28 November 2017

ElectraNet

South Australia's electricity transmission specialist

Grid Scale Battery Storage in South Australia

Large Scale Solar + Storage Conference, Sydney

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Presentation outline

- About ElectraNet
- South Australian power system overview
- ESCRI battery energy storage project
- Concluding messages

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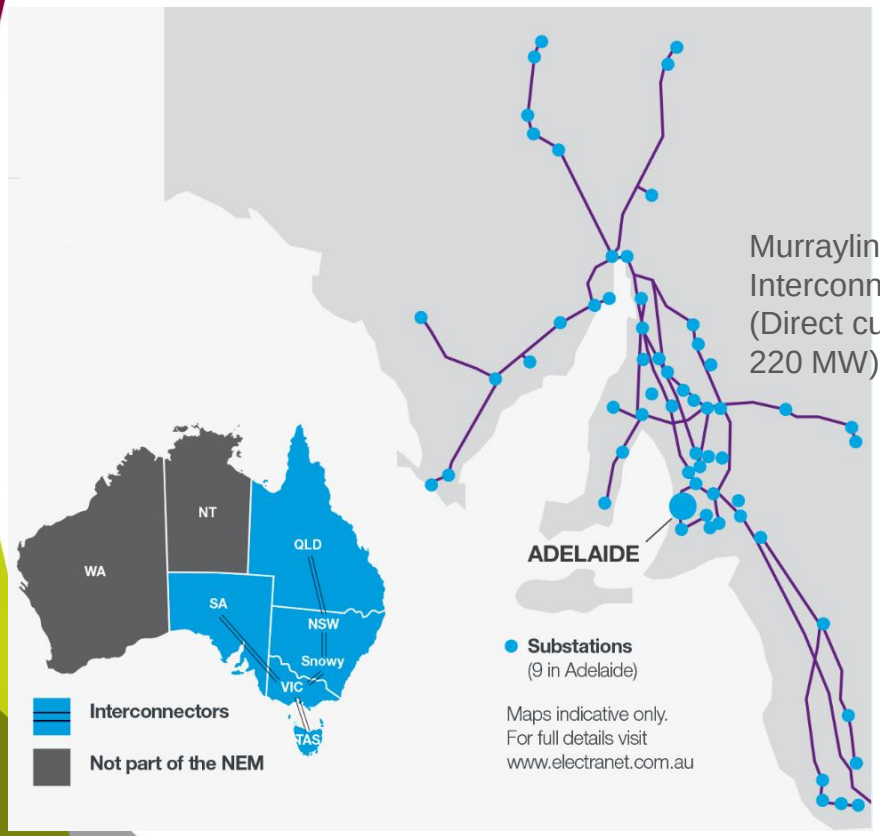
About ElectraNet

About ElectraNet

Owner and operator of South Australia's transmission network



Heywood Interconnector (currently 600 MW)

NEM – National Electricity Market
AEMO – Australian Energy Market Operator

- Connecting customers and moving power over long distances
- Private company with 3 major shareholders (State Grid Corporation of China, YTL Power and Hastings Funds Management)
- Total regulated assets of $2.5 billion
- Network covers area of over 200,000 square kilometers
- 91 high voltage substations
- 5,600 circuit km of high voltage transmission lines and cables
- 13,700 transmission towers

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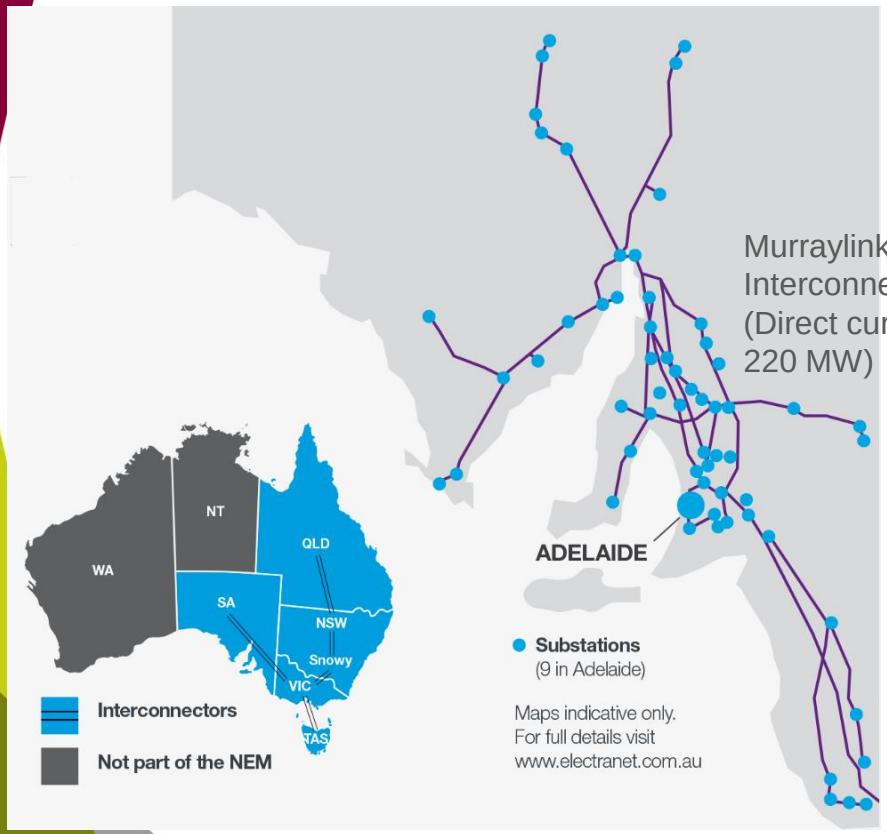
South Australian power system overview

South Australian system overview

South Australia (SA) is at the forefront of energy transformation



Heywood Interconnector (currently 600 MW)

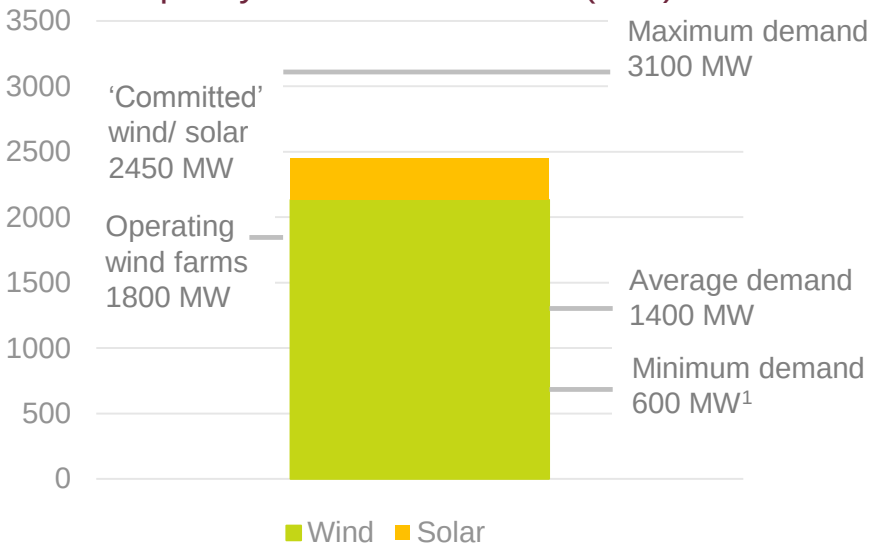
NEM – National Electricity Market
AEMO – Australian Energy Market Operator

- Abundant high quality renewable energy resources with leading wind and solar penetration levels compared to demand
- Last coal fired power station closed 2016
- Reliance on gas generation and impact of higher gas prices
- Recent SA separation and load shedding events have led to heightened concerns about power system security
- New measures have been introduced by AEMO and the SA Government to manage power system security
- Ongoing policy drivers to lower carbon emissions, new technology and customer choice are driving energy transformation

SA renewable energy integration

New challenges are emerging from the combination of high levels of intermittent generation and a relatively isolated and weakly interconnected system

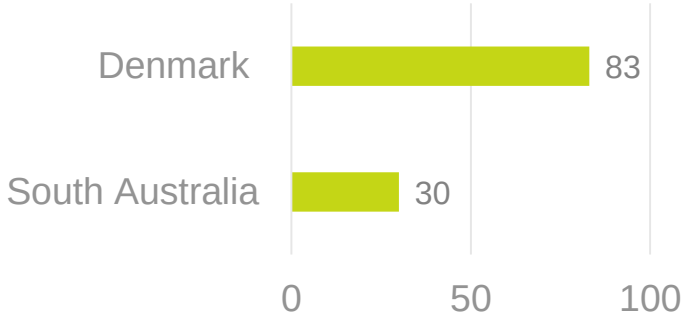
Grid connected intermittent generation capacity relative to demand (MW)



Current wind generation capacity is…

- About 130% of average demand
- > 300% of minimum demand

Interconnector import capacity relative to peak demand (%)

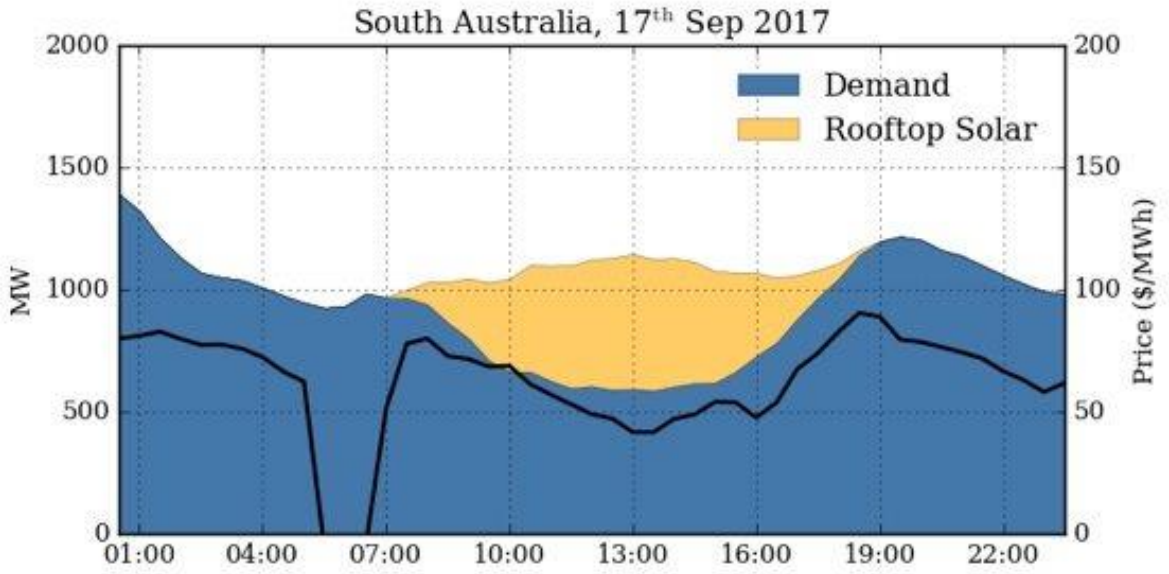


International experience shows that stronger interconnection is needed to support increasingly high levels of intermittent generation and to support energy transformation

1. Growing distributed solar PV (current capacity about 700 MW) is decreasing minimum demand

Changing generation mix

Record low SA electricity demand set on Sunday, 17 September 2017



Notes:

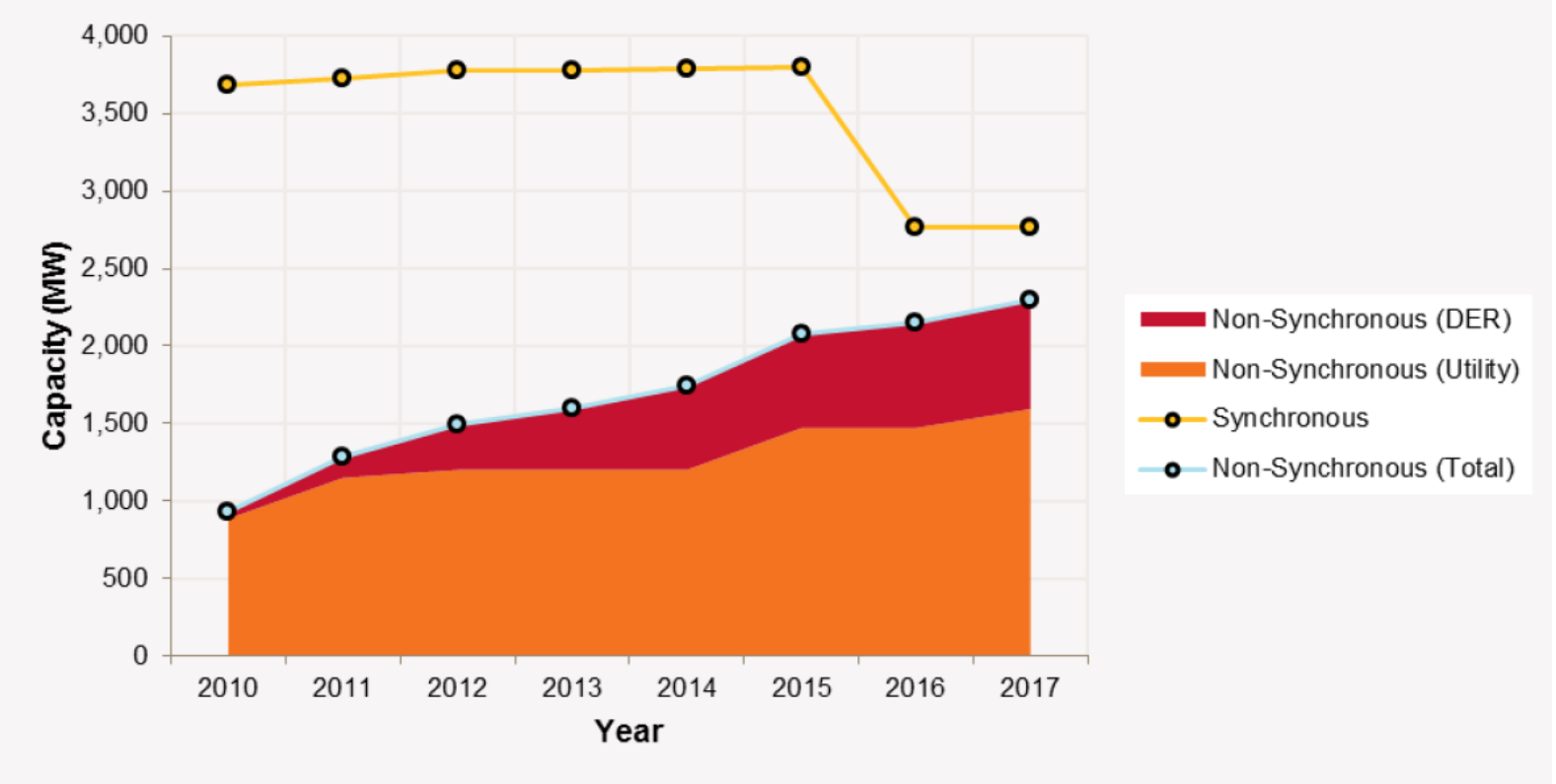
- SA's more than 700 MW of rooftop solar was producing 539 MW or 48% of total electricity demand at time of minimum demand
- Black line shows wholesale prices fall as rooftop solar accounts for a sizeable share of demand during the day – a negative price of minus $44/MWh at 6am occurred when there was abundant wind and a constraint on the interconnector with Victoria

Source: Renew Economy, 18 September 2017

Changing generation mix (cont.)

Increasing non-synchronous and decreasing synchronous generation

SA generation capacity per year



Source: Recommended Technical Standards For Generator Licensing In South Australia, Advice to ESCOSA, AEMO, March 2017

Role for energy storage

- As existing synchronous generators operate less or are retired, new system security ancillary services are required to maintain stability of the power system
- Grid scale battery storage can help provide…
  - Power system security (resilient to disturbances)
  - Energy security (to supply customer demand)
- Neoen/ Telsa 100 MW 129 MWh battery has been energised and is currently being tested ahead of 1 December deadline
- ESCRI 30 MW battery is next major battery project in SA
- Others have recently been announced paired with renewables projects

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ESCRI SA battery energy storage project

Project scope and objectives

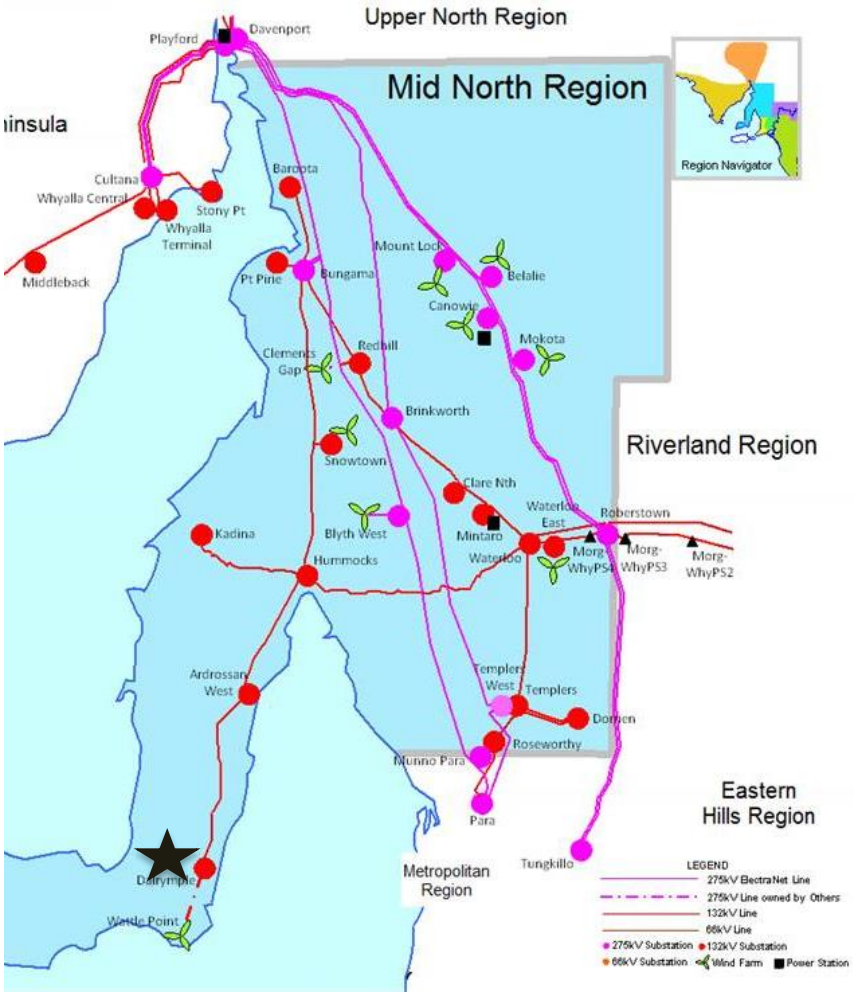
Scope: Nominal 30 MW, 8 MWh lithium-ion battery

1. Demonstrate that grid scale battery storage can effectively provide network reliability and security services alongside competitive energy market services
2. Demonstrate network ownership of battery storage and appropriate commercial separation of the provision of regulated services and competitive market services
3. Demonstrate islanded operation with 100% renewable generation following transmission outages

Location

Site selected to maximise value from BESS

- Connection at 33 kV at Dalrymple substation on Yorke Peninsula
- Opportunity to reduce expected unserved energy under islanding conditions (max demand is about 8 MW but on average need about 3 MW for 2 hours)
- Site is close to the 91 MW Wattle Point Wind Farm – provides opportunity for battery to support islanded operation with the wind farm and 2 MW of local rooftop solar, following network outages



BESS – Battery Energy Storage System

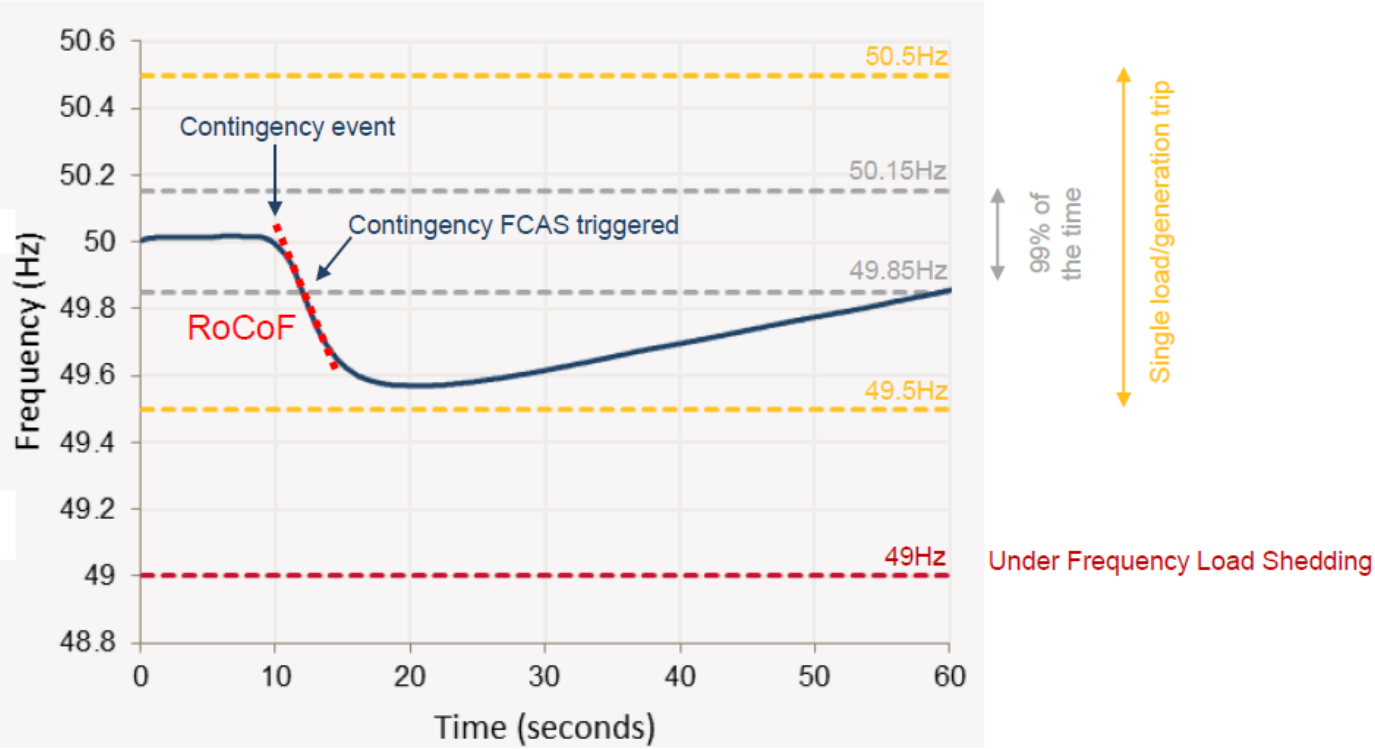
Revenue streams

Providing both regulated and competitive market services

Regulated services (ElectraNet)	Competitive market services (AGL Energy)
Fast frequency response Heywood Interconnector benefit[1]	Ancillary services revenue (FCAS)
Reduced unserved energy benefit	Market cap trading

1. Fast frequency response benefit arises from reducing Heywood Interconnector constraints that are limiting imports over the interconnector to manage high rates of change of frequency (the 3 Hz/s Rate of Change of Frequency (RoCoF) limit)

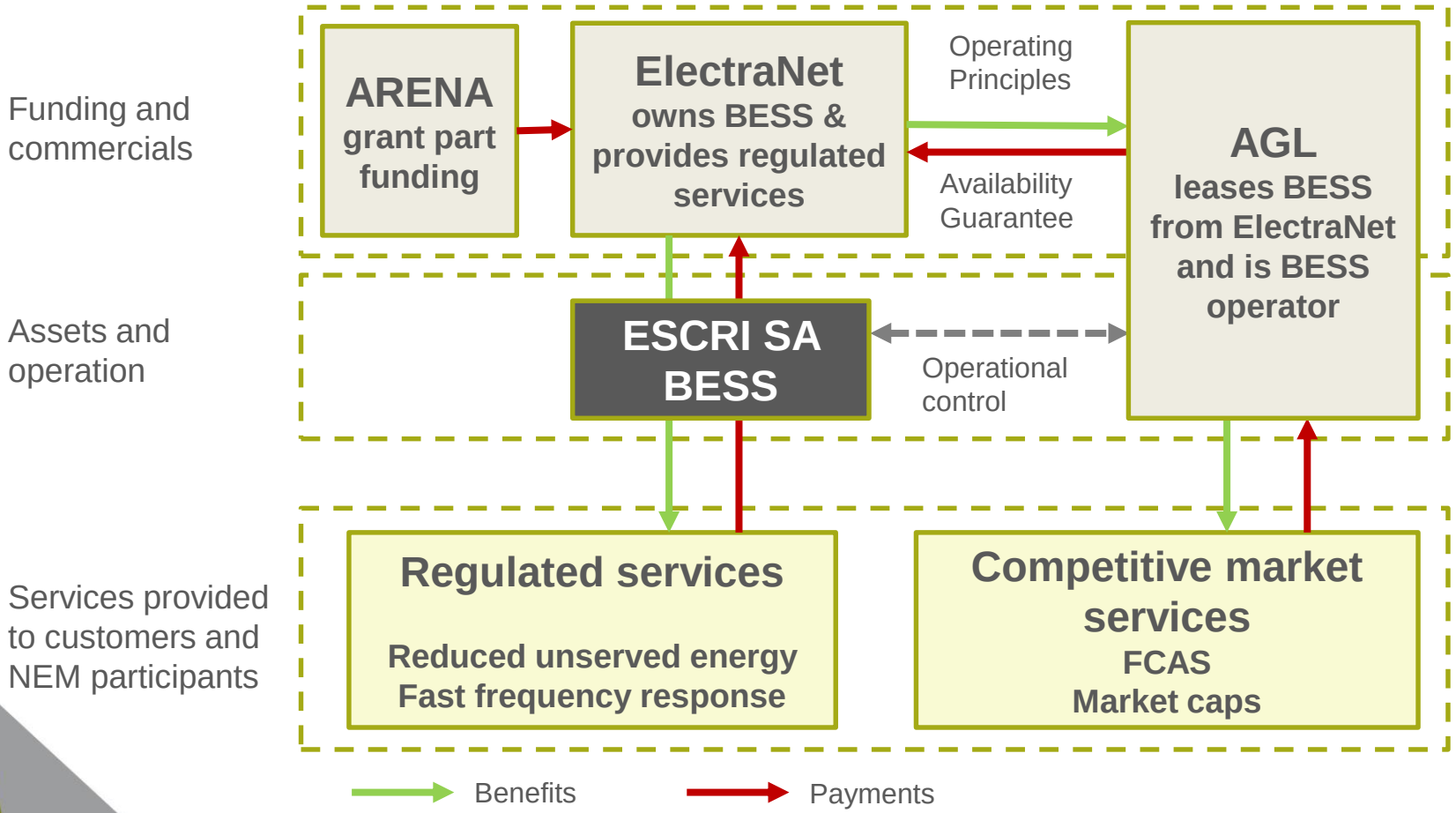
Fast frequency response



- Following an unexpected loss of generation/ load the resulting imbalance of supply and demand causes system frequency to fall/ rise
- If RoCoF is too high it could result in cascading trips of load or generation and emergency control schemes may not prevent system collapse
- Battery can provide fast injection of power to limit RoCoF

Commercial arrangements

Providing both regulated and competitive market services

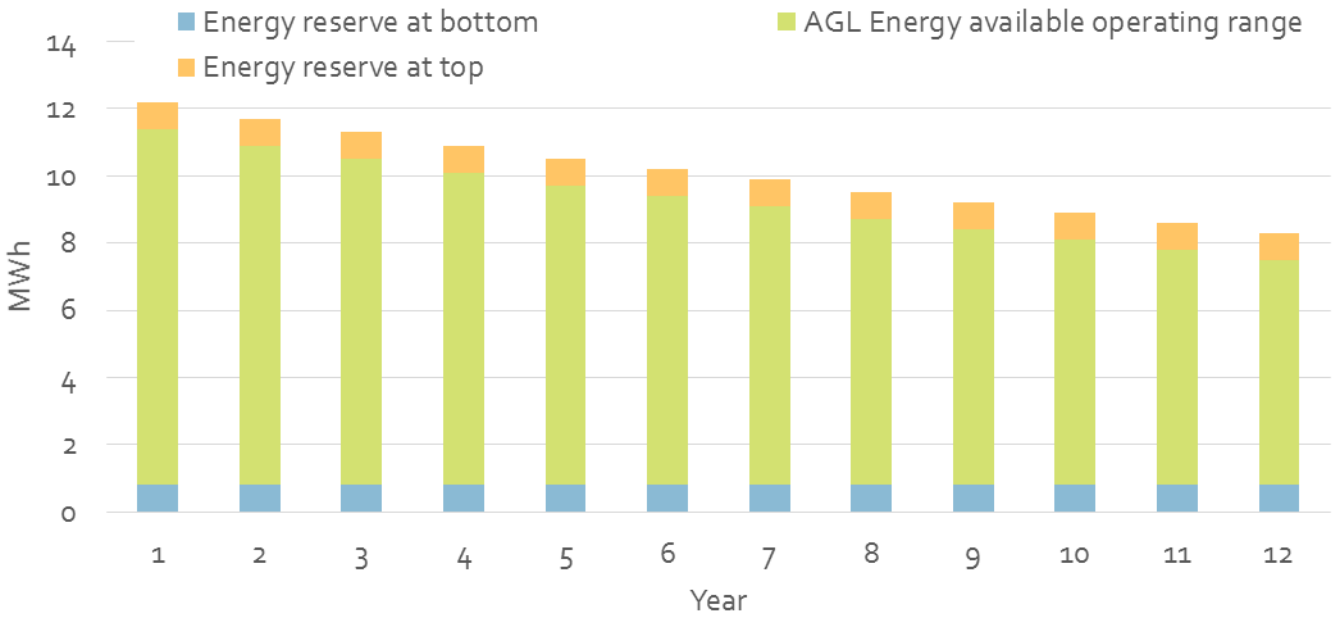


EPC/ D&C contract and 12-year maintenance agreement awarded to Consolidated Power Projects (CPP) following extensive procurement process

Operating principles

Battery Operating Agreement prioritises and protects regulated services

Level of charge at 33kV for non-regulated services	With Windfarm coordination	Without Windfarm coordination
Max allowable level of charge	X – 0.8 MWh	X
Min allowable level of charge	0.8 MWh	4.8 MWh



Regulated financials[1]

Benefits to regulated customers exceed costs

Estimated costs and benefits to regulated customers	PV ($m)
Prescribed costs of project (including operating costs)	(6.3)
Benefits of reduced unserved energy	5.3
Benefits of reduced interconnector constraints	8.2
Net benefits to customers	7.2

Capital cost allocation ($m nominal)	Cost allocation[2]
Total capital cost	**30.0**
ARENA grant funding	12.0
Capital cost offsets (in-kind contributions and R&D tax credits)	1.6
Non-regulated component (Battery operator lease)	10.6
Prescribed component	5.8

1. All figures approximate only
2. Direct attribution method applied

Contract award and knowledge sharing

- Design and Construct contract and 12-year maintenance agreement awarded to Consolidated Power Projects (CPP) following extensive procurement process
- CPP is working with international power company ABB and battery provider Samsung to deliver the project
- Project will deliver substantial knowledge sharing benefits…
  - Knowledge sharing plan agreed with ARENA
  - Advisian engaged as knowledge sharing partner to help implement the plan
  - Plan includes web portal, project reports, knowledge sharing reference group

Regulatory treatment

- Acceptance of a service based approach to regulation
- Create a new battery registration category under the National Electricity Rules that picks up relevant generation registration and charging/ discharging requirements so AEMO can manage constraints in market systems
- Current requirement to register as a scheduled load as well as a scheduled generator raises TUOS implications, jurisdictional licensing obligations etc.
- No issues with cost allocation, but AER suggests further work is required to develop a more general cost allocation approach for assets providing both regulated and competitive energy market services

Milestones

Key deliverable	Target date
Financial close and contract award	Completed 21 Sep 2017
Energisation of BESS	28 Feb 2018
Final commissioning of BESS	30 Apr 2018
Handover of operation to AGL Energy	1 May 2018
ARENA reporting and knowledge sharing period ends (two years)	29 May 2020

Concluding messages

- As existing synchronous generators operate less or are retired, new system security ancillary services are required to maintain stability of the power system
- Grid scale battery storage can help and is being deployed to gain necessary experience
- An increasing proportion of intermittent generation will be facilitated by stronger interconnection between regions and grid scale energy storage
- Connection of grid scale renewable resources will be enabled by extending the transmission network to where these resources are found
- A very interesting time of change, transition and opportunity in the electricity industry

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