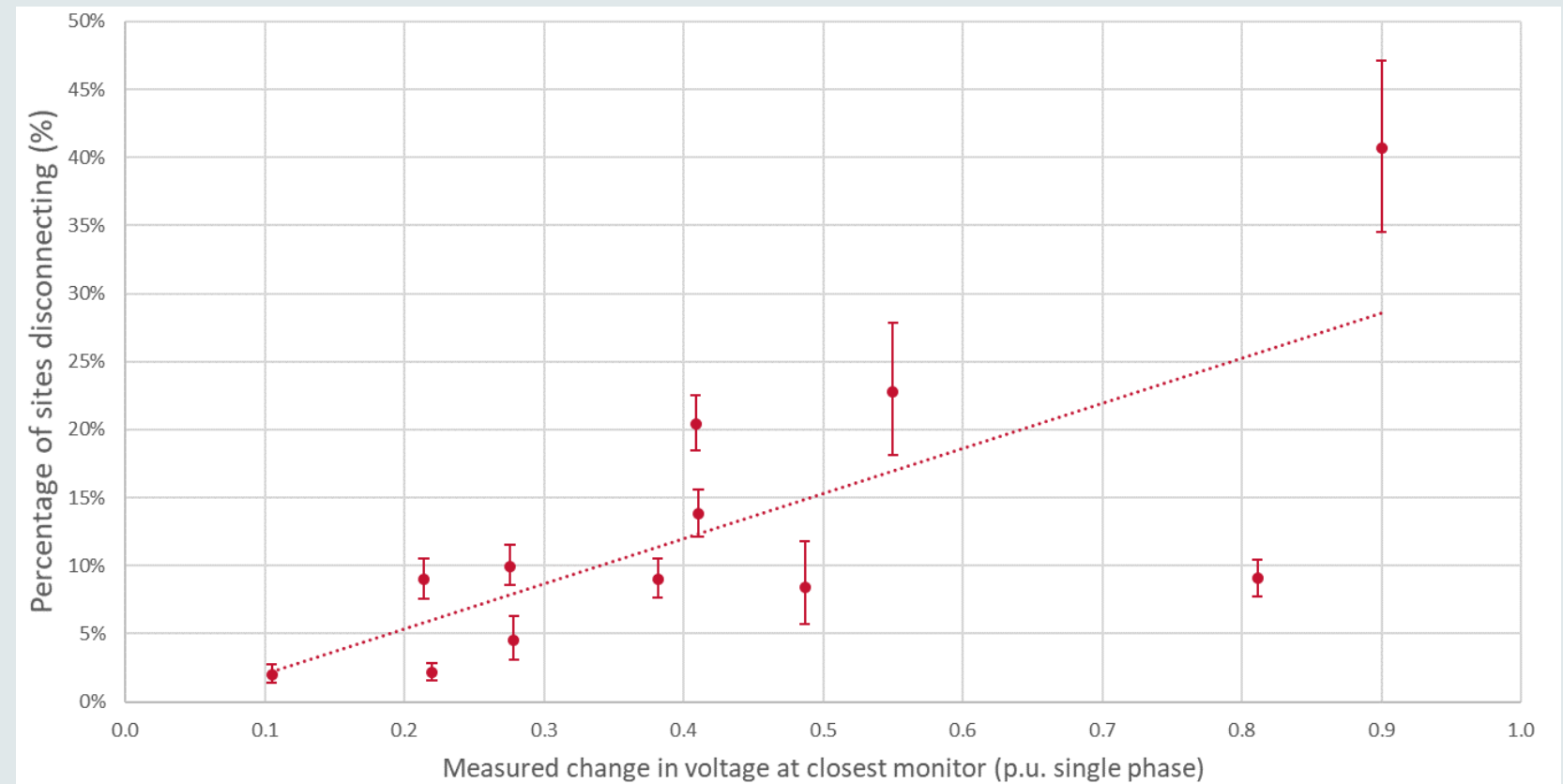
Minimum load required to operate necessary units

Under Frequency Load Shedding

Distributed PV disconnection

- Analysis of PV disconnection based upon data from individual inverters
- Verified by bench testing (ARENA project with UNSW)
- Used to calibrate PSS[®] E model of DER behaviour

Distributed PV disconnection observed



Distributed PV disconnection

- Severe but credible fault could cause significant disconnection of distributed PV
- Increases largest credible contingency
 - Added to largest generating unit
- When operating as an SA island:
 - Becomes almost impossible to maintain frequency >49Hz when DER-load loss exceeds ~150 MW (operating in this realm in some periods already)
 - AEMO may no longer have the ability to operate SA in a secure state, if islanding occurs at times of high distributed PV generation
- Issues emerging in VIC/QLD soon

Maximum net PV disconnection

Most severe fault in most severe period

	Calendar year	Central scenario (90% POE)			Central Downside, High DER sensitivity (90% POE)		
		SA	VIC	QLD	SA	VIC	QLD
Historical	2019	110 (30-210)	-	0 (0-90)	110 (30-210)	-	0 (0-90)
Forecast	2020	170 (80-290)	0 (0-170)	0 (0-260)	230 (150-360)	0 (0-220)	20 (0-290)
	2021	210 (130-330)	20 (0-340)	20 (0-330)	230 (150-360)	90 (0-380)	50 (0-350)
	2022	240 (160-370)	170 (0-480)	80 (0-390)	270 (180-390)	250 (20-560)	130 (0-440)
	2023	260 (180-390)	310 (90-670)	120 (0-440)	300 (220-430)	410 (180-760)	220 (0-530)
	2024	290 (200-420)	460 (230-790)	160 (0-490)	340 (260-480)	580 (350-920)	300 (50-620)
	2025	310 (220-440)	600 (370-940)	200 (0-530)	390 (300-530)	740 (500-1,100)	380 (140-730)

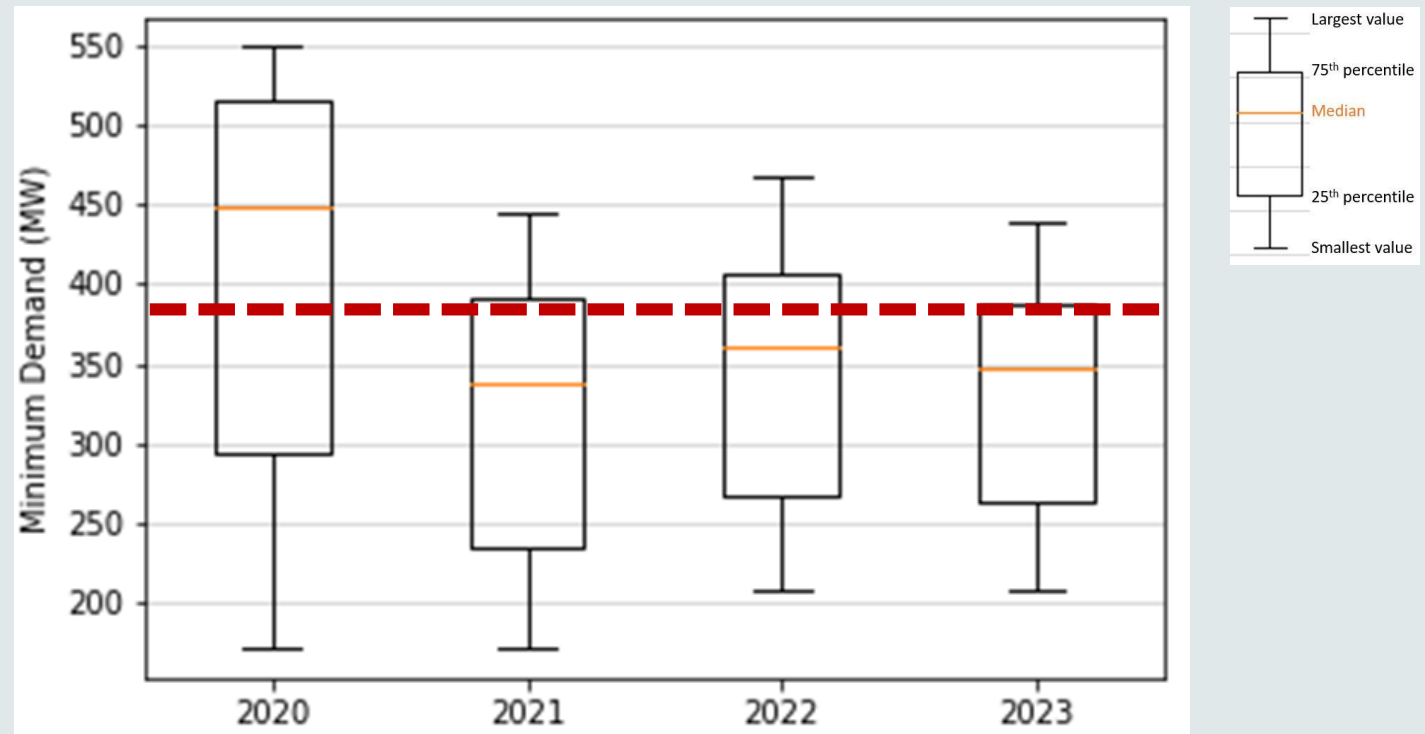
Measures to manage PV disconnection

1. Improve DER standards (AS4777)
2. Accelerated voltage ride through test in SA
3. Improve compliance with standards
4. Collaborate with DNSPs on connection requirements
5. Project EnergyConnect (SA)
6. Network constraints

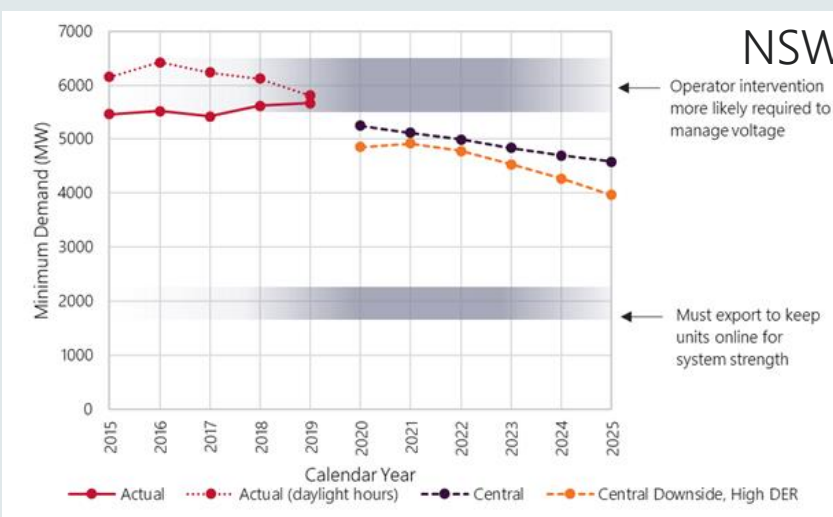
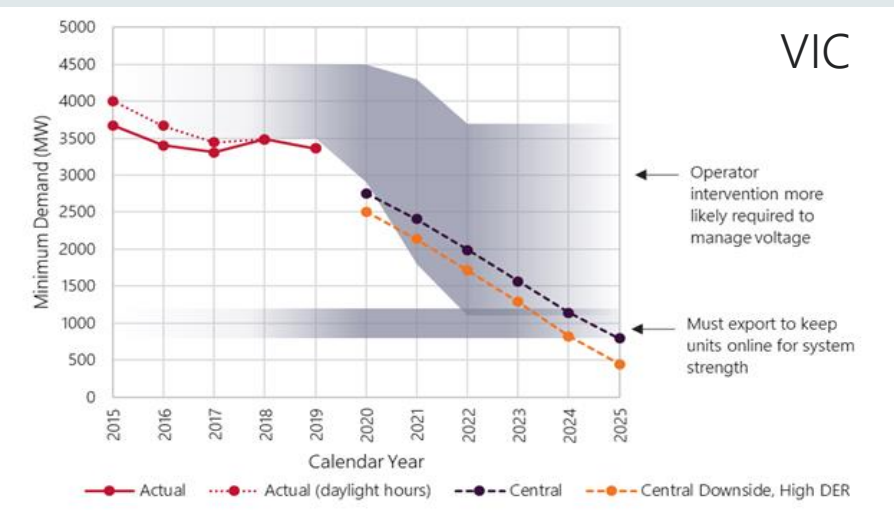
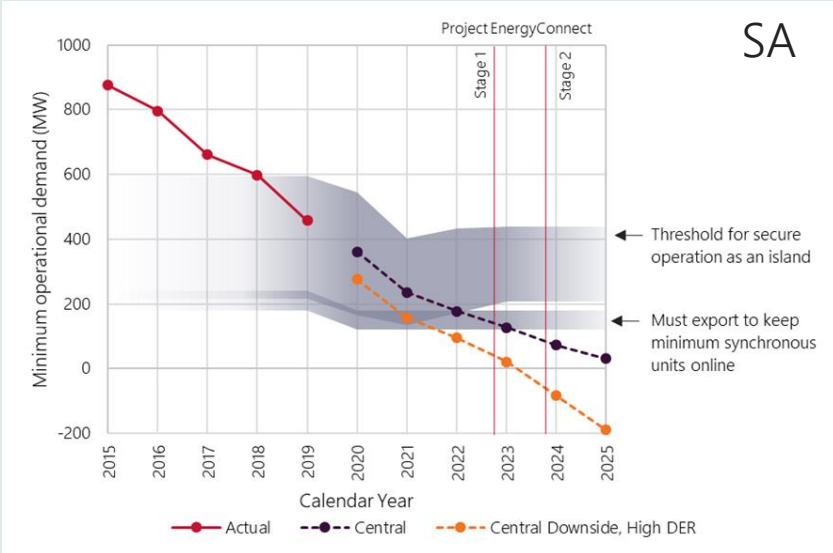
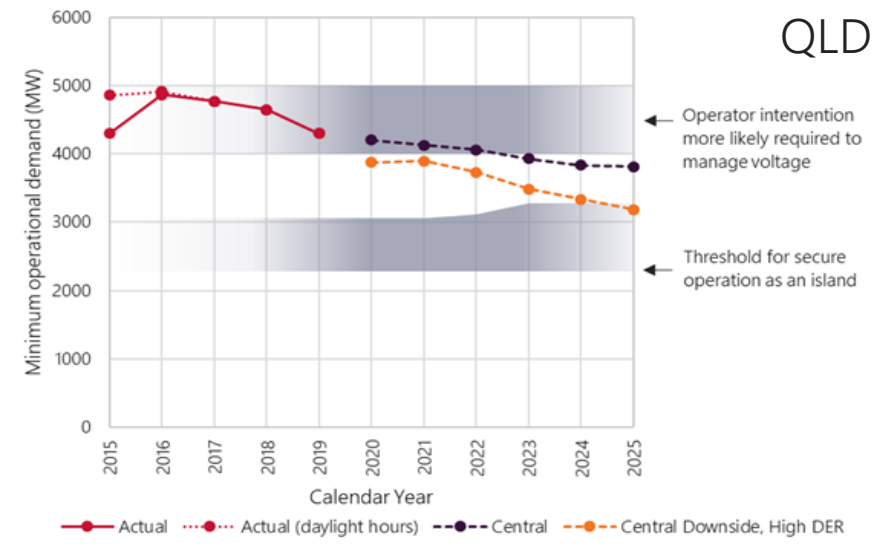
Minimum demand thresholds

- **Islanded operation:** Need adequate load to operate necessary units for system strength, inertia, frequency control and voltage management
- Lowest operational demand experienced: 379 MW (13 Sept 2020)

Minimum operational demand in SA



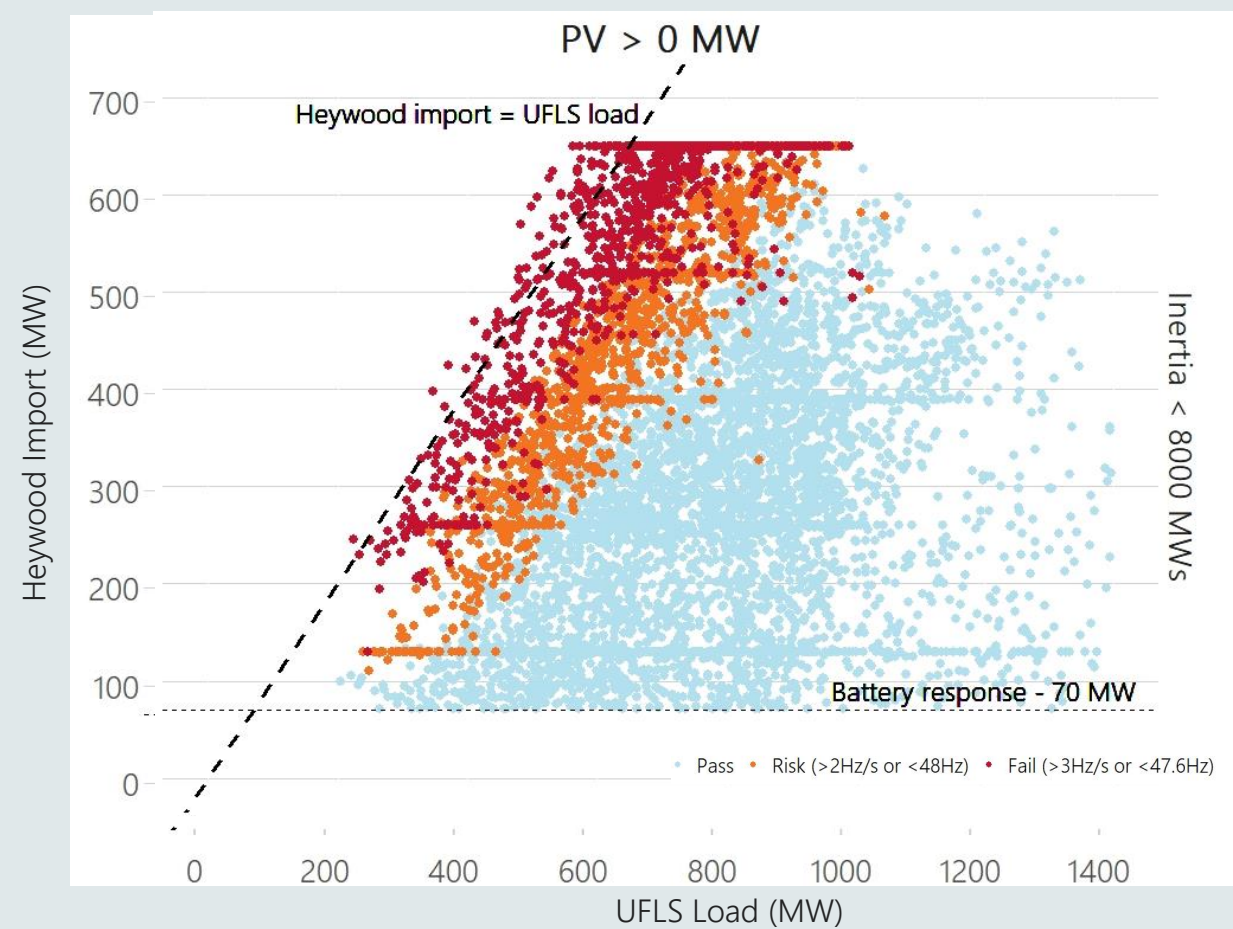
Minimum demand thresholds



- Action required urgently in SA and VIC, and promptly in QLD
- NEM-wide adoption of disturbance ride-through capabilities and emergency PV shedding capabilities recommended
- Opportunities for stakeholders in providing services in DER aggregation, load shifting, storage, frequency control

Under Frequency Load Shedding

- UFLS is our “safety net”, designed to arrest severe under-frequency events
 - Separation events
 - Multiple contingency events
- Security challenges identified:
 1. Reducing net load
 2. Reverse flows
 3. Distributed PV disconnection
- Actions:
 - Increase UFLS load
 - Dynamic arming of UFLS relays
 - Heywood constraint
 - NER review



Next steps

- Collaboration with stakeholders on design and implementation of mitigation actions
- Analysis ongoing
- Continuing development of tools and data



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