



# IoT-Enabled Virtual Power Plants

Innovation for Cool Earth Forum  
10 October 2018

# Our CV

Case study: VPP in Australia for grid frequency management



## Demand Response (DR)

- Manage >7GW of dispatchable DR capacity today
- ~15,000 C&I facilities participating in DR
- Operate DR in nearly all liberalised global markets
- Focus on load curtailment and backup generation

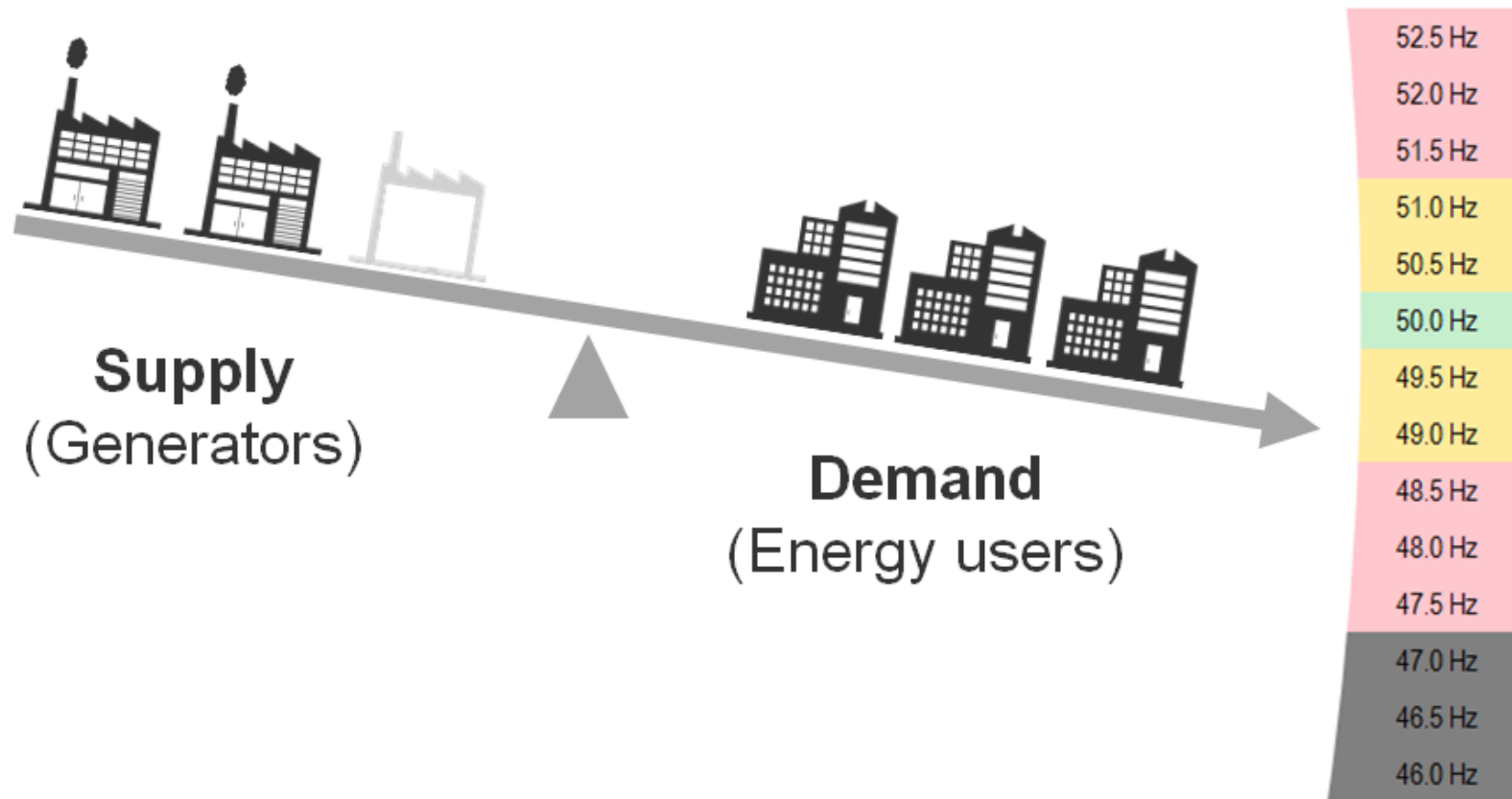


## Virtual Power Plants (VPPs)

- + Distributed renewable generation
- + Battery optimization
- + Smart charging and vehicle-to-grid
- + Microgrid controls

# Frequency control ancillary services (FCAS)

Case study: VPP in Australia for grid frequency management



**Regulation FCAS** involves AEMO continuously dialing some generators (and batteries) up or down every 4 seconds to correct for small imbalances between supply and demand.

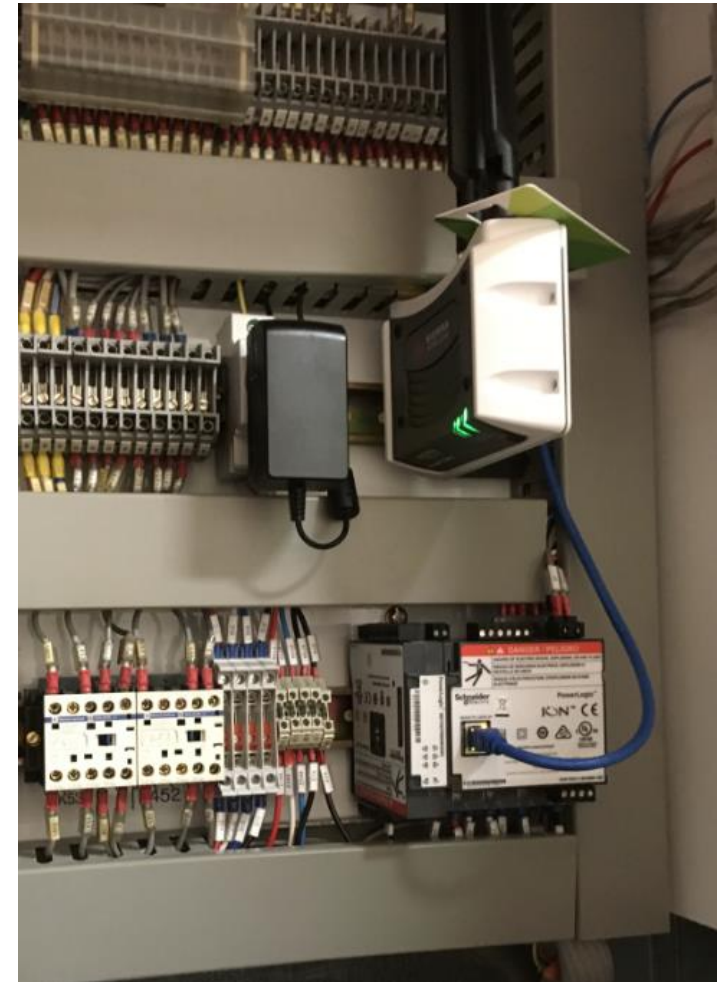
**Contingency FCAS** involves AEMO procuring resources to be on standby to respond automatically when large, unexpected events occur on the power system, such as the trip of a transmission line or (more commonly) the trip of a large generator.

# Enel X IoT Device for VPP

Off-shelf PQ meter with custom firmware, local sensing, relay outputs, modem

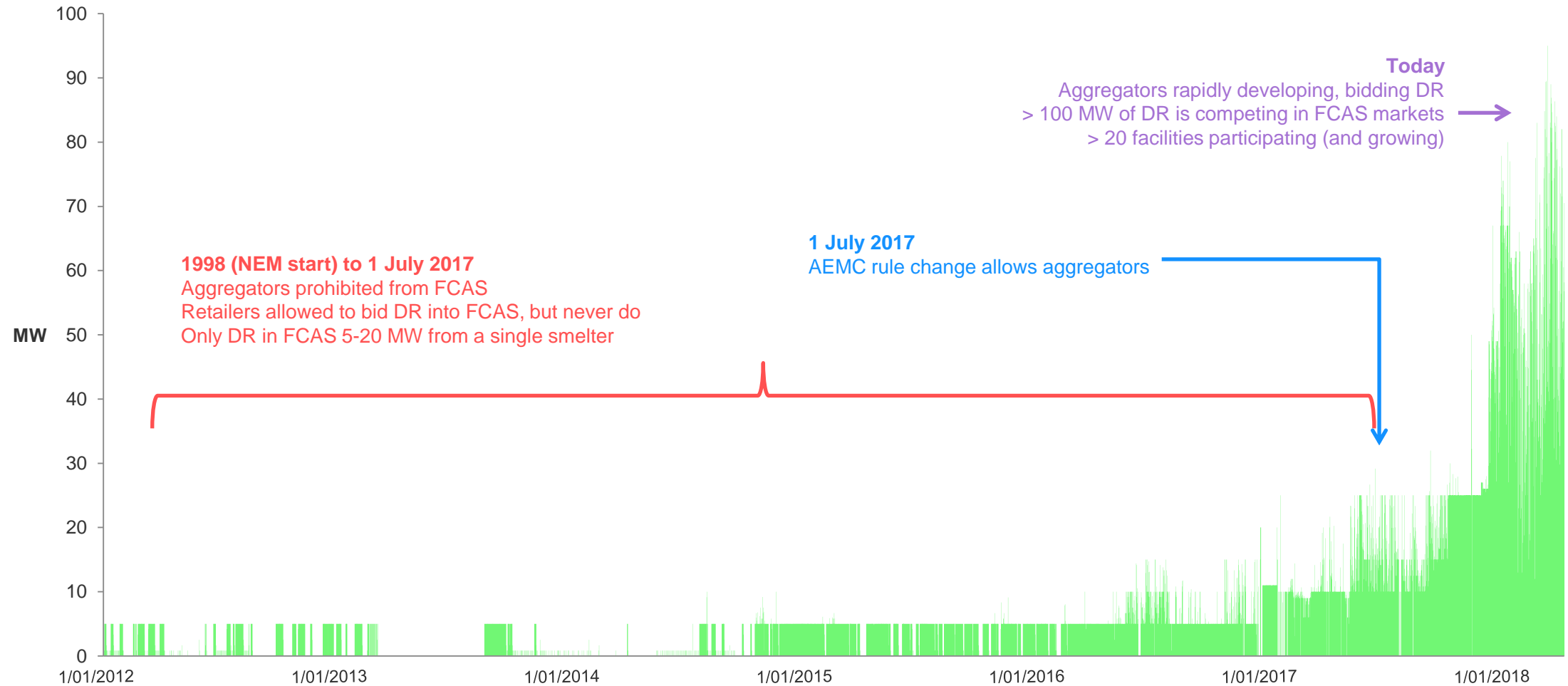


- Digital relay control
- Modem comms over private VPN on Telstra network
- Multi channel & individual phase data capture @ 256 samples/cycle
- High resolution 20ms data (small capture window 8s pre, 60s post)
- Low resolution 4sec (wider capture window 5m pre, 15m post)
- Integration with breaker or PLC
- RT power reading transmitted to EnerNOC every 1 minute
- High speed logs recorded & stored locally, retrieved on demand



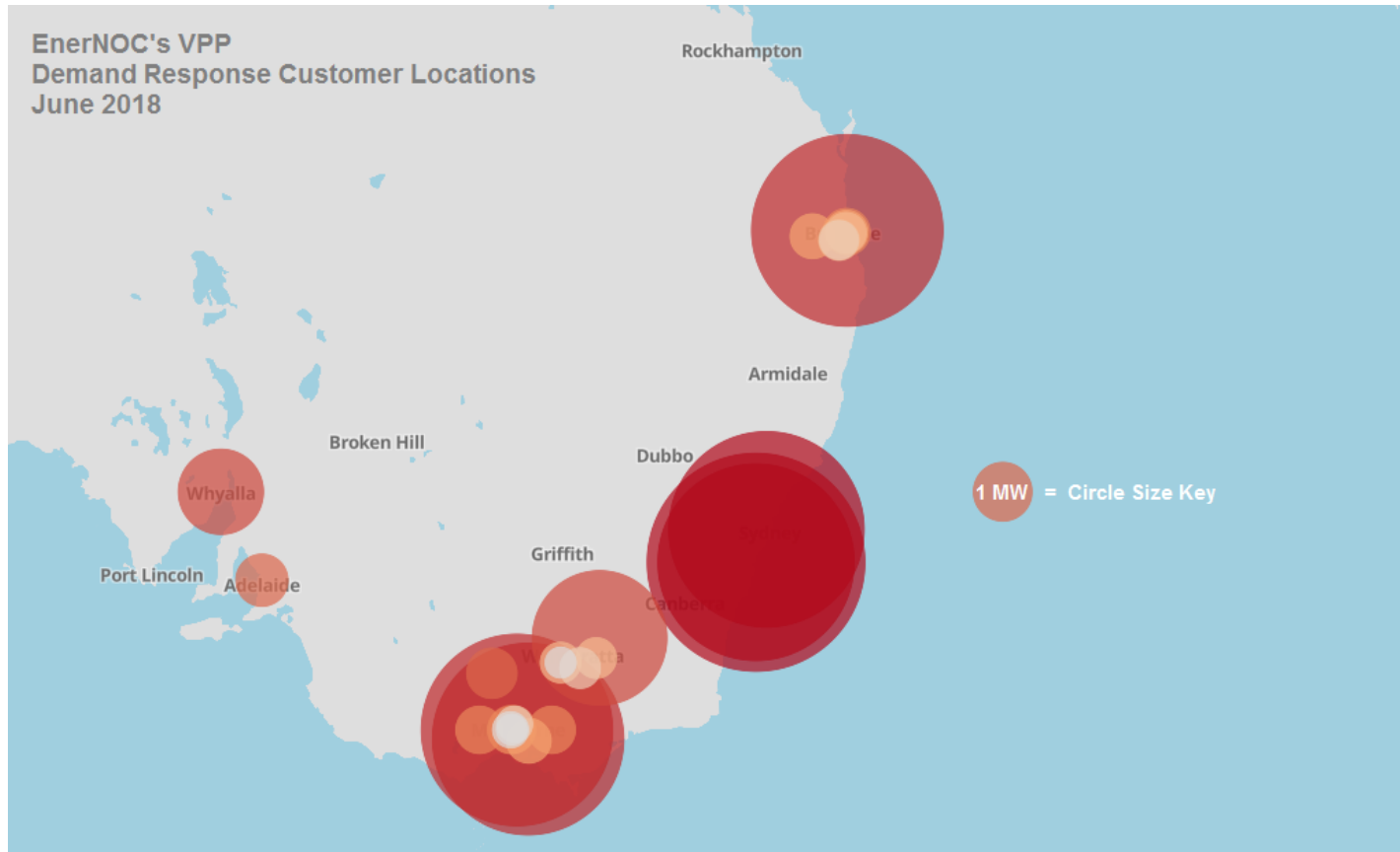
# The market opened to VPPs in late 2017

Case study: VPP in Australia for grid frequency management



# EnerNOC's VPP

Case study: VPP in Australia for grid frequency management



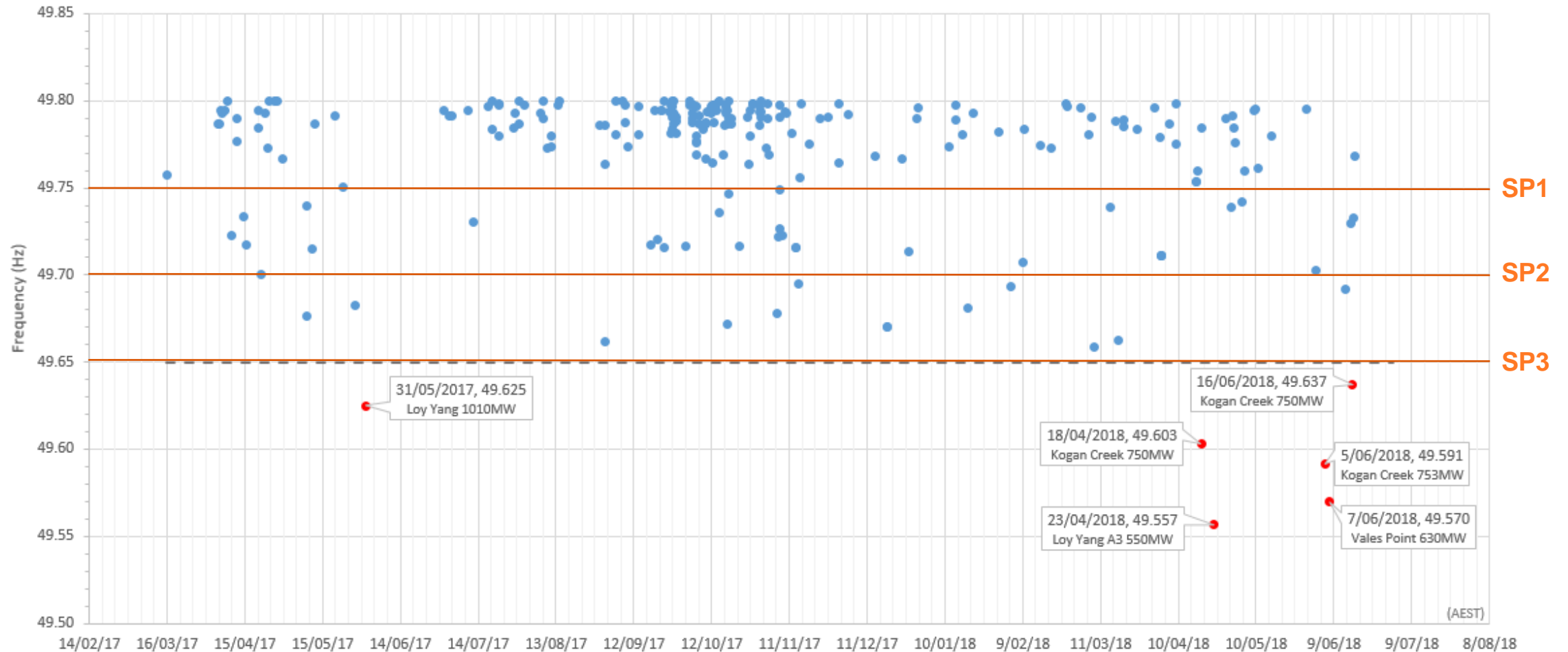
- >20 behind-the-meter resources
  - Load curtailment
  - Distributed generation
  - Battery storage (ESS)
- >100MW total dispatchable capacity
- Market trading every 5 minutes
- Continuous adjustment of offer quantities based on real-time monitoring

# Frequency deviations are increasingly common

Case study: VPP in Australia for grid frequency management

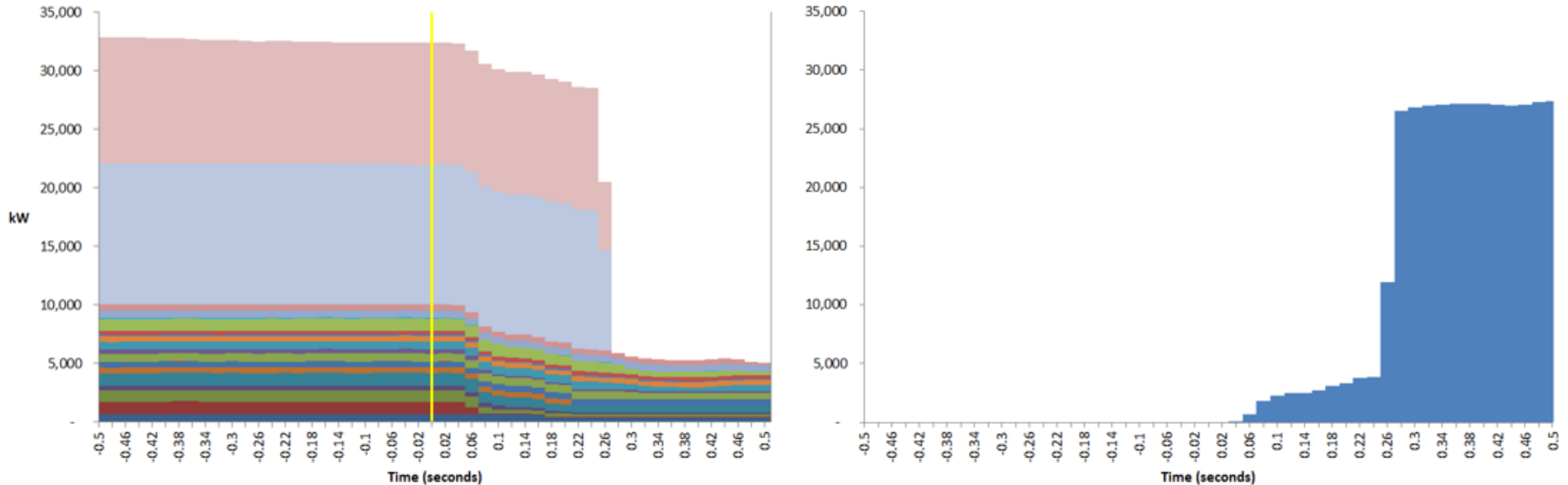


NEM - Frequency Excursions <49.8Hz



# VPP response: Up to 20x faster than generation

Case study: VPP in Australia for grid frequency management

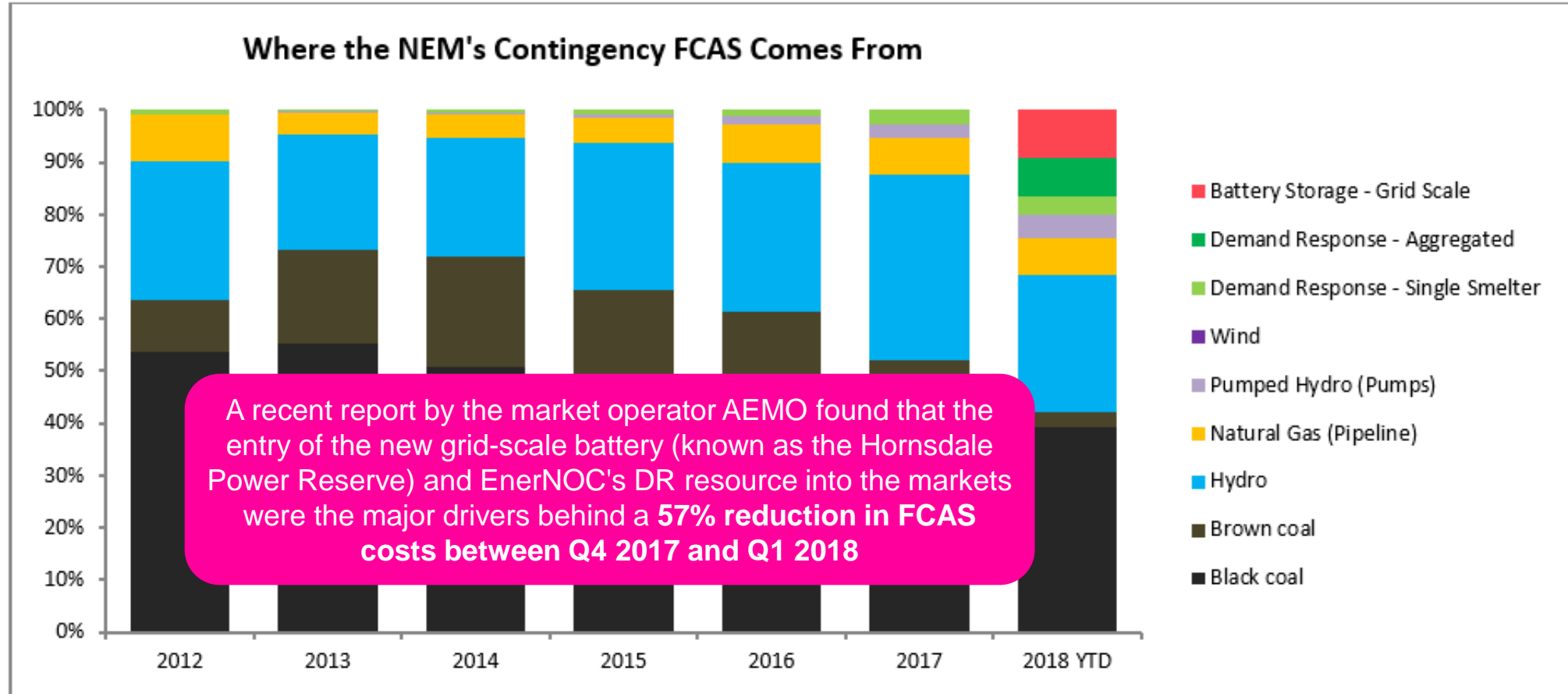


**Chart Data:** EnerNOC portfolio data following trip of Loy Yang Unit A3 from 500 MW | 23 April 2018 15:55:10 AEST



# VPPs are capturing market share, reducing costs

Case study: VPP in Australia for grid frequency management



**Chart data:** Sum of R6, R60, R5 FCAS | Enabled MWh (NB: not 'energy supplied') by technology type  
Calendar years | 2017 to 30 Sep (pre EnerNOC + Hornsdale PR) | 2018 to 31 May

# Implications for Japan

Case study: VPP in Australia for grid frequency management



商品のタイプ	大規模停電回避のツール (年間0-6回の発動)	偶発的需給変動対応リソース (年間0-30回の発動)	
商品 (応答時間)	Capacity DR (30 min-4 hrs) 容量市場		
		Tertiary / Non-Spin Reserves (10-30 min) 三次調整力①・②	
		Secondary / Spin Reserves (1-10 m) 二次調整力 (EDC-H)	
		Contingency Frequency Control (1-60 seconds) 周波数低下を食い止めるリソース (一次調整力GF相当)	二次調整力 (LFC) 周波数調整
市場規模 (需要側リソース)			

## Keys to success

- Direct market access, unbundled from the retail contract
- Allow VPPs to compete in all grid services product categories
- Design products for grid needs, not generator specifications
- Don't over-specify metering requirements

enel x

Thank you!  
ご清聴ありがとうございました。

**Shota Kobayashi**

Manager, Market Development

Enel X

