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Electricity markets – Energy networks & markets in Australia

Northern Territory:

- Operated by Power and Water Corporation

North West Interconnected System (NWIS):

- Serves the Pilbara region, which is rich in mining and heavy industry.
- Operated by HORIZON Power

HORIZON
POWER

Wholesale Electricity Market (WEM):

- SWIS
- Operated by AEMO



Wholesale Electricity Market (WEM)



National Electricity Market (NEM):

- New South Wales
- The Australian Capital Territory
- Queensland
- South Australia
- Victoria
- Tasmania

Operated by AEMO



National Electricity Market (NEM)

About AEMO

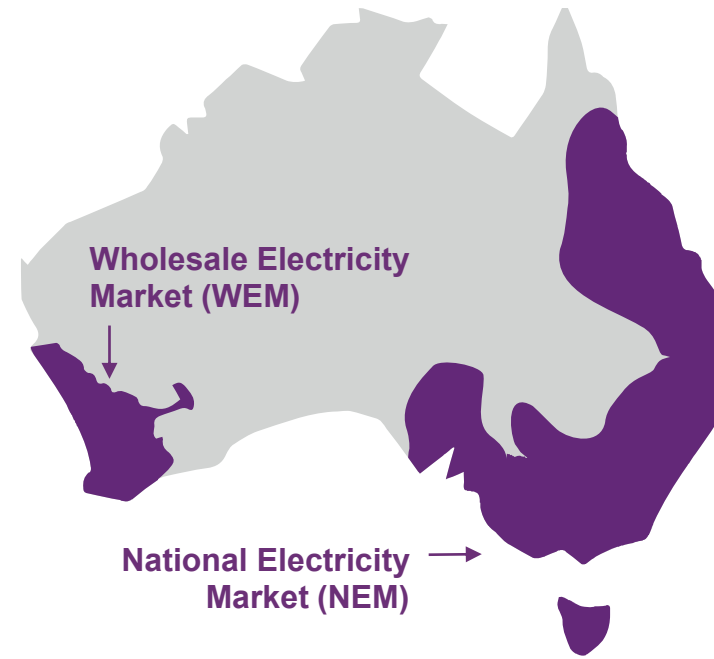
- AEMO is a member-based, not-for-profit organisation.
- We are the independent energy market and system operator for the National Electricity Market (NEM) and the WA Wholesale Electricity Market (WEM), and system planner for the NEM.
- We also operate retail and wholesale gas markets across south-eastern Australia and Victoria's gas pipeline grid.



ASL is an independent subsidiary of AEMO, established in 2021 to enable the transparent provision of advisory and energy services to National Electricity Market jurisdictions.



Electricity



Wholesale Electricity Market (WEM)

National Electricity Market (NEM)



Gas



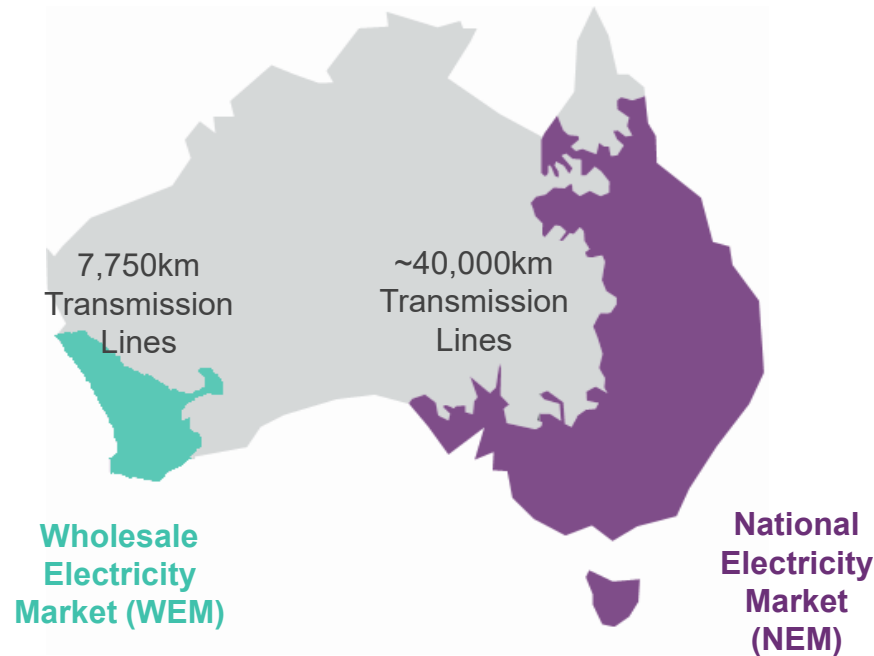
Declared Wholesale Gas Market (DWGM)

Short Term Trading Market (STTM) and Gas Supply Hub (GSH)

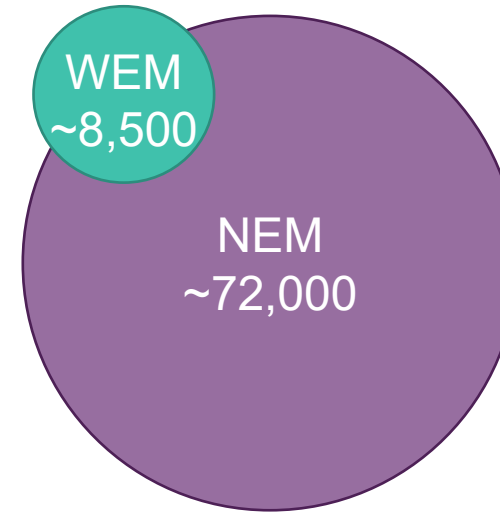
WEM vs NEM

The NEM is significantly larger market than the WEM, as shown by the comparison of generation capacities and the number of customers each market services. The WEM makes up a large geographic size for its capacity and demand and is not connected to any east-coast networks or energy sources.

A noteworthy difference between the two markets is that the WEM has both capacity and energy markets, while the NEM is energy only.



Geographic Spread of the Markets

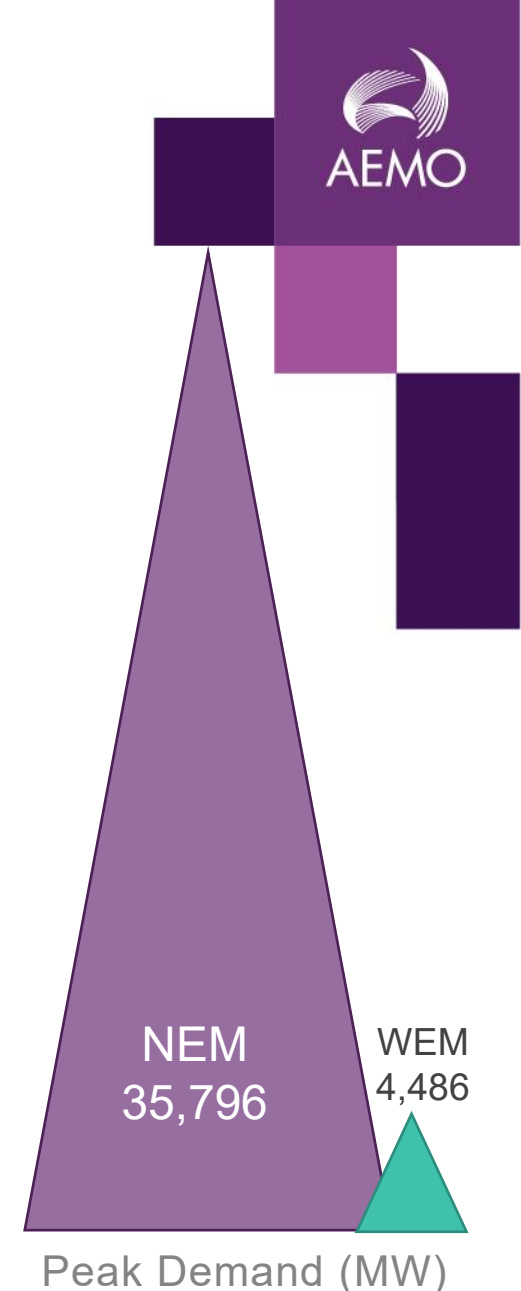


Generation Capacity (MW)



Number of Customers* (1M)

*Customers denotes the connection points on the network



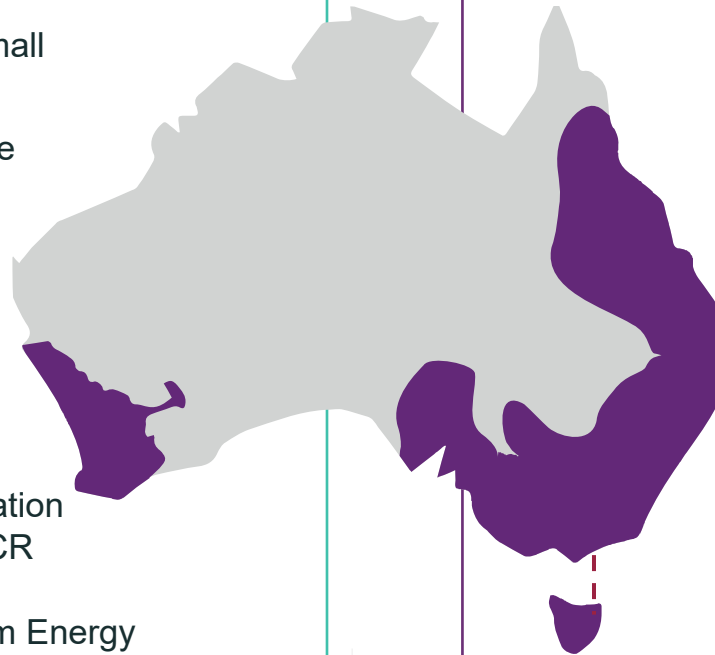
The WEM and NEM have distinct differences

Key differences between WEM and NEM

Capacity and Energy

WEM

- Single retailer (Synergy for Households, small customers)
- Smaller number of Retailers for Contestable customers (C&I)
- **Reserve Capacity Mechanism**
- Single network operator (Western Power)
- Isolated SWIS grid with no interconnectors
- Uncertain pathway for DER, WEM participation with Non-Market services, NCESS and IRCR
- Bilateral Market with a day head Short Term Energy Market (STEM) allowing for both long- and short-term hedging for retailers, respectively.

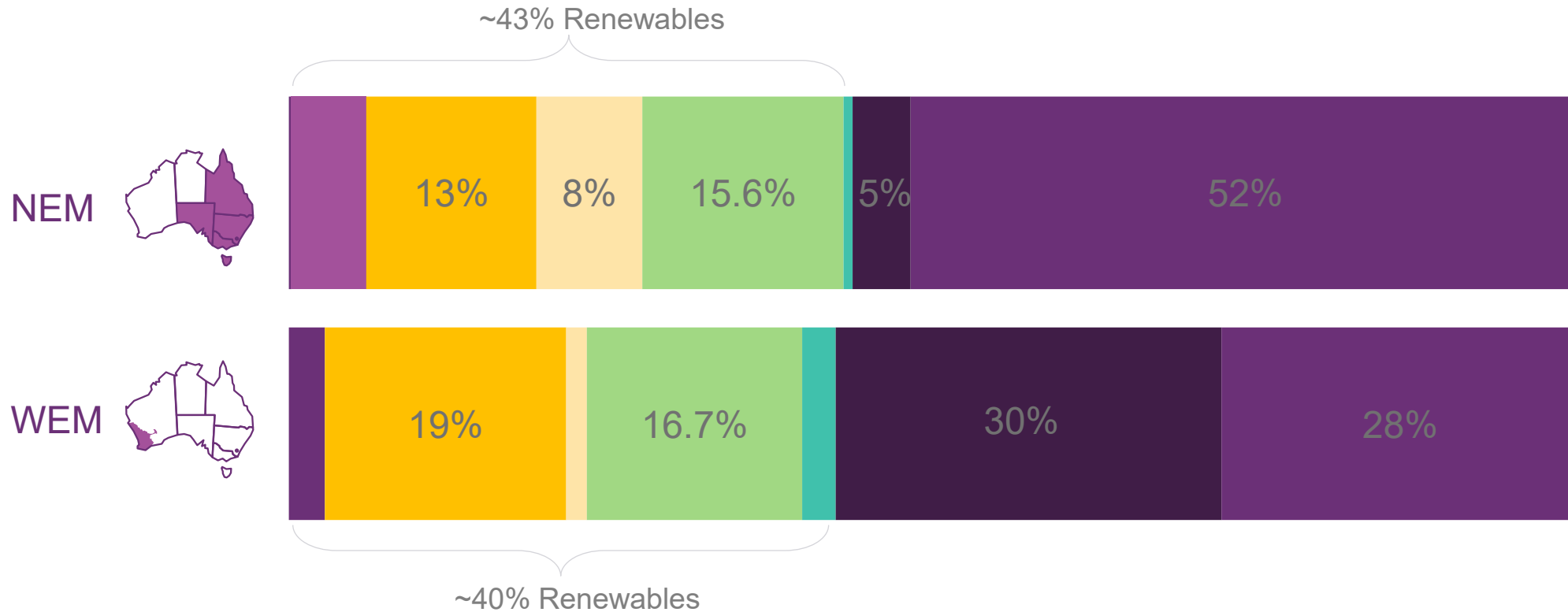


NEM

Energy Only

- Retail competition in most regions (>30 retailers)
- Mature futures/derivatives market that allows for hedging and price-smoothing in the retail sector
- **Gross pool (energy only) market with high price cap (>\$20k)**
- 13 DNSPs with varying technical standards and connection rules
- Highly interconnected across five states, enabling energy sharing (interconnectors)
- Pathway for DER participation – IPRR and VSR, market services

NEM vs WEM – Fuel Mix in 2025

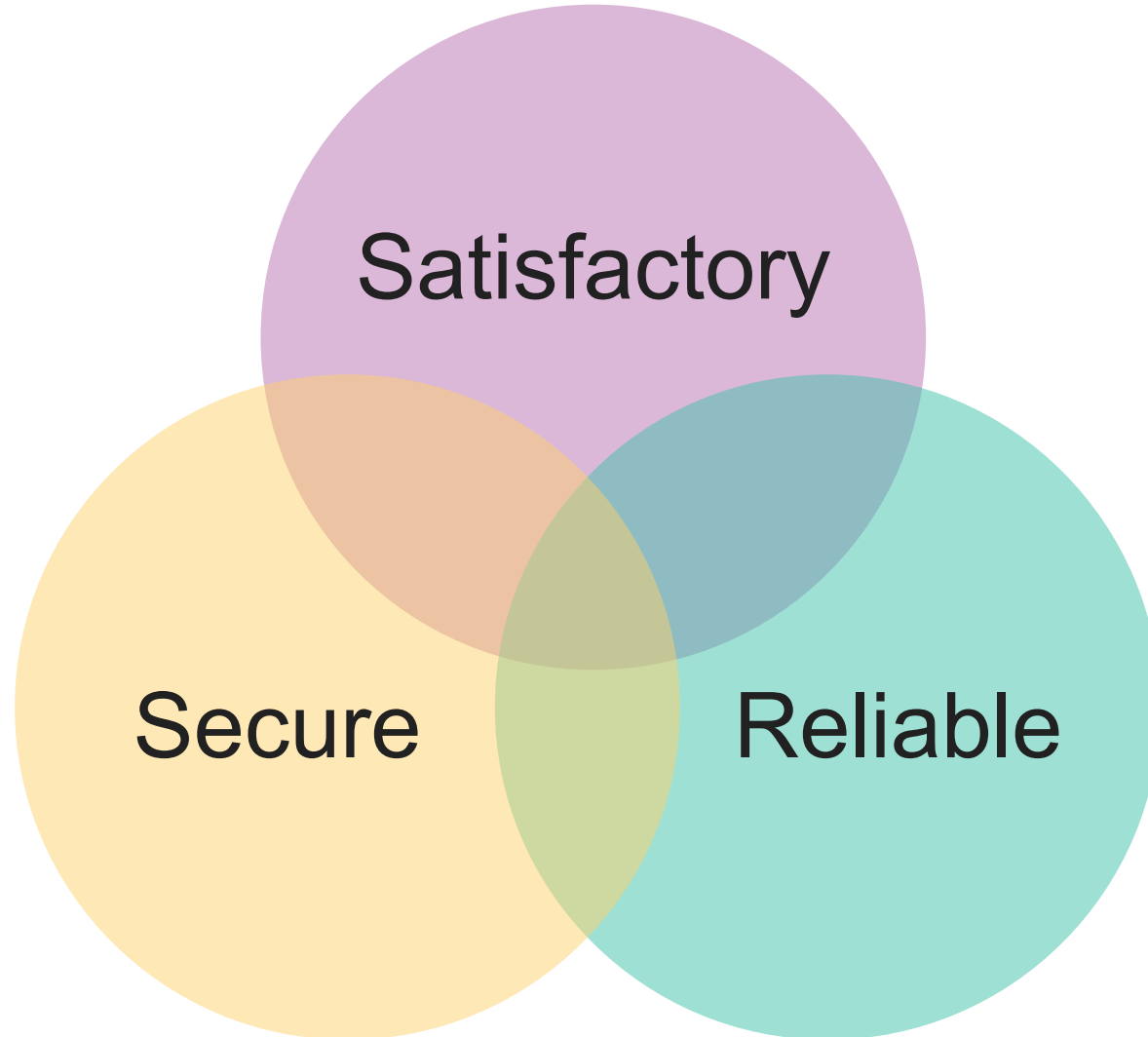


■ Other¹ ■ Hydro ■ Rooftop Solar ■ Grid Solar ■ Wind ■ Battery ■ Gas ■ Coal

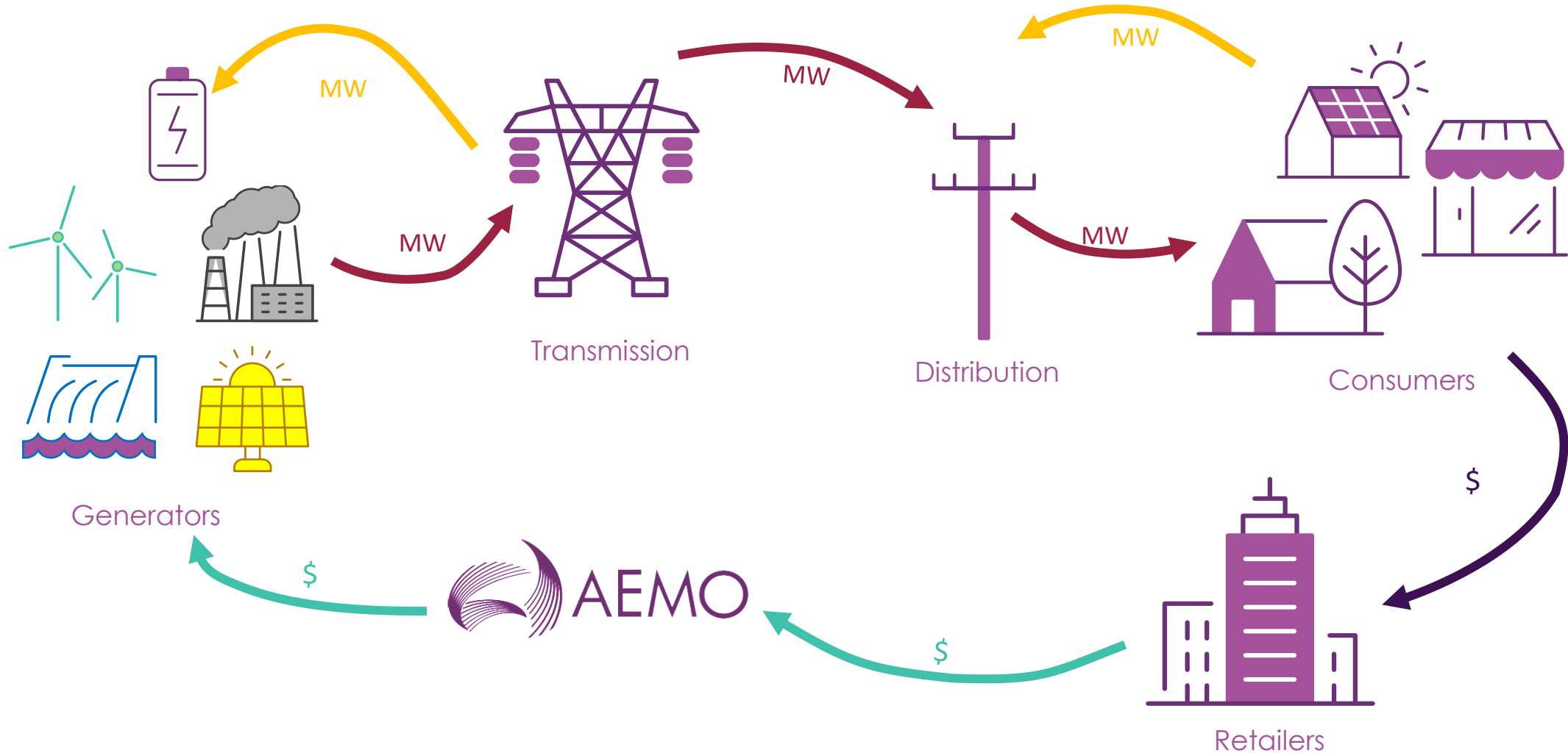
Generation Percentage Mix by Fuel Type in 2025

¹ Other includes biomass gas and hybrid⁶

One thing in Common – Power System Security is the Role of AEMO

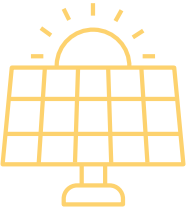
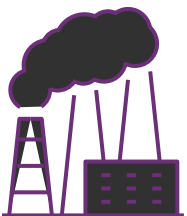


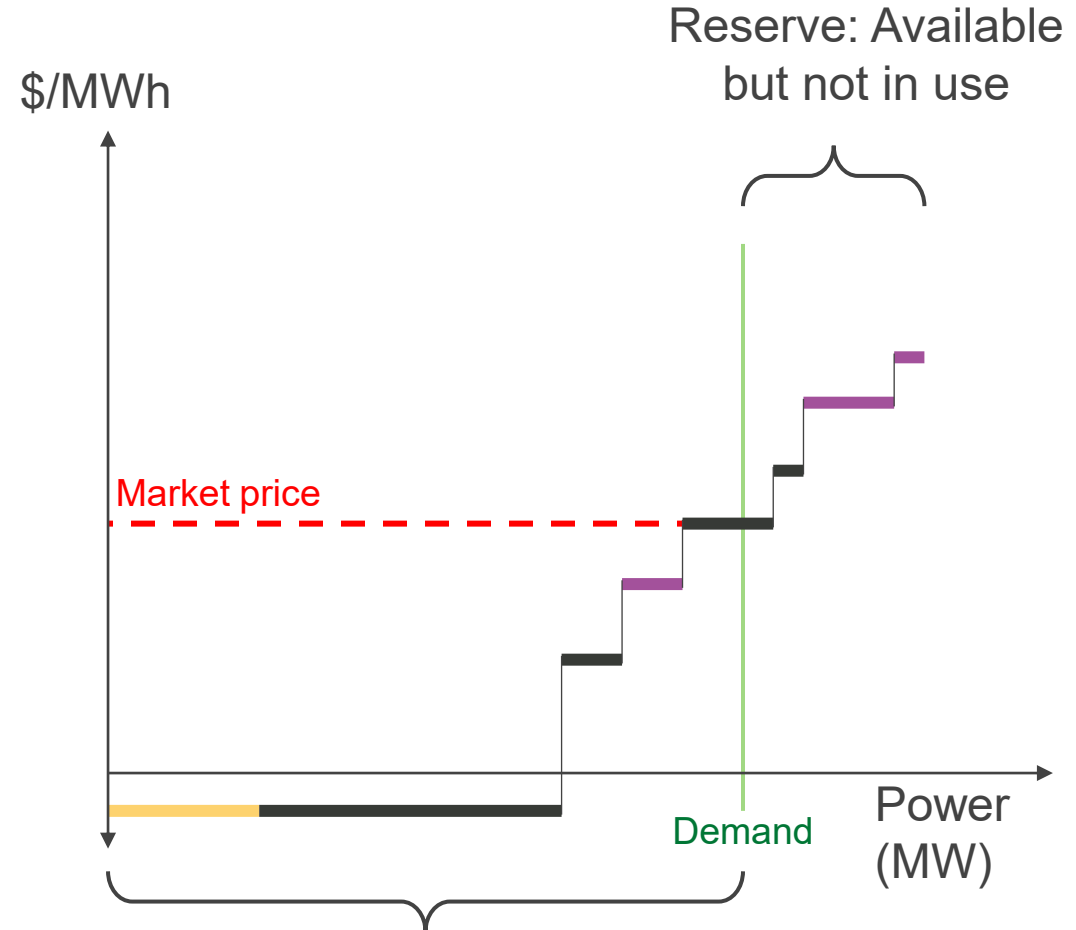
How an electricity market works



How is the price formed?

ECO101-Demand and Supply

Station	Bids
	<ul style="list-style-type: none">• 50 MW at -\$10
	<ul style="list-style-type: none">• 100 MW at -\$10• 20 MW at \$30• 30 MW at \$50• 10 MW at \$60
	<ul style="list-style-type: none">• 20 MW at \$40• 30 MW at \$70• 10 MW at \$80

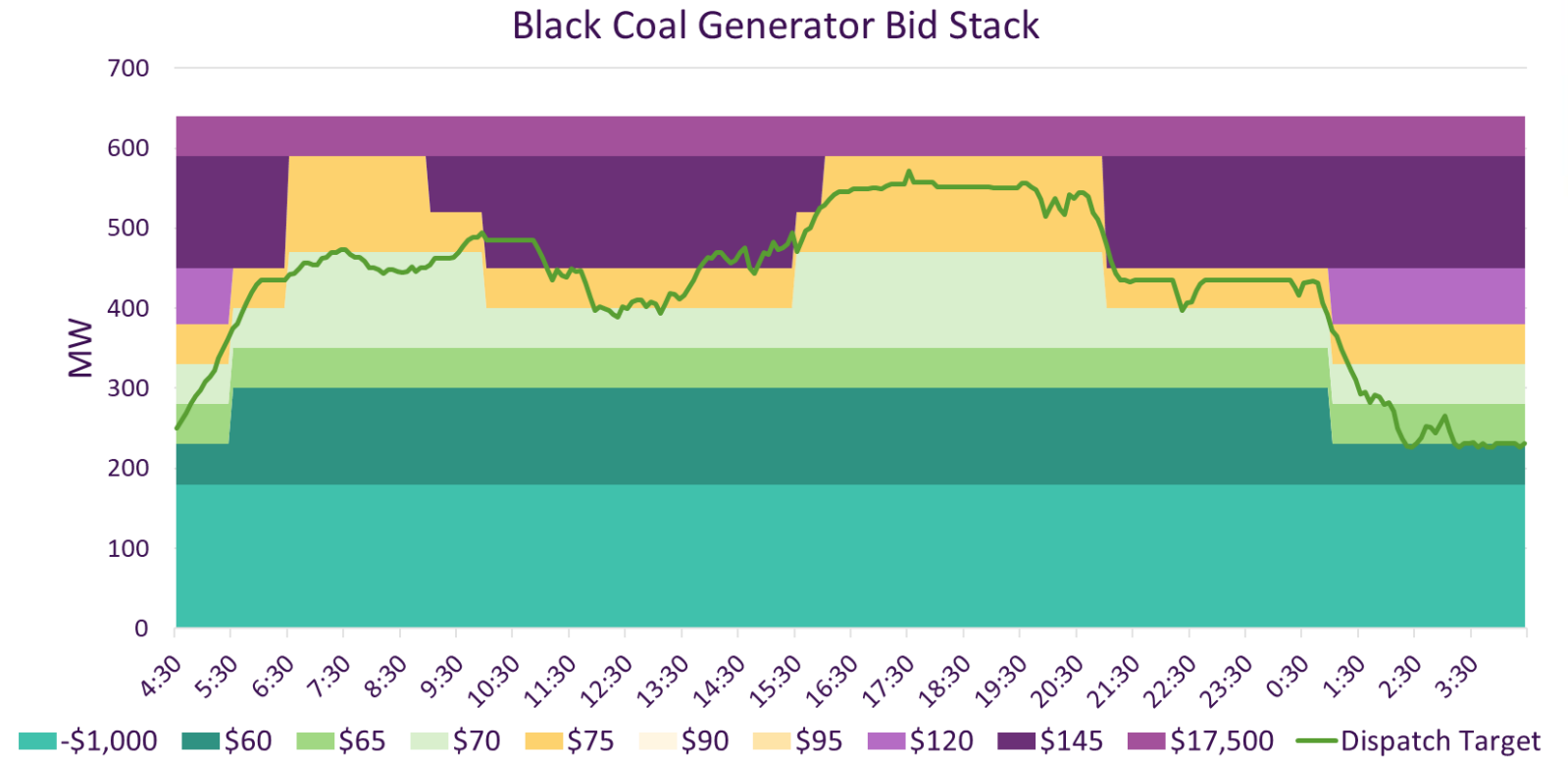


- All these bids are dispatched
- Everyone is paid at the market price

Bid structure – black coal generator

A few things to note,

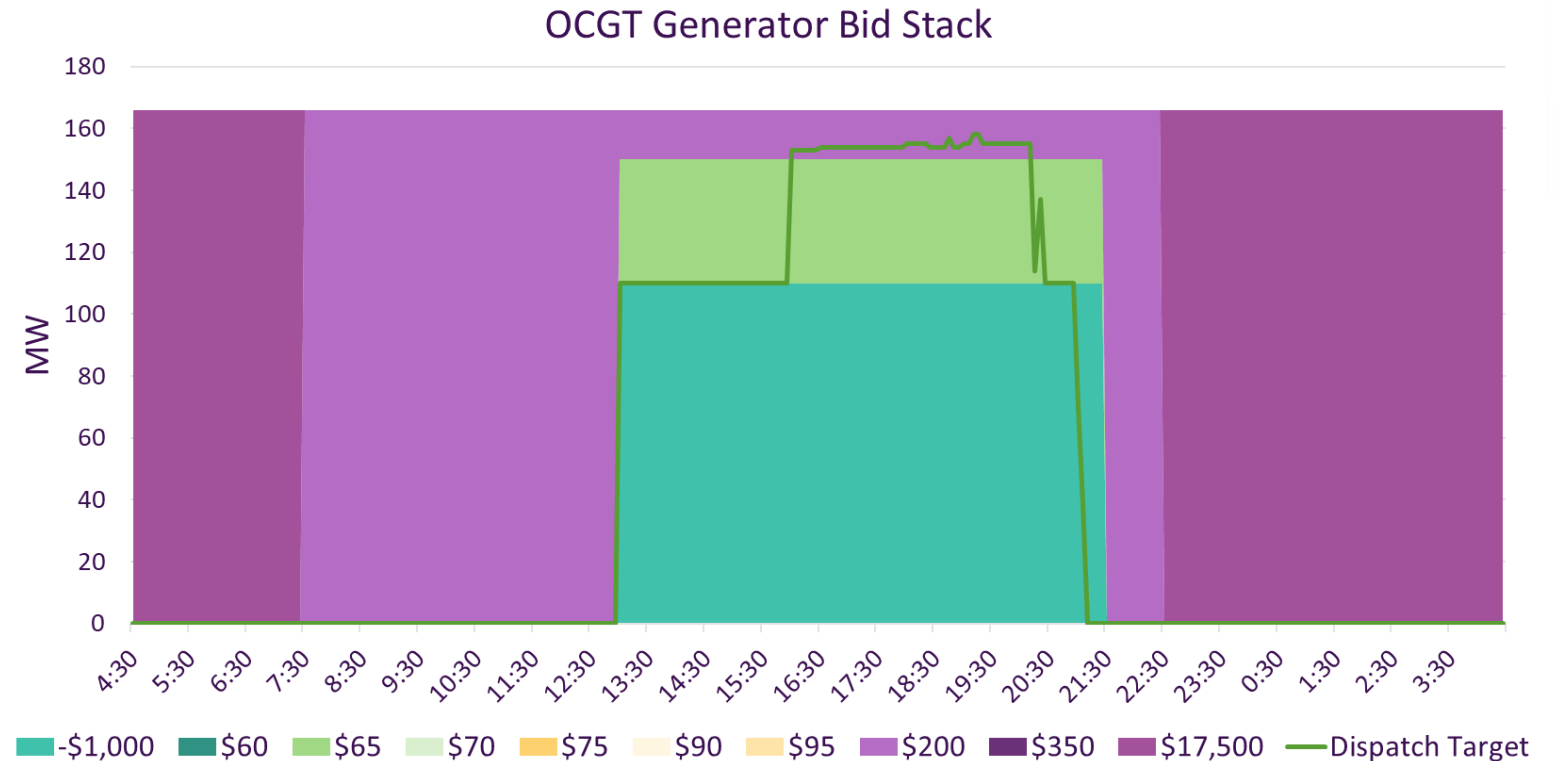
- Multiple price bands utilised
 - 10 x PQ pairs
- Volume in price bands profiled
 - Likely reflecting SRMC, Gentailer position and/or Sold contract position



Bid structure – gas fired generator

A few things to note,

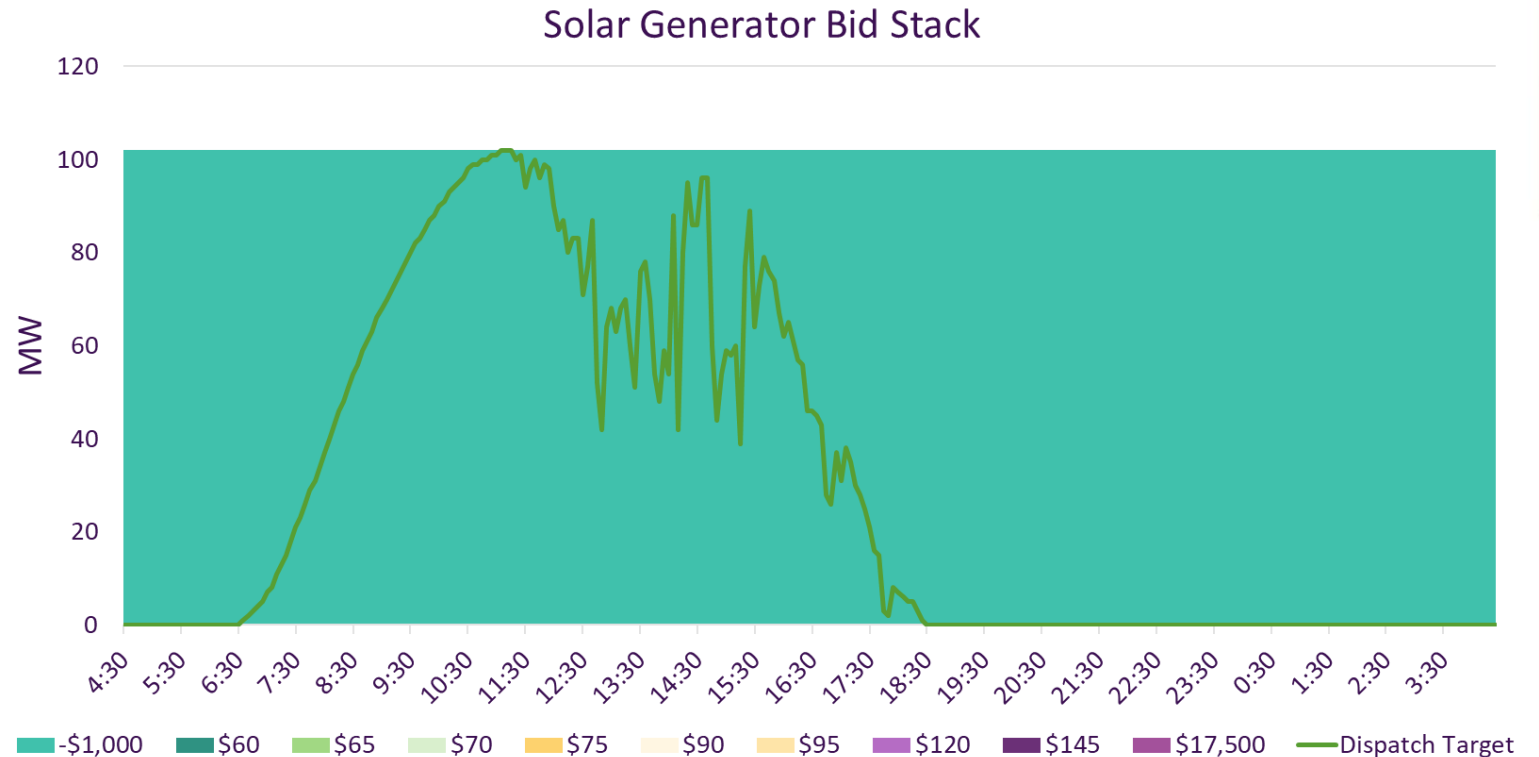
- All volume at high prices outside midday to evening
- Volume at \$200 band
 - Likely indicator of cap position (to be covered later)



Bid structure – solar generator

A few things to note,

- All prices at - \$1,000
 - Negative short-run marginal cost
 - Large generation certificates (LGCs) provide revenue outside spot energy



South West Interconnected System (SWIS)

Western Australia



The WEM and the SWIS

The WEM and the SWIS are not the same, but they could not operate in isolation.



The WEM is the economic framework which provides incentives for competition and governs how Rule Participants operate within the relevant markets.

The SWIS is the physical infrastructure of the power system which delivers energy through the network to the end-users. The SWIS has technical limitations and requirements it needs met to operate effectively.

Characteristics of the WEM and the SWIS



SWIS is geographically isolated with large sprawling network

Security Constrained Economic Dispatch (SCED)

Consumers

- ~1.2M connection points
- Limited contestability

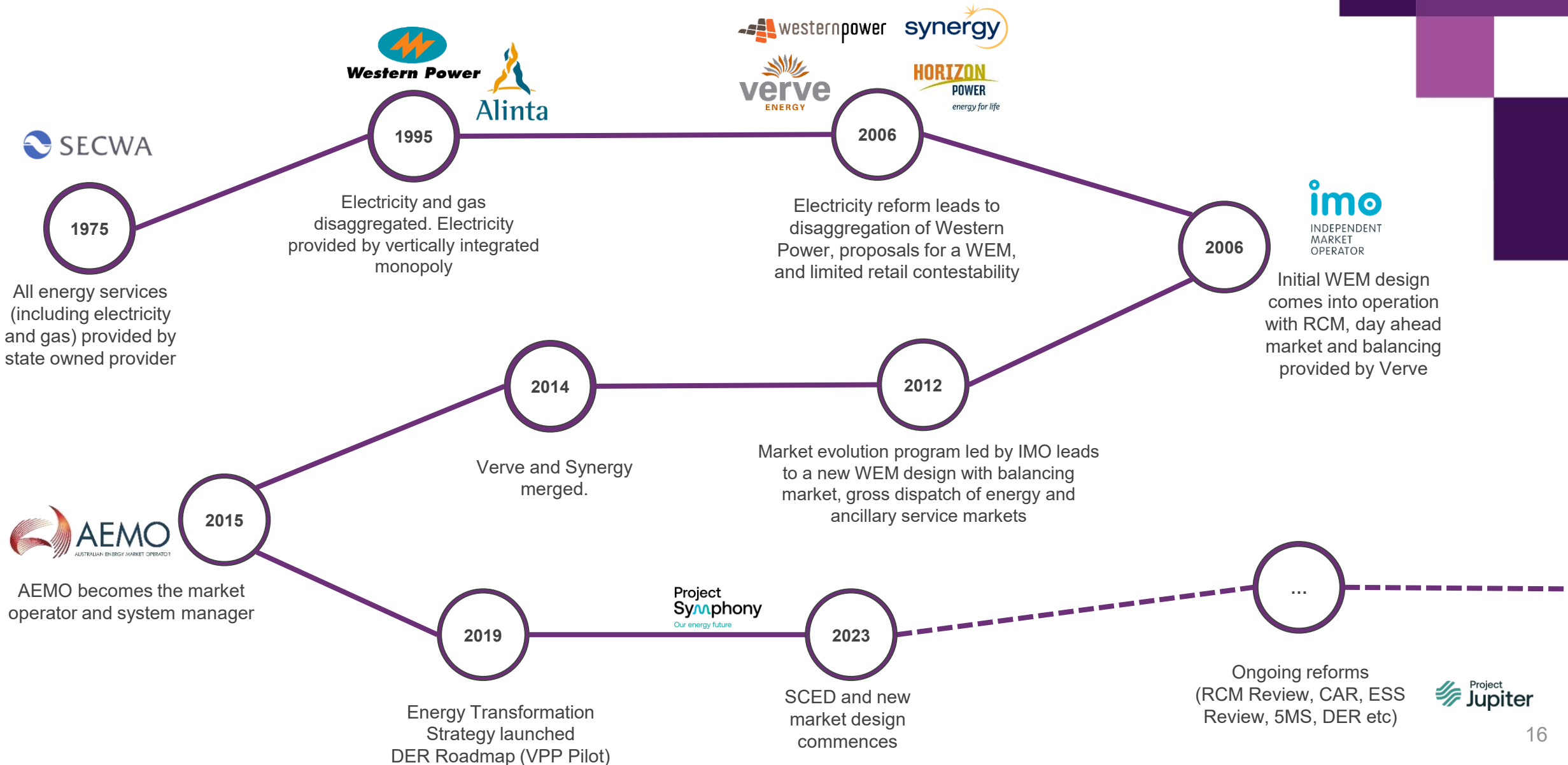
RCM ensures sufficient capacity is available to meet peak demand

Demand

- Peak ~ 4,500 MW
- Average ~ 2,100 MW
- Min record ~500 MW

More than 2 GW of rooftop PV
6x more than the next largest generator & ~40% total energy produced

Evolution of the WEM



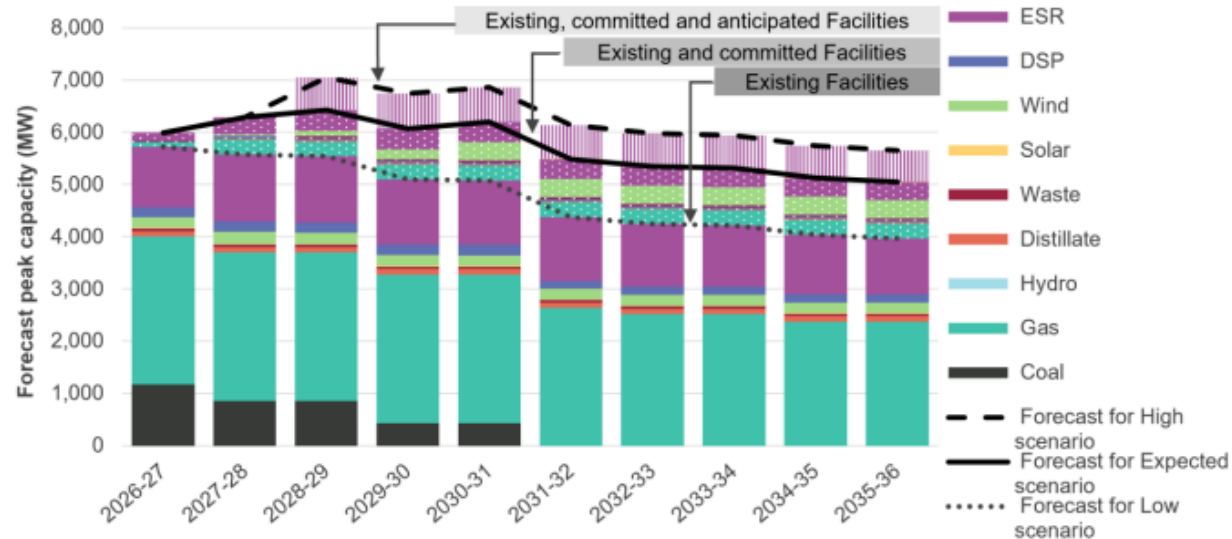
History of the SWIS

Generator Entry and Retirement

21-sept 2006 WEM Start

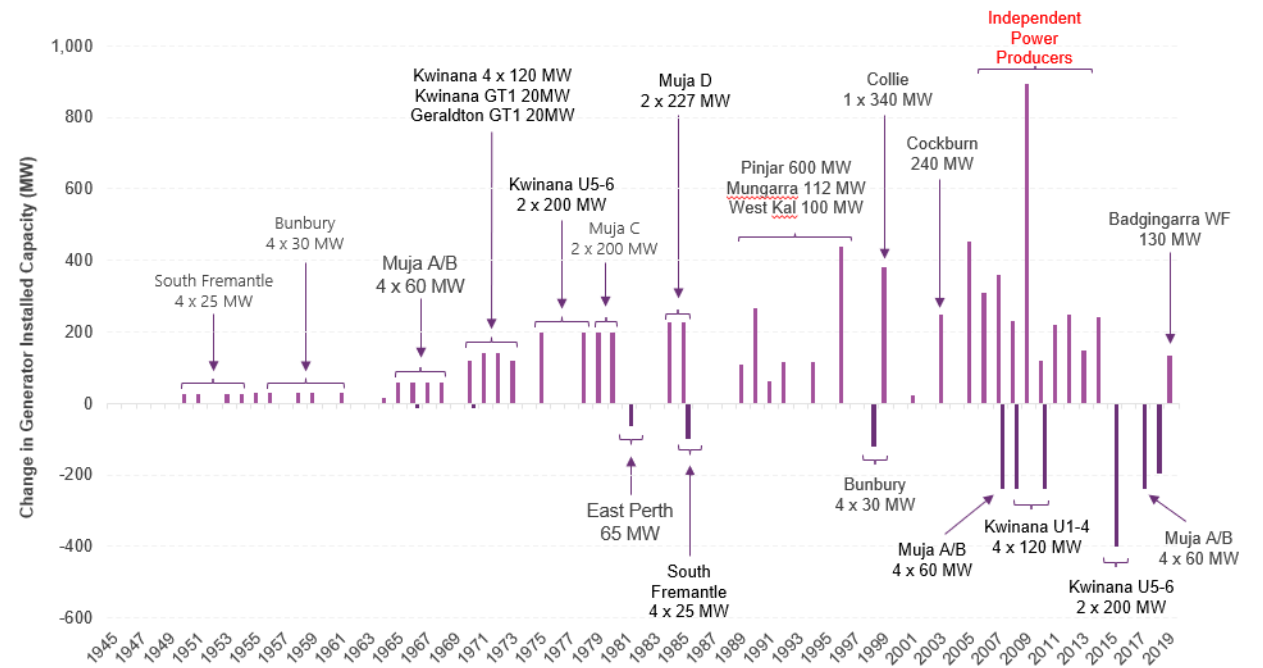
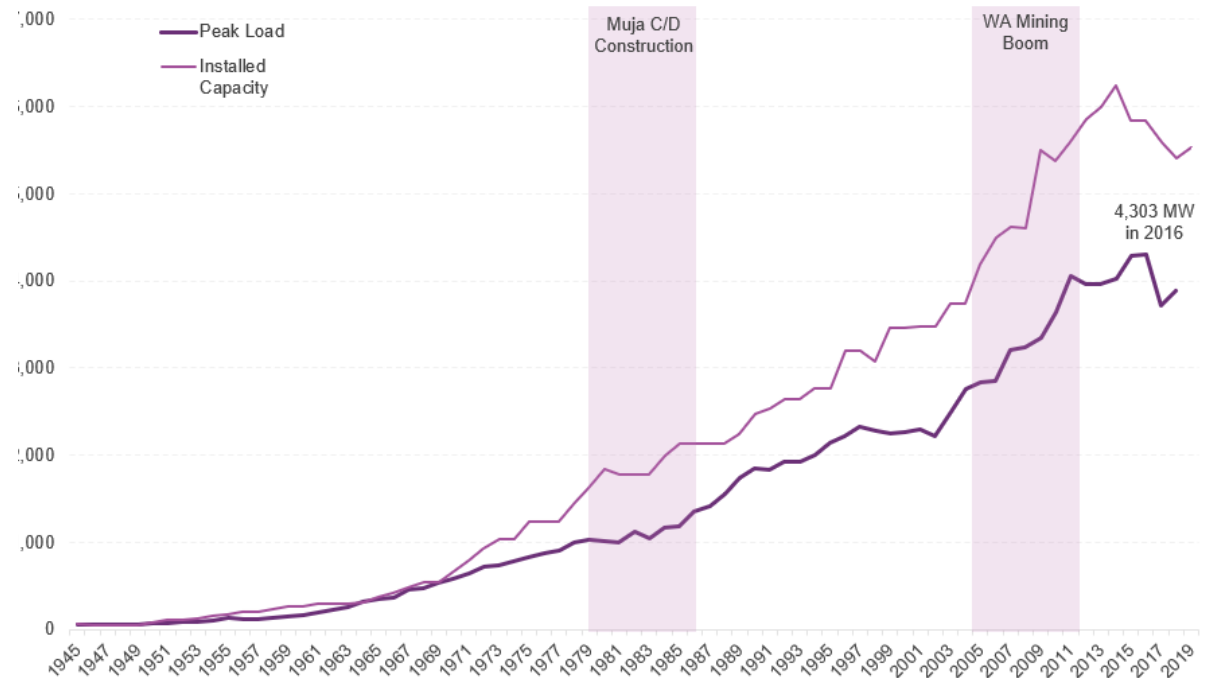
Forecast peak capacity for the first two years of this WEM 2026 ESOO outlook period

Figure 22 Forecast peak capacity by technology type, under three scenarios, 2026-27 to 2035-36 (MW)



Notes:

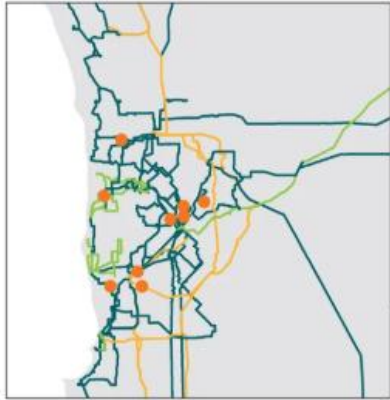
- The components of hybrid Facilities are split by their respective technology types.
- Solid colours are used to present technology types for existing Facilities. Corresponding dot and line patterned colours are used to present technology types for committed and anticipated Facilities respectively.



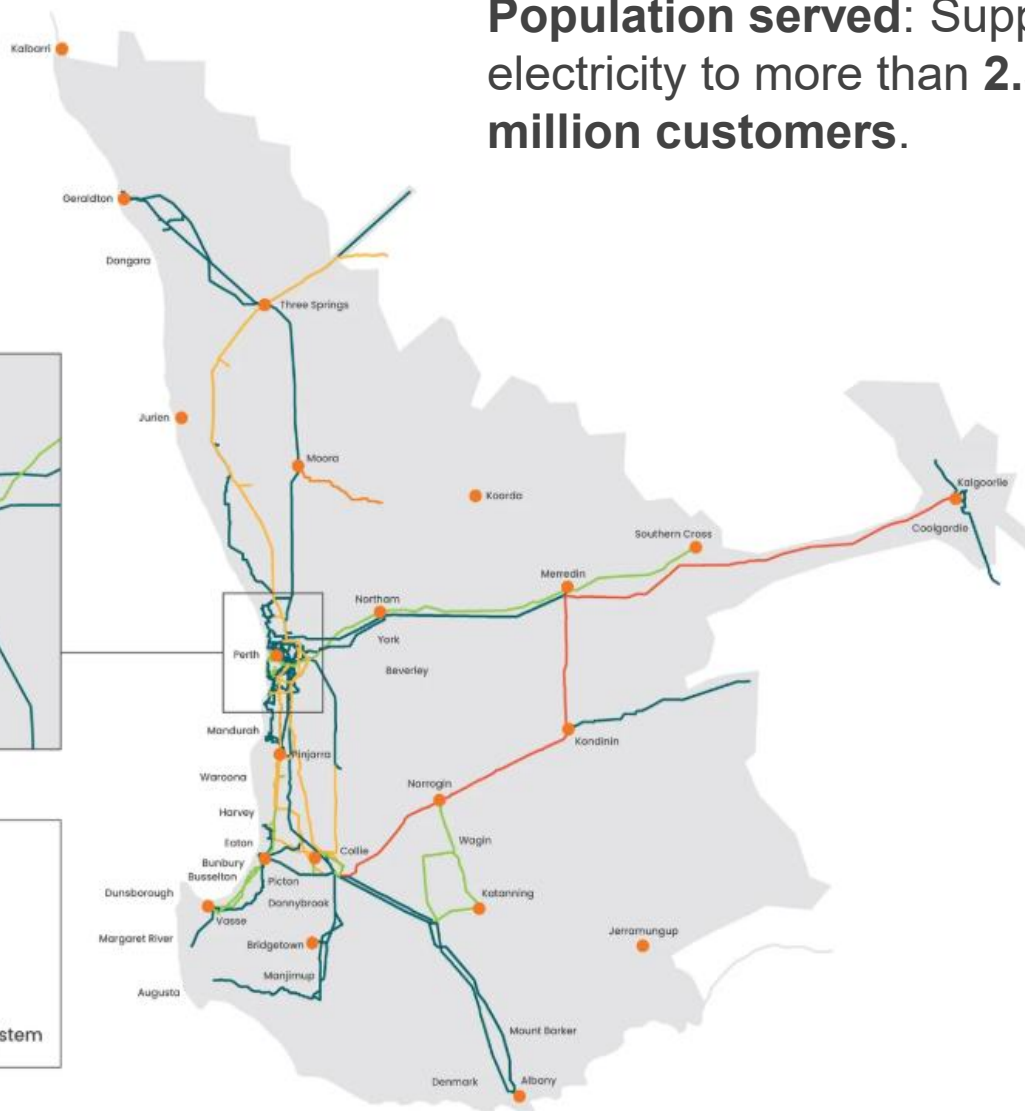
The SWIS today

Population served: Supplies electricity to more than **2.3 million customers**.

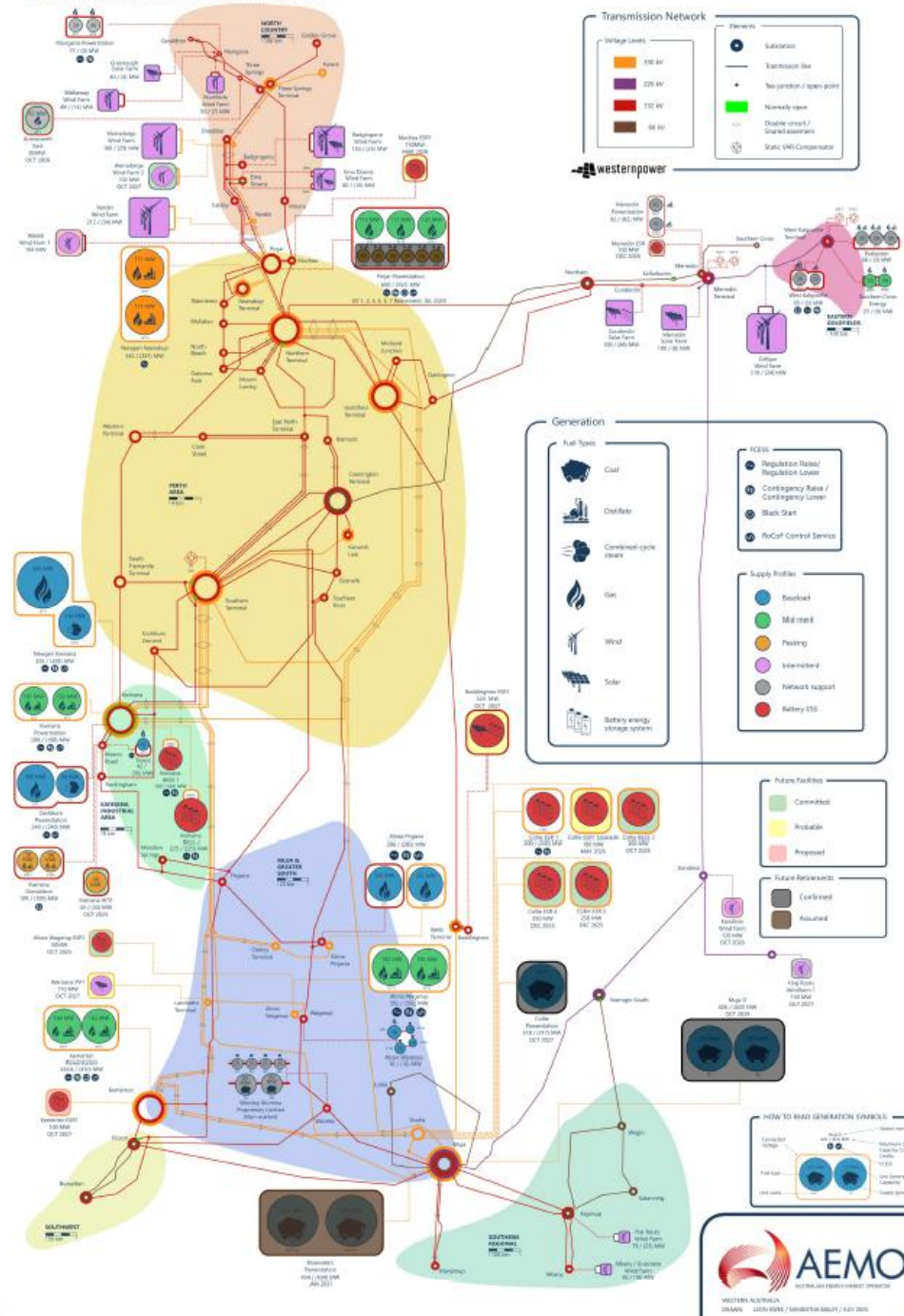
Perth Metro



Legend



THE SOUTH-WEST INTERCONNECTED SYSTEM
FUTURE OUTLOOK: JAN 2031 - CAPACITY YEAR 30/31 Q2



Trading mechanisms

Important: do not affect dispatch!

**Capacity
Credits**

Reserve
Capacity
Mechanism
(RCM)

Bilateral
contracts

Energy

Short Term
Energy Market
(STEM)

**Essential
System
Services**

SCED

Real-Time Market:
Energy

Real-Time Market:
Frequency Co-
optimised Essential
System Services

Contractual:
Non-co-
optimised
essential
system services

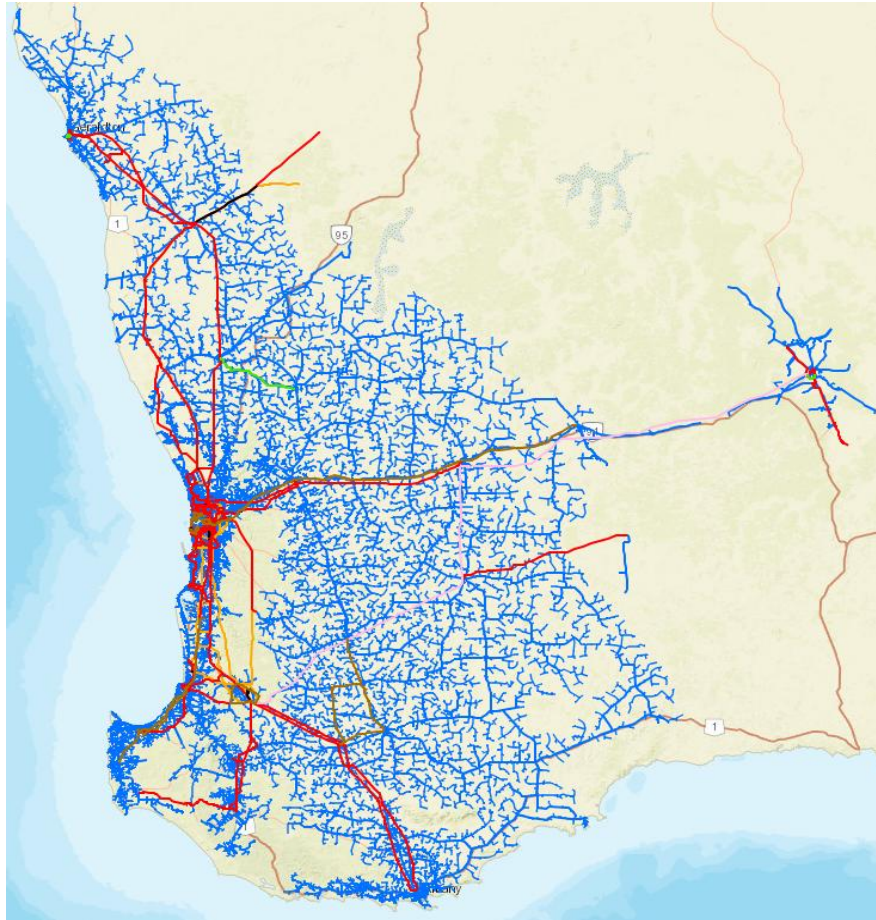
Market structure – The WEM Reserve Capacity Mechanism (RCM)

- The Reserve Capacity Mechanism (RCM) is a core feature of the Wholesale Electricity Market (WEM) in Western Australia, designed to ensure there is adequate generation and demand-side capacity available to meet the forecasted peak demand.
- The RCM is unique to the SWIS and plays a crucial role in maintaining system reliability.

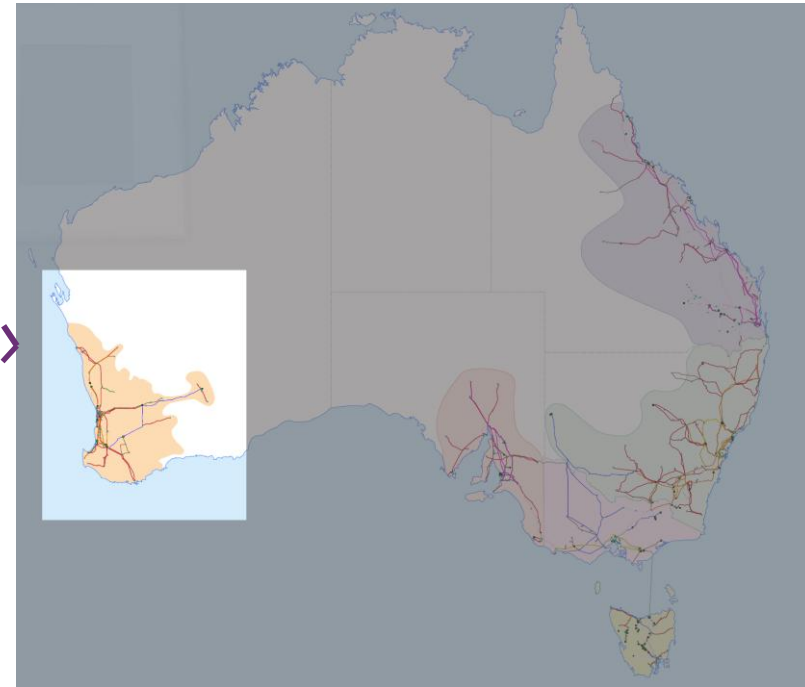
Purpose of the RCM:

1. to ensure that the WEM has enough capacity available to meet future peak demand;
2. to provide financial incentives for capacity providers (generators, demand-side resources, and storage systems) to be available when needed, even if the capacity is not utilised every year.
3. Funded by consumers (Retailers) through IRCR (summer peak periods)

Why does the SWIS have a capacity mechanism?

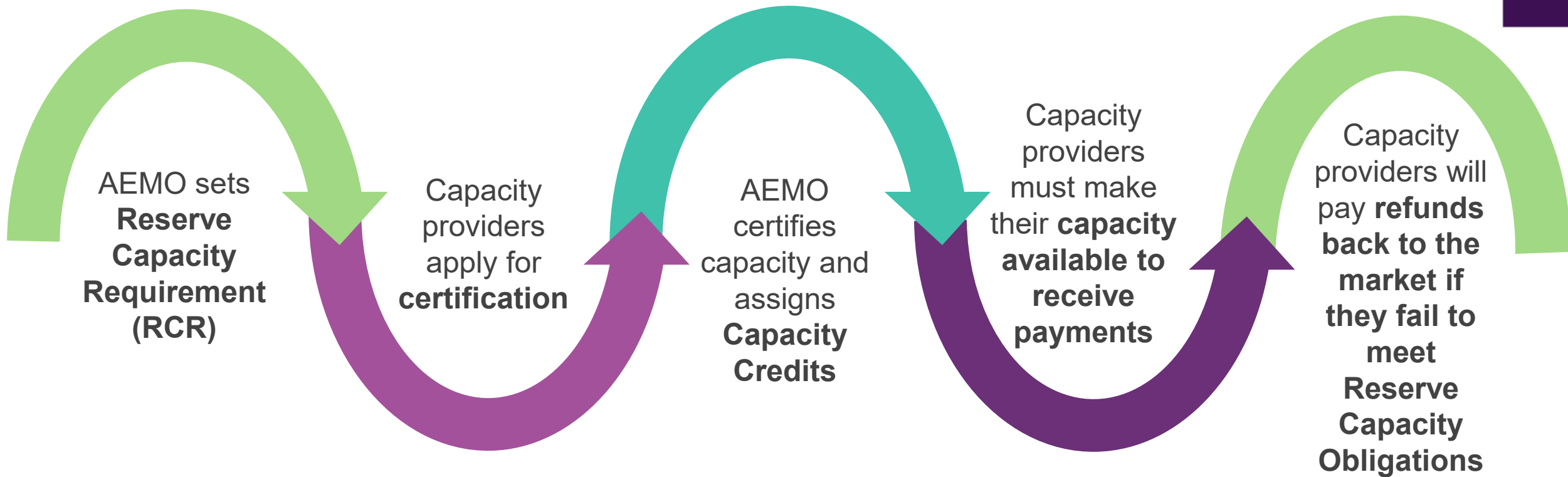


SWIS – isolated network

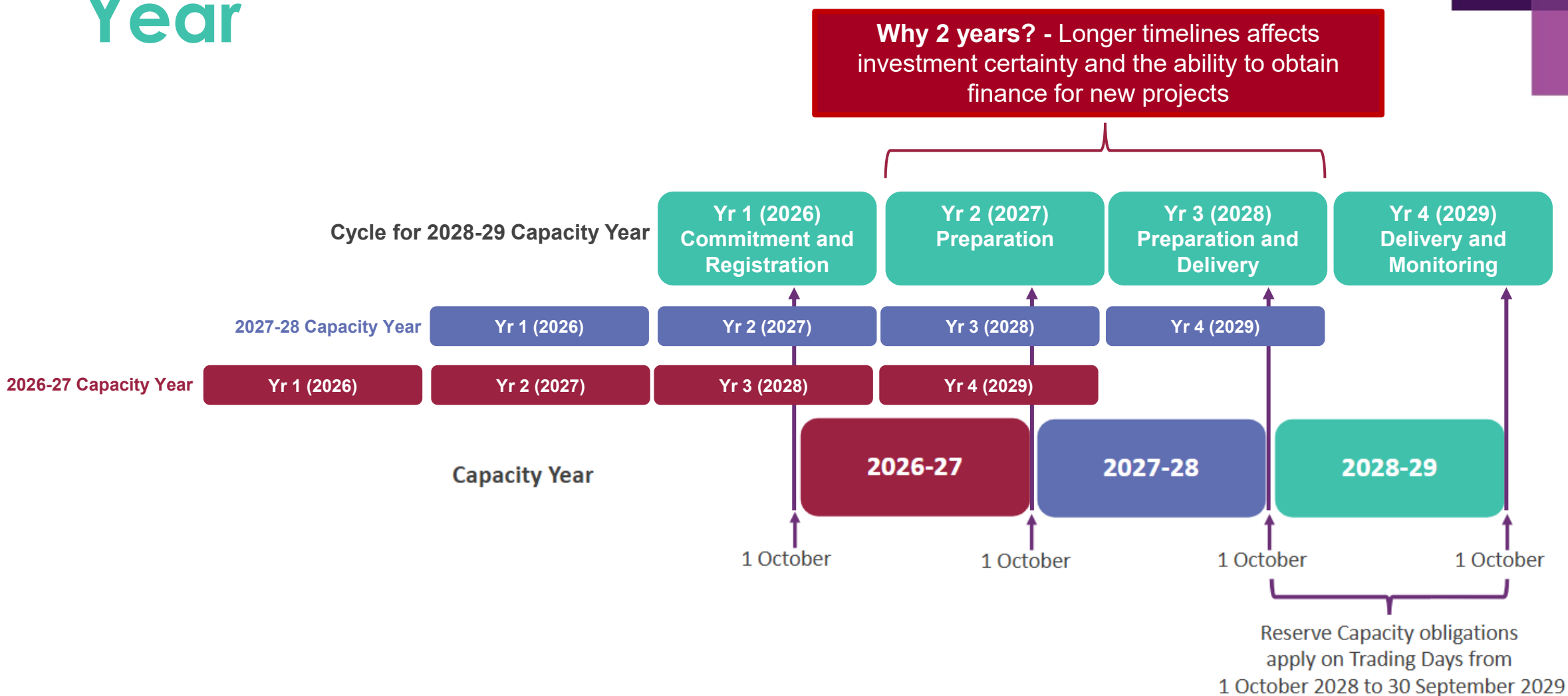


What is the RCM?

A mechanism to encourage capacity in the SWIS to meet peak demand two years in the future, in line with RCR expectations set in the ESOO.



Reserve Capacity Cycle and Capacity Year



Note: Year 1 activities can be deferred by AEMO, if the need arises (Clause 4.1.1C of the ESM Rules)

National Electricity Market (NEM)

Australian East Coast



Market Body Functions in the NEM



- AEMO (Australian Energy Market Operator)
 - Role is to facilitate operation of the power system within the NEM and the associated markets *



- AEMC (Australian Energy Market Commission)
 - Role is to make and amend rules for the national electricity market



- AER (Australian Energy Regulator)
 - Role is to enforce the National Electricity Law and the National Electricity Rules
 - Arm of the Australian Competition and Consumer Commission (ACCC)

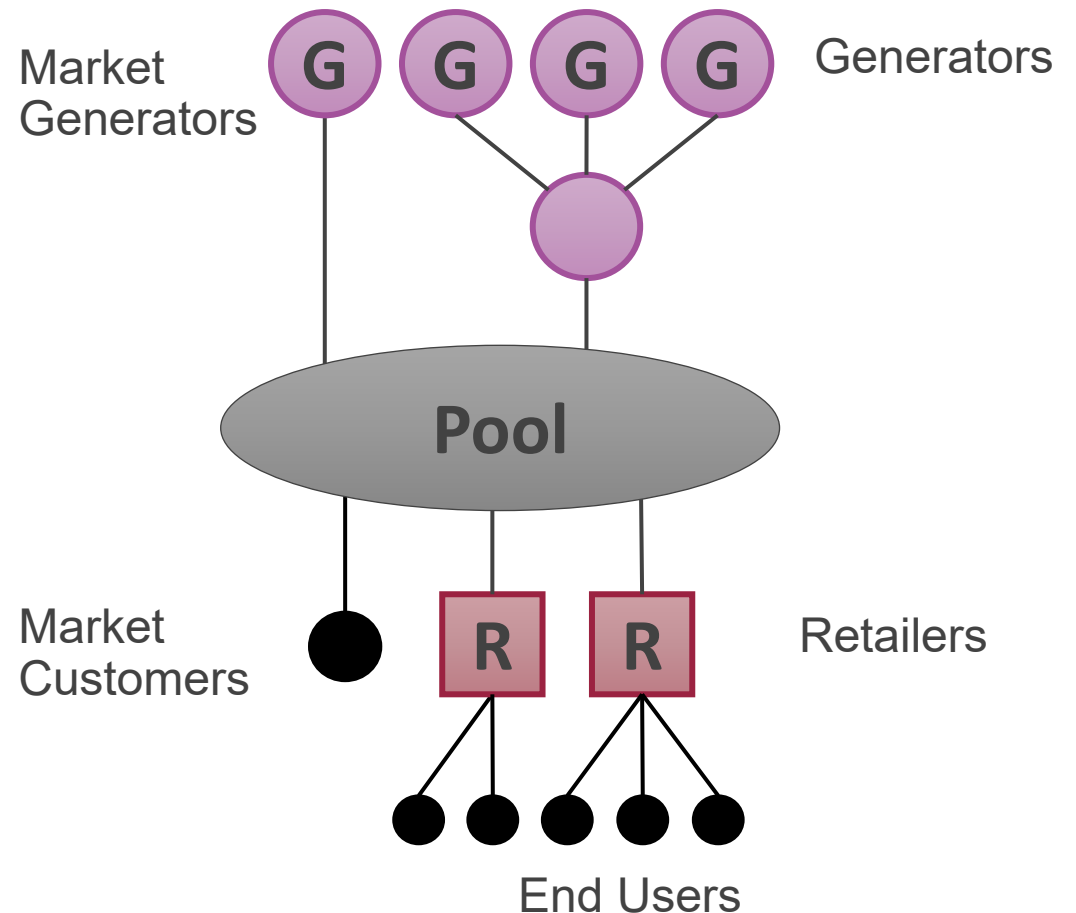


Market Pool

The NEM spot market operates as a centralised pool.

In a centralised pool market, buyers buy from and sellers sell from a 'pool' rather than directly between each other.

- Trading and settlement occur on a 5 minute basis (dispatch interval)
- Floor = -\$1,000/MWh
- Cap = \$22,000/MWh

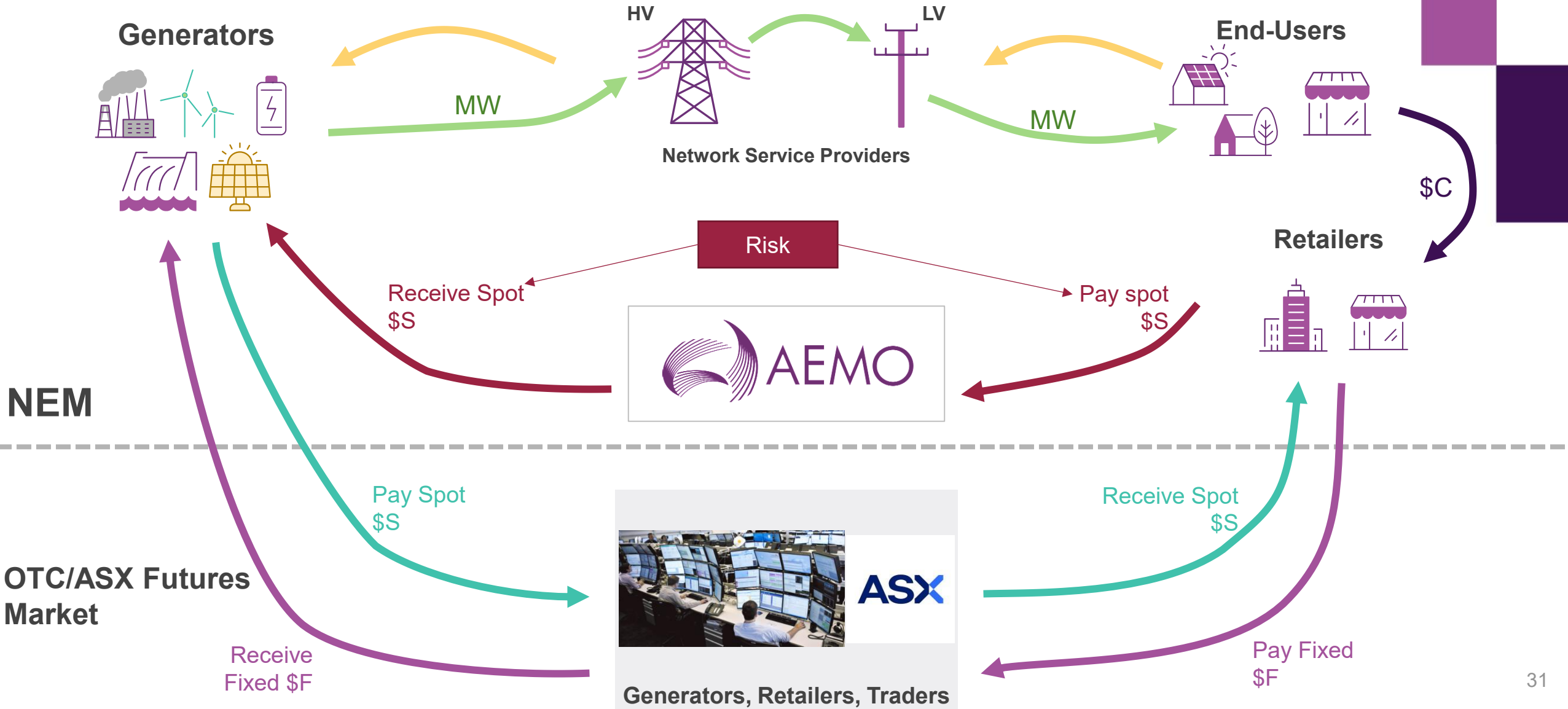


Who's who in the NEM - The “Gentailer”

- The NEM can have separate participants: Generators and Retailers.
- However, it is now common for participants to be both, i.e., a “*Gentailer*”.
- “Gentailers” are combined, or vertically integrated energy businesses, involved or owning both generation assets and retail businesses.
- Origin, AGL, EA, Snowy Hydro, Hydro Tasmania are all examples of Gentailers, some with the same branded retail and generation business, such as AGL, Origin and EA, and others have separate generation and retail entities, such as Snowy Hydro (generation) and Red energy and Lumo (retail).

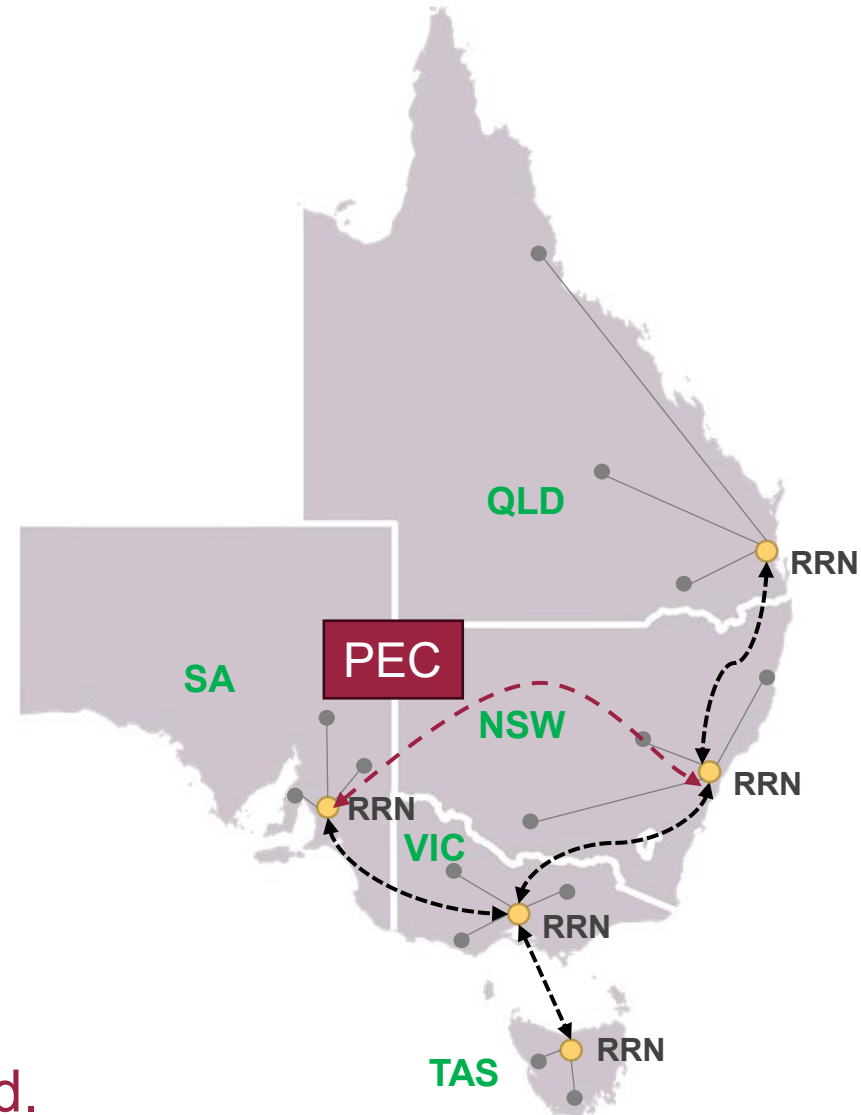


Energy and financial flows in the NEM



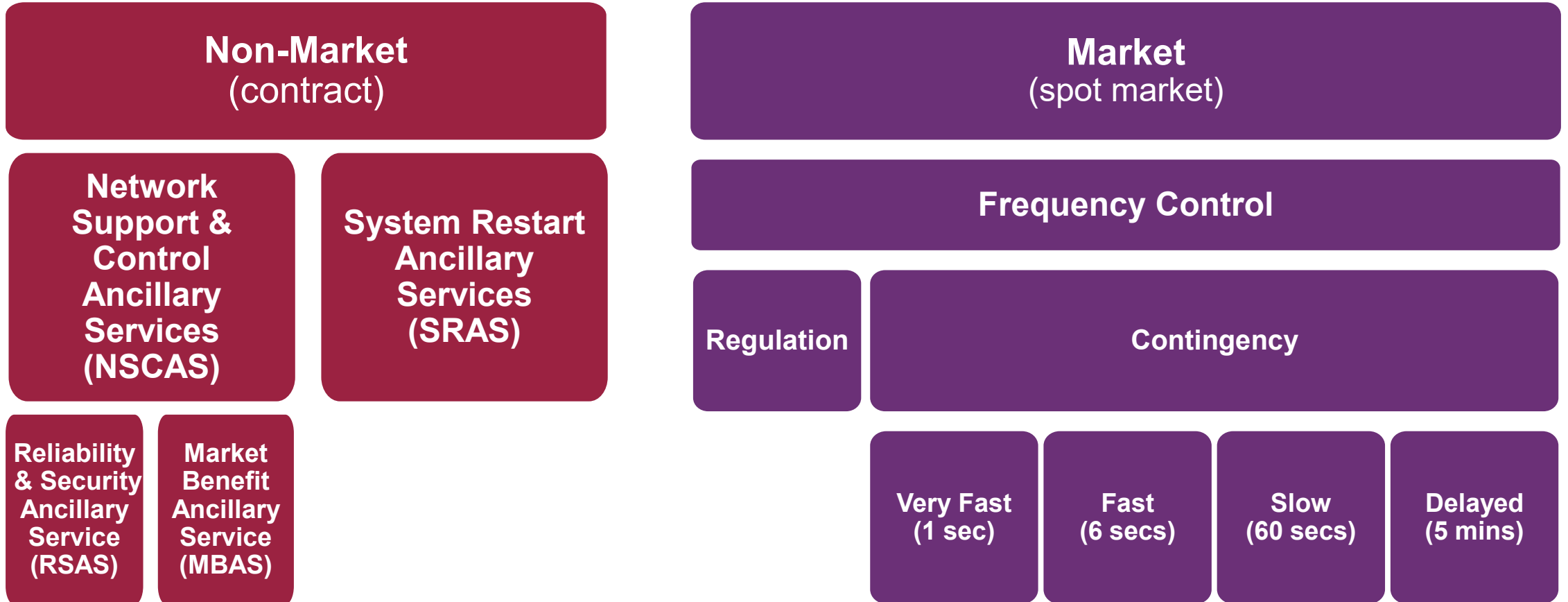
NEM dispatch and pricing model

- Regional prices apply at each Regional Reference Node (RRN)
- Losses between regions calculated dynamically based on dispatched interconnector flow
- All prices within a region related to RRN by fixed (annual) Marginal Loss Factor (MLF)
- NEMDE was a “Hub and Spoke Model”,
- Project Energy Connect (PEC ~800MWs) provides the first loop and the creation of Loop flow constraints are being introduced.



What are Ancillary Services and why do we need them?

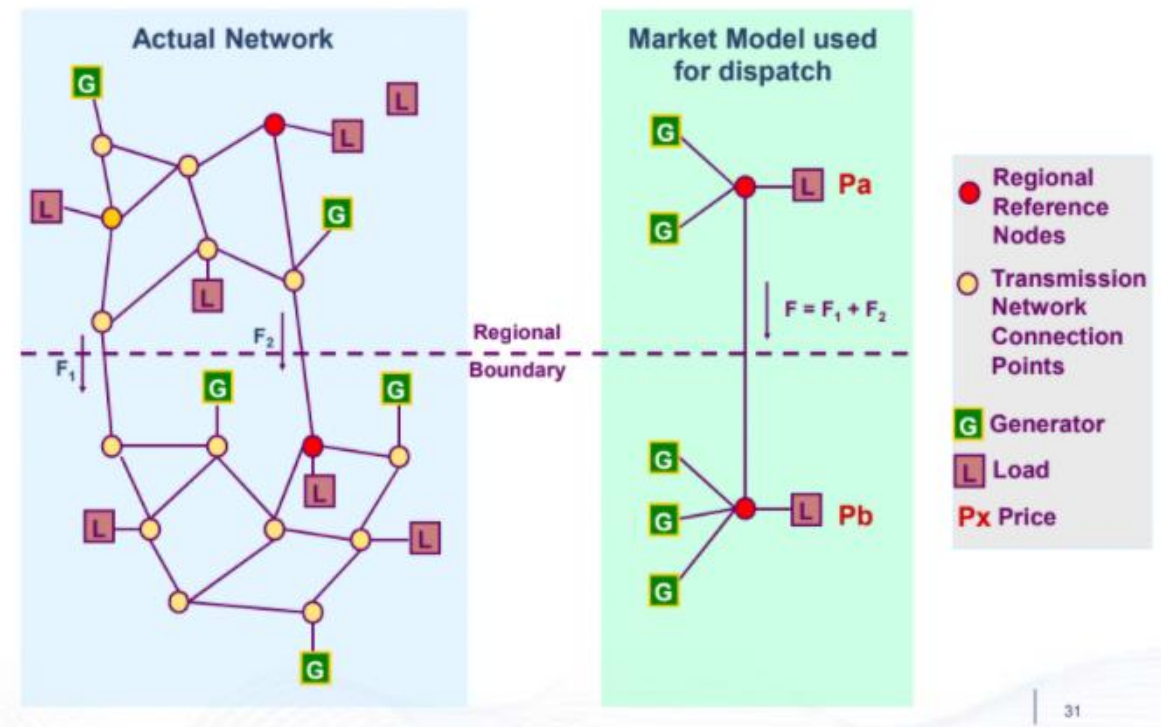
Enable AEMO to manage the power system safely, securely and reliably



Zonal Approximation

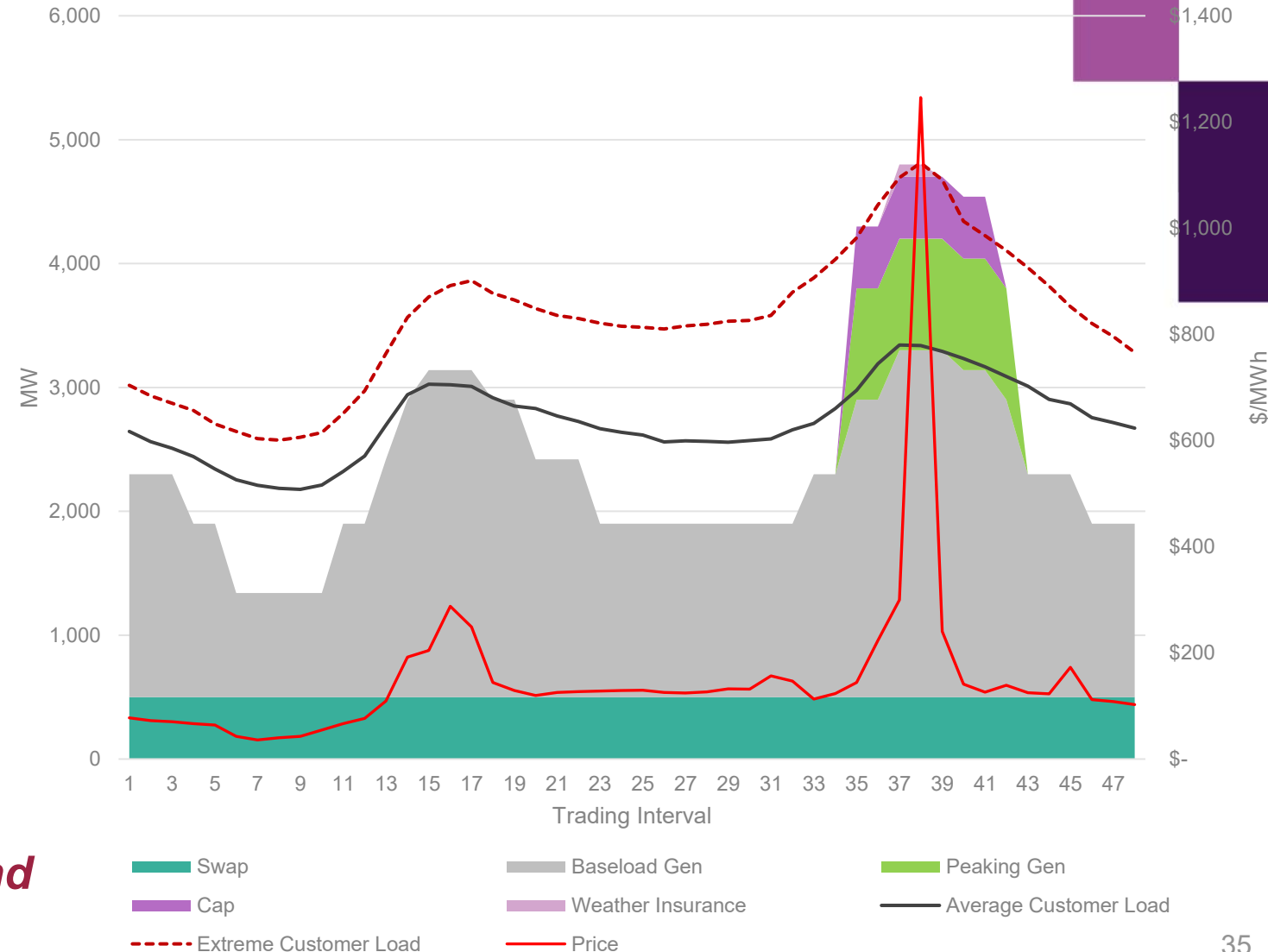
How can we simplify a problem as complicated as an electrical network to a point where it becomes workable?

- Combine network elements in market model
 - All loads and generators connected to same location (regional reference node, RRN)
 - Load aggregated into single value
 - Load definition to exclude non-controllable elements (rooftop PV = reduction in load)
 - Interconnectors simplified (parallel AC lines represented by single line)



Retail risk: hedging in the NEM

- **Black line** is average customer demand i.e. what our customers will use.
- **Swaps** are a fixed cost hedge
- Therefore, match up fixed costs with guaranteed load, i.e. buy swaps (light blue) to add to your baseload generation up to the black line.
- **Red dotted line** is what customer demand could be on a high demand day. Spot prices would likely be volatile on such a day.
- **\$300 Caps**, peaking generation and insurance are a hedge against spot price volatility
- Therefore, manage higher risk events with higher premium / lower probability products.



Hedging is a mixture of Generation and Derivatives to mitigate risk

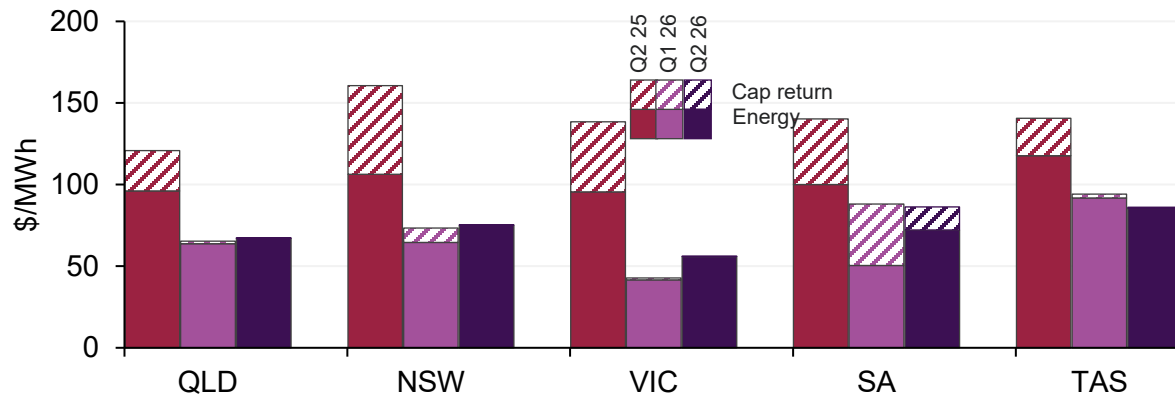
Common Trends in the Energy Market NEM & WEM

1. Low Carbon future – ISP and ESSO
2. Investment is required to maintain reliability over the next decade generation capacity and transmission
3. The energy transition is well underway in both Energy Systems
 - Coal retirements
 - Battery Storage and Grid Flexibility – the role that BESS play providing both energy and Ancillary Services (FCAS/FCESS)
 - DPV growth continues to impact Operational demand
 - Wind and Solar generation growth backed by Gas generation
4. Role of DER/ CER integration into the energy Mix
 - Virtual Power Plants (VPPs) are forecast to drive reduction in demand.
5. Increasing demand – Data Centres

Average NEM spot prices fell 47% year-on-year, with a much flatter time of day profile

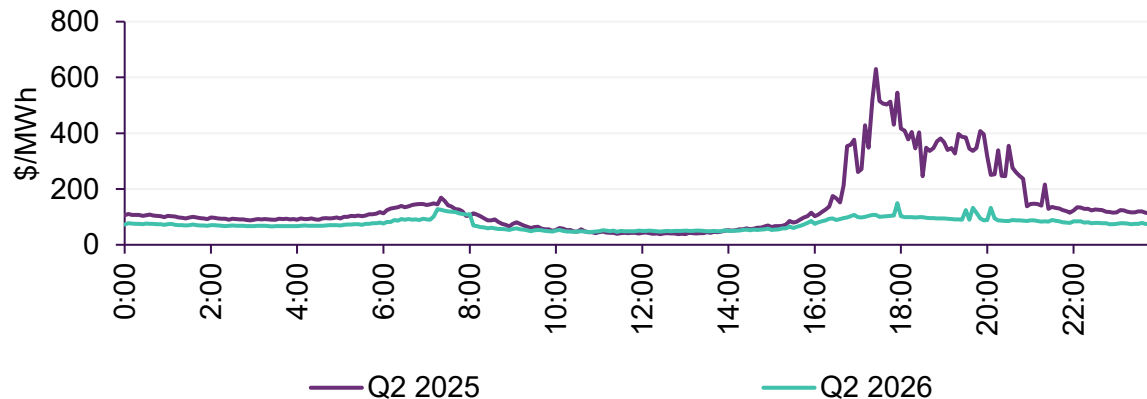
Year-on-year declines in both energy and cap return prices across all regions

Average wholesale electricity spot price by region – energy and cap return components



Flatter intraday price profile with lower evening peak prices

NEM average spot price by time of day – Q2 2026 vs Q2 2025



Shift towards higher daytime operational demand and lower evening peak demand

- Increased home battery charging, together with growing industrial and data centre loads, lifted daytime operational demand, more than offsetting growth in distributed PV output
- In the evening, home battery discharging and warmer weather's impact on heating requirements reduced operational demand.

Increased grid-scale battery activity influencing price-setting outcomes

- Increased battery discharge, combined with lower operational demand during the evening peak contributed to lower peak prices and less price volatility across most regions
- Battery charging growth overlaid stronger daytime operational demand, leading to fewer negative price intervals

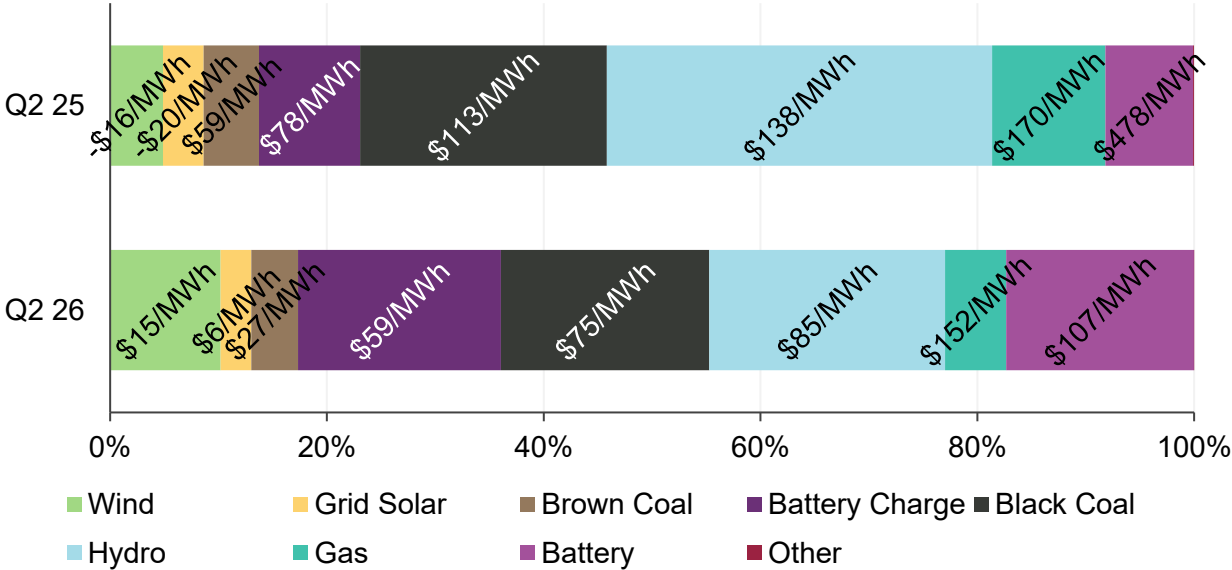
Higher renewable generation

- Both wind and grid solar generation reaching new Q2 highs
- Higher VRE output placed sustained downward pressure on wholesale prices across the NEM, particularly overnight, where stronger wind generation displaced coal-fired generation

Price-setting outcomes shift across the NEM, with increased grid-scale battery participation

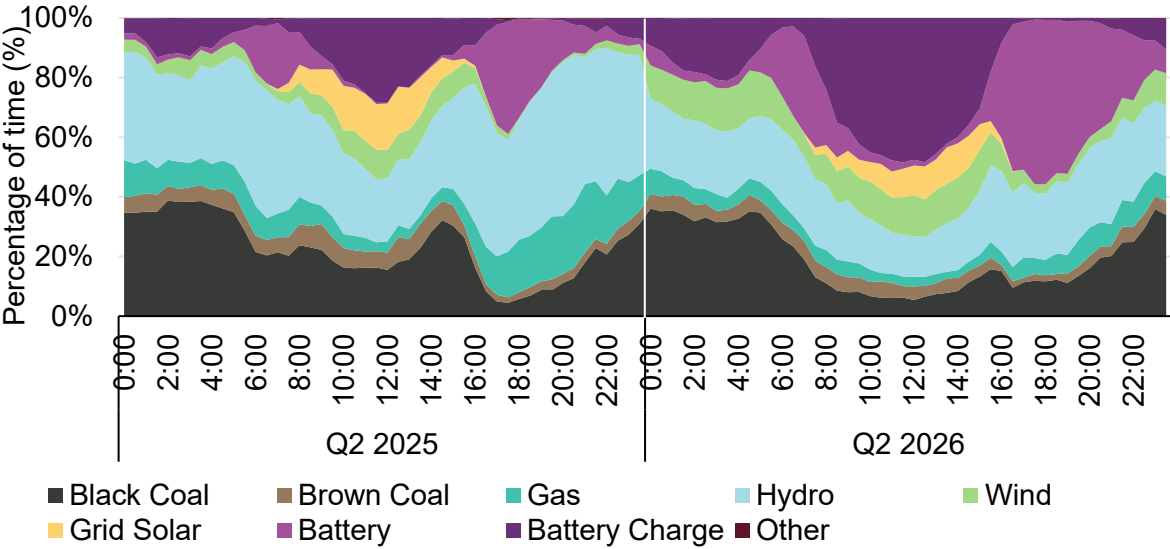
Increased battery price setting reshaped market outcomes in Q2 2026

NEM price-setting frequency and average price set by fuel type – Q2 2026 vs Q2 2025

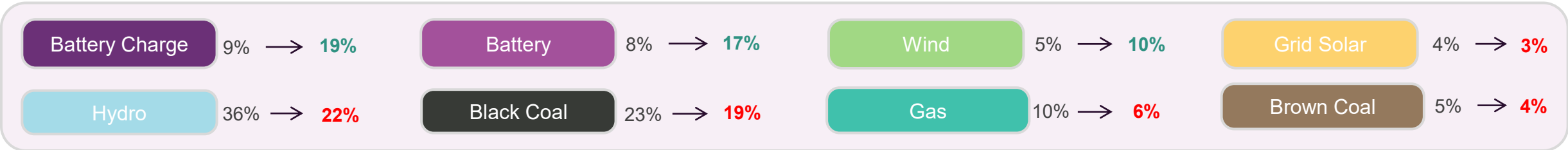


Battery charge and discharge drove time of day price-setting shifts in Q2 2026

NEM price-setting frequency by fuel type and time of day – Q2 2026 and Q2 2025



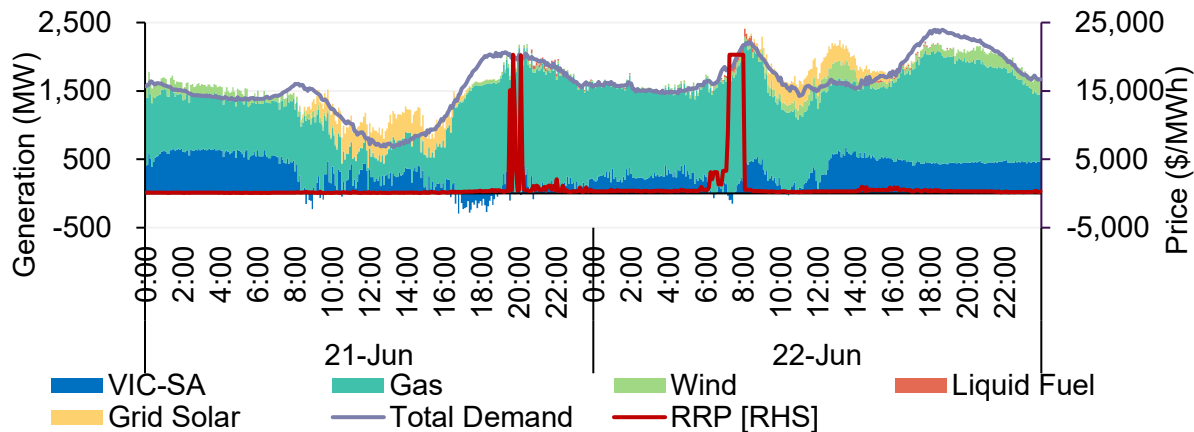
Change in NEM price-setting frequency



South Australia Price Spike: 21-22 June

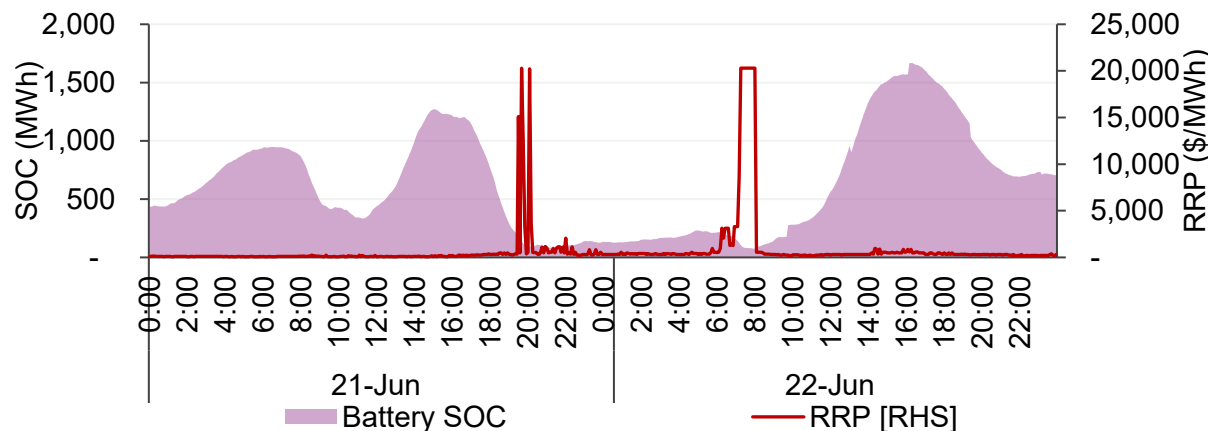
❑ Low wind and reduced interconnector imports during South Australia's price volatility on 21-22 June

South Australia Regional Reference Price (RRP), total demand, net interconnector flows and generation by fuel type – 21-22 June



❑ Low battery state of charge before the morning peak on 22 June

Battery state of charge (SOC) and RRP [RHS] on 21 -22 June - South Australia



Contributed **\$13/MWh** to South Australia's Q2 cap return

Extreme price outcomes: 4 intervals above \$10,000/MWh on 21 June evening; 10 consecutive intervals at the market price cap (MPC) of \$20,300/MWh on 22 June morning

Sunday (21 June) Evening



Cold weather pushed SA demand above 2,000 MW as Adelaide temperatures fell below 5°C



Low renewable output: Grid solar and DPV fell away, while wind dropped to ~50 MW during a three-day wind lull



Import capability reduced driven by X3 Balranald–Buronga line rating limitations



PD PASA forecast LOR2, but AEMO did not declare reserve conditions as updated market conditions could resolve the reserve shortfall

Monday (22 June) Morning



Battery fleet remained depleted (<200 MWh SOC) after limited overnight charging



Low wind, low solar, constrained imports and low battery SOC combined to drive Monday morning price spikes



PD PASA forecast LOR3, but AEMO did not declare reserve conditions as post-contingent actions were available to restore reserves

2026 WEM ESOO

The 2026 WEM ESOO presents an improved outlook compared to the 2025 WEM ESOO.

Highlights include:

- A capacity surplus is forecast for the first three years of the outlook, with a surplus of 347 MW (based on existing and committed capacity) against the Peak RCR of 6,323 MW in 2028-29.
- Average annual USE is forecast to be within tolerance through to 2029-30.
- More capacity will be needed from 2029-30 to meet demand growth and retirement of thermal generation, with investment required in advance to meet this timeframe.
- Virtual Power Plants (VPPs) are forecast to drive reduction in demand.
- A significant increase in grid scale battery storage is forecast to further flatten the peak



2026

Wholesale Electricity Market (WEM) Electricity Statement of Opportunities (ESOO)

The annual WEM ESOO forecasts electricity demand against expected available generation and storage capacity over a 10-year outlook.

The WEM ESOO informs investment decisions for Western Australia's main power system, the South West Interconnected System (SWIS).

About the SWIS

The SWIS and its associated market, the WEM, make up one of the world's largest isolated power systems. Due to this isolation, the power system has a Reserve Capacity Mechanism, which is designed to ensure sufficient electricity capacity is available two years in advance.

In Western Australia, AEMO operates the SWIS and the WEM and matches electricity supply to demand in real-time. This electricity is distributed throughout Western Power's vast transmission and distribution power line networks within the SWIS to households, businesses and industry.

Insights for the 10-year outlook period from 1 October 2026 to 1 October 2036

Consumption	Peak demand	Supply	Investment	Timely delivery
 Electricity consumption is forecast to grow steadily over the outlook period. At the same time, residential consumption will be increasingly offset by rooftop solar and batteries. Consumption delivered from the grid, is forecast to rise 48% from 16.4 TWh in 2025-26 to 24.4 TWh by 2035-36.	 Peak demand is forecast to grow steadily over the outlook period. The demand forecast is slightly higher than 2025, driven by population growth, switching to electric devices and increasing electricity use. Coordination of distributed energy resources, as part of virtual power plants, are forecast to reduce annual peak demand by 200 MW in 2028-29.	 The capacity forecast has improved from 2025 with surpluses forecast for the first three years of the outlook period. Strong levels of committed investment result in a 347 MW surplus in 2028-29. Additional committed capacity is needed to sustain reliability from 2029-30.	 More investment will be needed from 2029-30 to meet demand growth and replace exiting thermal generation. Opportunities for investment are projected to grow from 166 MW in 2029-30 to 2,161 MW by 2035-36. There is a strong investment pipeline, with a further 2,000 MW of projects responding to the 2026 reserve capacity expression of interest process.	 The near-term outlook to 2028-29 remains sensitive to the timely delivery of committed projects and planned transmission upgrades. Risks to project delivery include global supply chain and labour constraints.
 Consumer investment in rooftop solar, household batteries and other distributed energy resources is playing an increasingly critical role in the SWIS.	Rooftop solar is already the largest generator in the system and is forecast to almost double to ~6,000 MW by 2035-36.	Supported by government initiatives, household battery capacity is expected to grow significantly from 500 MW in 2026-27 to 2,300 MW by 2035-36.	Through participation in virtual power plants, these resources will also help reduce the peak, with benefits for all consumers.	

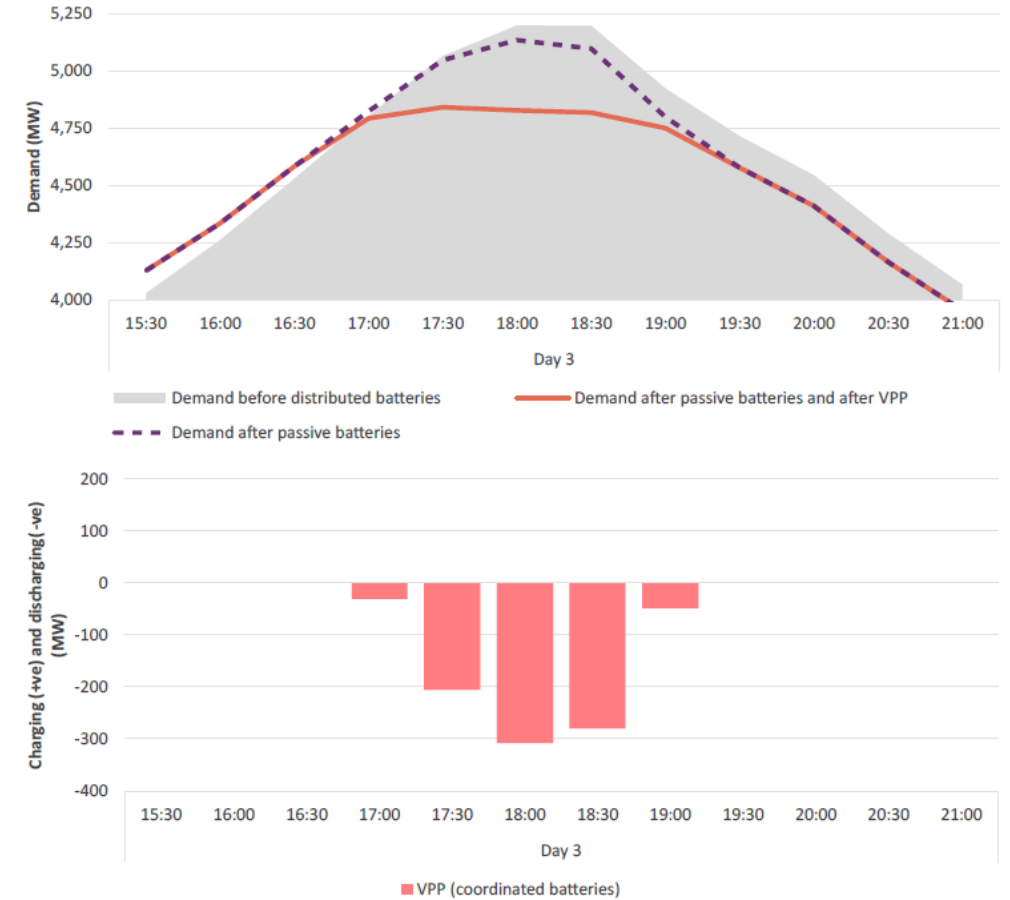
Future trends WEM

Insights from the 2026 WEM ESOO

- Consumers are playing a critical role in the energy transition through investments in rooftop solar, household batteries (supported by both the Western Australian and Commonwealth Governments) and other distributed energy resources (DER), such as electric vehicles (EVs).
- The 2026 WEM ESOO forecasts VPPs to reduce annual peak demand in 2028-29 by 200 MW.

Virtual Power Plants (VPPs) are forecast to drive reduction in demand

- VPP operation reduces peak demand by 124 MW on average.
- Passive distributed batteries reduce peak demand by 29 MW on average.
- As a counterfactual, if all distributed batteries operated passively and the VPP was not activated, the average reduction in peak unscheduled operational demand in 2028-29 would be 39 MW.





For more information visit

aemo.com.au