

31 October 2017



South Australia's electricity transmission specialist

# Battery Storage and Energy Transformation in South Australia

NEM Future Forum, Sydney

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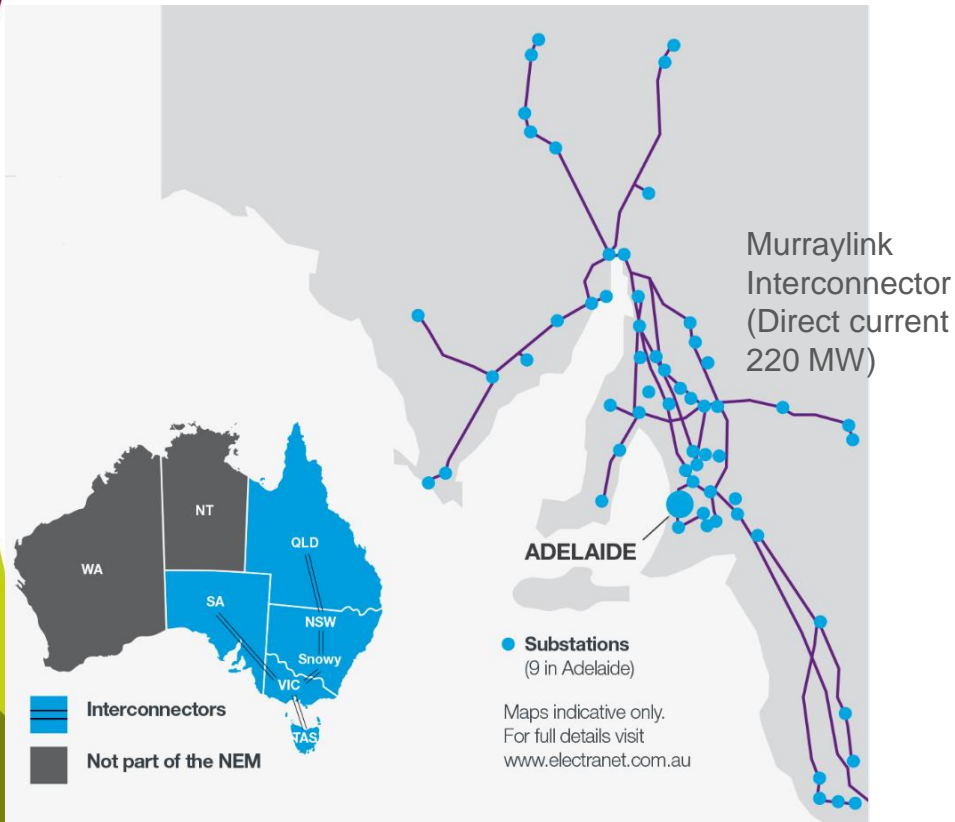
# Presentation outline

- > About ElectraNet
- > South Australian power system overview
- > Recent events and power system/ energy security initiatives
- > ESCRI battery energy storage project
- > Concluding messages

# About ElectraNet

# About ElectraNet

Owner and operator of South Australia's transmission network



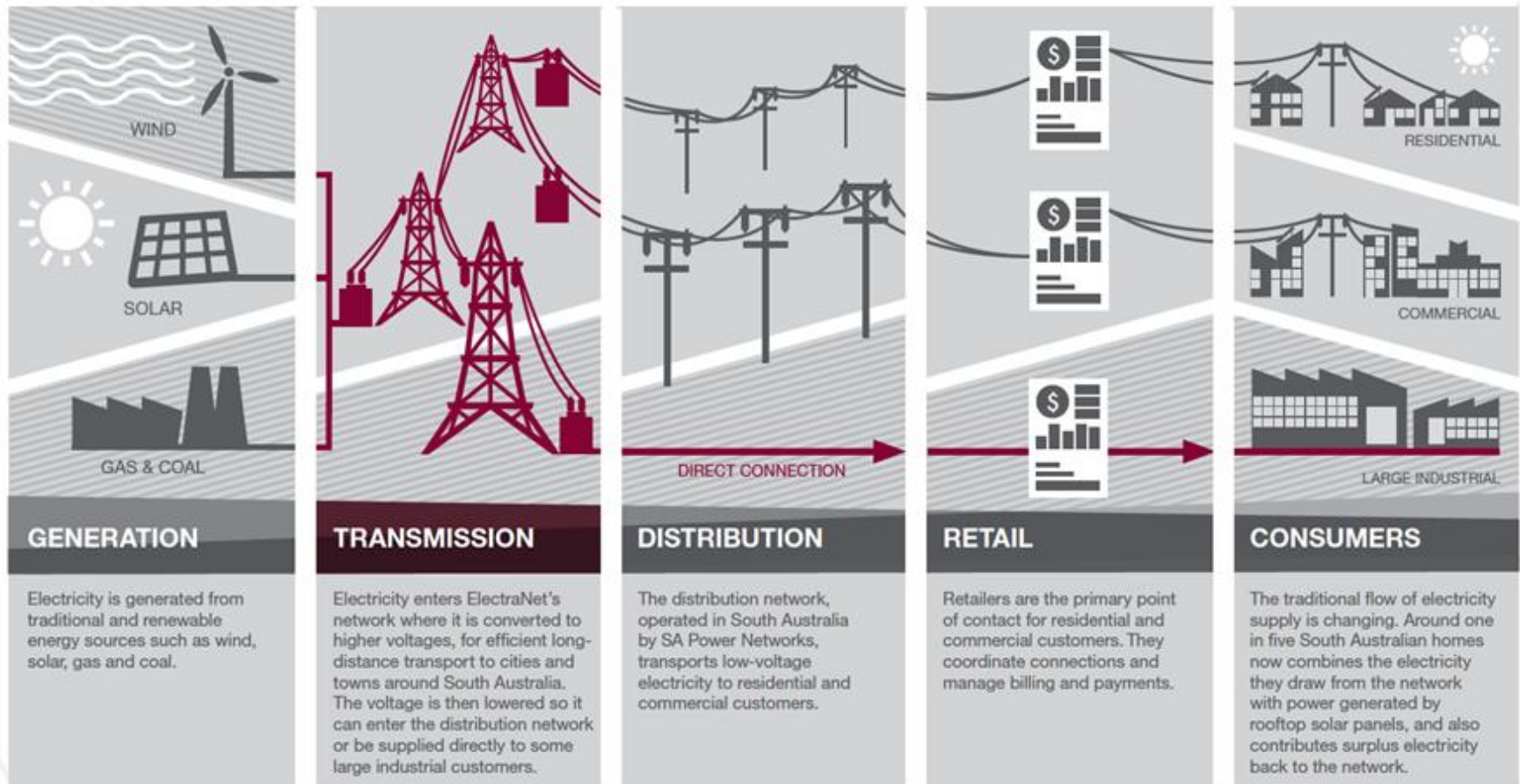
Heywood Interconnector  
(currently 600 MW)

- > 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
- > Capital expenditure of about \$400 to \$500 million over next 5 years
- > 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

# Electricity supply chain

Transmission costs are about 7% of average residential customer bill

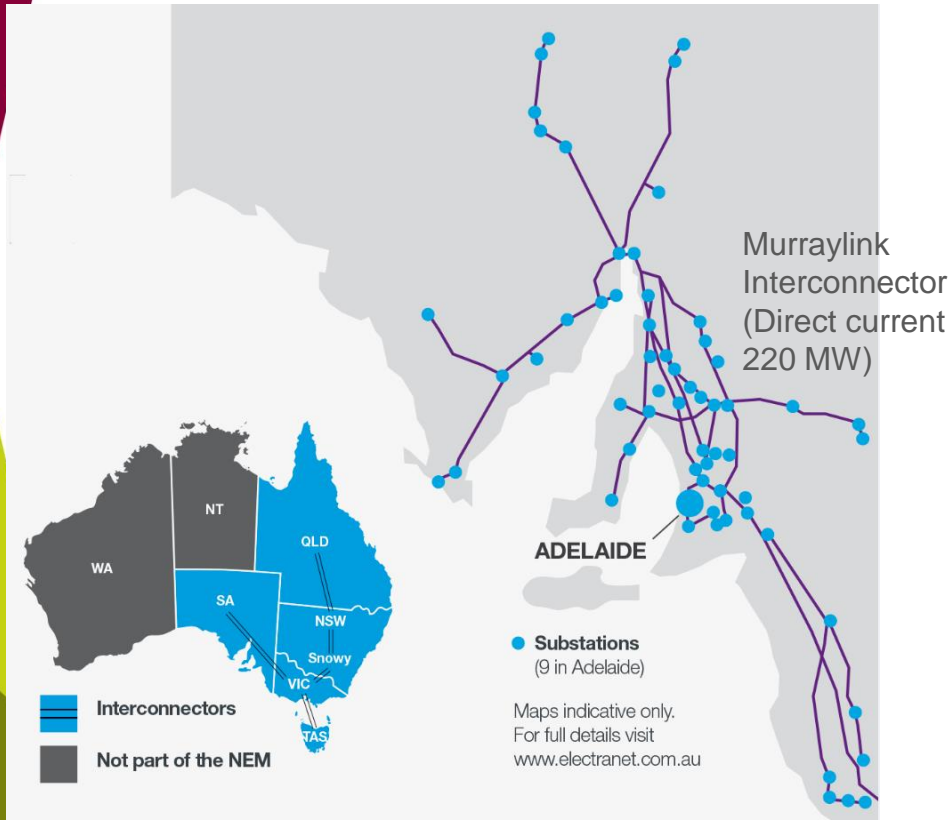
## How electricity gets to you



# South Australian power system overview

# 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

Heywood Interconnector (currently 600 MW)

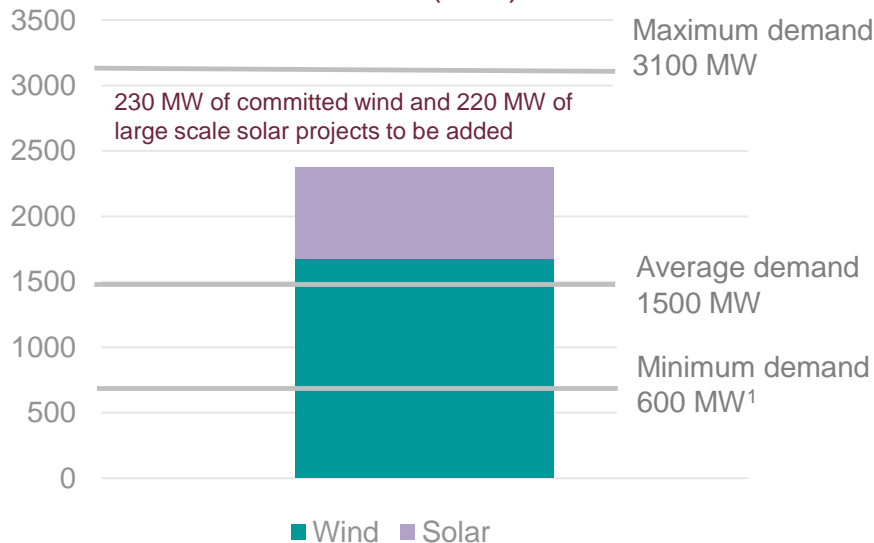
NEM – National Electricity Market  
 AEMO – Australian Energy Market Operator



# 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

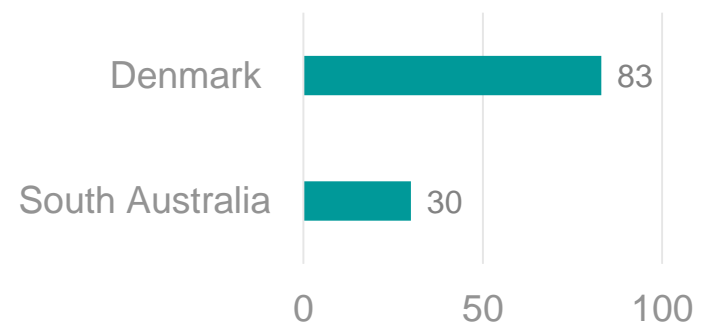
Intermittent generation capacity relative to demand (MW)



Wind plus solar generation capacity is...

- > 150% of average demand
- > 300% of minimum demand

Interconnector import capacity relative to peak demand (%)



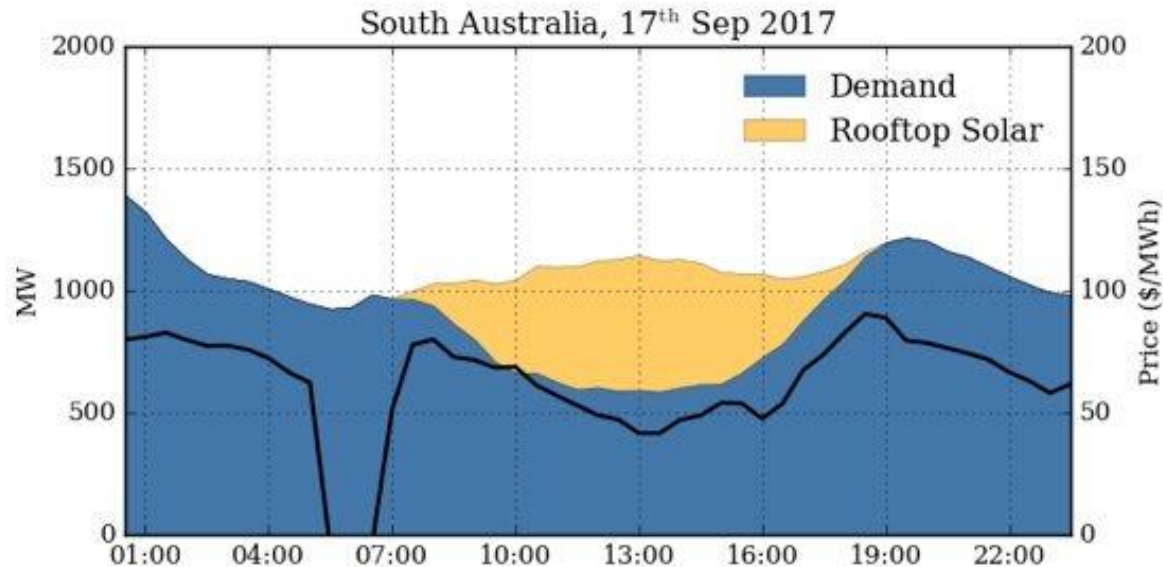
International experience shows that stronger interconnection is needed to support increasingly high levels of intermittent generation and to support energy transformation

1. Record low demand of 588 MW set on Sunday, 17 September 2017



# Changing generation mix

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



Notes:

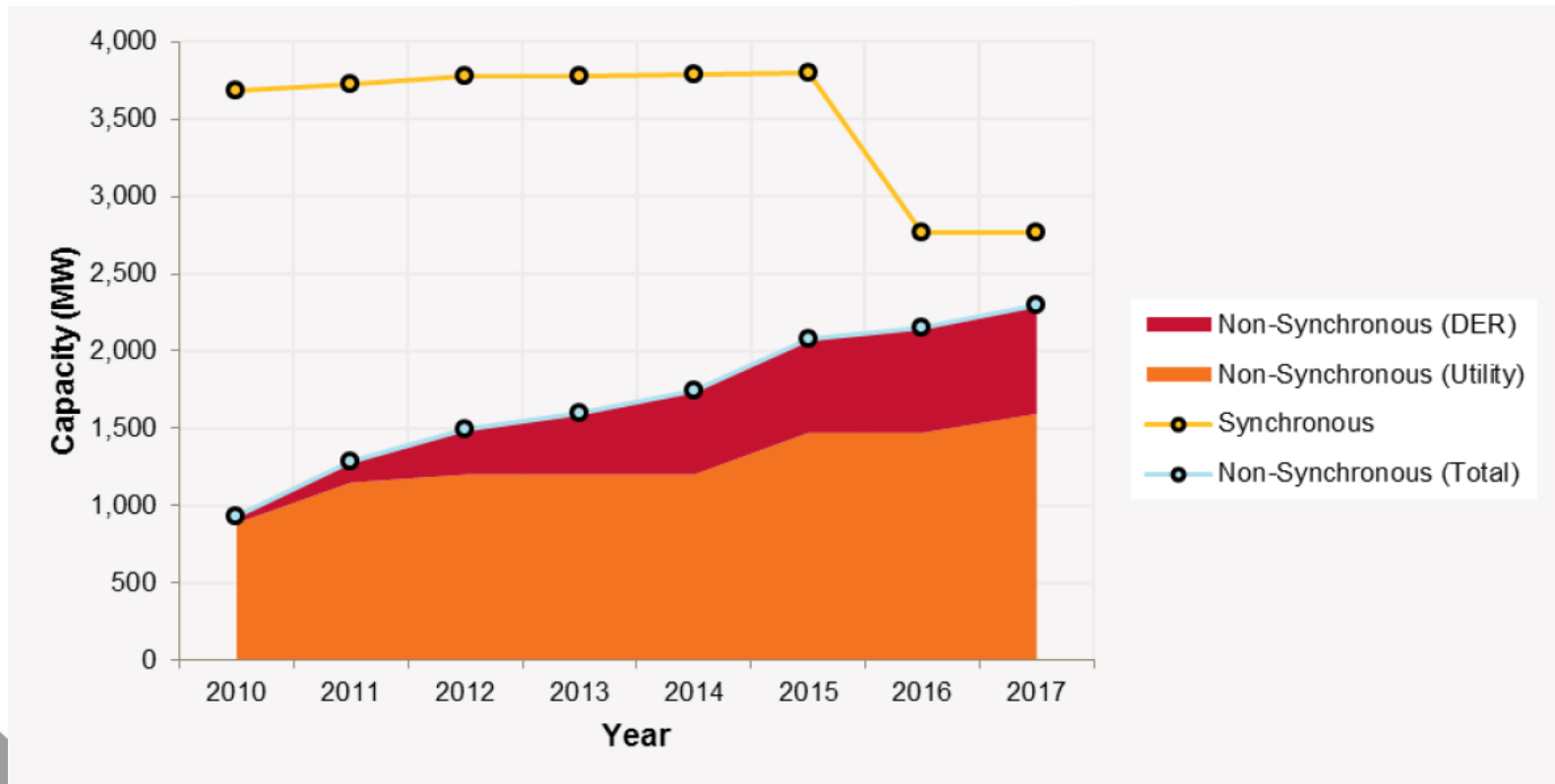
- SA's more than 700 MW of rooftop solar was producing 539 MW or 48% of total electricity demand at time of minimum demand
- Black line shows wholesale prices fall as rooftop solar accounts for a sizeable share of demand during the day – a negative price of minus \$44/MWh at 6am occurred when there was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

# Recent events and power system/ energy security initiatives

# Recent events

- > **9 May 2016** – Northern Power Station closes (546 MW brown coal-fired)
- > **28 September 2016** – SA storms, blackout and restoration
- > **7 November 2016** – ElectraNet releases SA Energy Transformation consultation report
- > **8 February 2017** – SA 45 minute load shedding during a heatwave
- > **14 March 2017** – SA Government announces its Energy Plan for South Australia to take charge of its energy future
- > **30 March 2017** – Hazelwood power station closes (1,600 MW or 13.8% of scheduled/ semi-scheduled generation in Victoria)
- > **9 June 2017** – Independent Review into the Future Security of the National Electricity Market, Final report and blueprint for a world class electricity system released (Finkel report)

## Recent events (cont.)

- > **6 July 2017** – SA Government commits to a 100 MW grid scale battery installation
- > **14 July 2017** – COAG Energy Council accepts 49 out of 50 recommendations of the Finkel report
- > **1 August 2017** – SA Government announces a long-term backup power plant to be in place by 1 December 2017 to provide up to 276 MW in times of emergency
- > **22 August 2017** – Federal Minister Josh Frydenberg announces part funding of 30 MW battery in South Australia by the Australian Renewable Energy Agency (ARENA)
- > **3 October 2017** – ElectraNet awards contract to build 30 MW battery on Yorke Peninsula in South Australia

# ElectraNet initiatives

# ElectraNet initiatives

ElectraNet is playing a leading role to deliver affordability, reliability and choice for customers



RIT-T – Regulatory Investment Test for Transmission

- > South Australian Energy Transformation RIT-T, investigating the feasibility of new interconnector options and non-network alternatives to put downward pressure on price and improve system security
- > Eyre Peninsula electricity supply options RIT-T, including Renewable Energy Zone considerations
- > Proof of concept battery storage project to demonstrate the role of battery storage in integrating renewable energy
- > Exploring synchronous condensers to meet system strength requirements and alleviate current wind constraints
- > Special protection scheme to ensure successful islanded operation of power system in an emergency



# ESCRI battery energy storage project

# Project development history

## ESCRI-SA Phase 1 – Business Case exploration

**November 2014 to  
December 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 to 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 to  
March 2017**

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

# Project scope and objectives

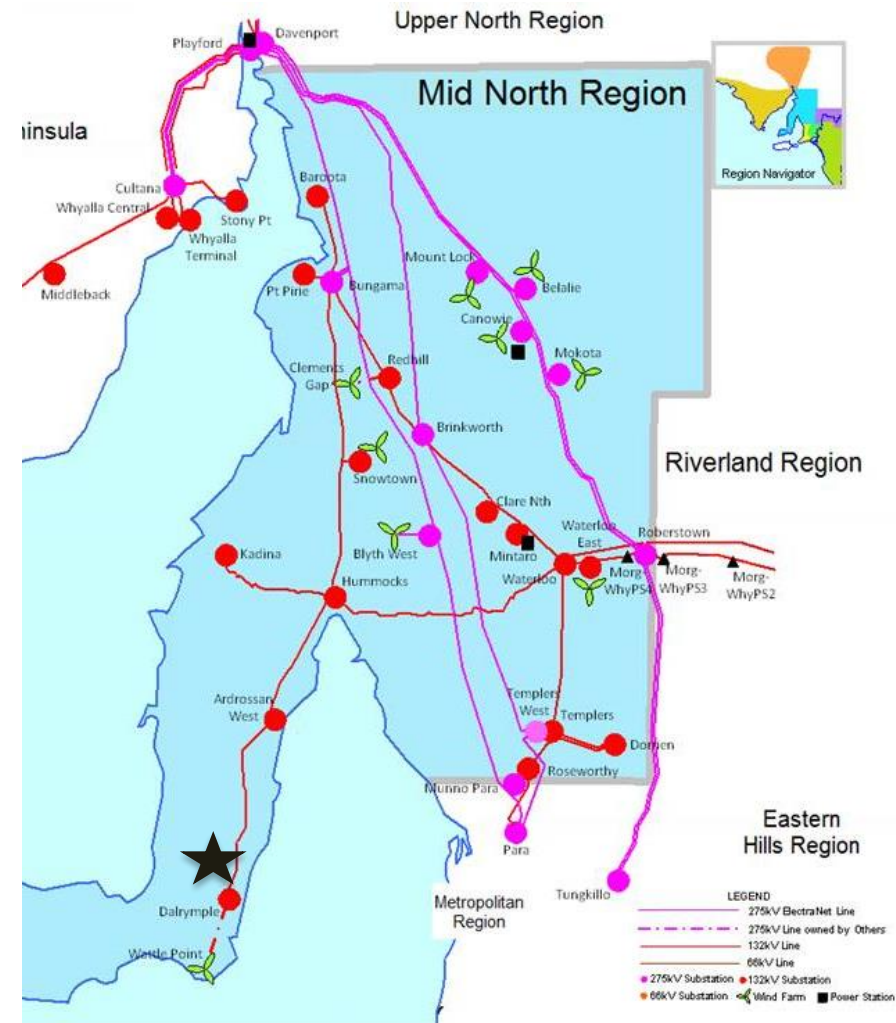
Scope: Nominal 30 MW, 8 MWh lithium-ion battery

1. Gain practical experience and learnings from the application of grid connected utility scale battery storage as an enabler of large scale intermittent renewable energy on an interconnected system
2. Demonstrate that utility scale battery storage can effectively provide network reliability and security services alongside market services
3. Demonstrate network ownership of battery storage and commercial appropriate separation of provision of regulated services and competitive energy market services
4. Demonstrate “seamless” islanded operation with 100% renewable generation following transmission outages

# Location

## Site selected to maximise value from battery

- > Connection at 33 kV at Dalrymple substation on Yorke Peninsula – land available
- > 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



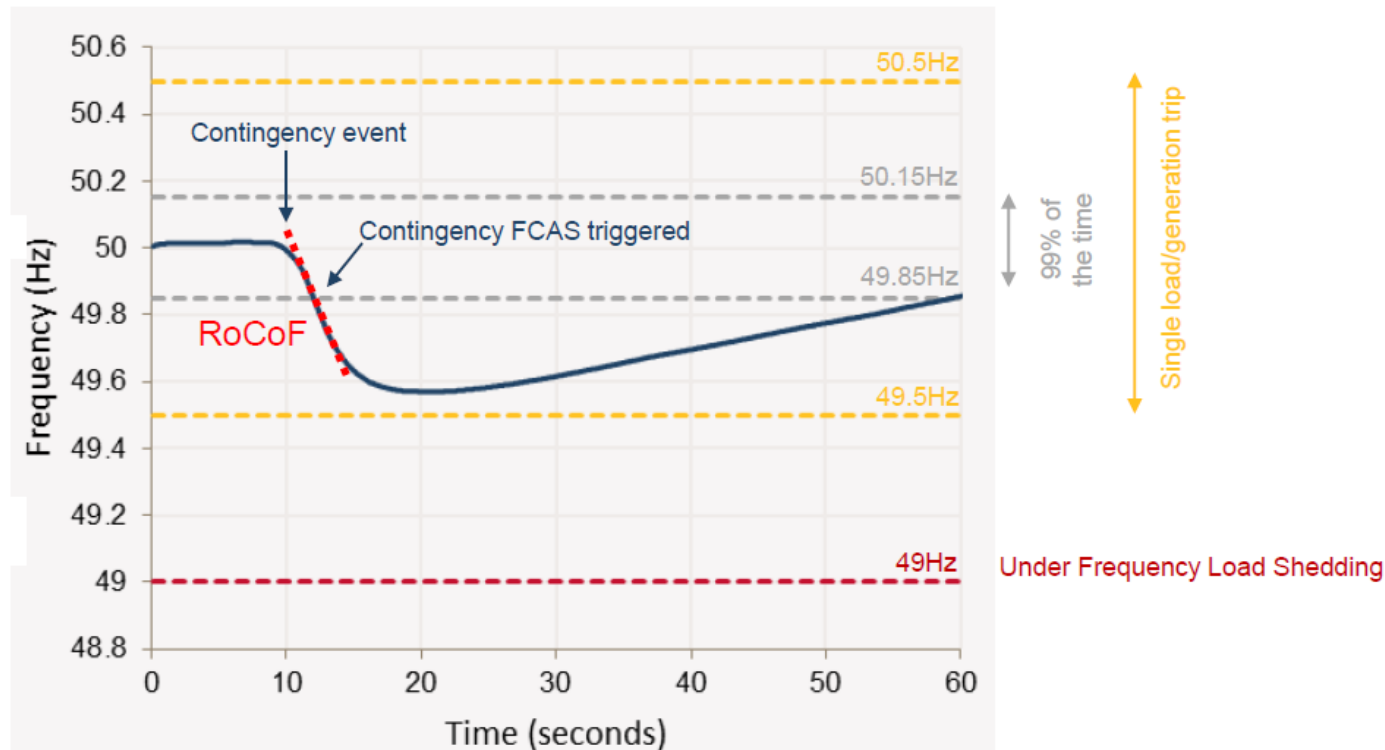
# Revenue streams

Providing both regulated and competitive market services

Regulated services (ElectraNet)	Competitive market services (AGL Energy)
Fast frequency response Heywood Interconnector benefit <sup>1</sup>	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)

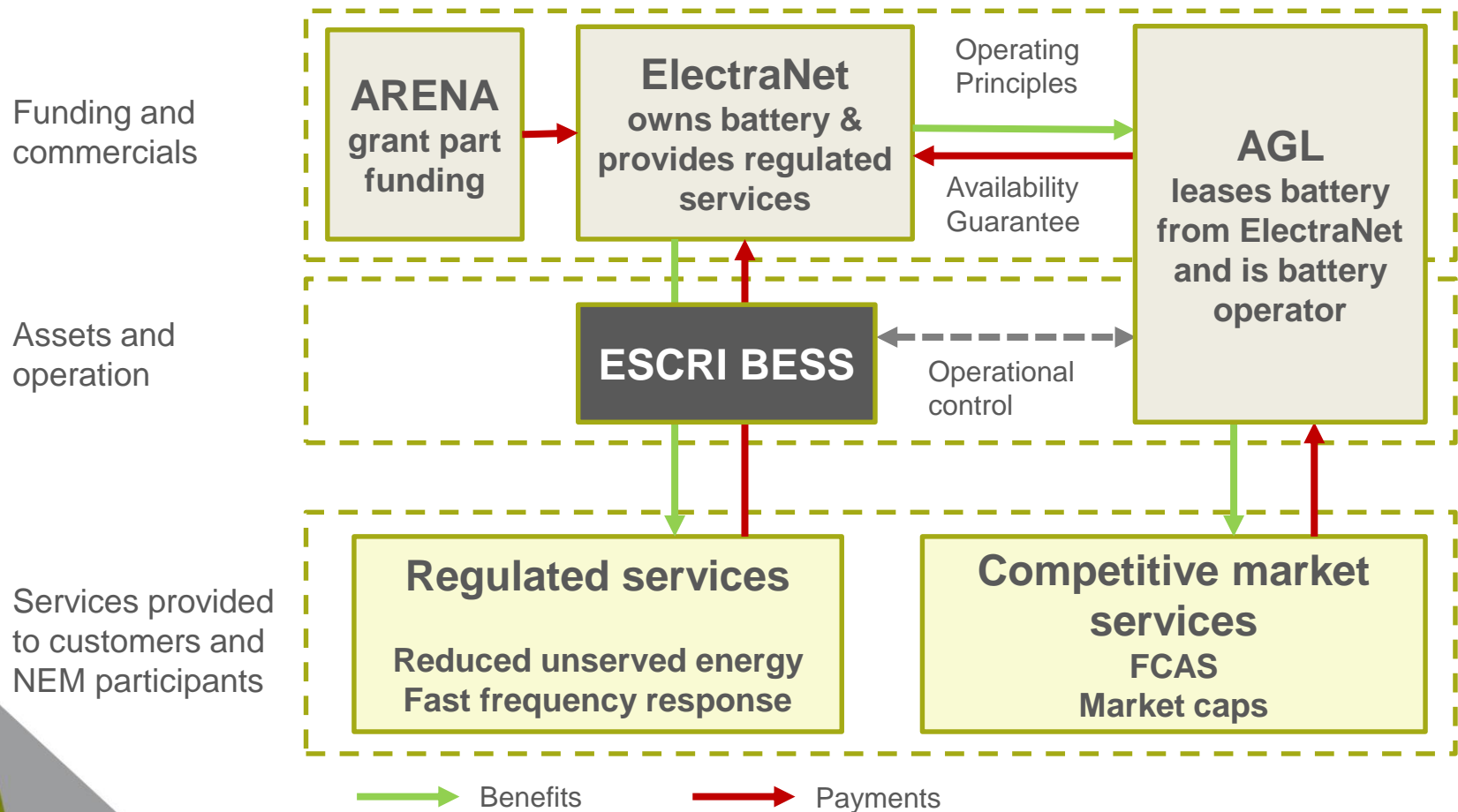
# Fast frequency response



- 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



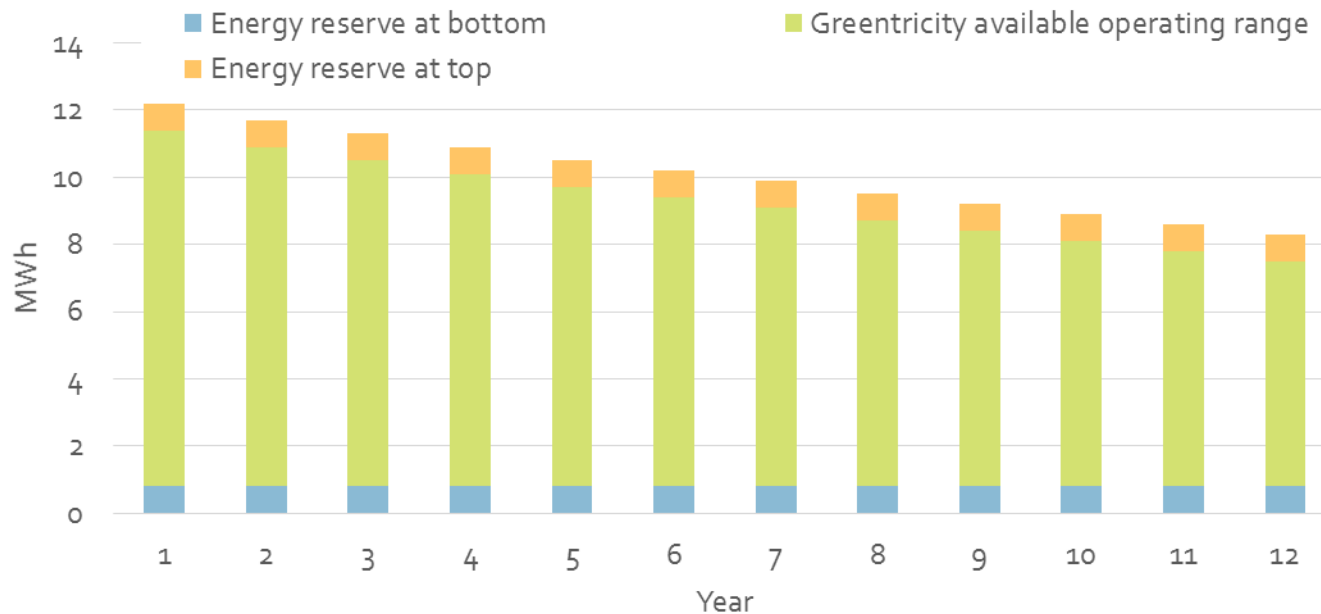
EPC/ D&C contract and 12-year maintenance agreement awarded to Consolidated Power Projects (CPP) following extensive procurement process



# 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<sup>1</sup>

## Benefits to regulated customers exceed costs

Estimated cost ands 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 <sup>2</sup>
<b>Total capital cost</b>	<b>30.0</b>
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 comments

- > 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
- > 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 non-regulated services
- > Battery 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
Energisation of battery system	28 Feb 2018
Final commissioning of battery system	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
- > Large 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 large-scale energy storage
- > Connection of large 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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