# Maintaining momentum

**Strategic investment | Emerging technologies**

Australian Energy Week

Merryn York

19 June 2025

**We acknowledge the Traditional Custodians of the land, seas and waters across Australia. We honour the wisdom of Aboriginal and Torres Strait Islander Elders past and present and embrace future generations.**

We acknowledge that, wherever we work, we do so on Aboriginal and Torres Strait Islander lands. We pay respect to the world's oldest continuing culture and First Nations peoples' deep and continuing connection to Country; and hope that our work can benefit both people and Country.

**'Journey of unity: AEMO's Reconciliation Path' by Lani Balzan**

AEMO Group is proud to have delivered its first Reconciliation Action Plan in May 2024. 'Journey of unity: AEMO's Reconciliation Path' was created by Wiradjuri artist Lani Balzan to visually narrate our ongoing journey towards reconciliation - a collaborative endeavour that honours First Nations cultures, fosters mutual understanding, and paves the way for a brighter, more inclusive future.

*Read our RAP*

# Today's discussion

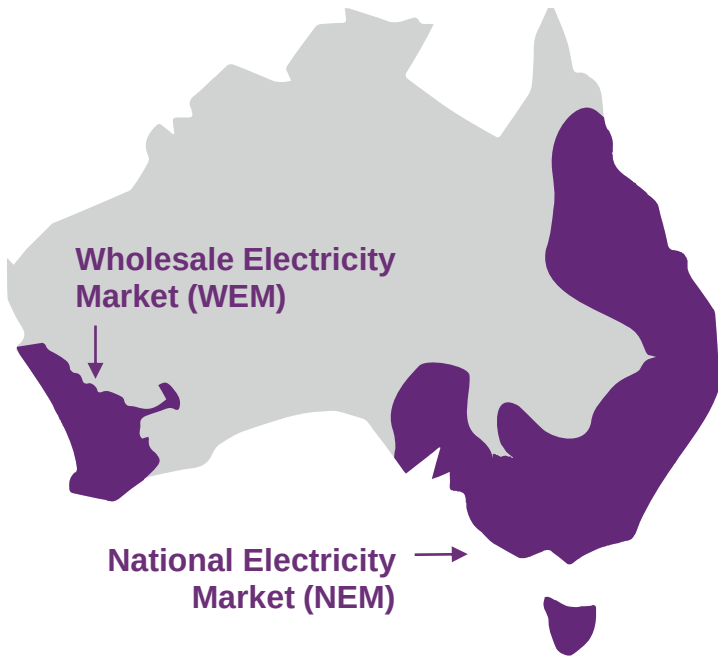
- About AEMO
- Planning for the energy future
- What is actually happening

# About AEMO

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

AEMO Services 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




## Gas

Declared Wholesale Gas Market (DWGM)

Short Term Trading Market (STTM)

and

Gas Supply Hub (GSH)

# What we do

## Operate energy systems:

Ensuring secure and reliable energy supply on Australia's main electricity systems, and the Victorian gas transmission system.

## Operate energy markets:

Operating the National Electricity Market (NEM) and Wholesale Electricity Market (WEM) which dispatch energy and essential system services every 5-minutes, as well as wholesale gas markets and trading hubs in Eastern Australia.

## Plan and enable future energy systems:

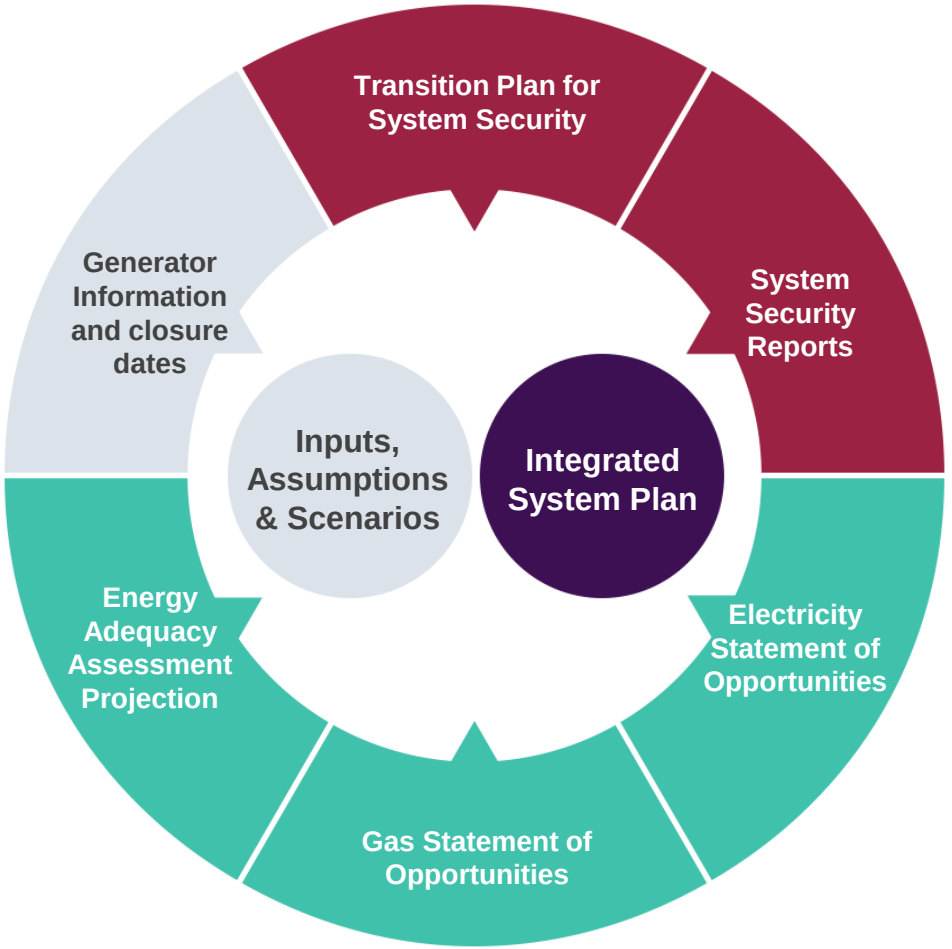
Identifying the investments needed to ensure secure and reliable electricity and gas to Australian consumers and meet Government energy and emissions targets into the future.

## Support new investment:

Provide information to inform decision making, and deliver tenders for energy infrastructure for federal and state energy investment schemes.

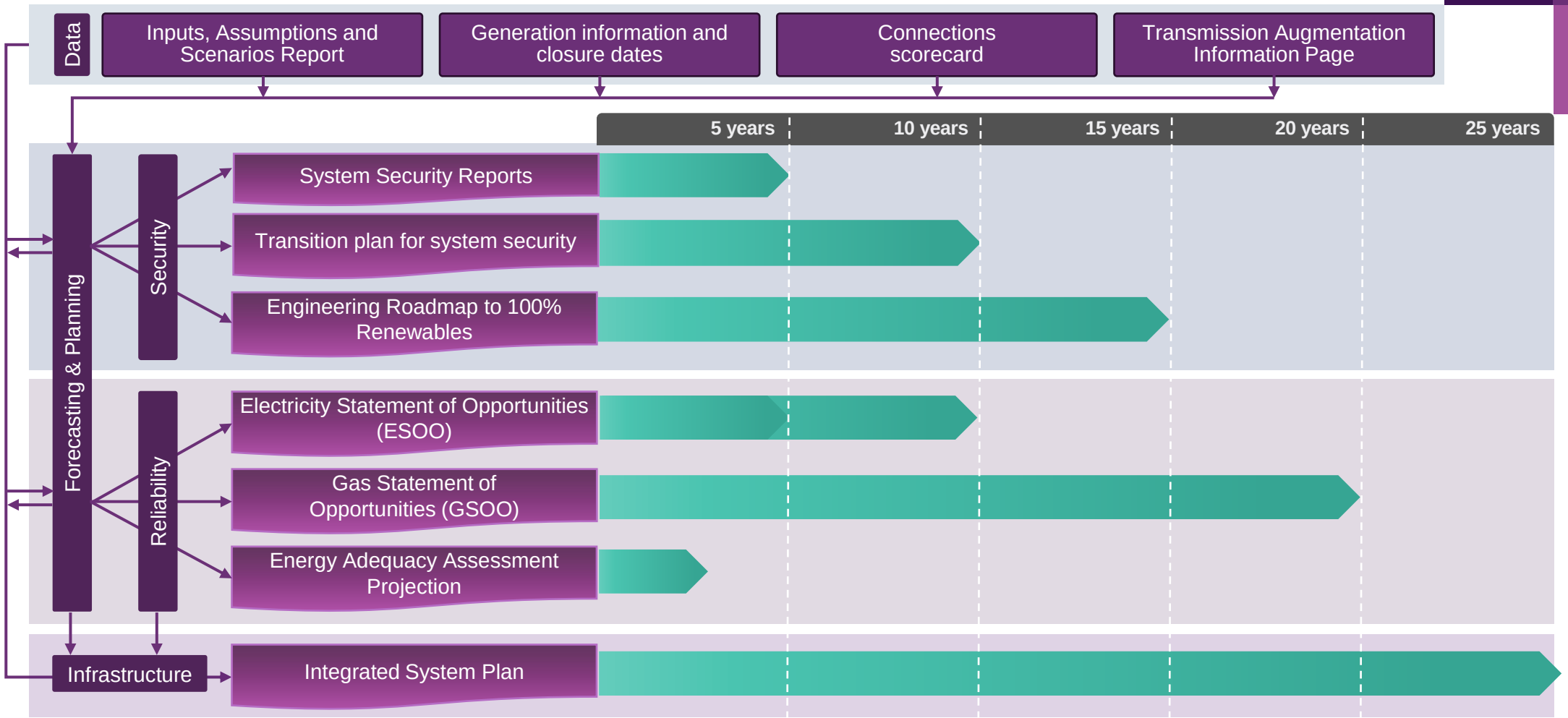
# Planning for the energy future

# AEMO's technical insights

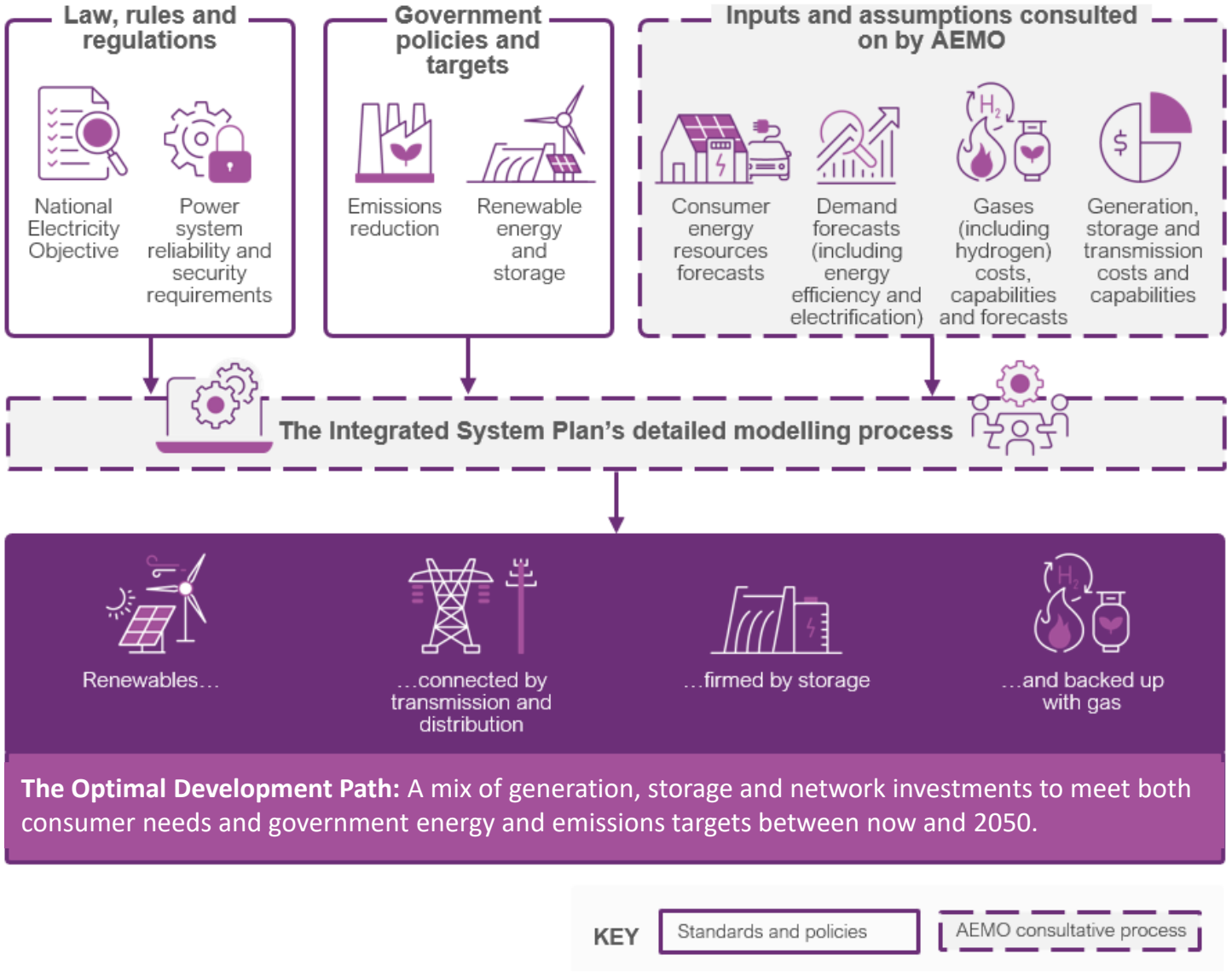



- Data
- Infrastructure
- Reliability
- Security

# AEMO planning across time horizons

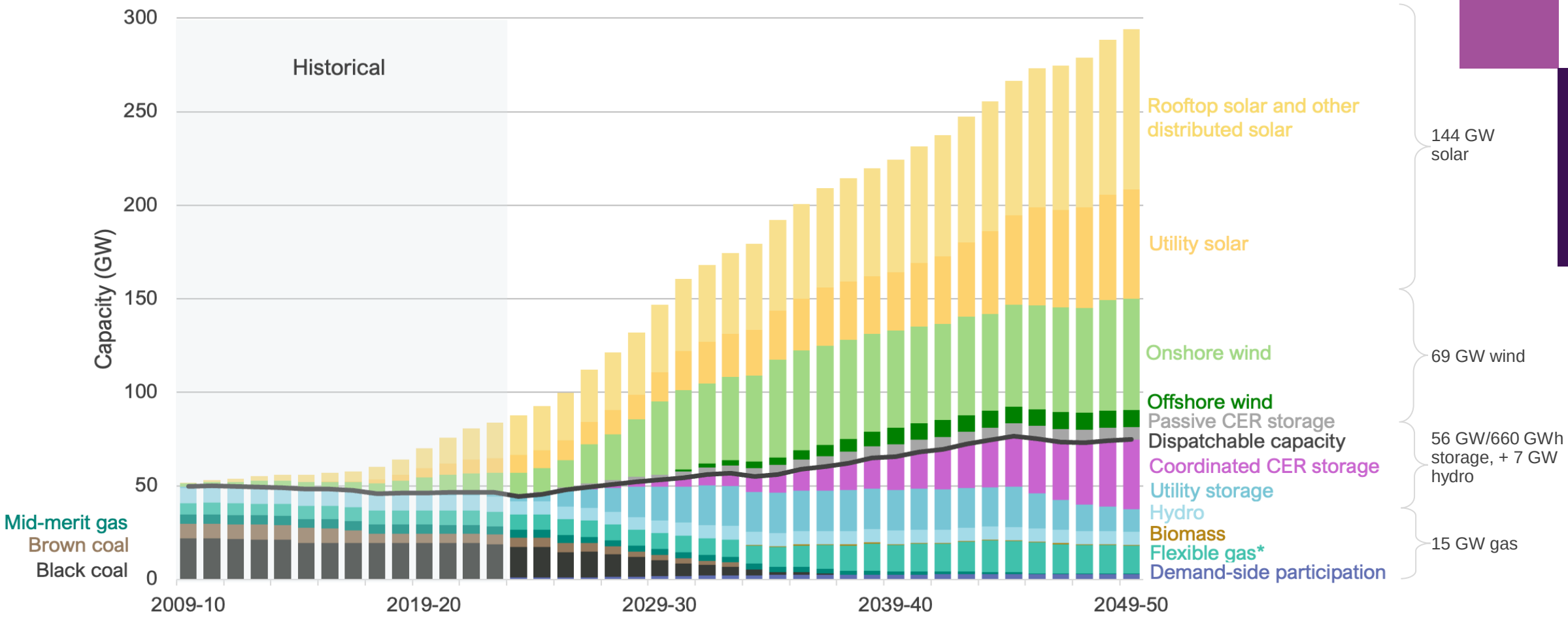


# The ISP takes standards, policies and consulted-on inputs and assumptions to model the optimal development path



# The 2024 ISP central scenario

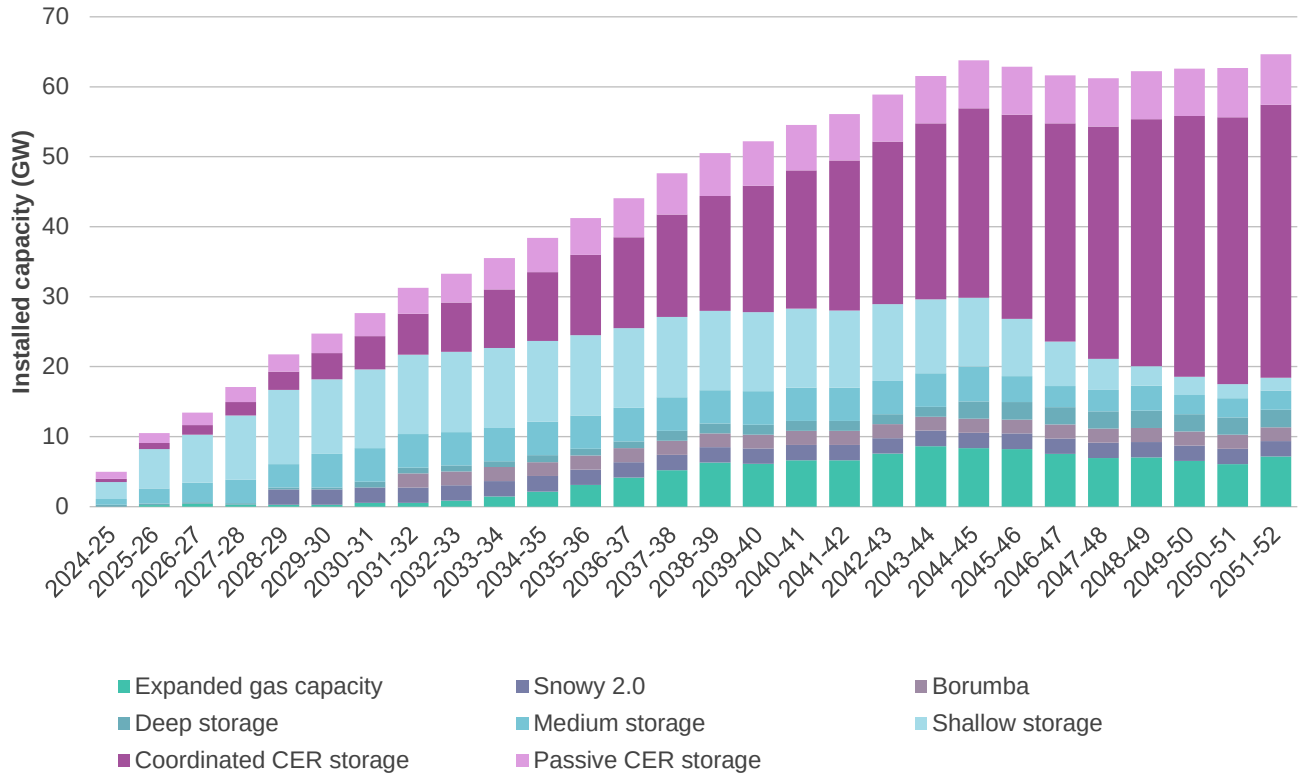
## Up to 6GW pa utility scale to 2035



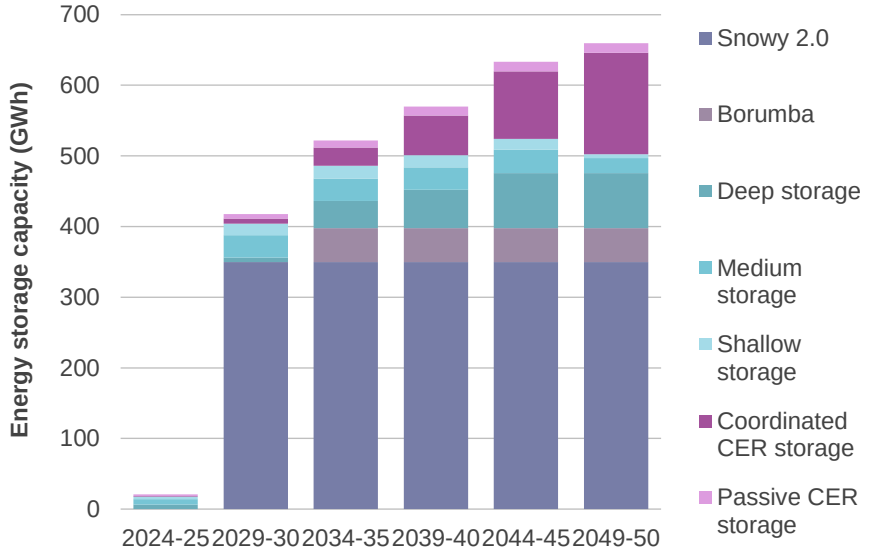

Source: Integrated System Plan 2024

# When there's no wind or sun

## NEM storage and new flexible gas – installed capacity




## Storage depth

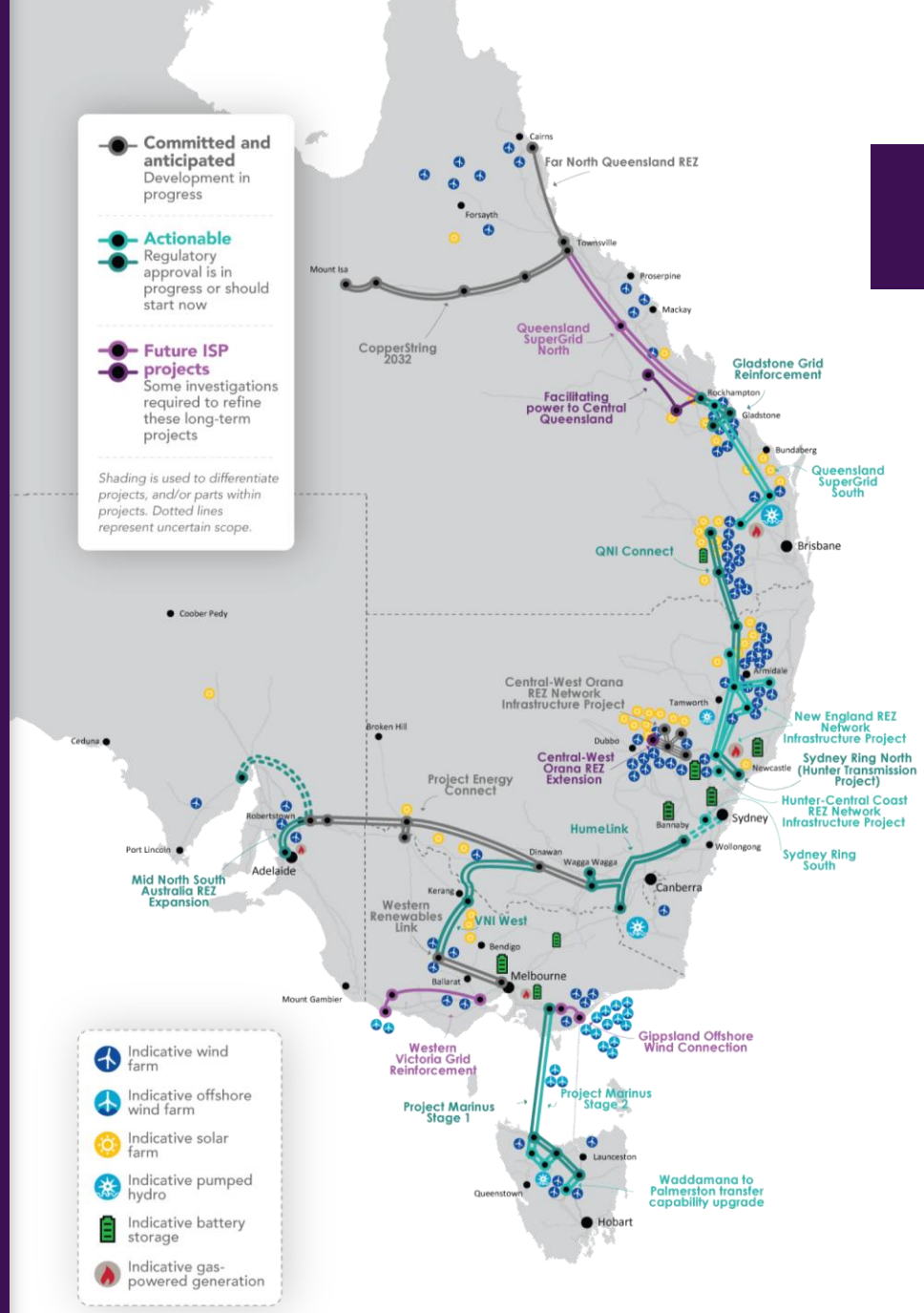



Source: Integrated System Plan 2024, Step Change scenario

# Connected by transmission

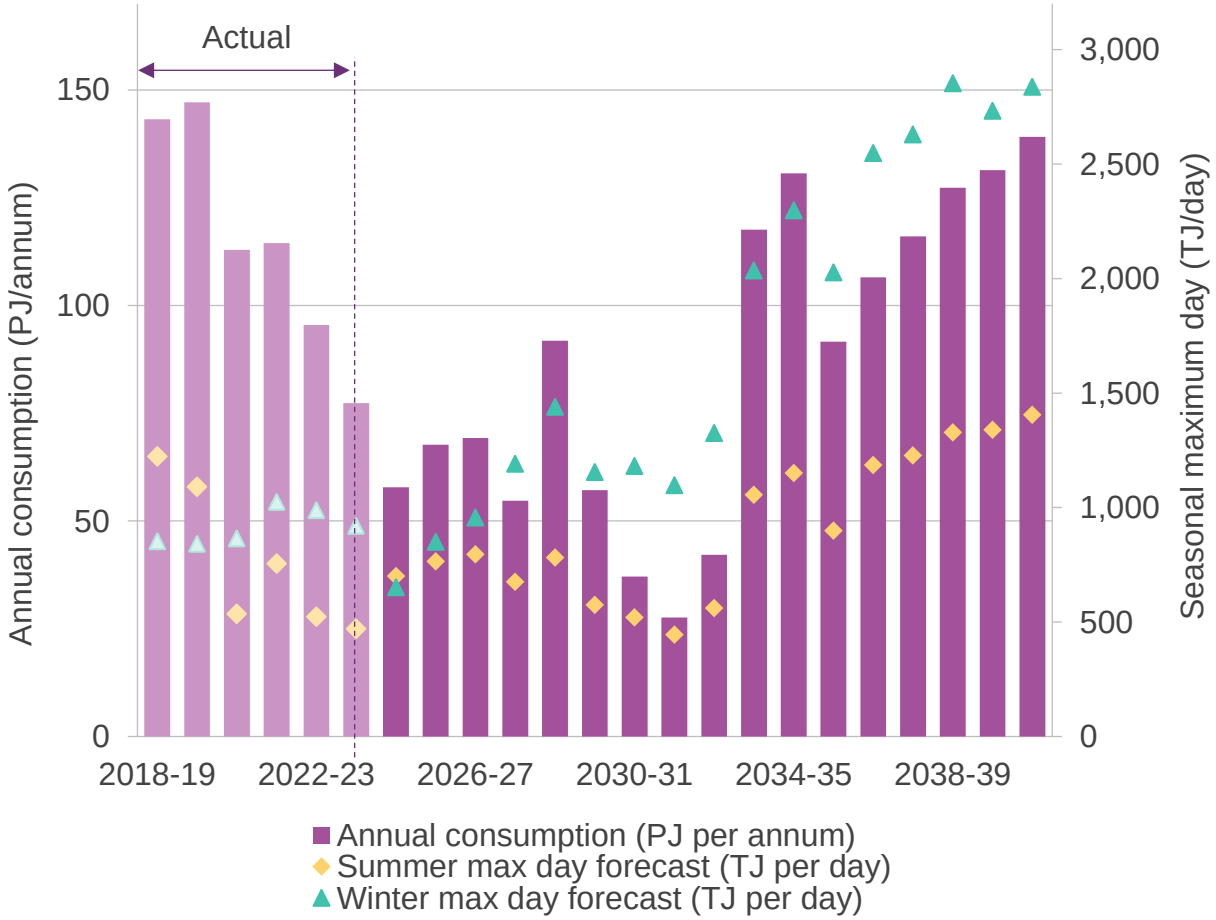
**2024 ISP:**
**10,000 km of transmission line needed to 2050 – 2,500 km underway**

This map shows indicative new generation and storage in 2040, and transmission projects that include new transmission lines, increase capacity by 500 MW or more, and are required in all scenarios by 2050.

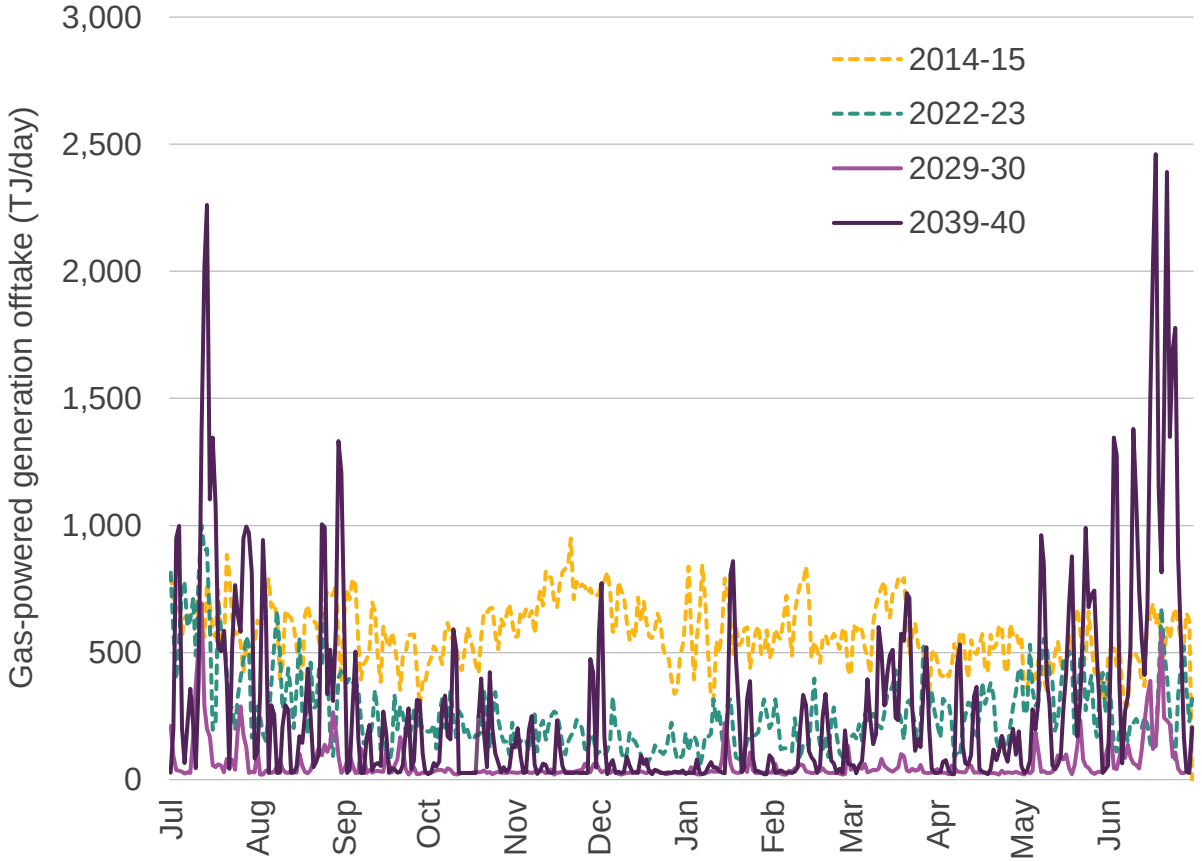


# Gas-powered generation - the ultimate backstop
# More capacity required operating less frequently

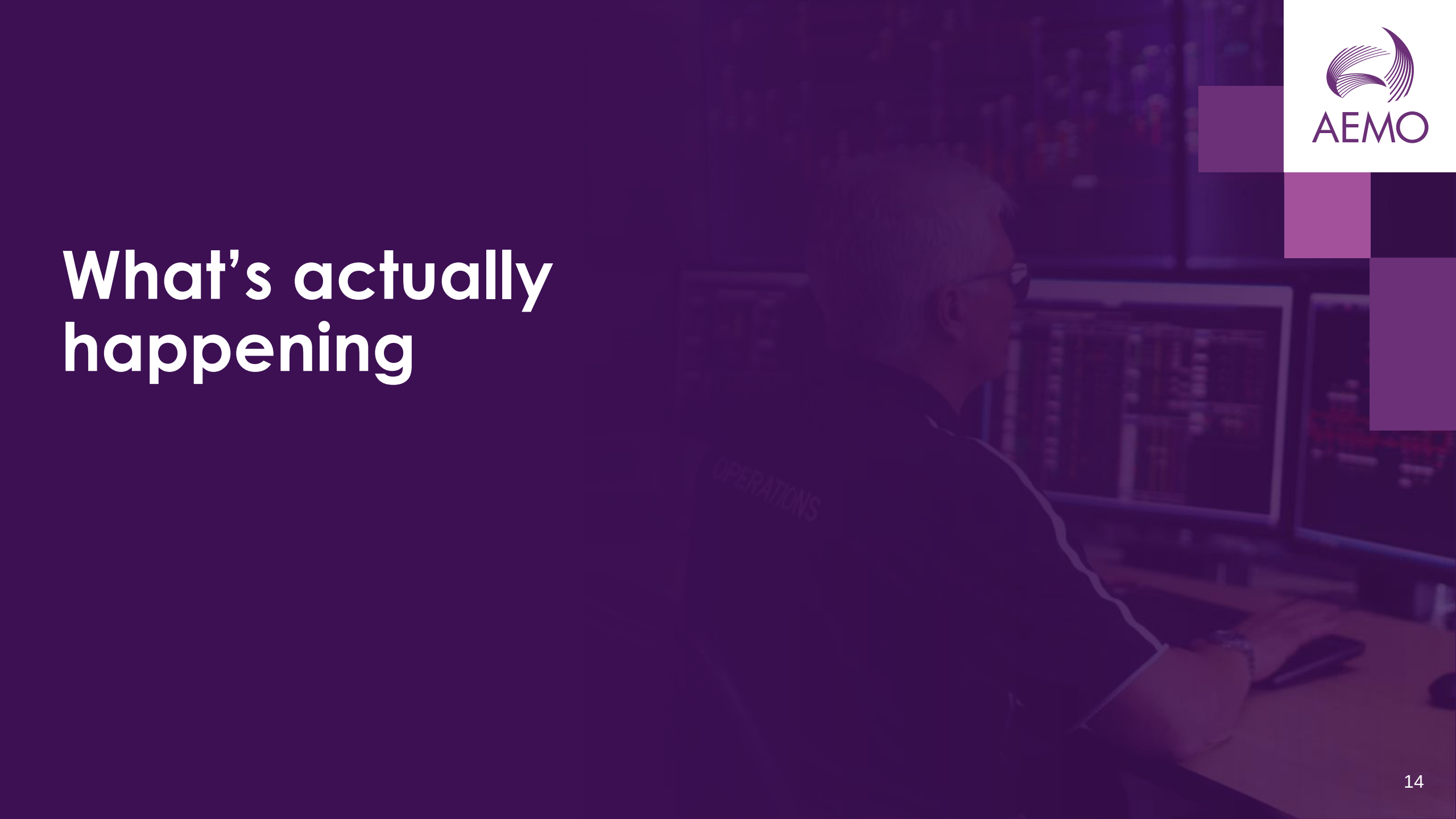
**Actual and forecast NEM gas-powered generation annual consumption (PJ/y) and seasonal maximum daily demand (TJ/d) in *Step Change*, 2019-40**




**Forecast daily NEM gas-powered generation offtake in 2029-30, and 2039-40, *Step Change*, (TJ/d)**



# What's actually happening



# Developing and connecting plant

The connection process involves project proponents, OEMs, Network Service Providers (NSPs), AEMO and other parties.

**NER Connection stages (AEMO oversight)**

- Enquiry and pre-application
- ★ Connection application
- Proponent implementation
- ★ Registration – commence commissioning
- ★ Full output achieved

**Project development stages**

## Project Concept

| | | |
|---|---|---|
| Assess resource quality | Secure land and land planning approval | Original Equipment Manufacturers engaged |

## Detailed project scope development

| | | | |
|---|---|---|---|
| Original Equipment Manufacturer identified and supply of plant secured including EPC | Establish offtake agreement (PPA) or market based – Reach FID | Connection Agreement negotiated and executed with TNSP | Generator Performance Standards agreed with TNSP and AEMO – Connection Application Approved |

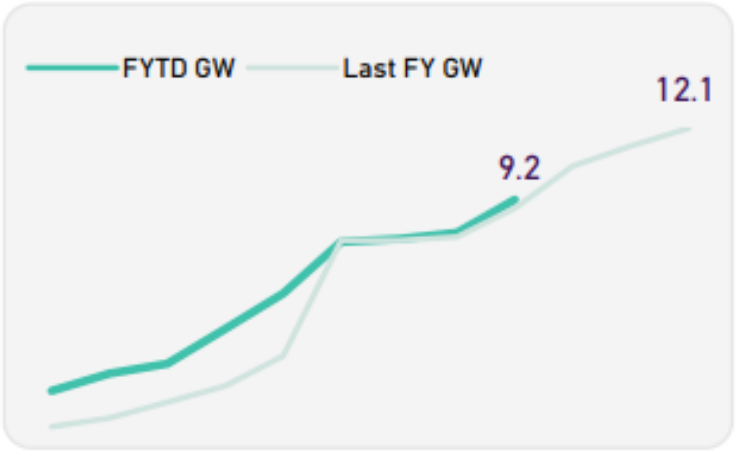
## Project construction and completion

| | | | | |
|---|---|---|---|---|
| EPC constructs project | Network connection assets constructed | Project registered under NER | Progressive commissioning in stages to confirm technical operation in the NEM | Full commercial operation |

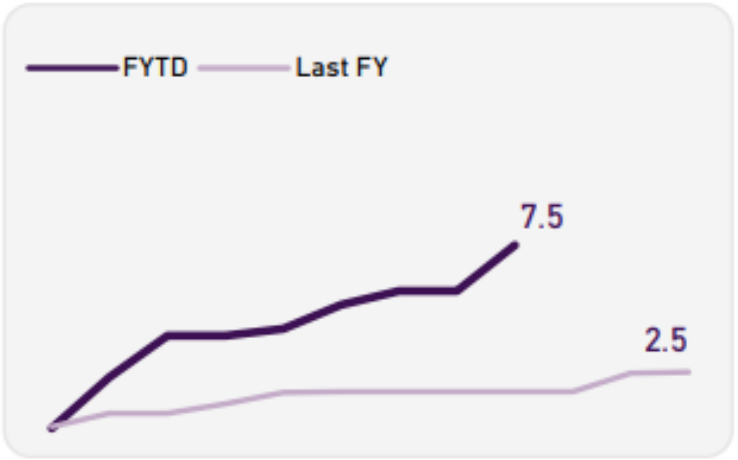
# Connections Scorecard – March 2025

## Approved FYTD GW by stage in relation to last FY – NEM

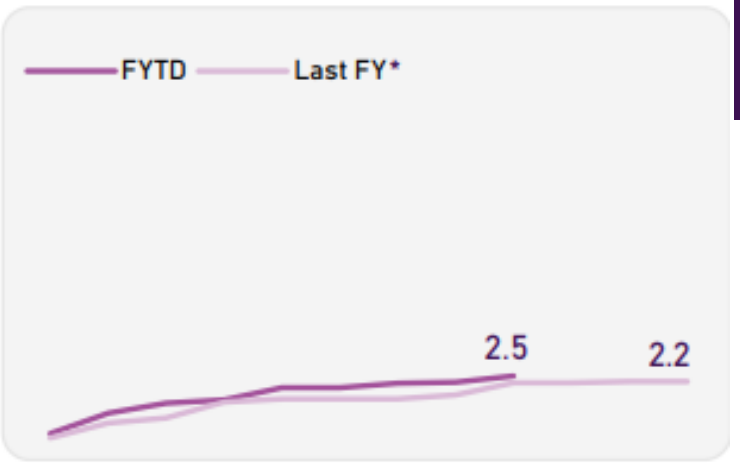
### Approved Applications




### Approved Registrations



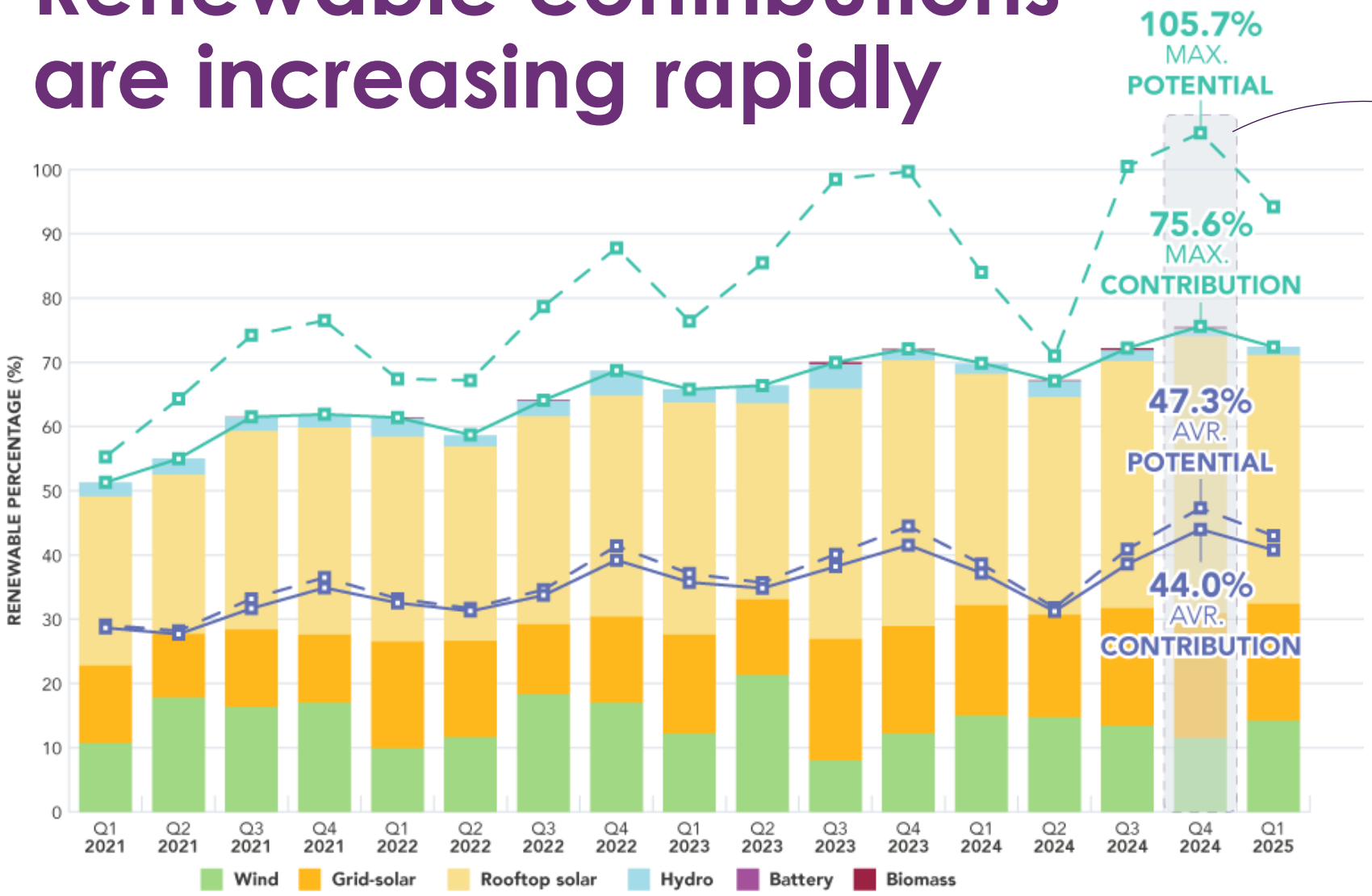

### Full Output Achieved




More anticipated in final quarter to end June

Full output achieved estimated to reach around 4.8 GW – a new record

# Renewable contributions are increasing rapidly




## Record breaking renewables

**Potential:** available renewable generation over a 30-minute window – regardless of actual generation

**Contribution:** renewable generation produced over a 30-minute window

# Transition points - system changes

AEMO is working with industry and governments to plan for major transition points for low or zero emissions power:

Retiring thermal generation (coal and gas)

Increases in inverter-based resources

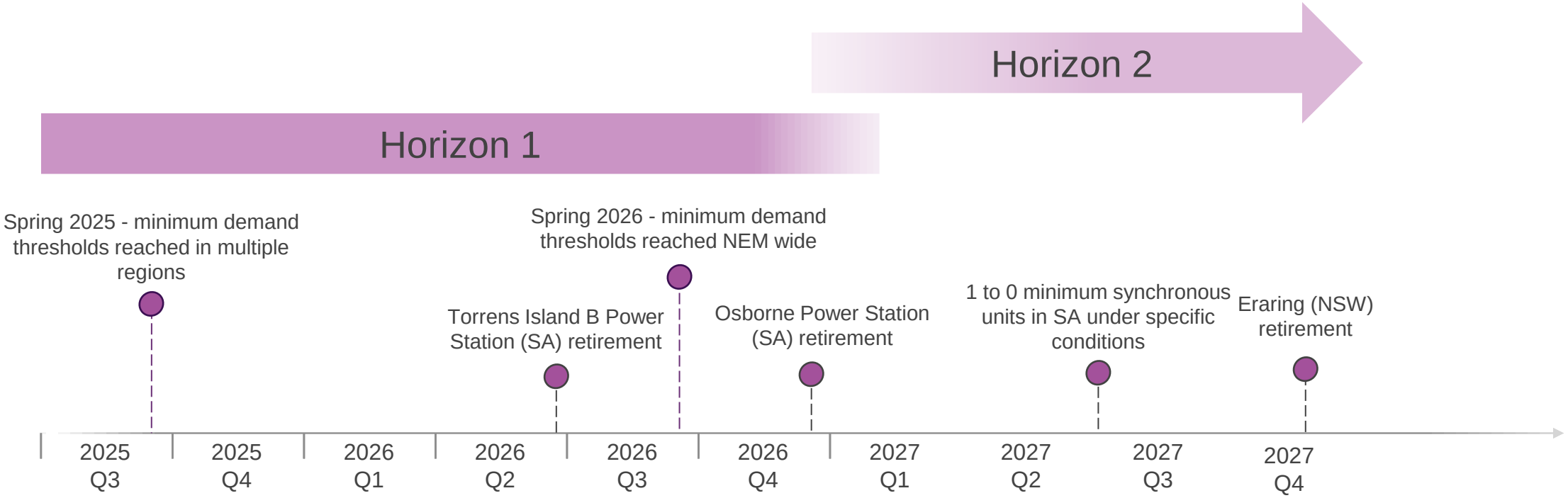
High levels of consumer energy resources (CER)

**Keeping the power system secure**

The need for new assets and providers of essential system services, including:

- system strength
- inertia
- frequency management
- voltage control
- ramping capability
- system restoration services

# Transition points - system changes



# AEMO explores technical requirements in preparation for a transition point

- Electricity reliability
- Gas adequacy
- System strength
- Resecure risks
- Outage planning
- Inertia
- Voltage levels
- Reactive power margins
- Rapid voltage step
- System restart
- Transient & oscillatory stability

# System security investment options

**Synchronous plant is needed – particularly for fault current and can be configured to provide multiple services for efficiency**

Contracts with existing synchronous units (hydro, coal, gas)

New synchronous condensers – with fly wheels for inertia

Gas turbines fitted with clutches, and/or the retrofit units to operate as synchronous condensers when needed and include system restart capability

Inverter-based resources will also help – trials to confirm capability and improving technology

Grid forming technology

Coordination of consumer energy resources

# Technology opportunity – advanced inverters

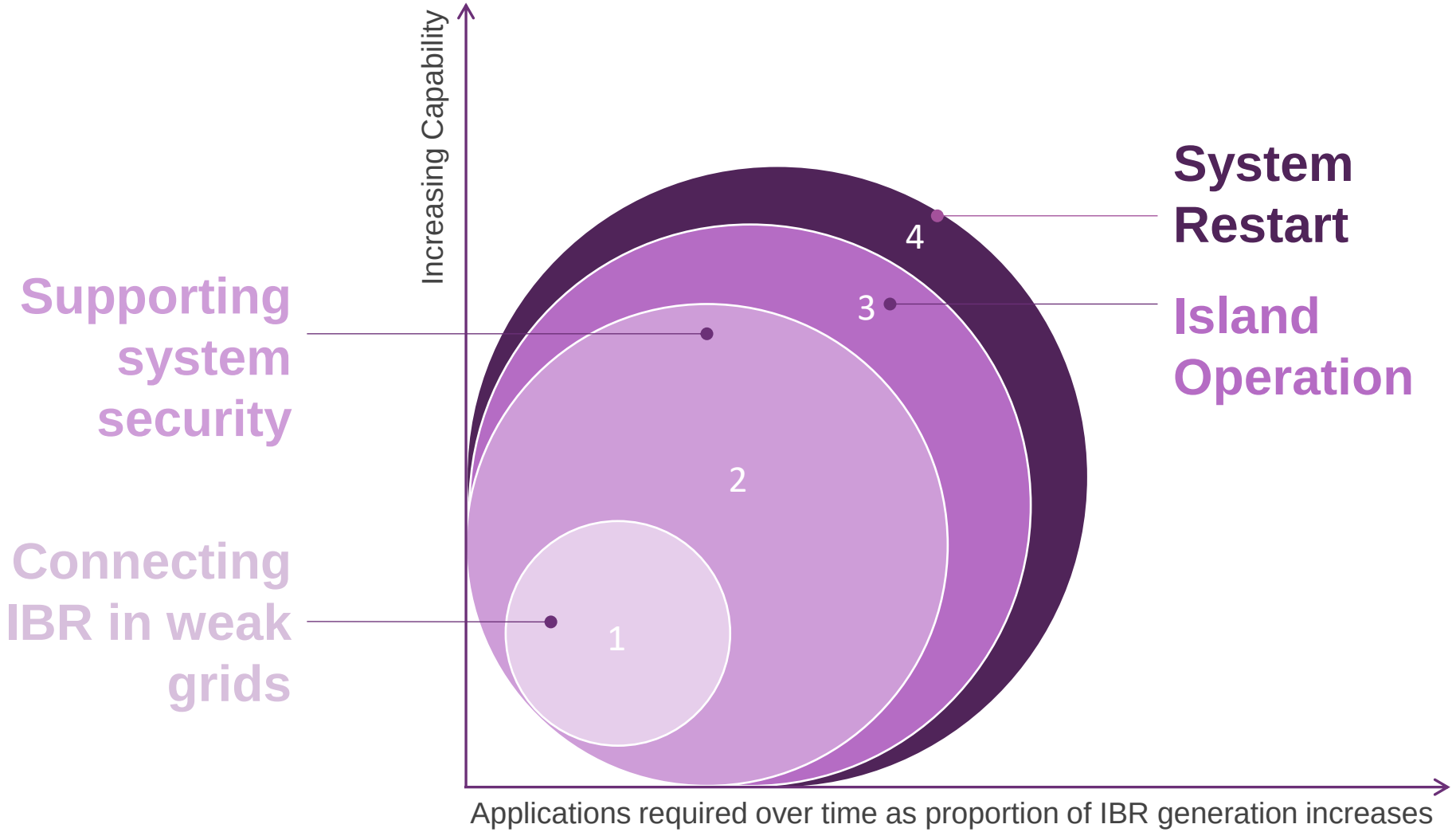
## Grid-*following* inverters

Inverter control system measures and synchronises to the grid voltage waveform, adjusting power output to 'follow' voltage.

## Grid-*forming* inverters

Inverter control system sets an internal voltage waveform reference and adjusts power output to help maintain this voltage.

# Applications of advanced inverters



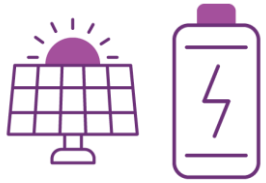
# International collaboration

- AEMO's work to-date has included ongoing collaboration with leading international counterparts
- Peer reviews by international experts on AEMO's voluntary specifications and test framework
- There is a need to continue working with system operators, manufacturers and standards bodies internationally to solve this problem that is mirrored globally.

# GFM – current status

## Operational sites – all standalone BESS

- 5 in NSW - 250MW/430 MWhr
- 2 in SA – 230MW/420MWhr



## Application stage – 56 projects!!

- 45 standalone BESS
- 9 hybrid BESS with renewable generation

Voluntary specification issues – setting out what needs to be delivered to meet system needs

Initial learnings - not all GFM is the same

# Conclusion

- Transition of the NEM is progressing
- There is still a lot to do
- We all need to work together for a safe, secure and reliable transition that meets the needs of consumers


AUSTRALIAN ENERGY MARKET OPERATOR

For more information visit

**aemo.com.au**