2021 APERC Conference

Electricity Reliability

Reliability Challenges & Lessons from Integrating Intermittent Renewable Energy Sources - Australia

IAN MCLEOD – DIRECTOR SMART ENERGY

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About Us

- Australia has a diverse range of energy sources and a challenging energy and emissions problem to solve
- We have not committed to a target date for Net Zero Emissions but there is some noise
- We are committed to a technology led reduction in emissions

Australia

Challenges

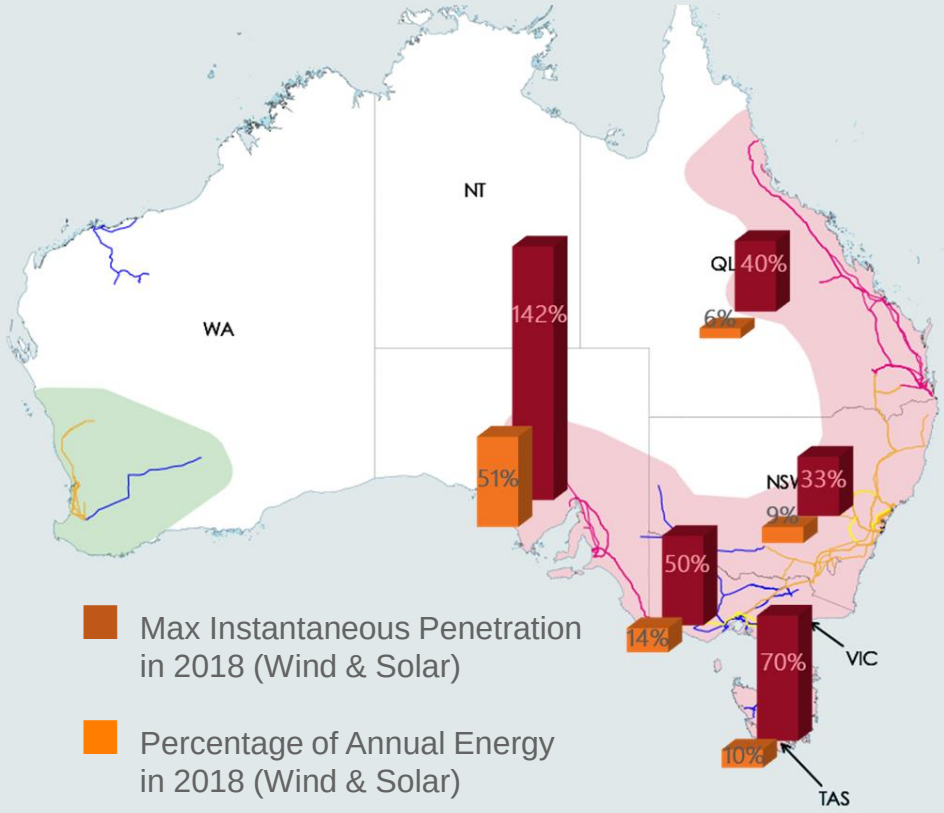
- Worlds flattest & driest continent
- An isolated island
- Constitution doesn't include energy
- Regulation
- Coal & gas
- No nuclear

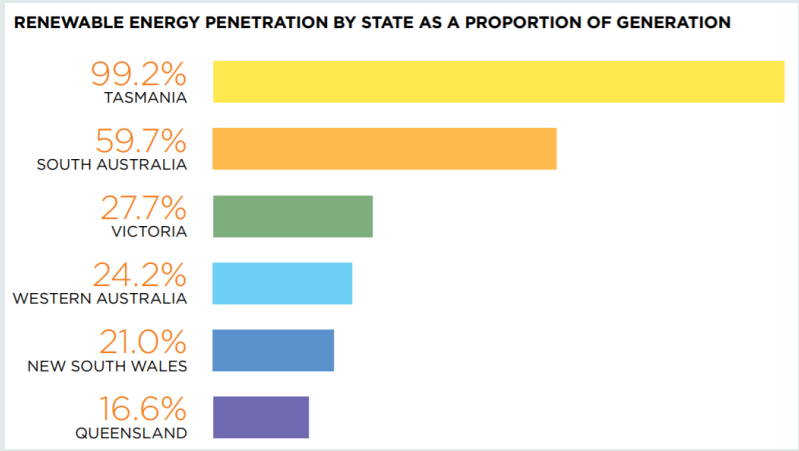
Attributes

- Diversity and abondance of low cost fuels
  - Coal
  - Gas
  - Uranium
  - Sun
  - Wind
- National Electricity Grid

High Growth & Penetration

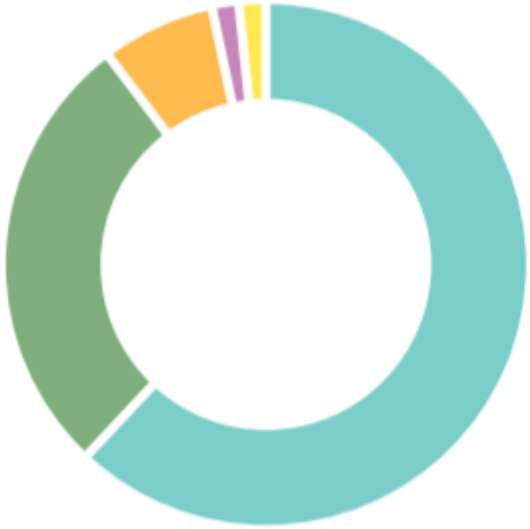
- Australia has one of the highest penetrations of renewables in the world
- 27.7% of Australia's electricity came from renewable sources in 2020
- In recent years Australia has had the highest renewables investment per capita in the world





High Growth & Penetration

ANNUAL ELECTRICITY GENERATION IN 2020

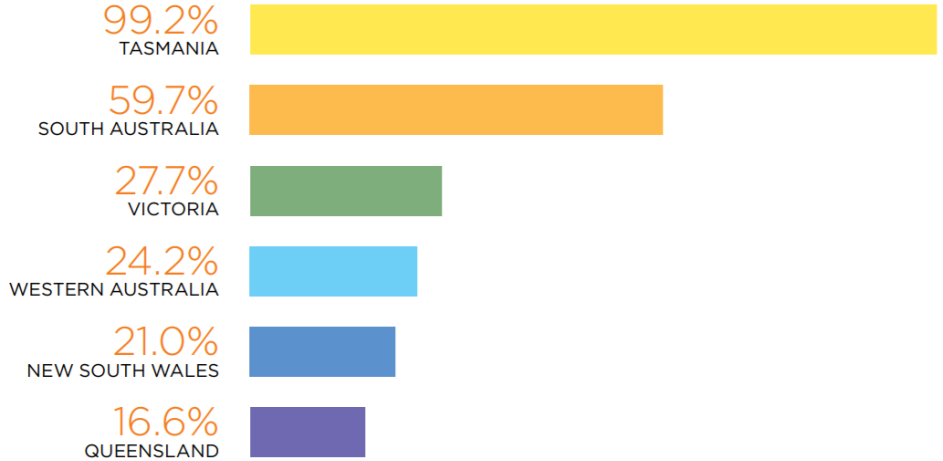


Coal	62.0%
Renewables	27.7%
Gas	9.9%
Waste coal mine gas	0.4%
Liquids	0.1%

RENEWABLE GENERATION BY TECHNOLOGY TYPE

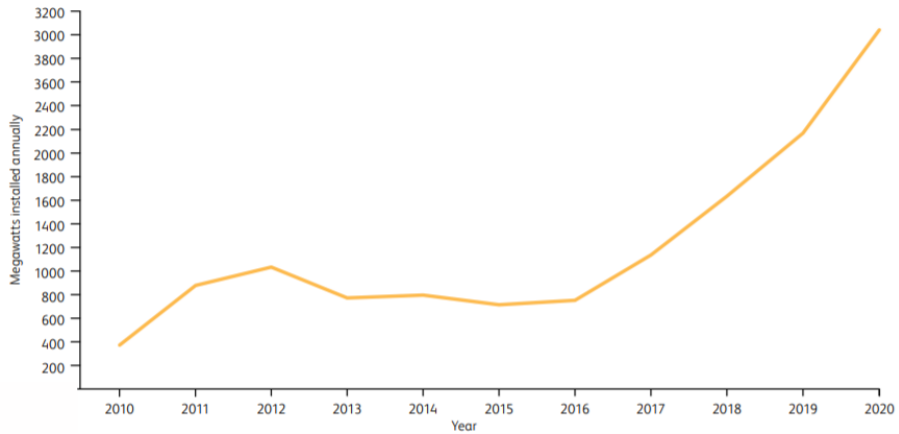
Wind	35.9%
Small-scale solar	23.5%
Hydro	23.3%
Large-scale solar	10.9%
Bioenergy	5.0%
Medium-scale solar	1.4%

RENEWABLE ENERGY PENETRATION BY STATE AS A PROPORTION OF GENERATION



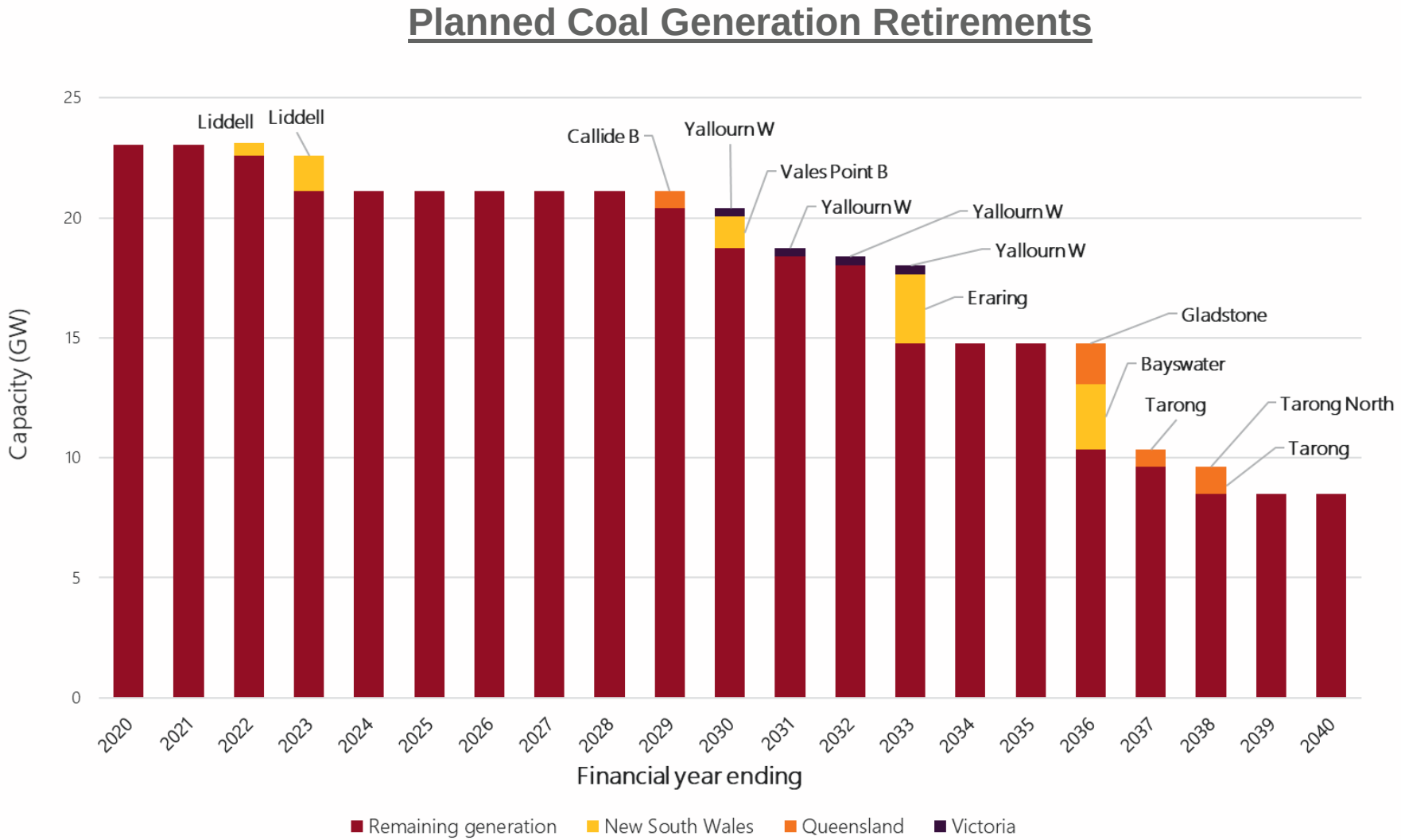
Small scale < 100KW

ANNUAL INSTALLED CAPACITY OF SOLAR PV (MW)[88]



The Base Load Generation Squeeze

- Base load coal is being economically squeezed by the market and scheduled aged retirements
- There are no firm commitments for new baseload coal

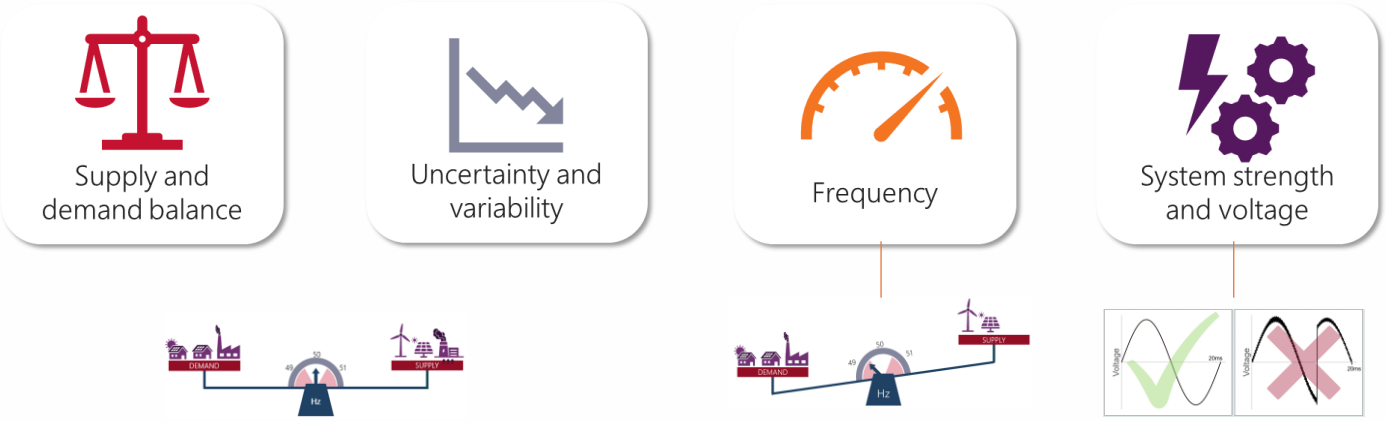


Consequence and Challenges

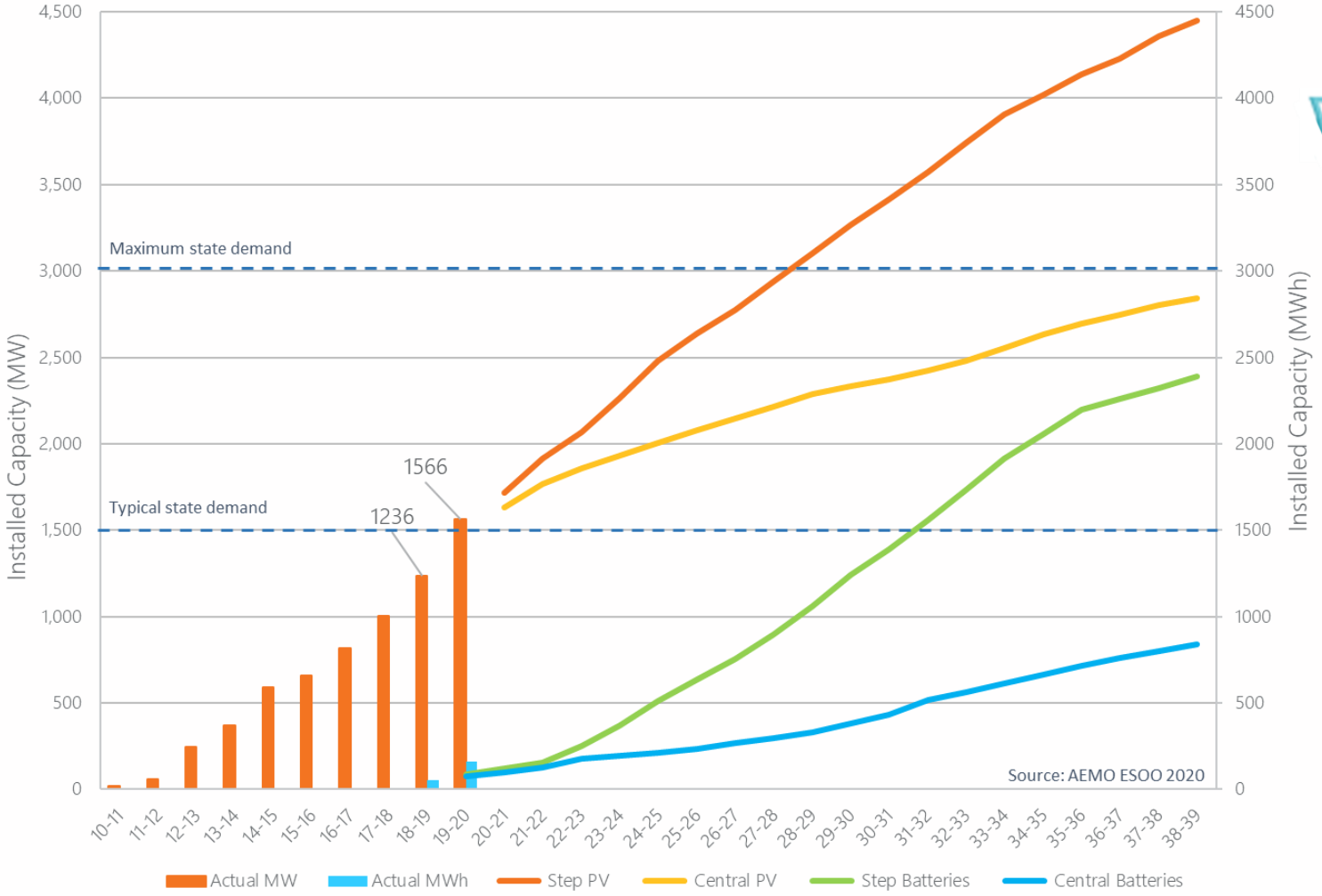
- The power system is changing
- System strength and security are becoming key issues
- Energy markets are more volatile and traditional base load is becoming un-economic
- Lack of active monitoring, co-ordination and control at the MV and LV levels are compromising operations and renewable hosting capacity
- Parts of the grid are now constrained
- Customer equity issues are growing

The Power System is Changing

	Conventional	Wind and Solar	RIS Analysis	
Technology	Electro-Mechanical (Synchronous)	Power Electronic (Inverter Based or Asynchronous)	Managing Frequency (& System Strength)	Operability
Energy Source	Firm	Variable	Variability and Uncertainty	
Location	Centralised	Centralised and Decentralised	Distributed PV	



Consequence and Challenges: An example - South Australia



~280,000 systems, 1 in 3 customers – world's highest

State's largest generator

Record growth in 2019 & 2020

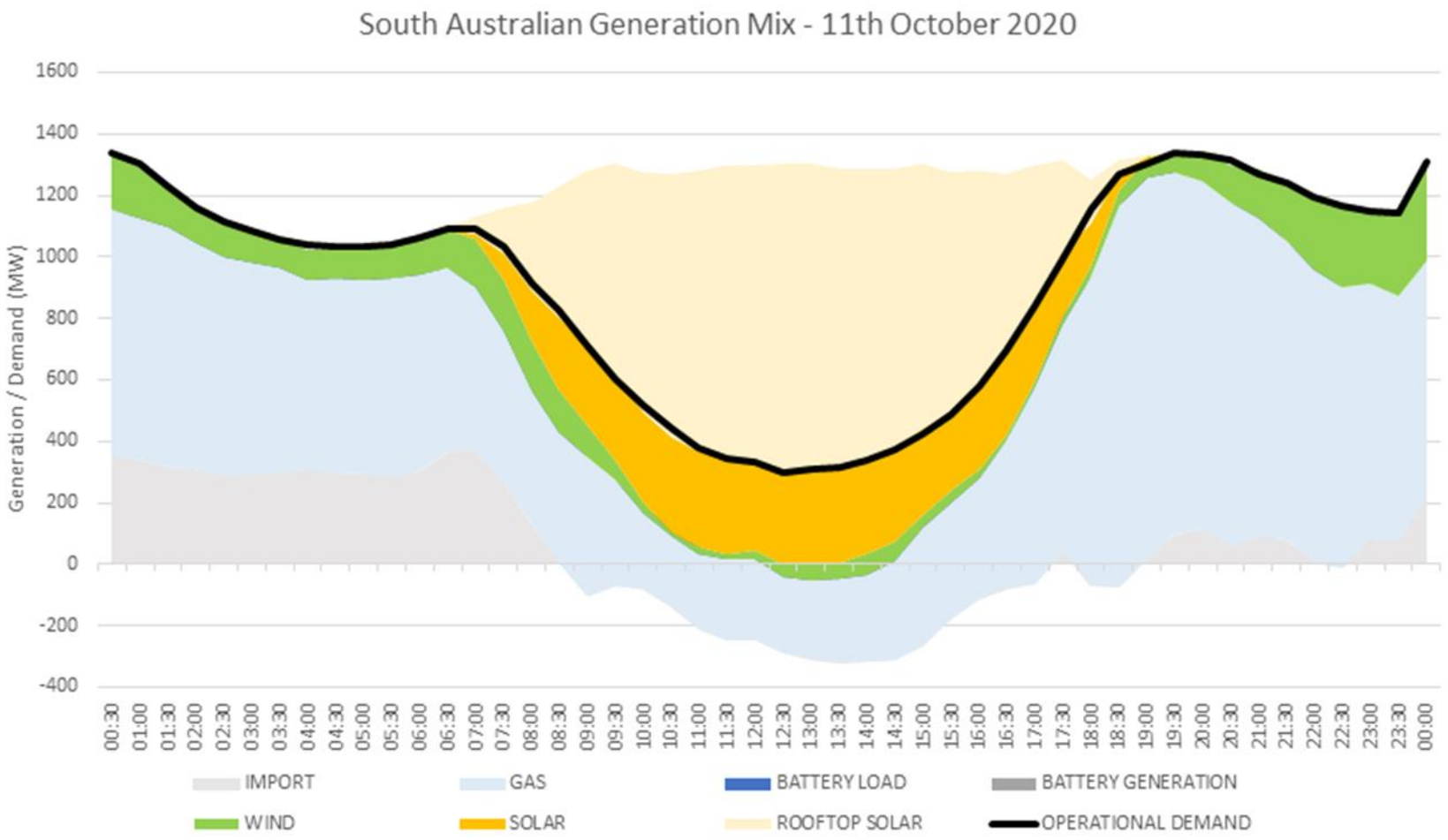
Up to 90,000 batteries in coming years under SA Government schemes

Positioned to be a world leader in VPP adoption

9 active VPPs in the state

Consequence and Challenges: An example - South Australia

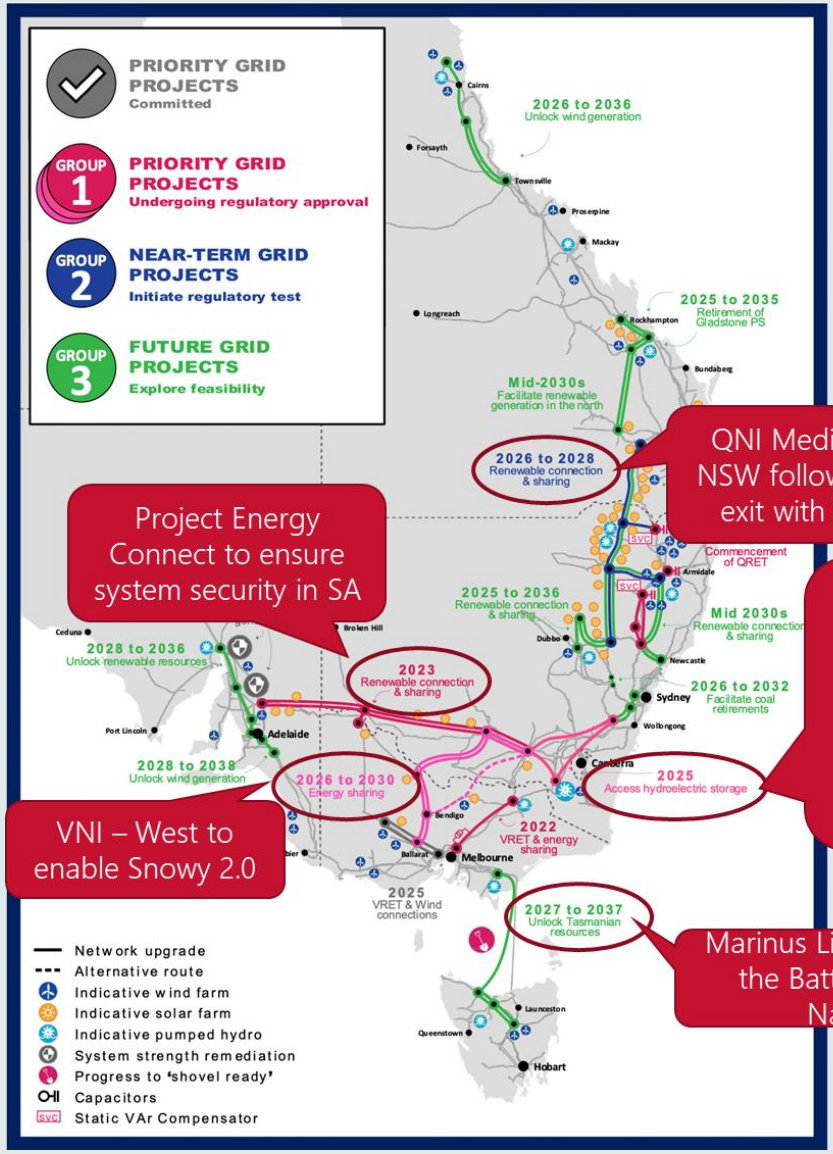
- On 11 October, operational demand fell to 300MW
- SA 100% solar powered for the first time
- Distribution network import reached 21MW
- Net residential and business loads were negative
- No gigawatt scale power system in the world has been operated at this level
- >50% of substations in reverse flow



Our Response

- Australian Energy Market Operator delivers
  - Integrated System Plan – Long Term – whole of system
  - Renewable Integration Study
- Renewable energy zones
- New invertor standards
- Invertors being switched off during low load events
- New and upgraded transmission links
- Increased hydro pump storage and battery storage capacity
- Market reform – Demand response & other new services
- Tariff reform

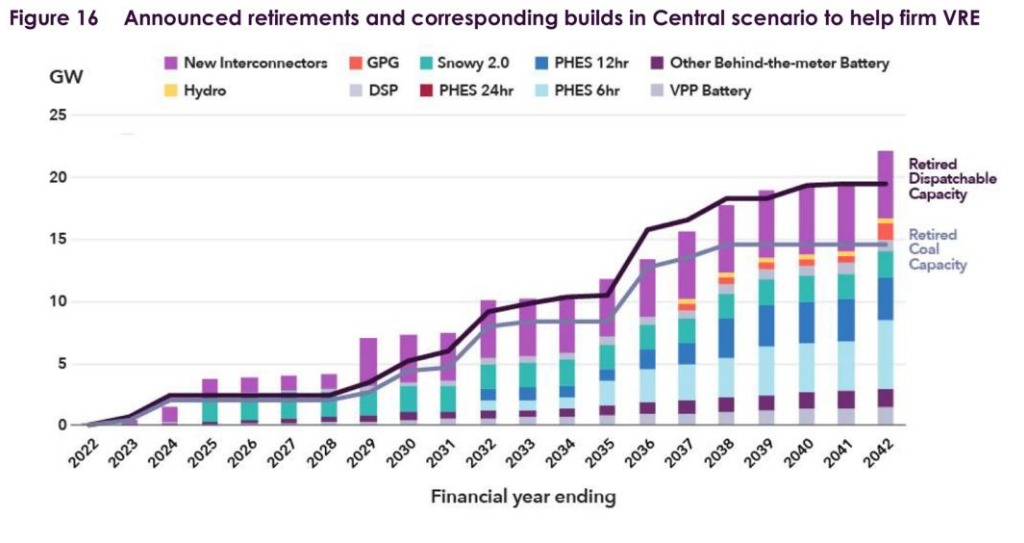
Strengthening The Grid



Source: AEMO Draft 2020 ISP

Our Response - Gas

- To achieve the least cost pathway small additions of new gas is needed
- Role of gas would change if gas prices were less than $6/GJ
- Significant investment in Green Hydrogen development



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