AGL Loy Yang site tour

23 October 2018

AGENDA

1.	**Overview - About AGL Loy Yang**	Steve Rieniets General Manager, Coal Operations
2a.	**Optimisation - Portfolio management**	Melinda Buchanan General Manager, Physical Markets
2b.	**Optimisation - Asset management**	Doug Jackson Executive General Manager, Group Operations
3.	**Optionality - Beyond base load**	Doug Jackson Executive General Manager, Group Operations
4.	**Q & A**	Brett Redman Interim Chief Executive Officer

Overview

About AGL Loy Yang

AGL Loy Yang history

Part of a century of power generation in the Latrobe Valley

One of the newest power stations in the Latrobe Valley

Newest and largest mine development

1982 Mine development commenced

1984-88 Power station commissioned

1995 Corporatised Loy Yang Power (LYP) entity

1997 LYP purchased by international consortium

2004 GEAC acquired LYP (32.5 % AGL)

2012 AGL acquired Loy Yang A power station and adjacent mine

Closure of AGL Loy Yang power station expected no later than **2048**

Mining license to **2065** to include final rehabilitation activity

Power station

Mine development and license

1980 1990 2000 2010 2020 2030 2040 2050

***1998** National Electricity Market (NEM) established*

About Loy Yang

Integrated power station and adjacent fuel source

The mine supplies both AGL Loy Yang and Loy Yang B, fueling more than half the state's energy

Coal reserve:
2 billion tonnes

Annual extraction:
28-32 million tonnes

Coal bunker capacity:
85 thousand tonnes or 20 hours

Fuel consumption:
2,400 tonnes coal per hour at full generation

Capacity: 2,210 MW
- 3 x 560 MW (Siemens) units
- 1 x 530 MW (Alstom) unit

Annual generation:
~ 15,000 GWh

24-hour operation

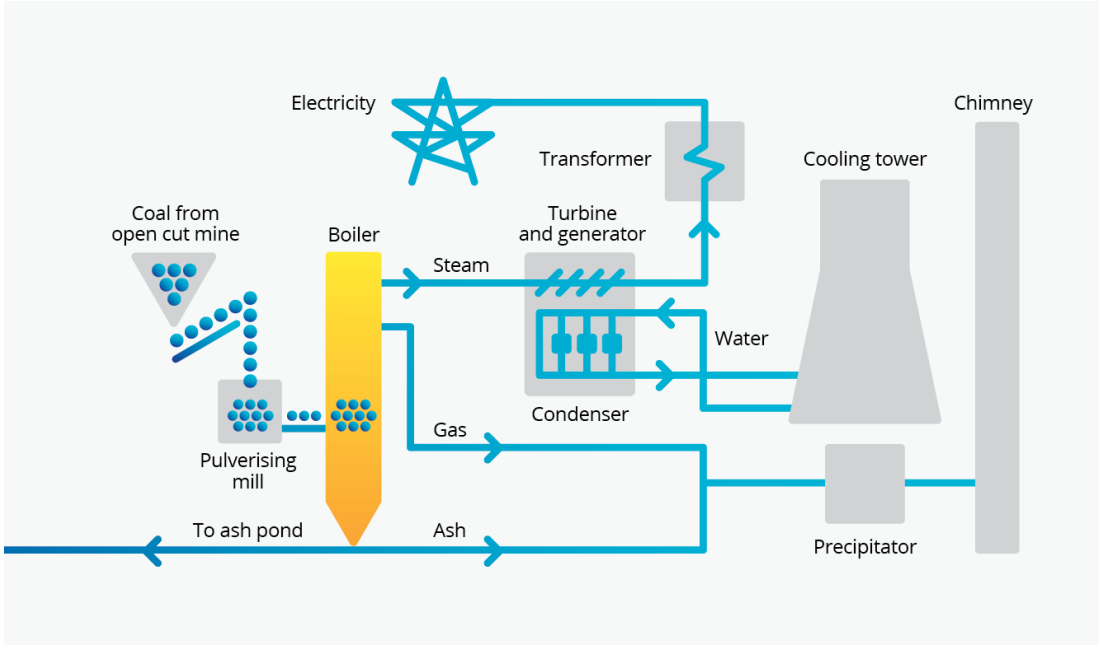
Key features of operations – power plant

AGL Loy Yang control room provides centralised control for the **four** generation units and their associated plant, 24 hours a day

Turbine and generators: 4
- 3 x 560 MW and 1 x 530 MW at 3,000rpm
- Total length stator winding strands: 100 km

Boilers: 4
- Height: 105 metres
- Fuel use: 600 tonnes coal/hr per unit
- Total length of tubes: 485 km per unit

Auxiliary firing system:
- Brown coal briquettes or black coal
- Ignition fuel – natural gas



Adjacent, reliable fuel source

Key features of operations – mine

A large producing brown coal mine the size of the Melbourne CBD with 30 million tonnes annual output

Mine:

- Area: 1,200+ Ha
- Depth: 200+ metres
- Width: 2.5 kms
- Length: 4.5 kms
- Coal seams age: 15-30 million years
- Strip ratio: 6 coal to 1 overburden

Mine dredgers

Dredgers: 4

- 2 for coal, 1 for overburden, plus contingency
- Bucket wheel: 13.2 metres in diameter (10 buckets/wheel)
- Bucket capacity: 2.3 cubic metres
- Machine size: 190 metres long, 50 metres high, up to 5000 tonnes in weight
- Output: Coal – up to 3600 tonnes/hour, and
  Overburden – up to 2500 cubic metres/hour
- Travel speed: 8 metres/minute = 0.5 km/h

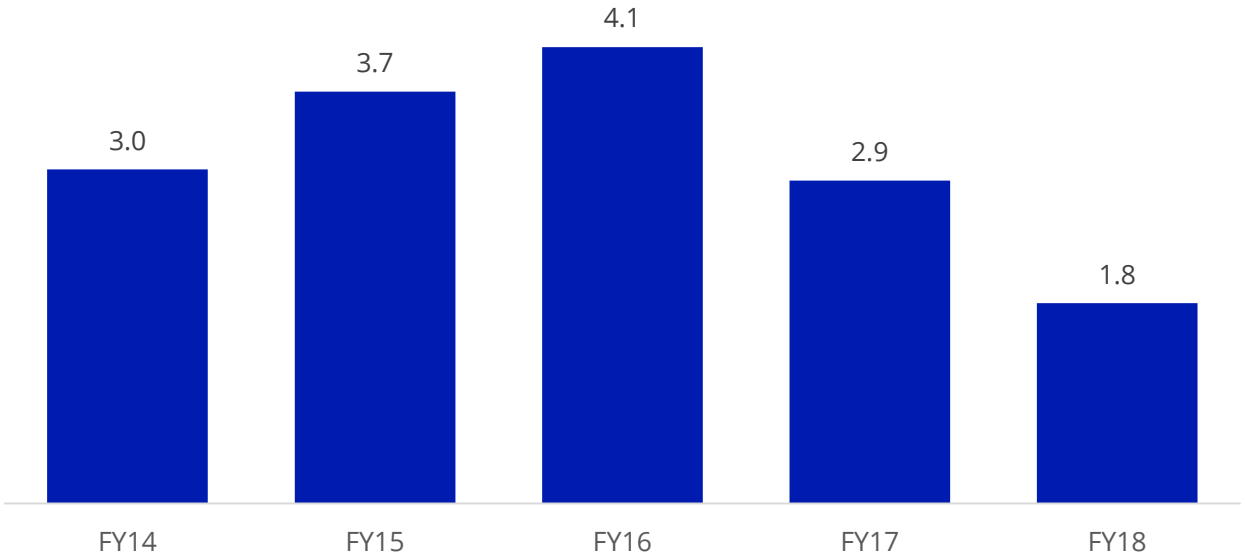
Safe and sustainable operations

Safety performance improvement since Target Zero strategy implemented

Combined workforce of employees and contractors:
On average 1,000, and up to 2,000 during major outage work program

Target Zero strategy:
Implemented in FY16

AGL Loy Yang - Combined Total Injury Frequency Rate (per million hours worked)

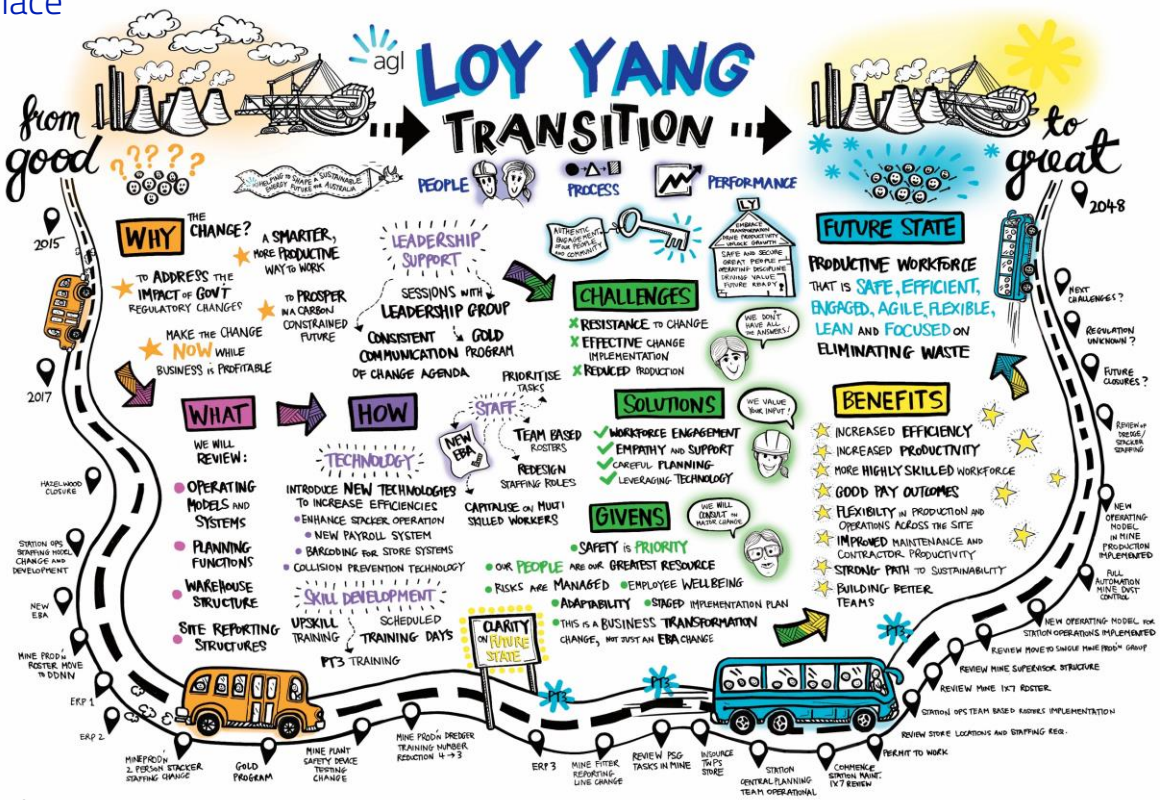


Modernising the way we work

A safe, engaged and productive workplace

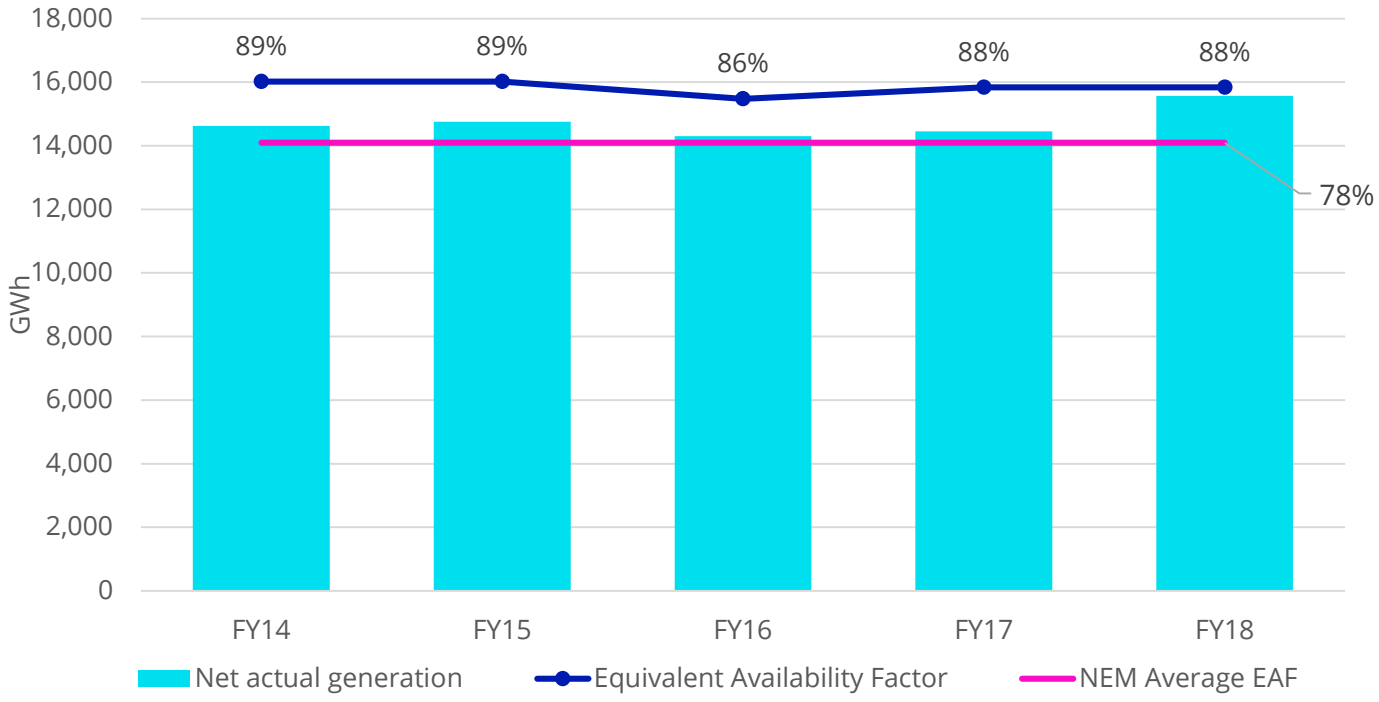
Goals:

- Leadership
- Flexibility
- Productive processes
- Technology benefits



Reliable performance

Historical performance of the power station since AGL ownership



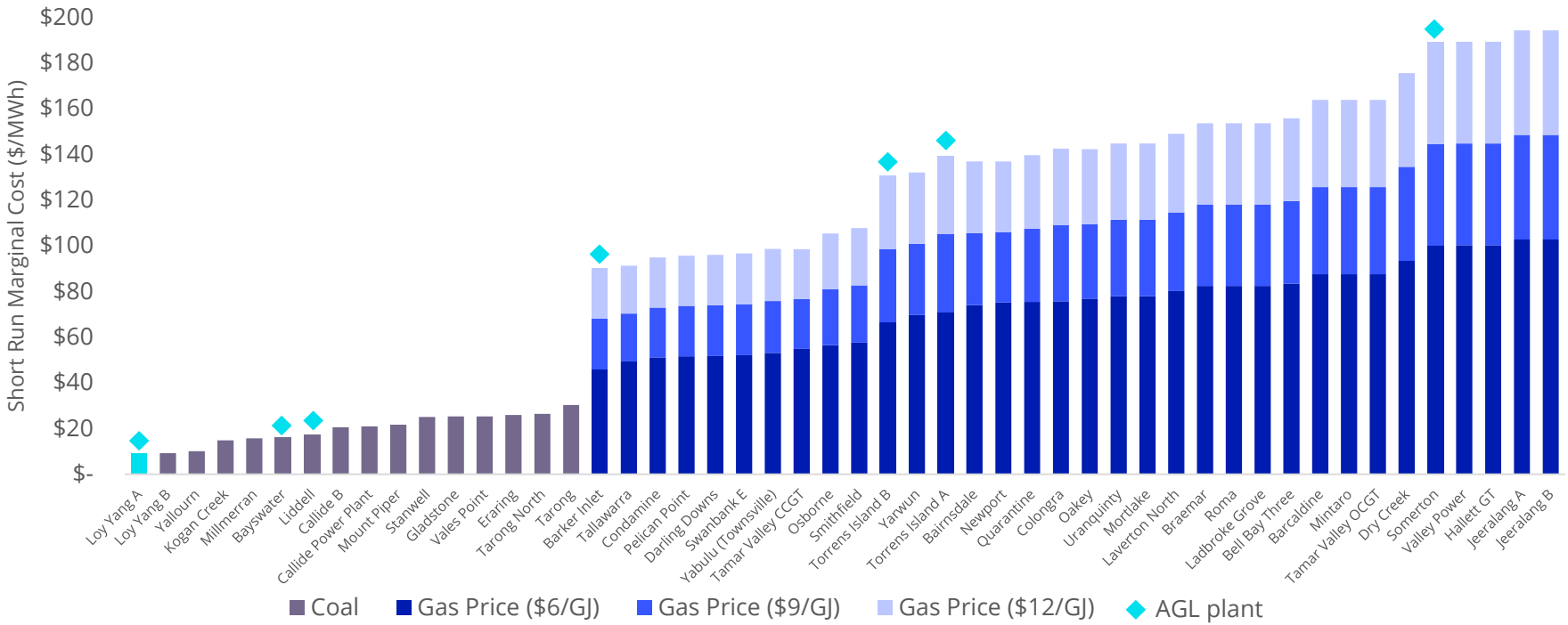
Increased generation since Hazelwood closure, March 2017

Optimisation

Portfolio management

AGL Loy Yang in the National Electricity Market

One of the largest and lowest cost generators in the NEM – supplying 9% of generation output

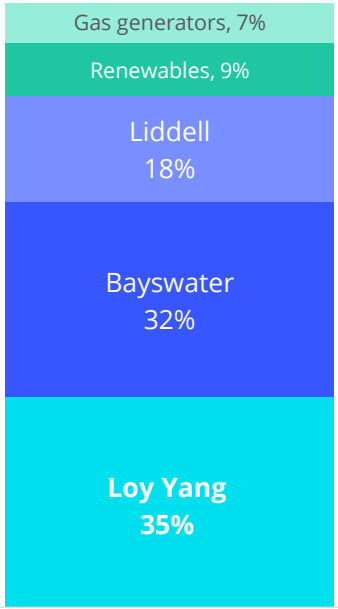


Source: AEMO Integrated System Plan 2018 Assumption Workbook heat rate, VOM and coal costs. Diesel generators excluded

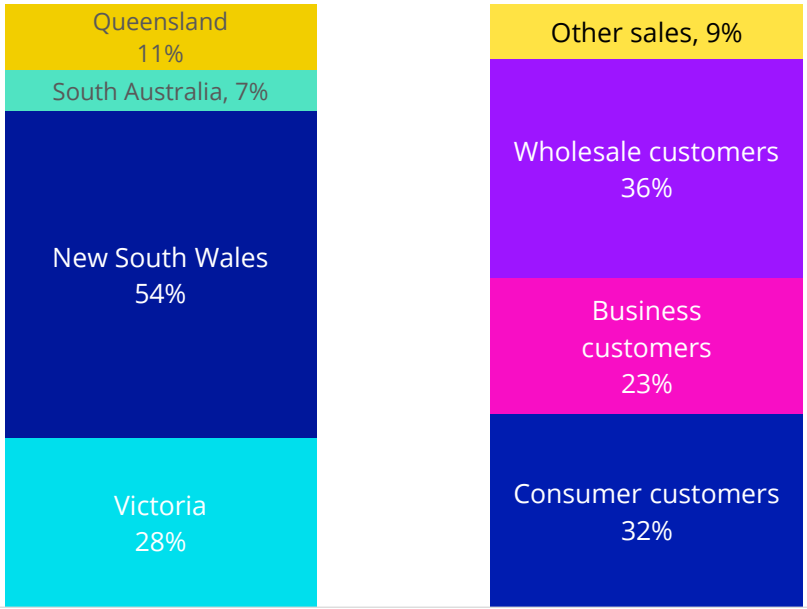
Enhancing AGL's portfolio

Loy Yang adds to fleet's fuel and geographic diversity

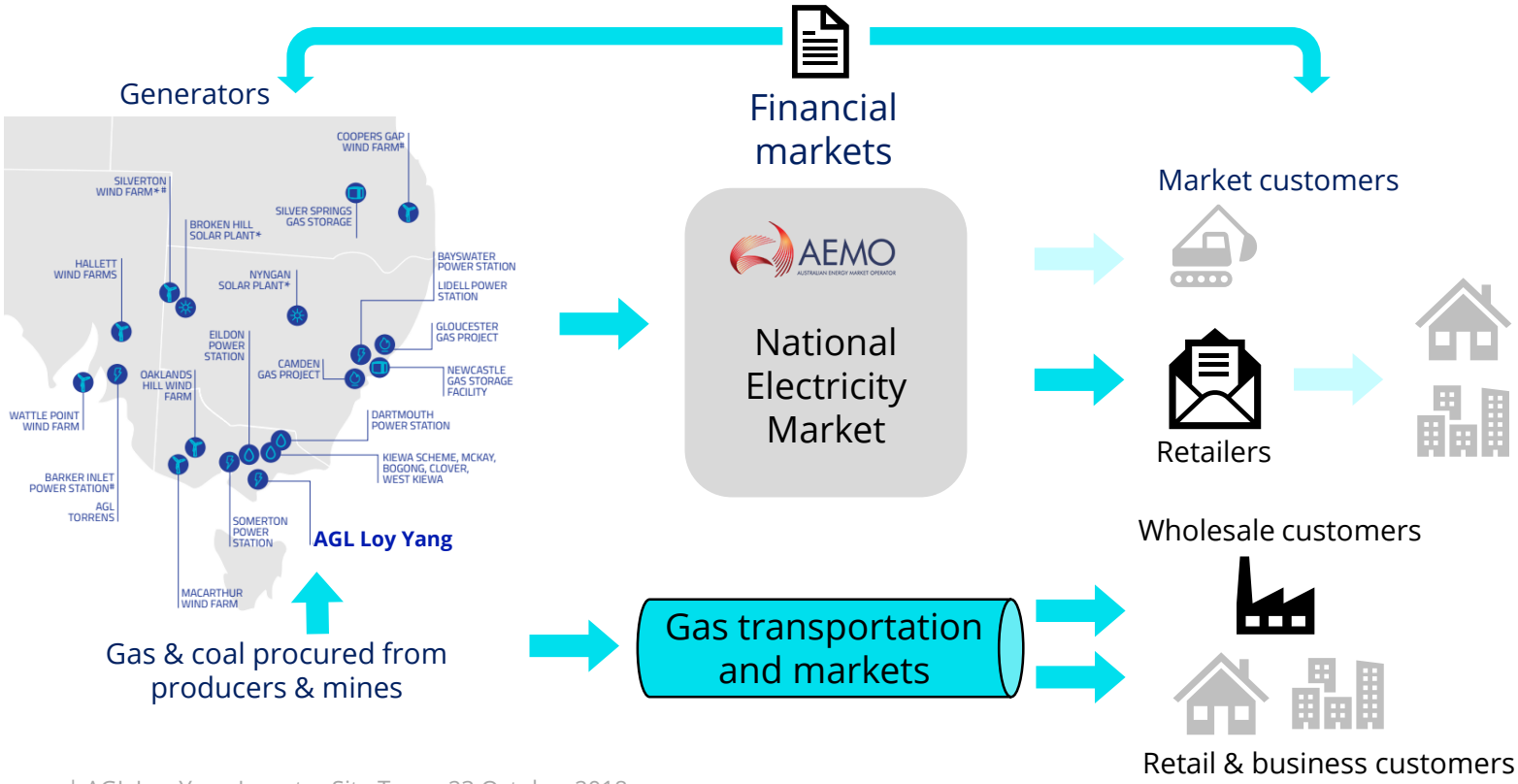
FY18 AGL NEM supply by MWh



FY18 AGL NEM demand by MWh

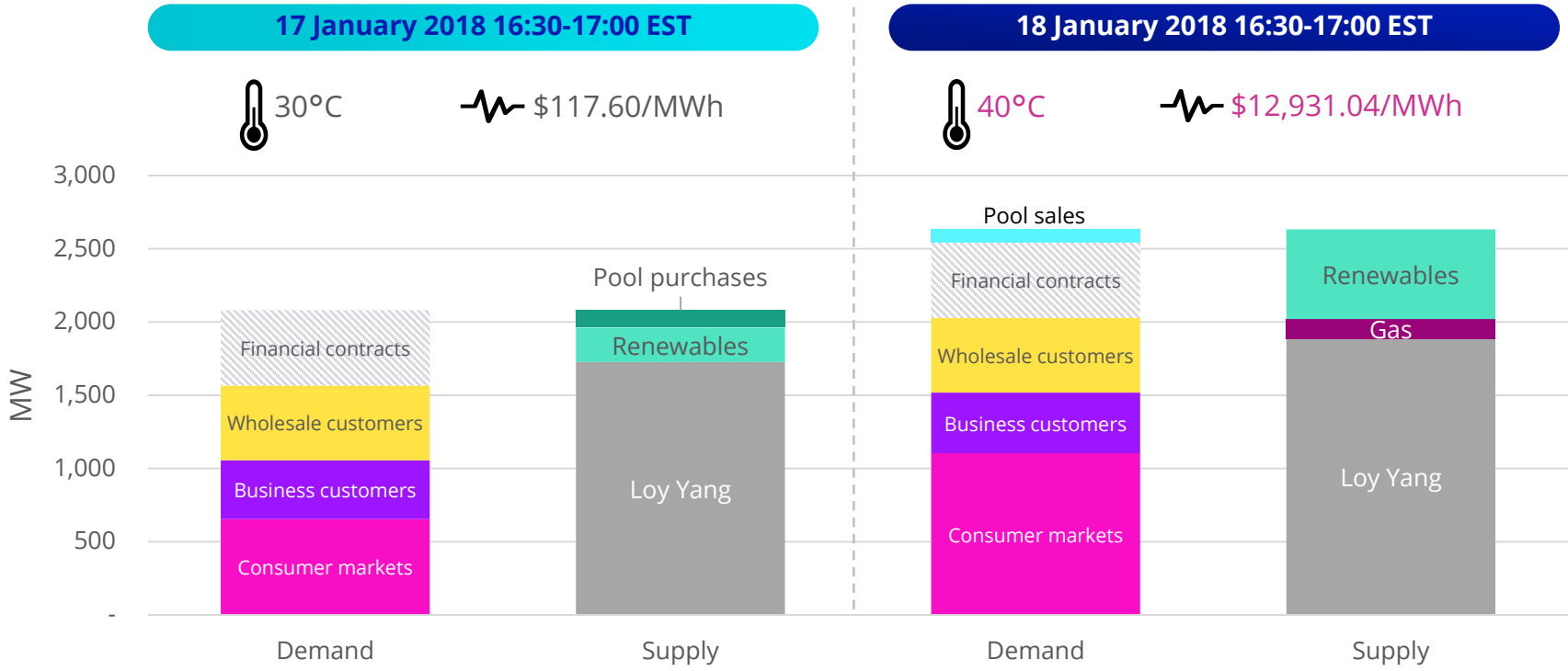


Wholesale market optimisation



A day in the life: Electricity in Victoria

Aka "what a difference a day makes!"



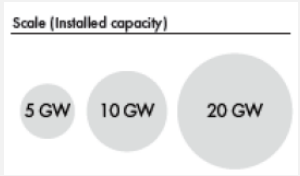
Long-term portfolio optimisation

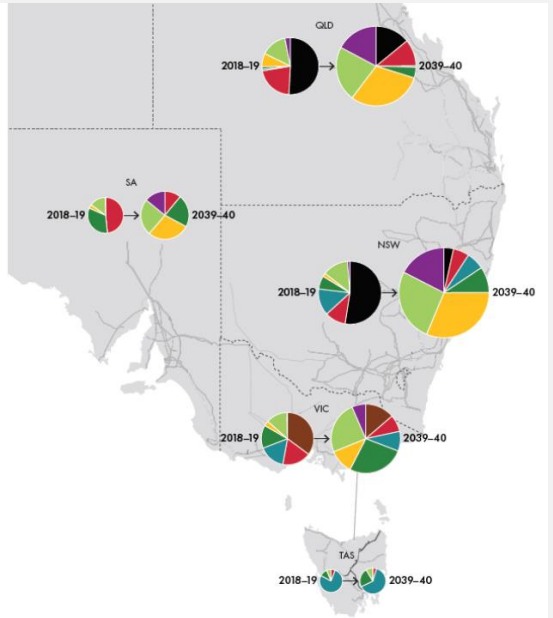
Flexibility as the market changes

Opportunities and challenges for AGL Loy Yang with:

- Increasing renewable penetration – large and small scale
- Changing demand profiles with battery storage, demand response and behind the meter orchestration
- Frequency control, system strength and inertia services increasingly valuable
- Increase in interconnectors – number and capacity

Projected change in generation resource mix (installed capacity) 2018- 2040: AEMO Integrated System Plan Neutral case



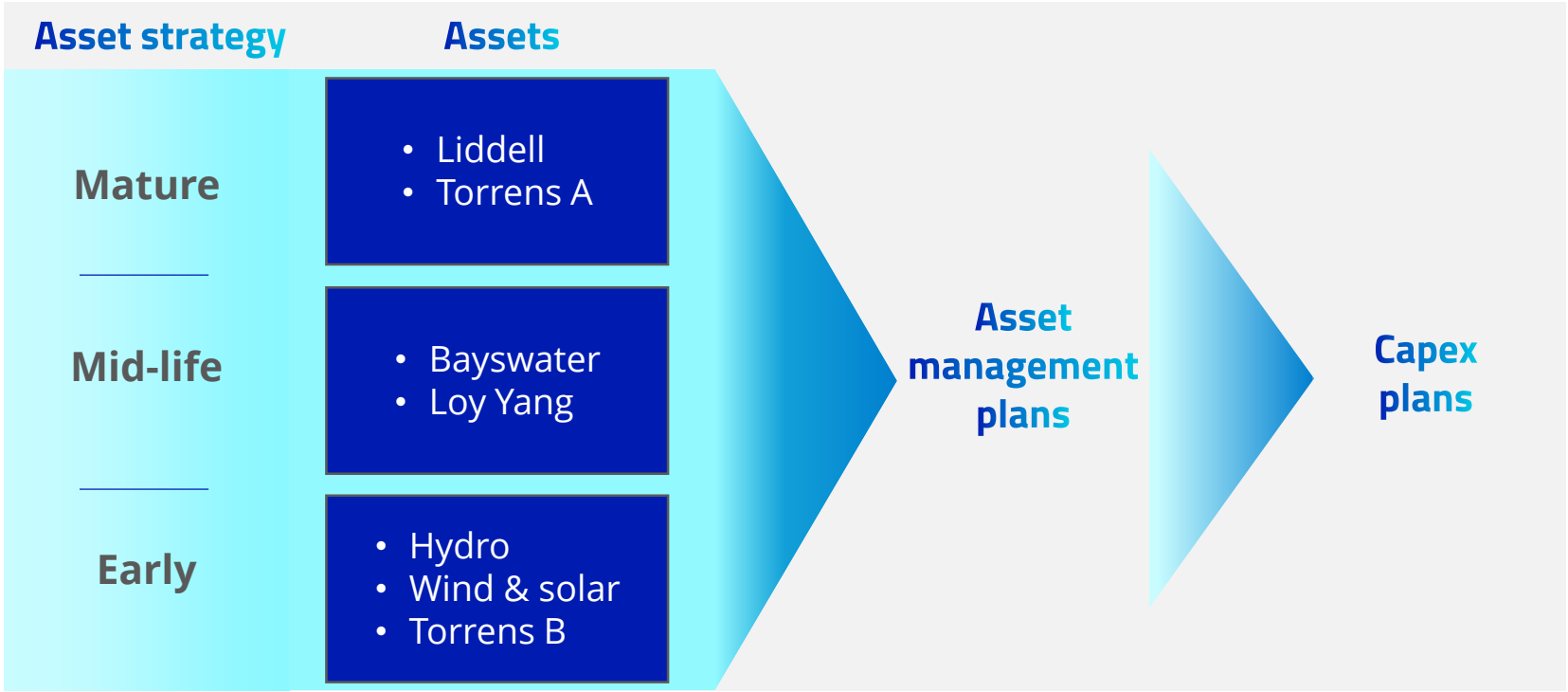


Source: AEMO Integrated System Plan 2018

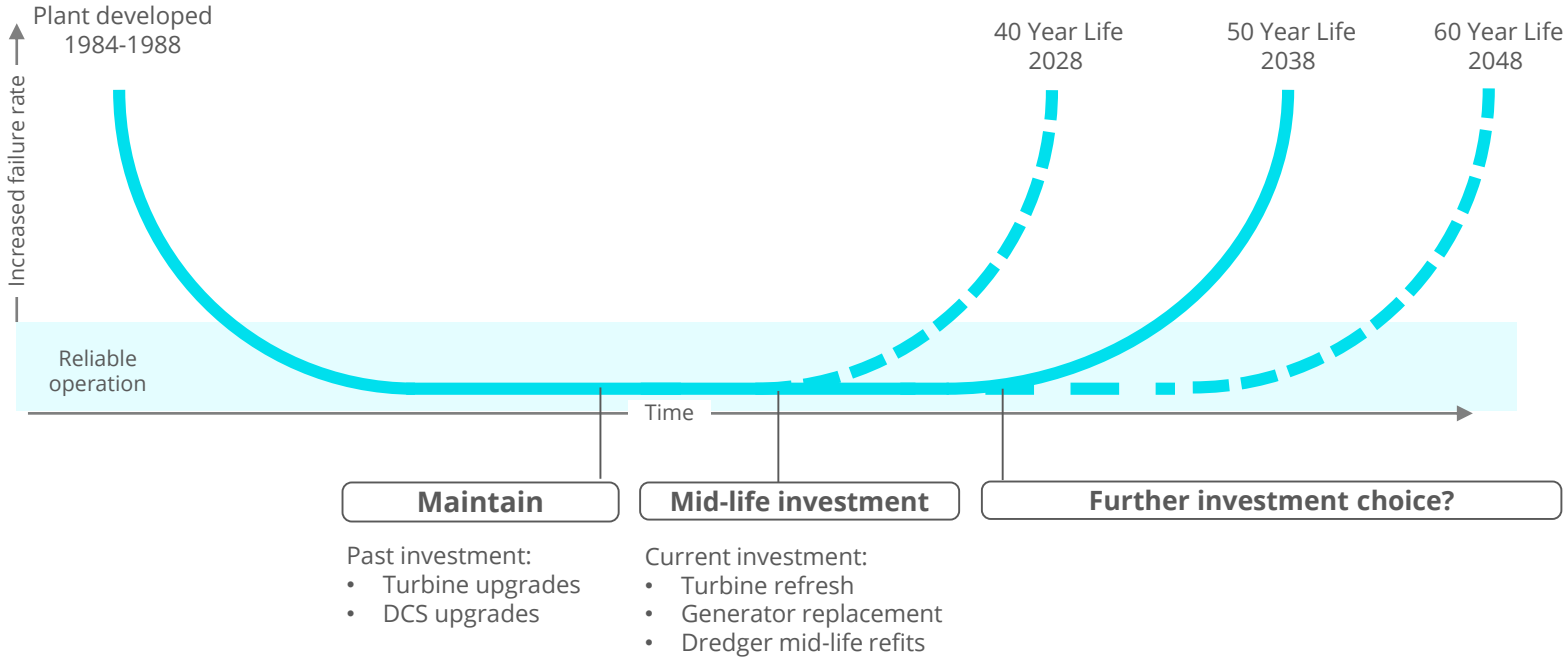
Optimisation

Asset management

Agile asset strategy



AGL Loy Yang 'whole of life' planning



Extending ‘normal life’ operation

Investing in mine and power station

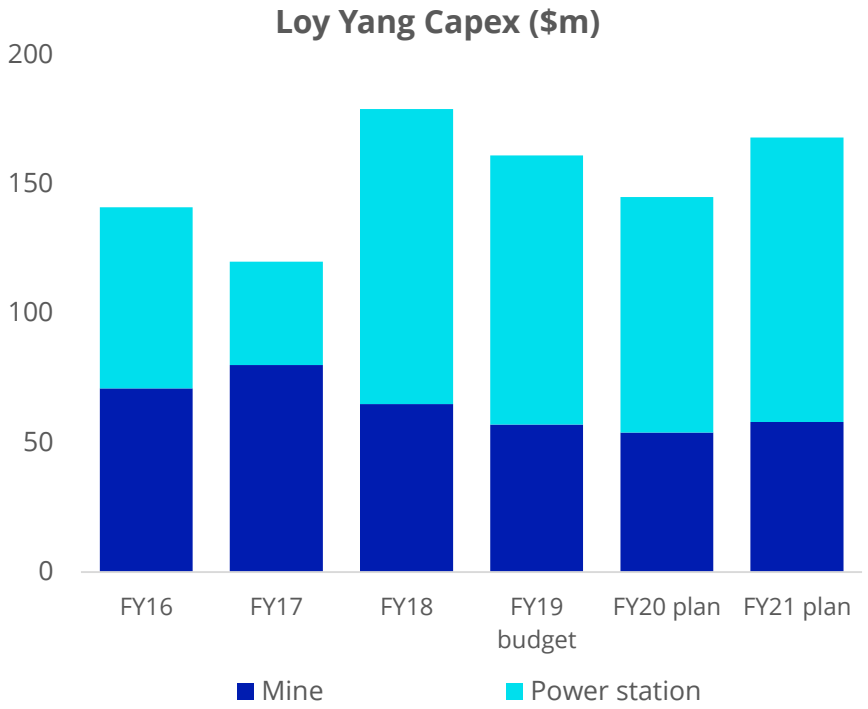
Power station:

- 4-year maintenance cycle
- Turbine and critical boiler components are upgraded in major outages every

	Year 1	Year 2	Year 3	Year 4
LY1				
LY2				
LY3				
LY4				

Major outage

Minor outage



Power station upgrades

Using latest technology to improve reliability, efficiency and component life.


Generator


High Pressure Turbine Refurbishment

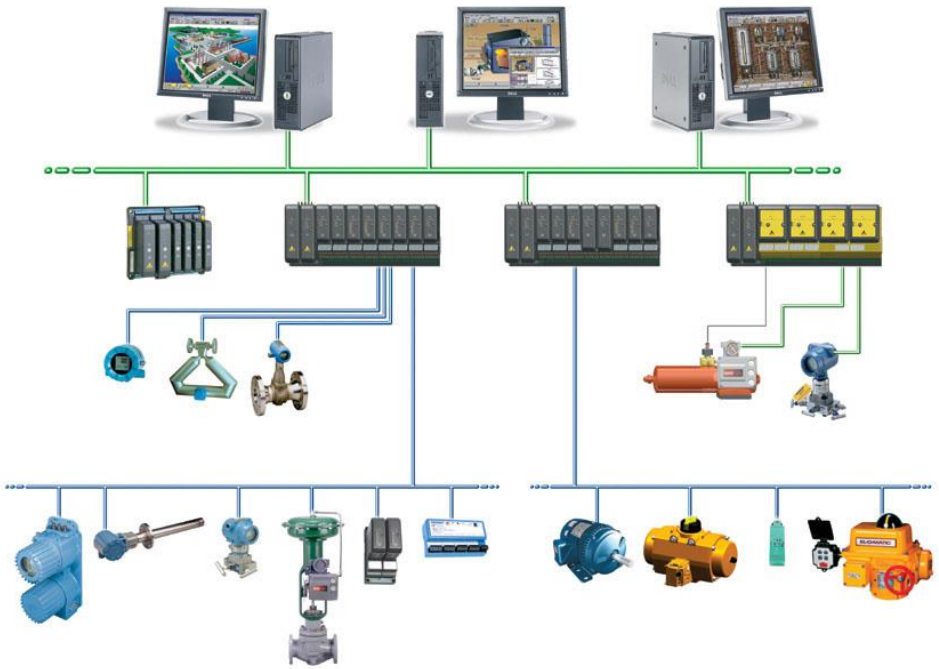

Upgraded Titanium Condenser Tube Bank


Low Pressure Turbine Inspection


Single 1 Piece Forged Steam Strainer Basket


Loy Yang High Pressure Turbine Rotor

Typical power station distributed control system



Human machine interface (HMI)

Supervisory control and data acquisition (SCADA)

Programmable logic controller (PLC)

Field devices I/O

AGL Operational Diagnostic centre

Using data analytics to predict and prevent failures – "our digital twin"

Early Warning System

- Providing diagnostic service to Group Operations Business Units
- Foresight through early fault detection (weeks & months vs hours)
- Installed on Central PI System April 2015

Total set up cost $1.2m
Annual running costs $620k

- Over 2700 models monitoring over 45k critical points every 5 minutes
- Proven tool to reduce forced outage events and optimise maintenance effort

$21 million value realised since installation

$6.9 million in FY18

Incorporating smart technology

Increased data, improved monitoring and analysis enhances performance and productivity

Remote Sensors

- Connection of low cost instruments in remote areas
- Ideal for increased monitoring of environmentally sensitive processes
- Improved monitoring translates to improved performance

sigfox

Cloud Connected

- Low cost collection of data from isolated digital devices

Online Condition Monitoring

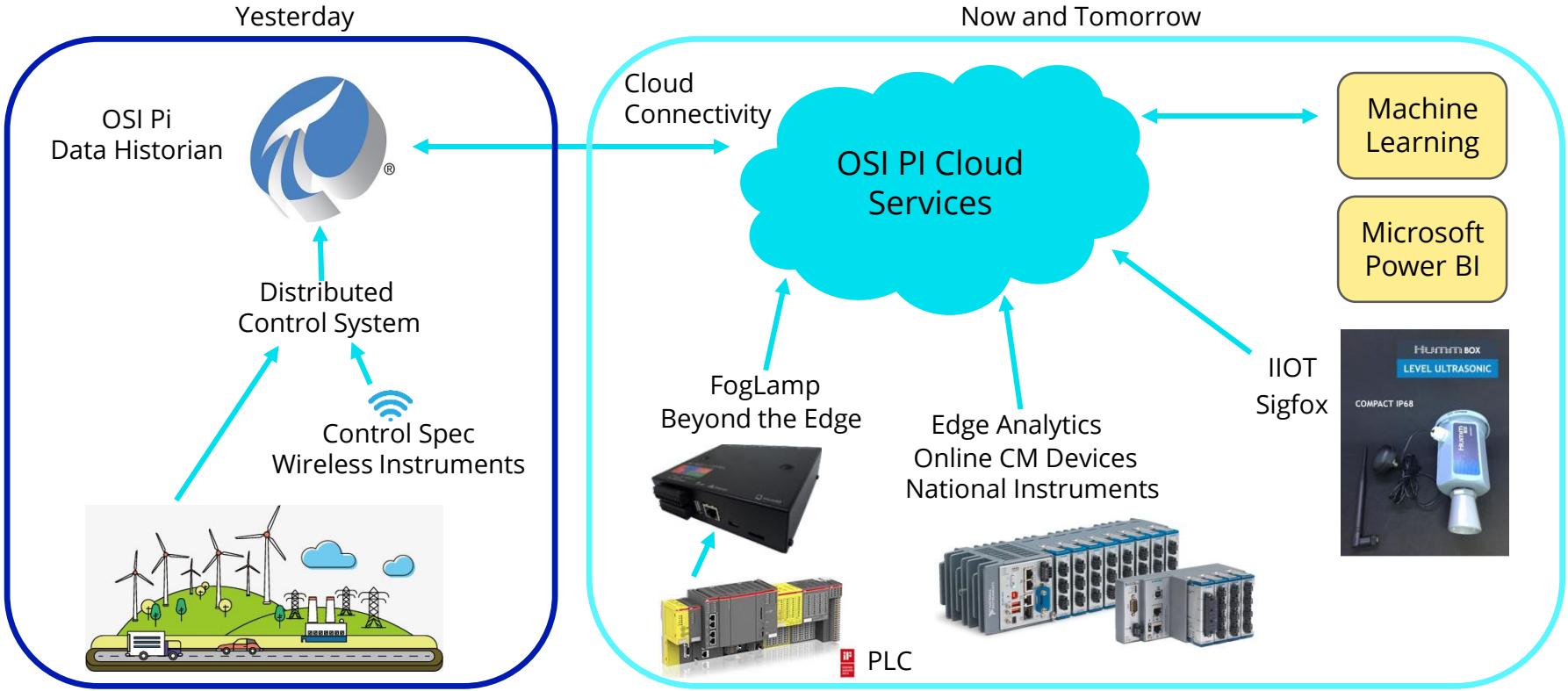
- Enables high speed sampling to provide advanced online condition monitoring capabilities at the “Edge”
- Greatly enhances existing diagnostic capabilities - reduces the need for preventative maintenance and increasing reliability

NATIONAL INSTRUMENTS

Drones

- Fully autonomous technology, 13km mission range, 40 minute mission uptime, 6 hours uptime per 24 hours
- 4 camera technologies including: HD Video + Infra Red Heat sensing; LIDAR 3D Mapping; Optical 3D Mapping; Thermography
- Improvements include: mine planning team efficiency; situational awareness; emergency response; Asset Structural Condition Monitoring

Data to results at the speed of light

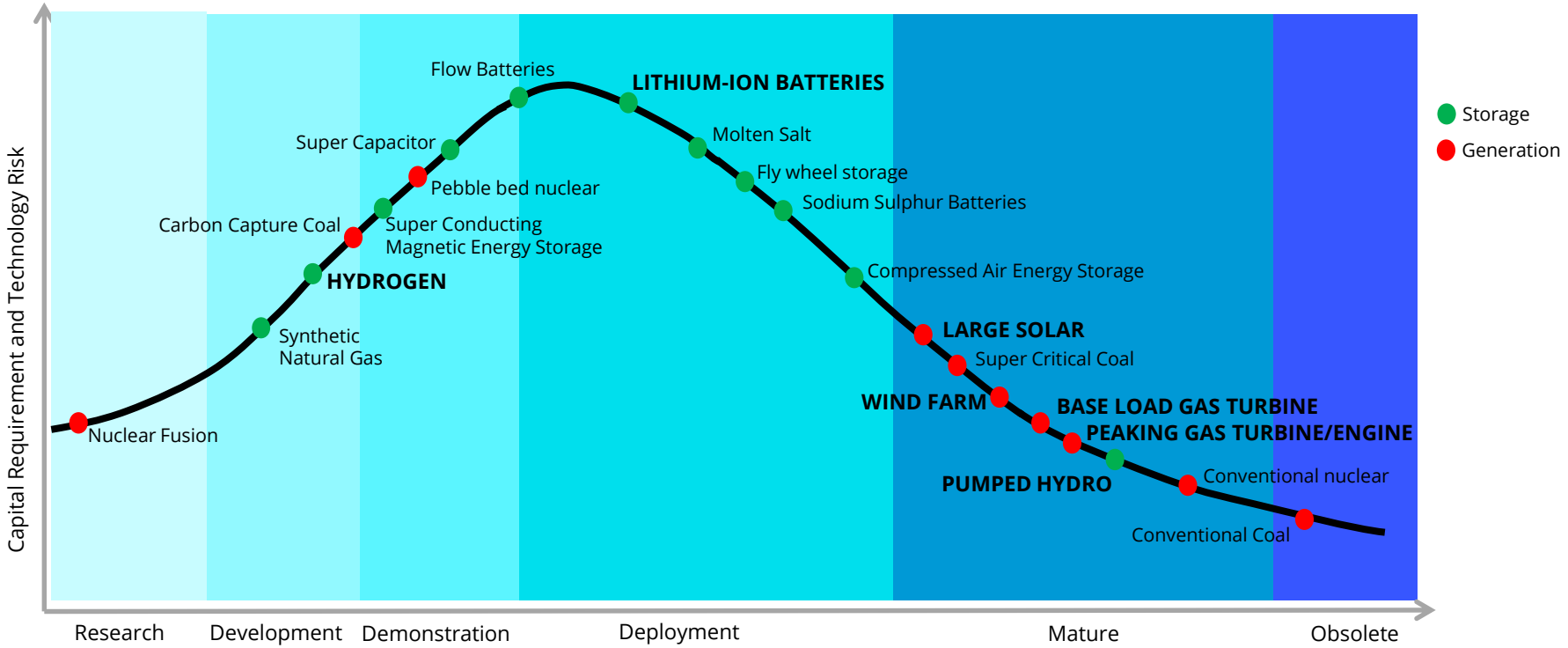


Optionality

Beyond base load

Energy technology options

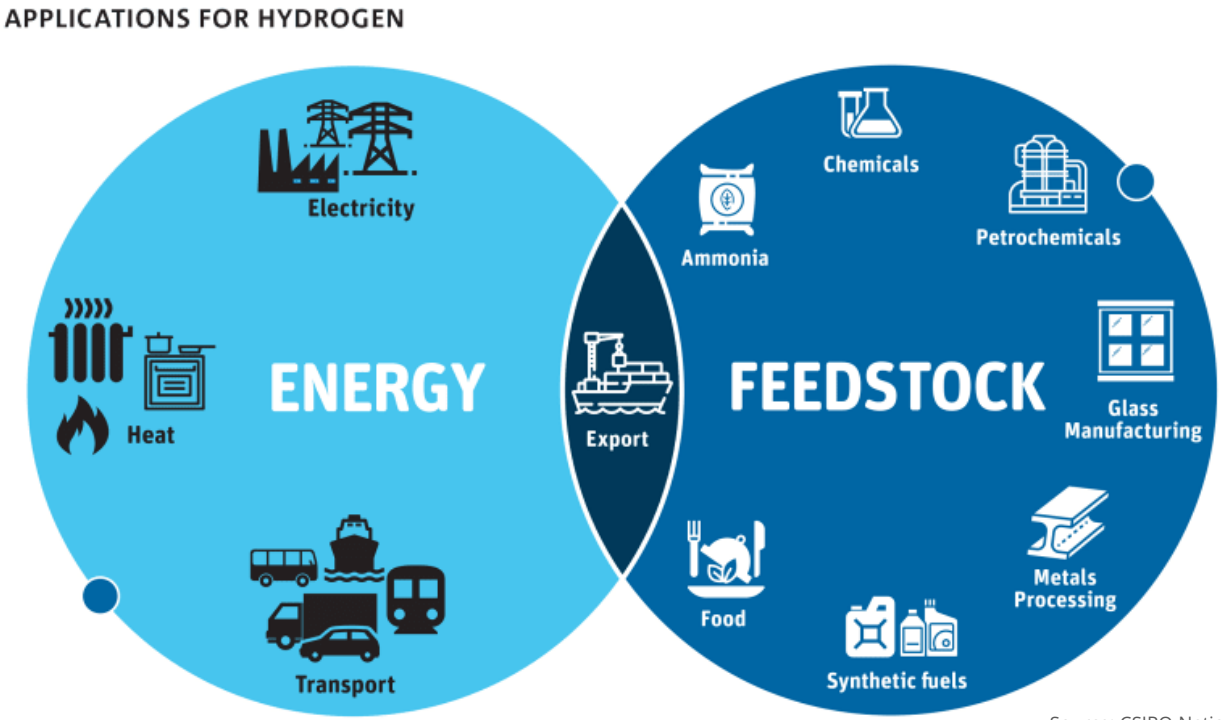
Electricity technology maturity curve for new build



Source: AGL Energy, various

Alternative uses for AGL Loy Yang resources

Including hydrogen



Source: CSIRO National Roadmap for Hydrogen, 2018

Life beyond ‘end of life’

Rehabilitation and community

- AGL has an integrated planning process for AGL Loy Yang mine rehabilitation
  - Reviewed annually
  - In excess of 628 Ha of rehabilitation already completed.
  - Provision of $58 million for rehabilitation as at 30 June 2018
- AGL continues to work closely with all stakeholders to secure certainty over water rights and end use options.
- Our approach to the Liddell Innovation day has given the AGL Loy Yang team some strong insights into potential next use opportunities.

Source: AGL rehabilitation report 2017

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