ESCRI SA

Grid Scale Battery Storage in South Australia

Solar + Energy Storage Congress
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ElectraNet agl ARENA Australian Government Australian Renewable Energy Agency Advisian WorleyParsons Group

Presentation outline

- South Australian power system overview
- Energy security and system security
- ESCRI SA battery energy storage project
- Discussion / Questions

South Australian Power System Overview

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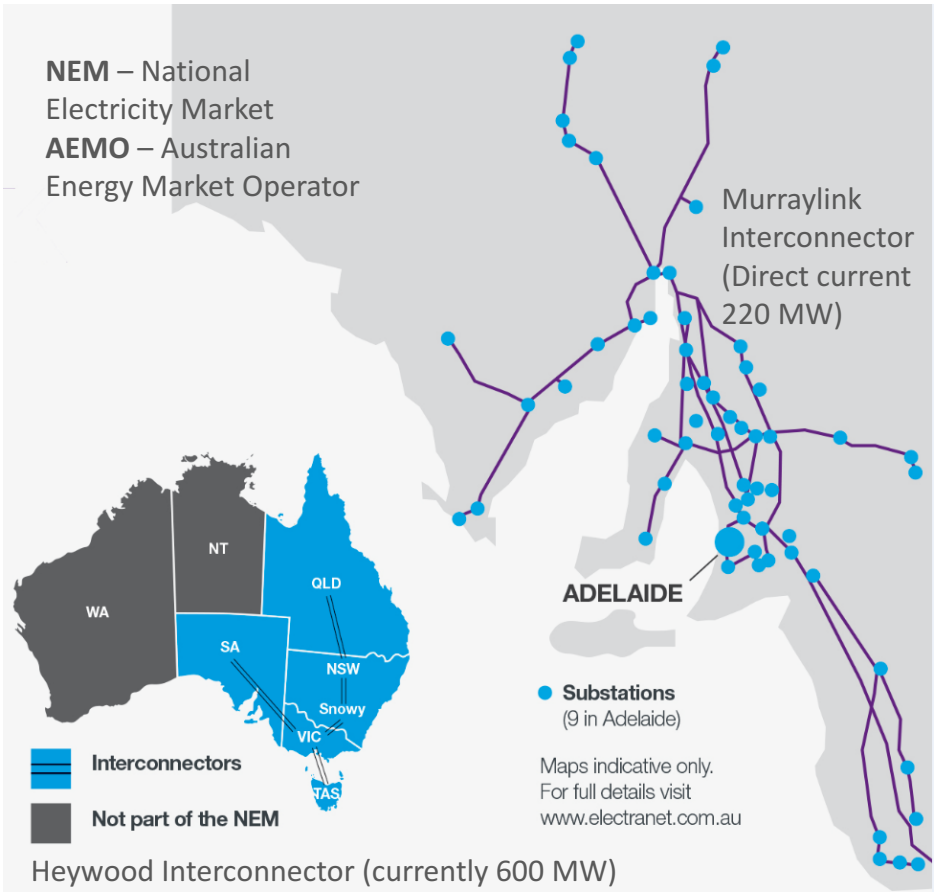
An Advancing Renewables Program project
with the Australian Renewable Energy Agency

About ElectraNet

Owner and operator of South Australia's transmission network



- Connecting customers and moving power over long distances
- Private company with 3 major shareholders
- Total regulated assets of $2.5 billion
- Network covers area of over 200,000 square kilometres
- 91 high voltage substations
- 5,600 circuit km of high voltage transmission lines and cables
- 13,700 transmission towers

South Australian overview

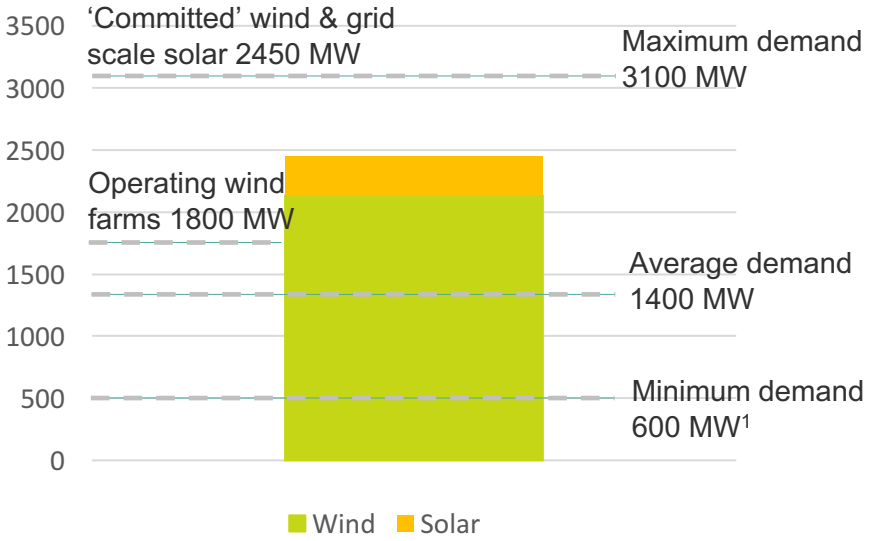
South Australia (SA) is at the forefront of energy transformation

- Leading levels of integration of intermittent wind and solar energy with abundant high quality resources
- 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

Intermittent generation capacity relative to demand (MW)

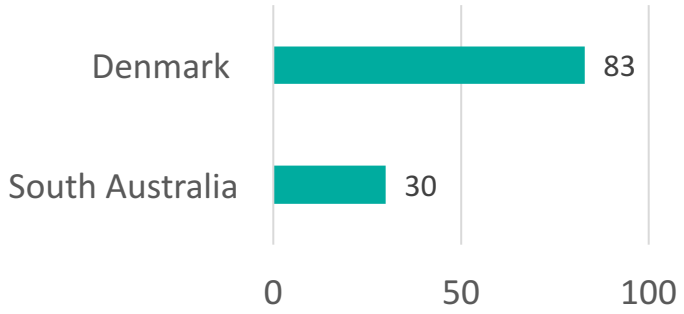


Wind plus solar generation capacity is…

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

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

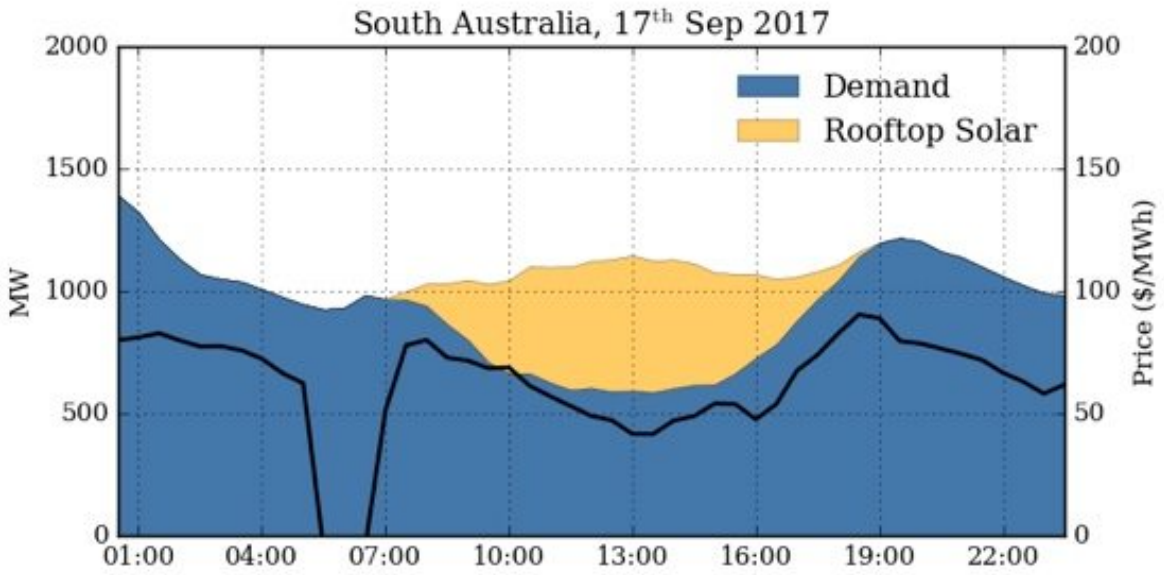
Interconnector import capacity relative to peak demand (%)



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

Changing generation mix

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



NOTES:

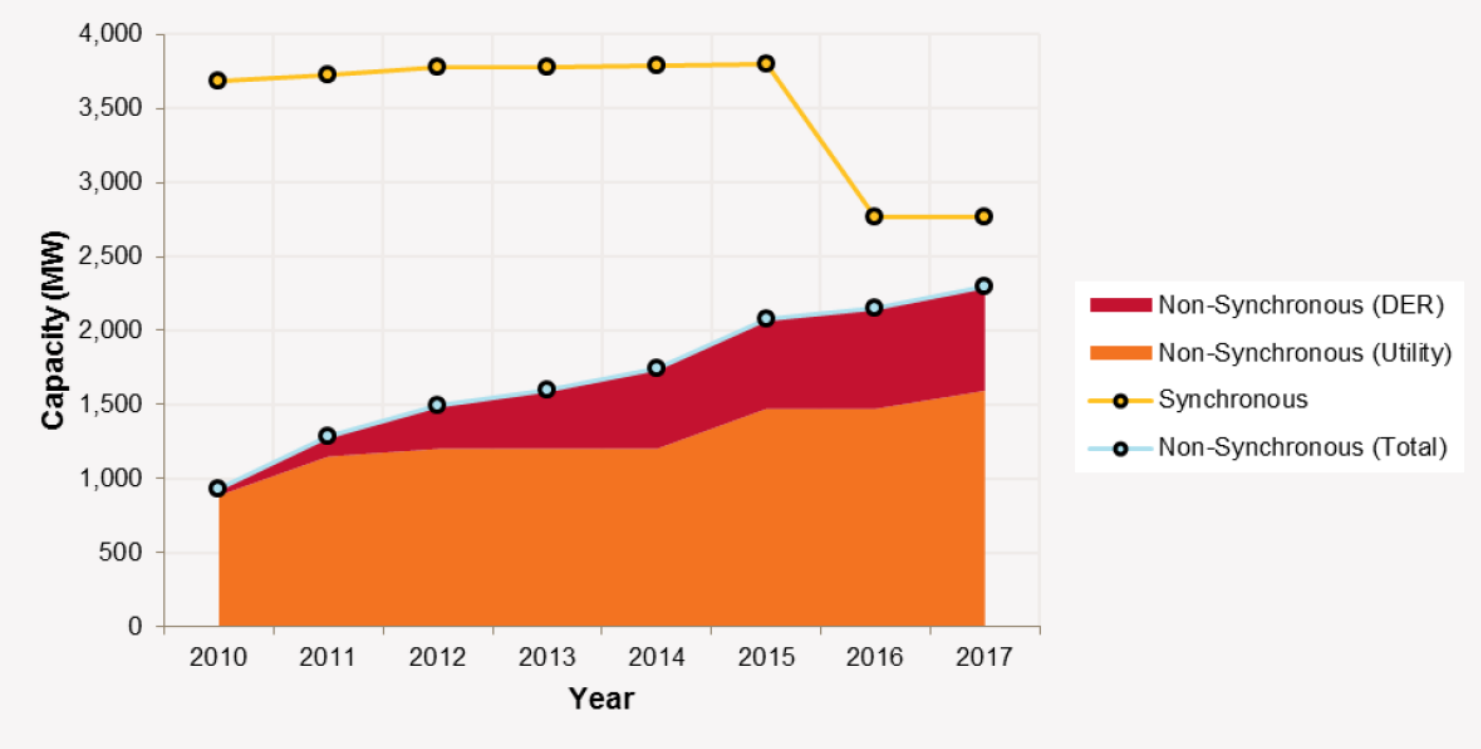
- SA's more than 700 MW of rooftop solar was producing 539 MW or 48% of total electricity demand at time of minimum demand.
- Black line shows wholesale prices fall as rooftop solar accounts for a sizeable share of demand during the day – a negative price of minus $44/MWh at 6am occurred when there was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

Source: Renew Economy, 18 September 2017

System security challenges

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

Energy Security and System Security

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Energy batteries and power batteries

Batteries alone unlikely to provide required energy security

Energy providers for energy security:

- Energy batteries (limited)
- Fast start synchronous generators (in combination with sufficient fuel source)
- Solar thermal energy storage
- Pumped hydro energy storage
- Transmission interconnectors

Grid scale batteries are well suited to assist with system security:

- Fast Frequency Response
- Part of a Special Protection Scheme (SPS)
- Frequency Control Ancillary Services (FCAS)
- Voltage control

ESCRI SA battery energy storage system (BESS) project

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Project development history

ESCRI SA Phase 1 – Business Case exploration

Nov 2014 - Dec 2015	Examined regulatory, commercial, technology and technical issues and publicly reported results – Business case for a 10 MW, 20 MWh battery was poor

ESCRI SA Phase 2 – Expression of Interest for delivery phase

March - July 2016	30 MW, 8 MWh battery for targeting fast frequency response, but unable to monetise – Benefits included increased Heywood Interconnector import capability, reduced unserved energy, and market price cap trading. Business case improved.

ESCRI SA Phase 2 – Full Application for delivery phase

January – March 2017	Same 30 MW, 8 MWh battery but with fast frequency response system security benefit monetised (reducing Heywood Interconnector import constraints) and ancillary services revenue added. ARENA grant funding of up to $12m required.

Project scope and objectives

Nominal 30 MW, 8 MWh lithium-ion BESS demonstration project

1. Demonstrate that grid scale battery storage can effectively provide network reliability and security services alongside market services

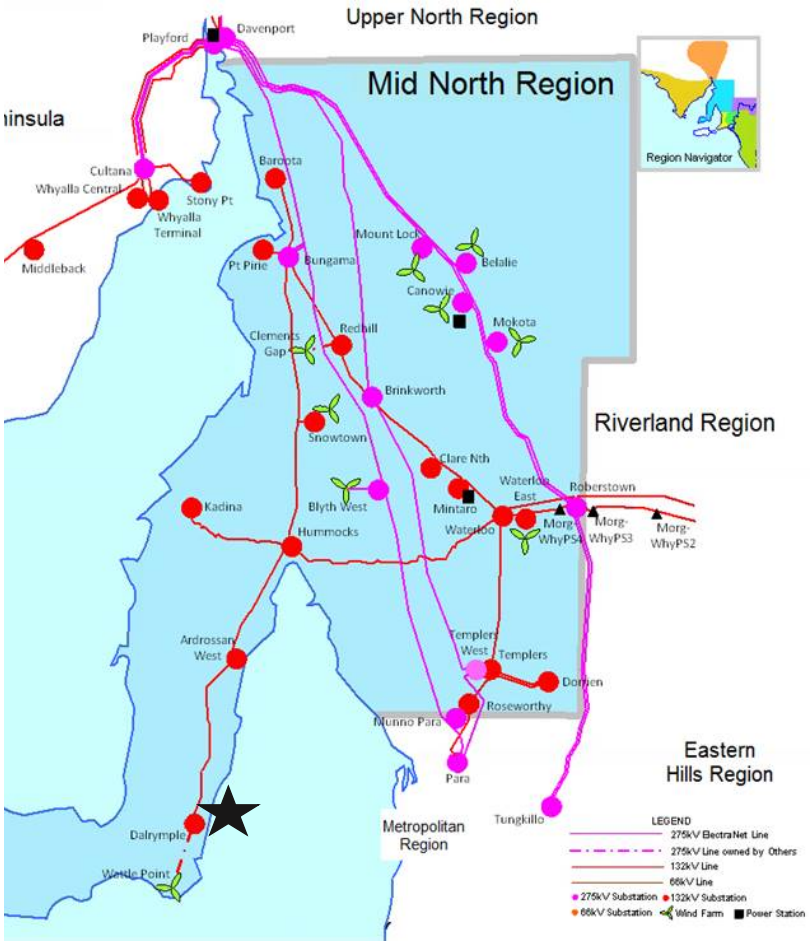
2. Demonstrate network ownership of battery storage and appropriate commercial separation of provision of regulated services and competitive energy market services

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



Revenue streams

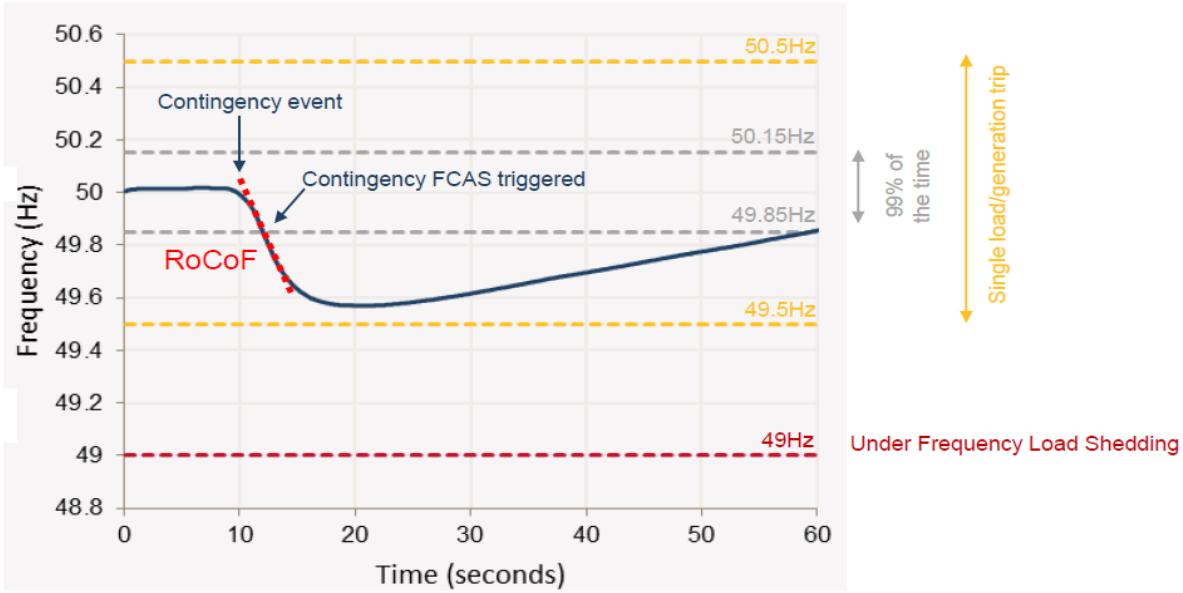
Providing both regulated and competitive market services

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 (FFR)

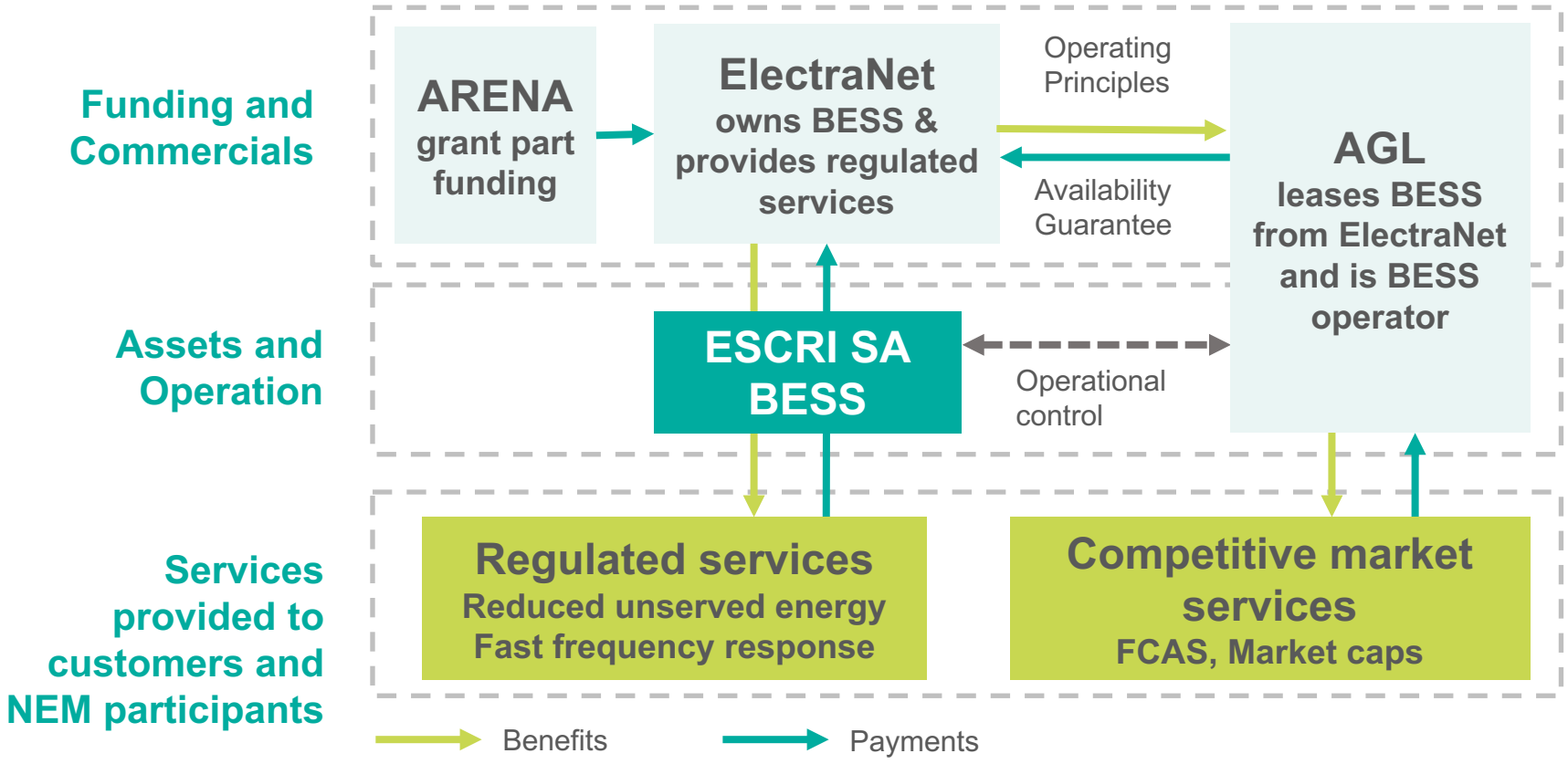
Fast response is also beneficial as part of a Special Protection Scheme



- 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
- BESS can provide fast injection of power to limit RoCoF

Commercial arrangements

Competitive market services at arm's length

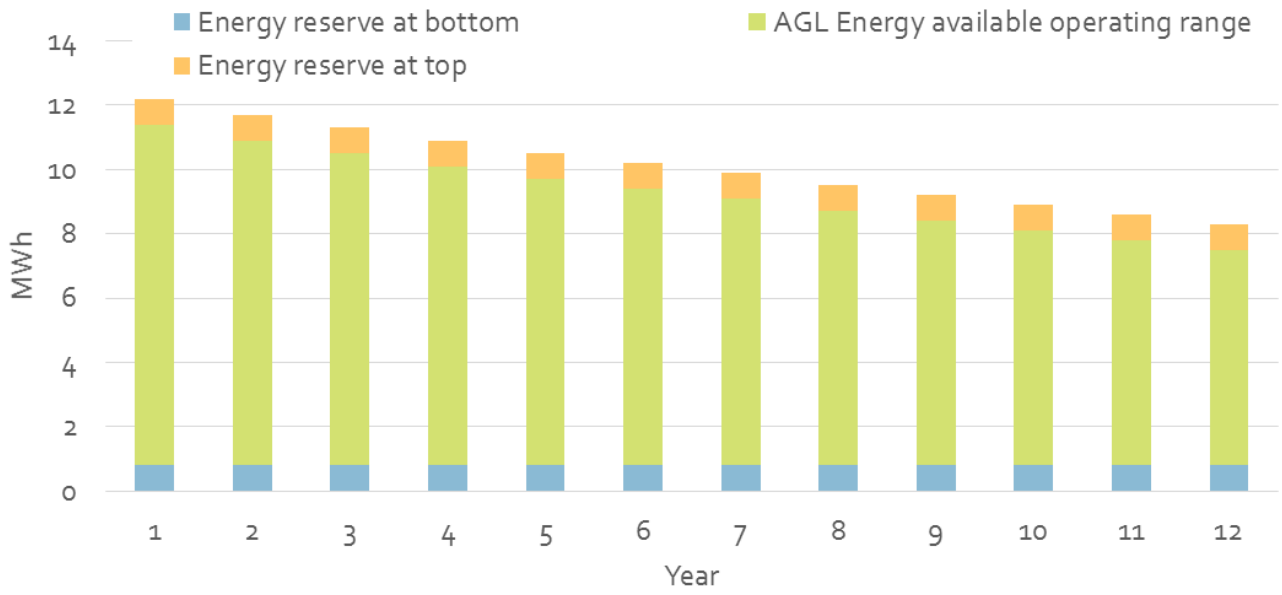


EPC/ D&C contract and 12-year maintenance agreement awarded to Consolidated Power Projects (CPP) following extensive procurement process

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

Battery Operating Agreement prioritises and protects regulated services

Estimated cost ands benefits to regulated customers	PV ($m)[1]
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

Other aspects

- 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 to stakeholders - Advisian engaged as knowledge sharing partner to implement Knowledge Sharing Plan: Web portal, project reports, knowledge sharing reference group
- Regulatory treatment – Cost allocation follows direct attribution method – AER supportive but suggests further work is required to develop a general cost allocation approach for assets providing both regulated and competitive energy market services
- BESS connection treated as a negotiated transmission service under the National Electricity Rules – so transmission charges (TUOS) not payable

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

Discussion/Questions

ESCRI SA

Thank you

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