Transgrid

People. Power. Possibilities.

Meeting system strength requirements in NSW

Industry briefing: outcomes of Transgrid's system strength PACR

18 July 2025

Welcome

Jason Krstanoski
Acting Executive General Manager of Network

Acknowledgement of Country

In the spirit of reconciliation, Transgrid acknowledges the Traditional Custodians of the lands where we work, the lands we travel through and the places we live.

We pay our respects to the people and the Elders past, present and emerging. And we celebrate the diversity of Aboriginal peoples and their ongoing cultures and connections to the land and water.

Agenda

Please note: today's workshop will be recorded and shared on our website (available for 60 days)

Time	Agenda item	Presenter
3:00pm (5 mins)	Welcome	Jason Krstanoski (Acting Executive General Manager, Network)
3:05pm (35 mins)	Outcomes of the system strength PACR	• Robbie Aherne (General Manager, System Resilience) • Jesse Steinfeld (Energy Transition Manager)
3:40pm (20 mins)	Q&A	• Robbie Aherne • Jesse Steinfeld • Li-Wen Yip (Energy Transition Specialist)

Submit and vote on questions via Menti (www.menti.com): 2859 5472

1

Context

What is system strength?

System strength is the 'heartbeat' of the power system, required to enable the stable and secure flow of electricity around the grid

What is system strength?

AEMO Definition: system strength can broadly be described as the ability of the power system to maintain and control the voltage waveform at any given location in the power system, both during steady state operation and following a disturbance.

We need a strong system 'heartbeat' to enable the flow electricity around NSW – it needs to be robust enough to sustain incidents like lightning strikes and equipment failure

Why is system strength important?

A network with ample system strength enables:

- ✓ Renewable generation to stay connected to the grid during disturbances on the power system
- ✓ Correct operation of protection systems ensures the safe operation of the grid
- ✓ Maintains the stable control of system voltage.

How is system strength managed?

Planning timeframe

Under the National Electricity Rules, system strength is planned for by the System Strength Service Provider (e.g. Transgrid). Beginning 2 December 2025, Transgrid's obligations are to:

- ✓ maintain the minimum three phase fault level specified by AEMO at the system strength nodes ('minimum' level); and
- ✓ achieve stable voltage waveforms for the level and type of IBRs and market network service facilities projected by AEMO in steady state conditions and following any credible contingency or protected event ('efficient' level).

Operational timeframe

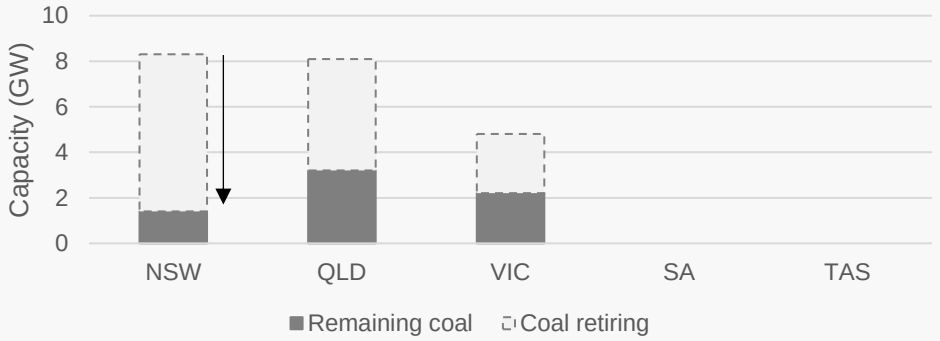
AEMO will seek to close projected gaps in system strength in pre-real time by 'enabling on' system strength services via a new 'Improving Security Frameworks' scheduler.

The need for new sources of system strength is growing rapidly

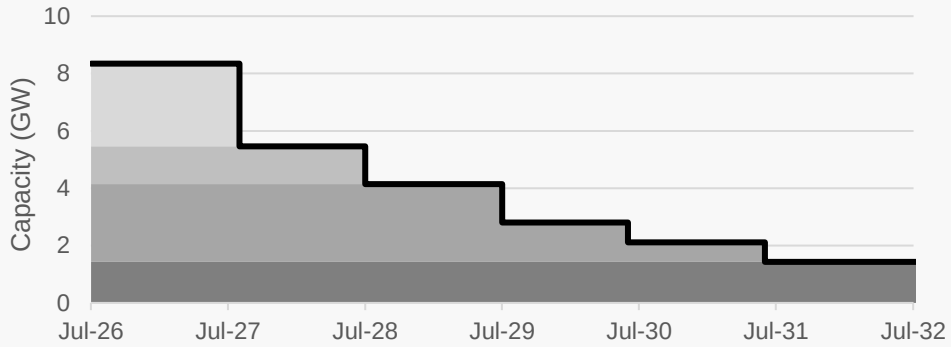
80% of coal capacity in NSW is forecast to retire in the next eight years and investment in renewables is increasing

Historical source of system strength is declining

NEM view: Forecast coal capacity by state by 2032/33

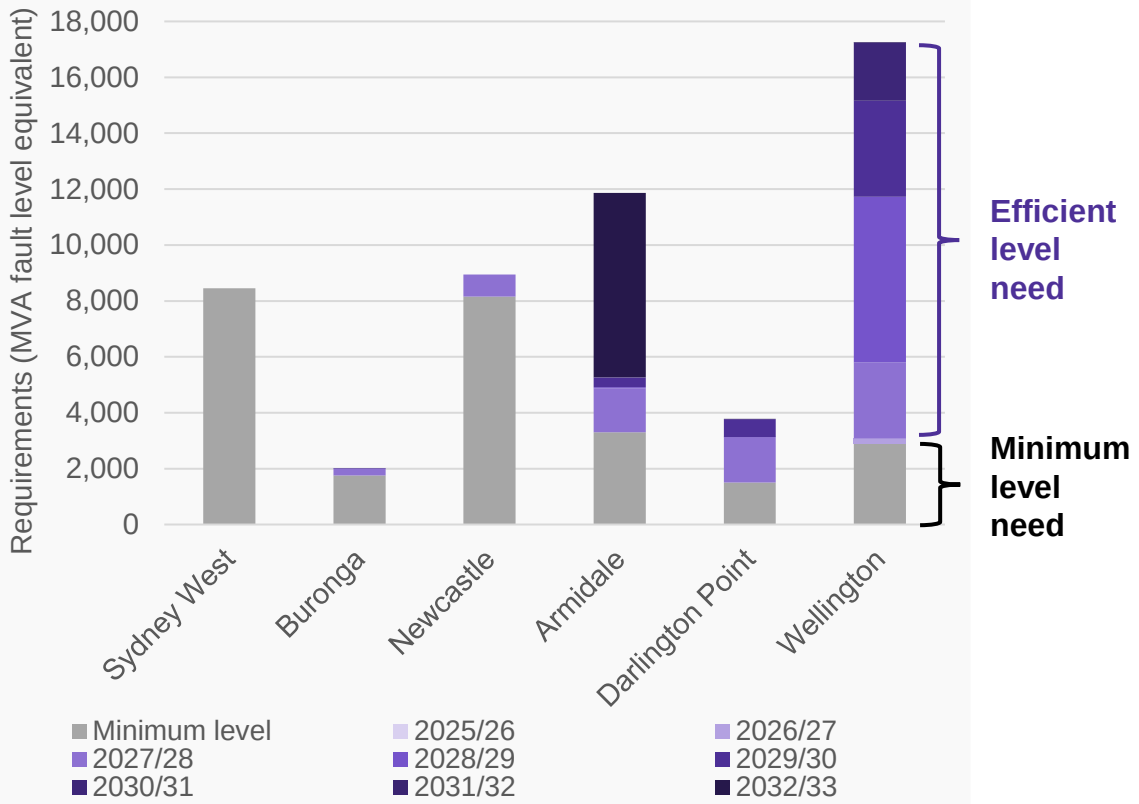


NSW view: Forecast coal capacity by year



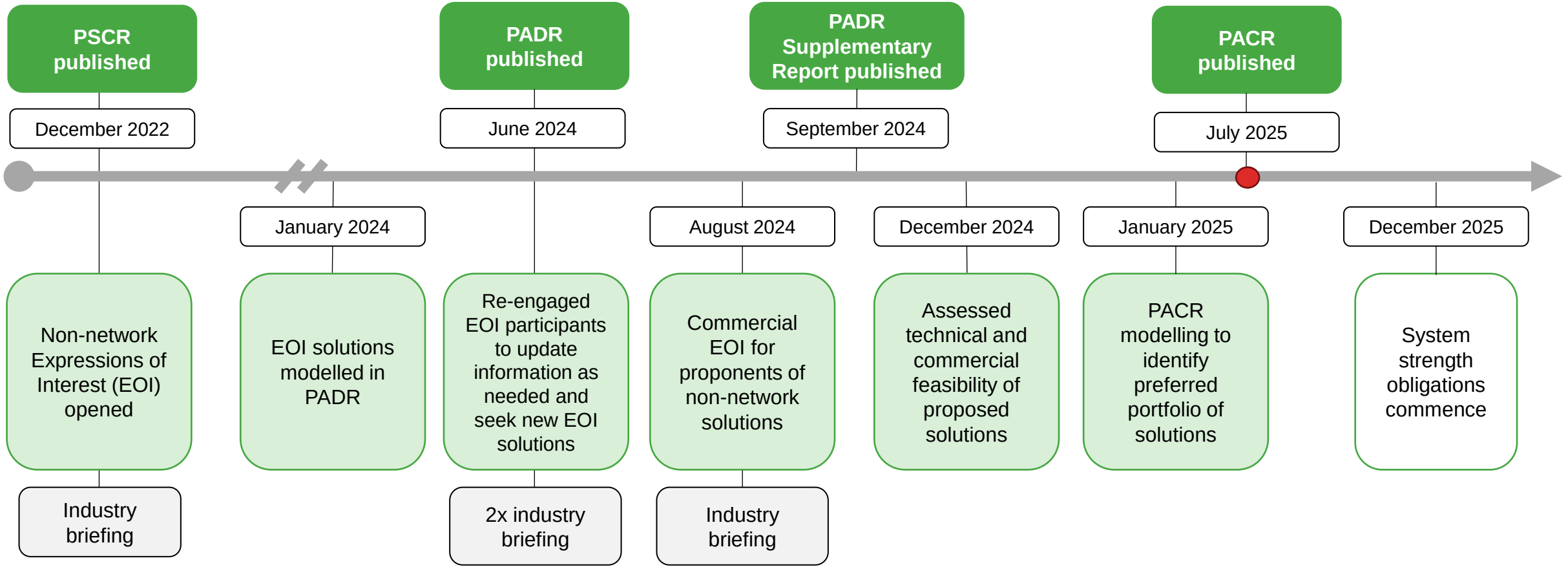
Forecast coal retirement under AEMO 2024 Step Change scenario

Need for 'stable voltage waveform' support is growing



Transgrid's RIT-T and engagement timeline

The RIT-T analysis has been strongly informed by stakeholder consultation and Joint Planning since late-2022



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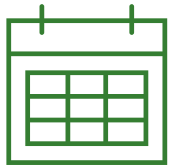
PACR inputs, methodology and portfolio options

Key updates between the PADR and PACR

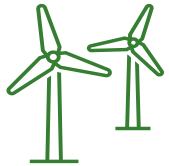
PACR modelling has refined PADR inputs and assumptions using latest information

Key changes since the PADR

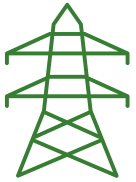
Updated non-network system strength options



Updates to major transmission projects



Efficient level requirements



Revised treatment of Renewable Energy Zones

Revised assumptions for synchronous condensers

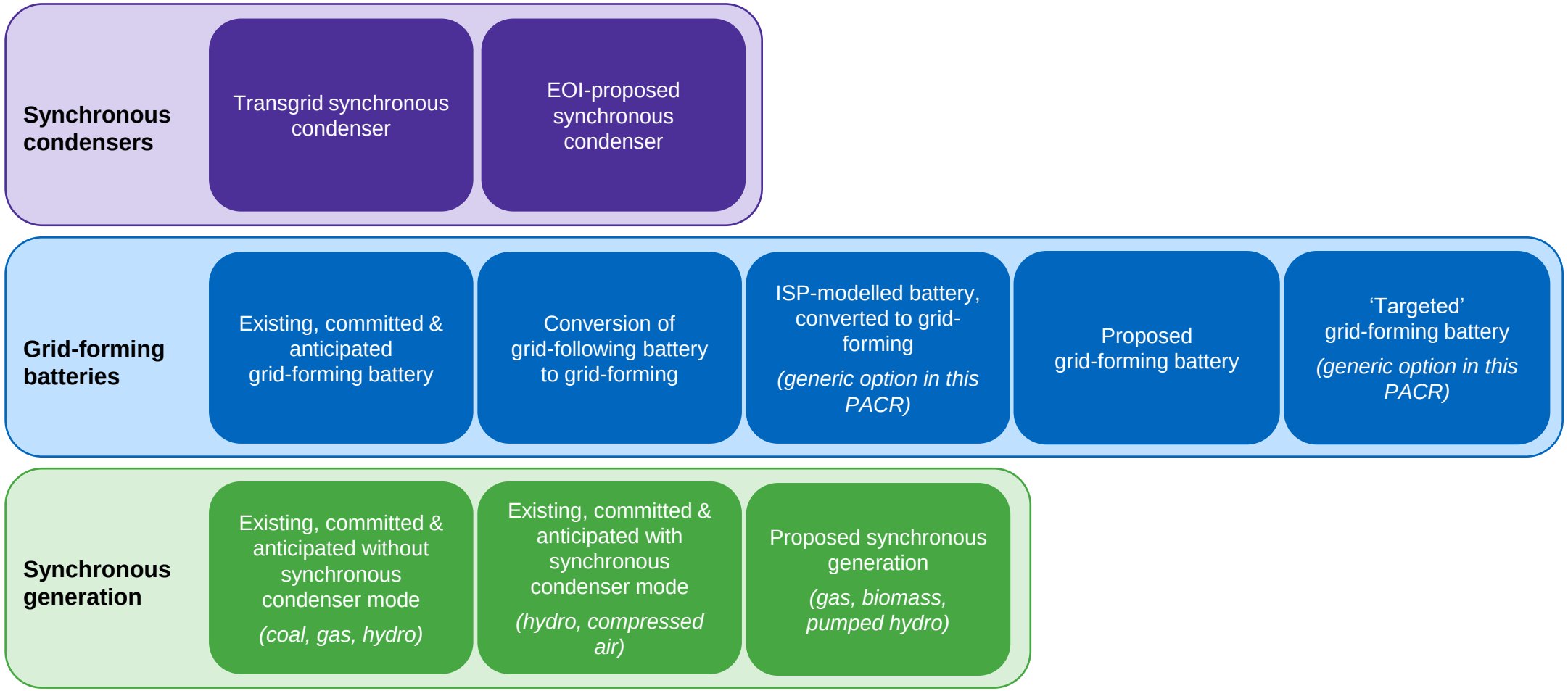
Enhanced the assessment of grid-forming batteries

Transgrid has refined the inputs and assumptions since the PADR by:

- Further engagement with proponents of non-network solutions
- Extensive PSCAD studies of grid-forming BESS including collaboration with original equipment manufacturers
- Independent assessment (GHD) of gas and hydro units to provide system strength
- Joint Planning activities with industry bodies
- Engagement with suppliers of synchronous condensers

Over 100 individual system strength solutions were assessed

Transgrid's EOI process resulted in over 60 individual non-network solutions



Process to identify the optimal portfolio composition and timing

Portfolio options 1 and 2 were assessed to derive the optimal portfolio. Portfolio options 3, 4 and 5 were used to identify optimal delivery timing

Objective: Identify optimal portfolio composition

Synchronous condensers are assumed to be first available from the earliest credible timing of March 2029

Option 1: Basic portfolio

Portfolio with minimal margin of error to manage uncertain future conditions

Option 2: Enhanced portfolio

Added robustness by bringing forward one synchronous condenser required in 2031/32 under portfolio option 1, to 2029/30, to mitigate risk of future uncertainties

Objective: Identify optimal portfolio timing

All options apply the identical location and quantum of solution developed in the robust portfolio (portfolio option 2) with only the timing of synchronous condenser availability varied

Option 3: Standard timing

Synchronous condensers available from Feb-2030

Option 4: Partial acceleration

Five accelerated synchronous condensers available from May-2028 with remaining from Feb-2030

Not currently a credible option

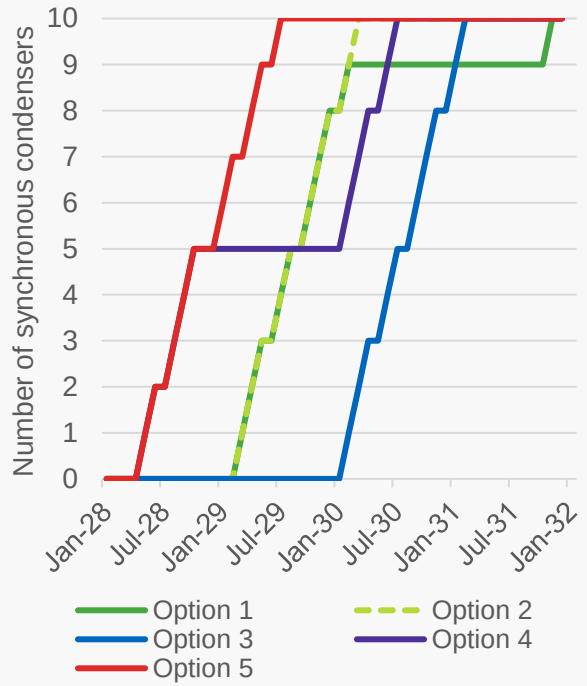
Option 5: Full acceleration

All accelerated synchronous condensers available from May-2028

Not currently a credible option

Timing of Transgrid synchronous condensers per portfolio option

includes 1.5-month stagger between synchronous condensers



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Identifying the optimal portfolio composition

Composition of the ‘preferred’ credible portfolio option

A portfolio of both network and non-network solutions are required to meet the need for system strength in NSW, as coal retires and renewables grow

Transgrid solution

- 10 Transgrid network syncons

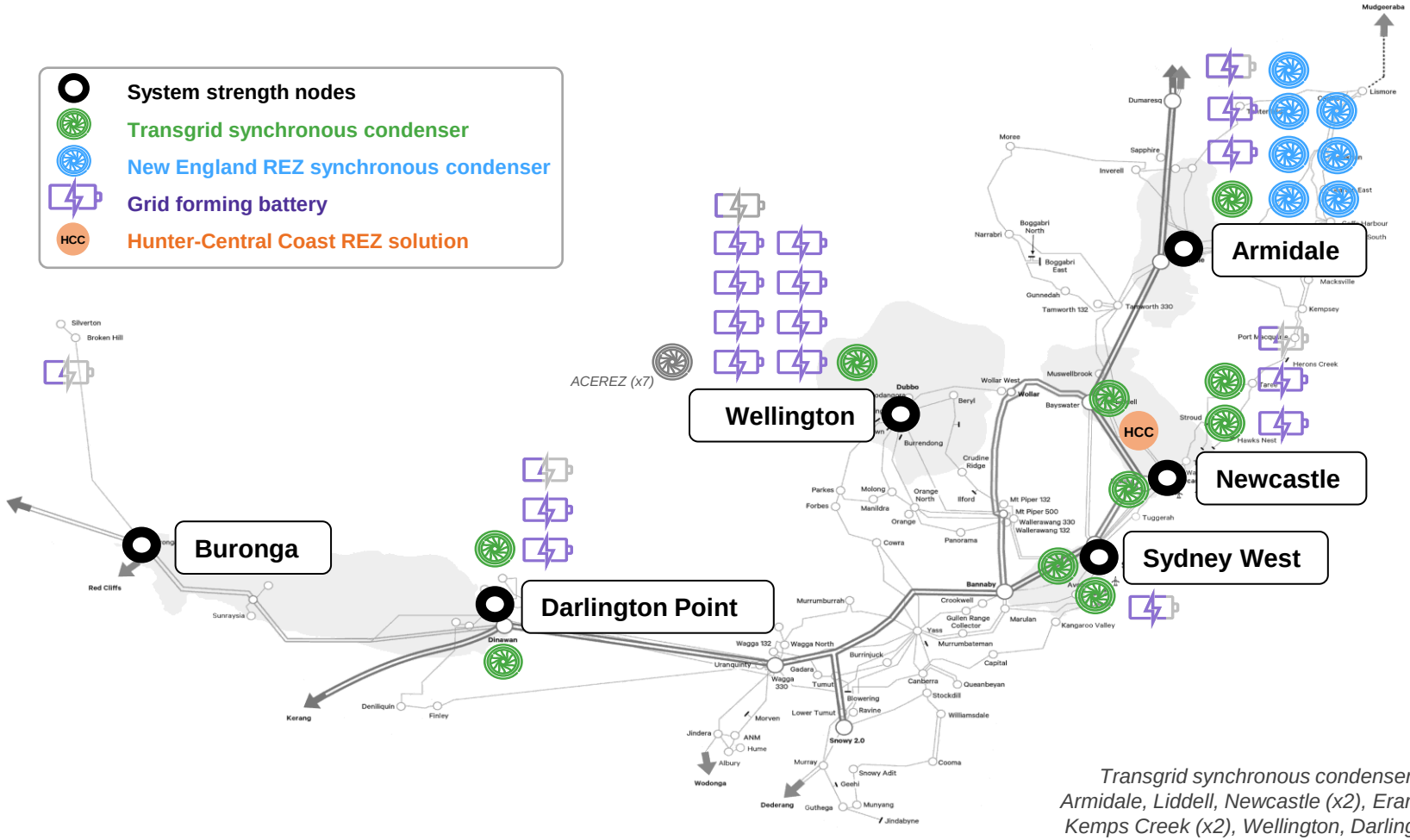
Non-network solutions

- 5 GW of grid-forming batteries *(providing the equivalent contribution of ~17 synchronous condensers)*
- Conversion of synchronous machines to enable syncon-mode (650 MW)
- Re-dispatch of hydro, coal and gas (including in synchronous condenser mode where available)
- 4 small syncons or 200MW grid-forming BESS in Hunter-Central Coast REZ

Proponent TBC

- 7 syncons for New England REZ (in 2031/32 - 33)

Portfolio of new or upgraded system strength solutions by 2032/33

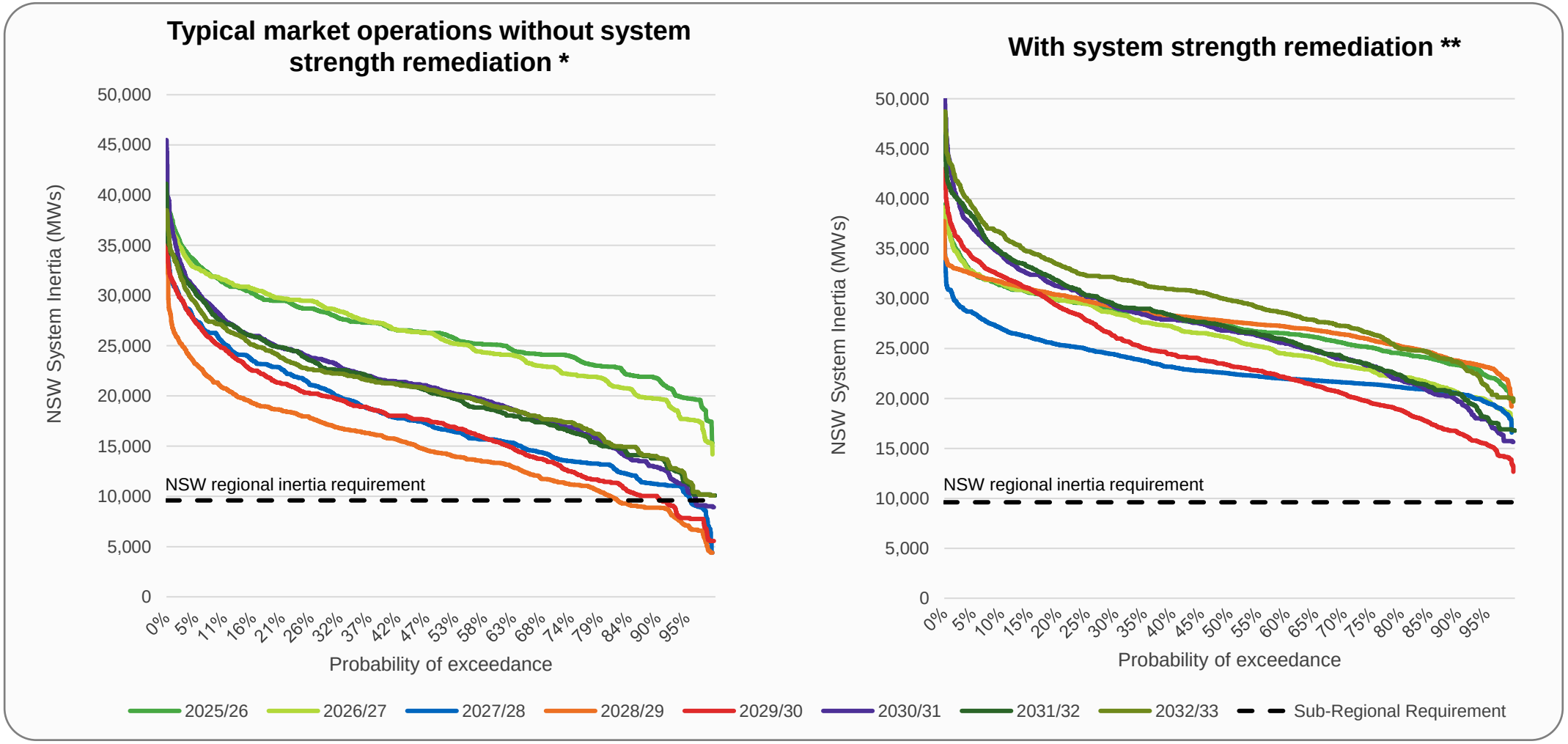


Transgrid synchronous condensers at Armidale, Liddell, Newcastle (x2), Eraring, Kemps Creek (x2), Wellington, Darlington Point and Dinawan

Inertia requirements for NSW will be met by system strength solutions

Portfolio option 2 'enhanced portfolio' is expected to meet inertia requirements in all years

Forecast inertia levels in NSW



** Includes synchronous condensers being delivered for Project Energy Connect (by Transgrid) and for Central West Orana REZ (by ACEREZ)*

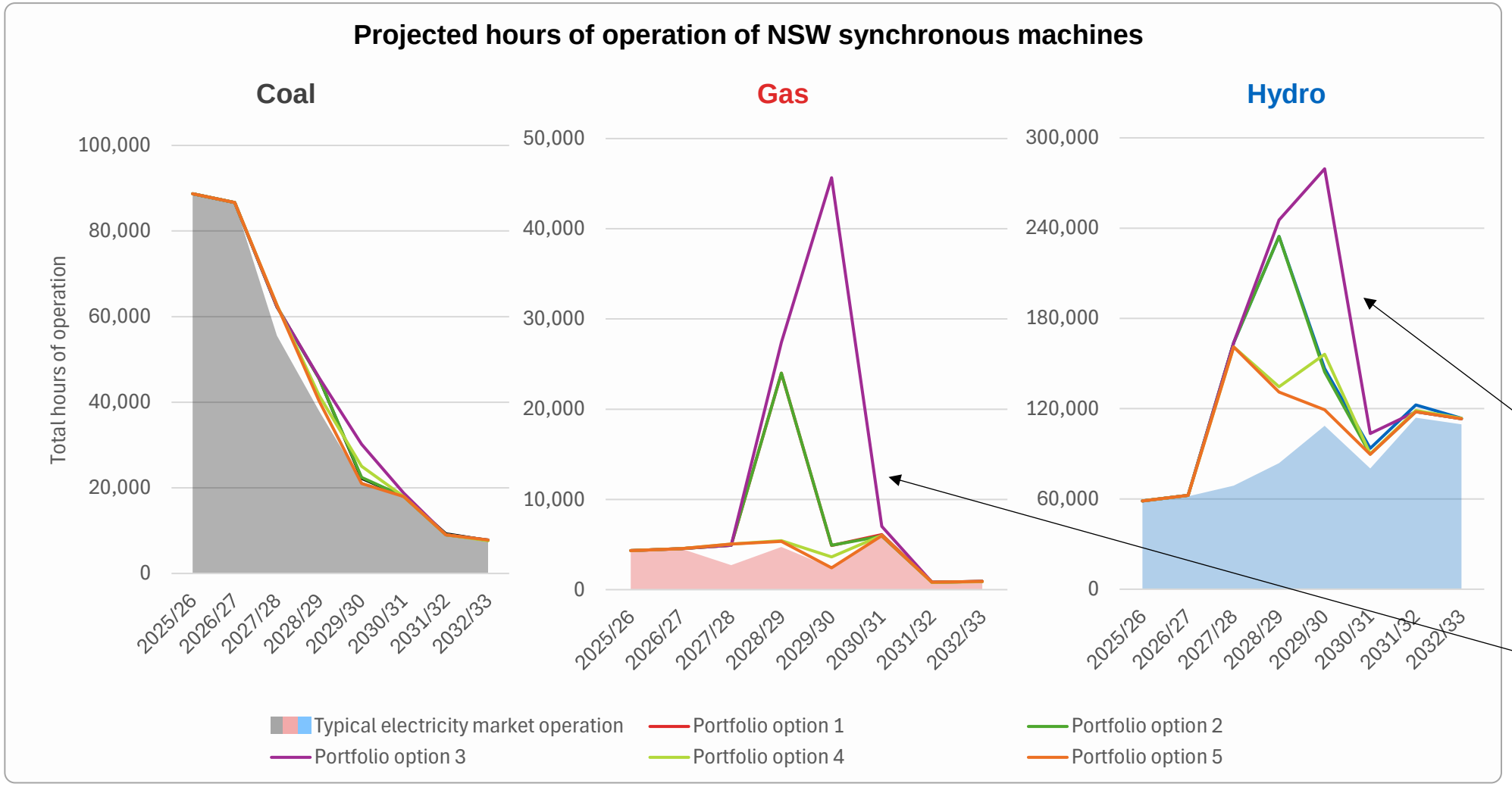
*** Includes synchronous inertia only. When synthetic inertia capabilities of grid-forming batteries are included, inertia would be higher than presented above*

4

Assessing optimal portfolio timing

Additional hours of synchronous machines is crucial until 2030/31

Transgrid will enter non-network system security contracts with committed and existing synchronous units to minimise gaps in system strength



Risk of system strength gaps to the minimum level are present in:

- 2027/28 in all portfolios
- 2028/29 in portfolio option 1, 2 & 3
- 2029/30 in portfolio option 3

Re-dispatch of synchronous units spike between 2027/28 and 2029/30 to manage the risk of system strength gaps

Earlier deployment of synchronous condensers reduces reliance on significant re-dispatch of thermal synchronous generation

5

Net market benefits analysis

The enhanced portfolio is the ‘preferred’ credible option

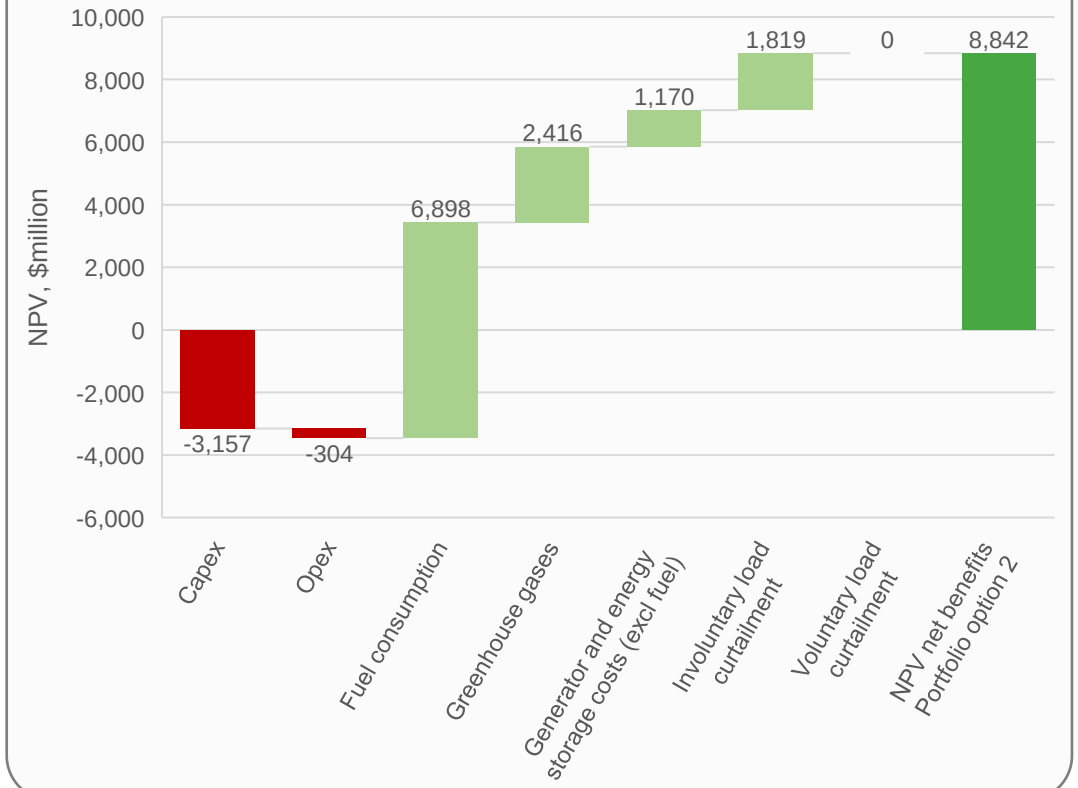
The enhanced portfolio is more resilient than portfolio option 1 to future uncertainty through earlier procurement of one synchronous condenser

Net market benefits of credible options

- Earlier timing of synchronous condenser drives additional $2.2 billion of benefits (portfolio 1 and 2, versus 3)
- Marginal difference between (1) and (2) justifies enhanced portfolio option as preferred given unquantified benefits of added resilience

Breakdown of benefits for the enhanced portfolio (2)

- Benefits driven by avoided additional operating hours of synchronous generation and unserved energy events (against the ‘do-nothing’ counterfactual)



Acceleration of synchronous condensers drives additional benefits

Earlier deployment reduces reliance on thermal assets, reduces risks of gaps and provides resilience to the power system

Acceleration has significant net market benefits, if credibility can be confirmed

+$1.1 bn

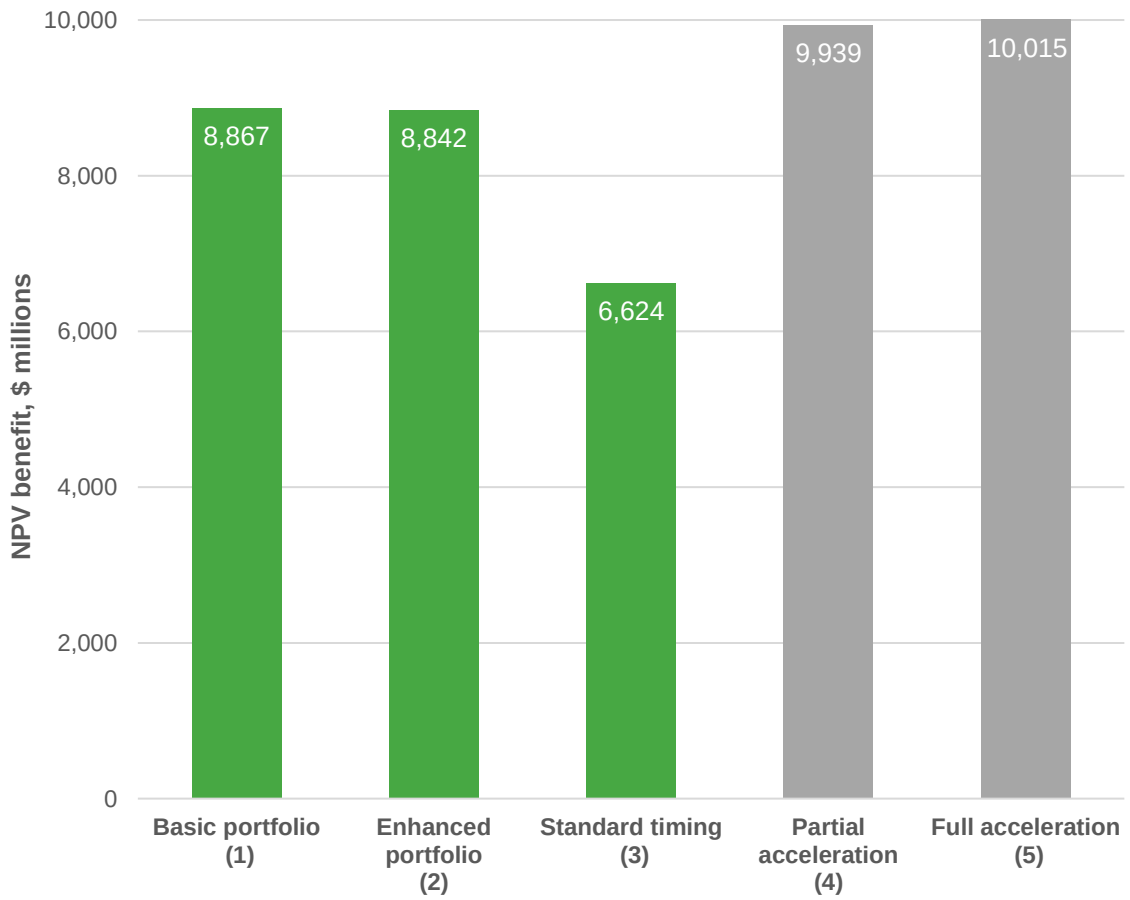
Additional benefits of accelerating synchronous condensers (portfolios 4 or 5) compared to the enhanced portfolio (2)

+$76 m

Additional benefits of full acceleration (5) in comparison to partial acceleration (4)

AEMC Reliability Panel, April 2025

"the risks of over- and under-investment are asymmetric. The risk of over-investment in security services, or investment earlier than needed, comes with much lower costs than under-investment or investment that is too late. Under-investment could lead to periods when the NEM cannot be securely operated. This means that proactive planning and identification of needs is required."



6

Next steps

The PACR is the final step of the RIT-T

Transgrid will now work to deliver the portfolio of system strength solutions, of which non-network solutions form a key component

Additional details for non-network solutions will be provided via email to proponents who have submitted an Expression of Interest. Additional details for non-network proponents are on Transgrid's website. [1]

- **For grid-forming BESS:** Transgrid expect to initiate procurement for this first tranche in late 2025.
- **For synchronous generators:** Transgrid has already begun procurement to meet the need from 2 December 2025 for years 2025/26 and 2026/27.

Next steps for network solutions

Tender process for synchronous condensers and site works

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Binding offers from suppliers

↓

Submit regulatory filing to AER

Next steps for non-network solutions

Commence procurement process for non-network system security contracts

↓

Undertake detailed network studies of responses against identified performance requirements

↓

As appropriate, AER determination for prudent & efficient expenditure (before contract execution)

[1] https://www.transgrid.com.au/projects-innovation/meeting-system-strength-requirements-in-nsw/

Q&A

Submit and vote on questions via Menti (www.menti.com): 5621 7221