

SA to NSW Interconnector

Sydney Public Forum

Thursday 16 August 2018

What are we talking about today?

- ElectraNet has investigated interconnector and network support options aimed at...
 - reducing the cost of providing secure and reliable electricity in the near term
 - facilitating the medium to longer-term transition of the energy sector across the National Electricity Market to low emission energy sources
- Includes an economic cost benefit (RIT-T) assessment of feasible options to support this energy transformation
- Our investigation has been undertaken in consultation with national and jurisdictional planning bodies AEMO (National and Victoria), Powerlink (Queensland) and TransGrid (NSW)

Our purpose

- We published a Project Assessment Draft Report (PADR) on 29 June 2018
- Our purpose today is to clarify understanding of the draft report findings and invite your feedback
- Submissions on the draft report are due by 24 August 2018
- Feedback will be considered as input to the next and final stage of ElectraNet's investigation

Outline

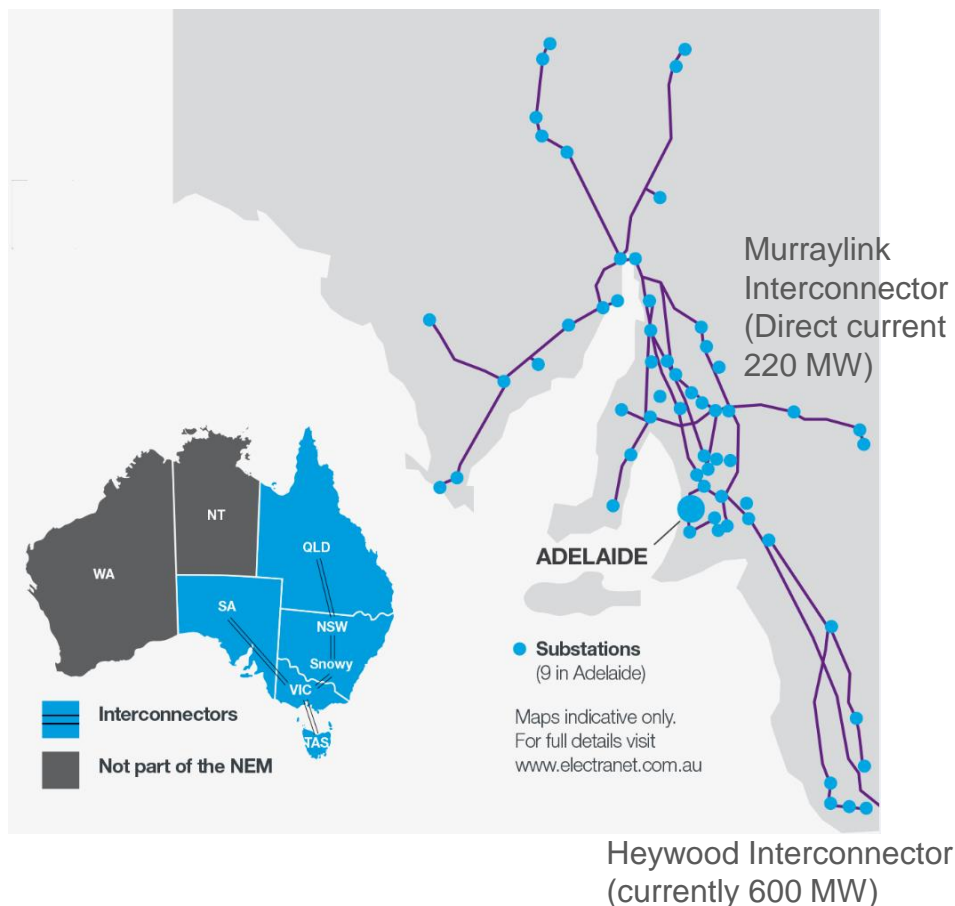
| Item | Notes | Lead |
|----------------------------------|--|------------------------|
| 1. Opening, welcome and overview | Provide high level overview of context and PADR outcomes | Rainer Korte (20 min) |
| 2. Options considered | Summary of options considered | Rainer Korte (10 min) |
| 3. Market benefits assessment | Present outcomes along with high level summary of approach and assumptions | Brad Harrison (20 min) |
| 4. AEMO Integrated System Plan | Overview of ISP including what is says about new SA interconnection | Craig Price (20 min) |
| 5. Q&A | Panel discussion | Rainer Korte (40 min) |
| 6. Summary, next steps and close | | Rainer Korte (10 min) |

Context and overview

Rainer Korte, Executive Manager Asset Management

South Australian context

South Australia (SA) is at the forefront of energy transformation

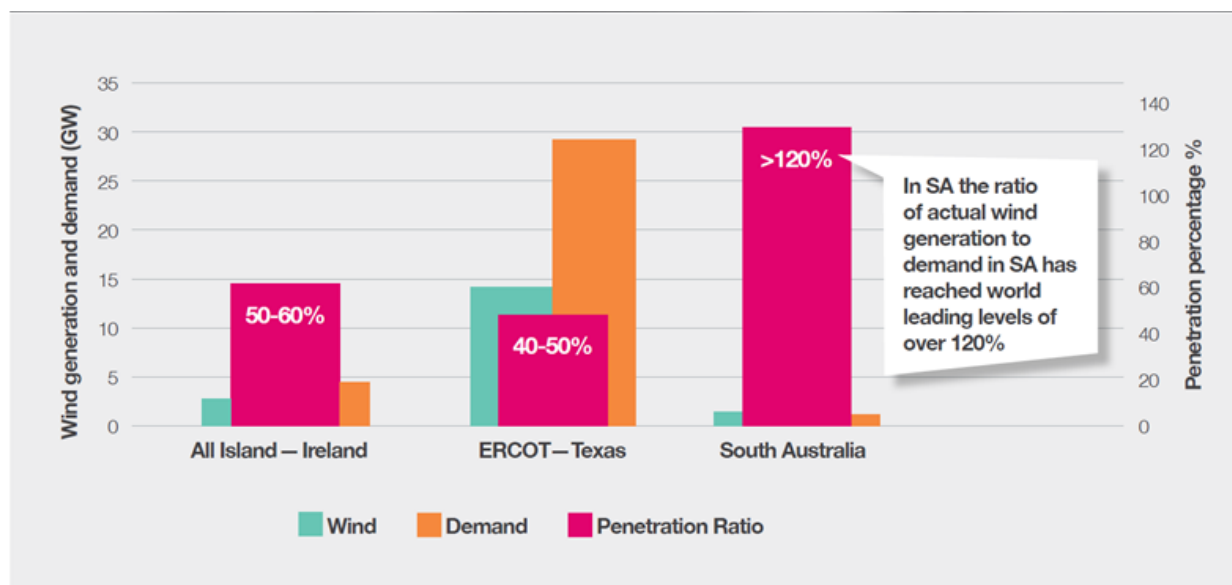


NEM – National Electricity Market
AEMO – Australian Energy Market Operator

- > Leading levels of integration of intermittent wind and solar energy compared to demand
- > Last coal fired power station closed 2016
- > Reliance on gas generation and higher gas prices is impacting electricity prices
- > SA separation and load shedding events have led to heightened concerns about power system security
- > New measures have been introduced by AEMO and the SA Government to manage power system security
- > Ongoing policy drivers to lower carbon emissions, new technology and customer choice continue to drive energy transformation

SA Energy Transformation

- New challenges are emerging from the combination of relatively high levels of intermittent generation and a relatively isolated and weakly interconnected system

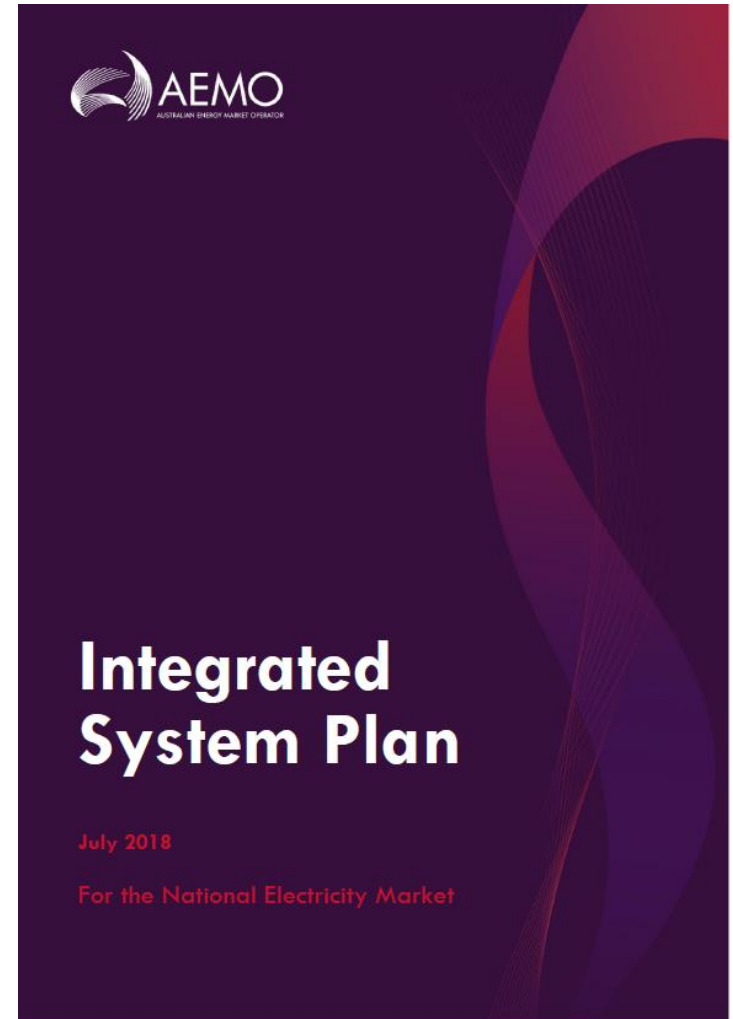


Source: AEMO, South Australian System Strength Assessment, September 2017.

- SA is unique compared with other major systems with high levels of intermittent wind:
 - Denmark** – has many interconnections with neighbouring countries
 - Ireland** – restricts non-synchronous generation to 55% penetration levels
 - Germany** – has many interconnections with neighbouring countries
 - Texas** – has low levels of wind relative to system demand

AEMO Integrated System Plan

- Developed in response to the Federal Government commissioned “Finkel Review” recommendations and published 17 July 2018
- Key themes...
 - Large amounts of coal fired generation is expected to close over the next 20-years (about a third of current energy supplies)
 - This generation will be largely replaced with large and small scale solar and wind generation
 - This transformation needs to be supported by large amounts of energy storage and targeted investment in transmission between regions – to minimise costs and enable an affordable, reliable and secure energy system for energy customers now and into the future



Consultation to date

Project Specification Consultation Report (PSCR) and other associated reports from November 2016

| | | |
|--|---------------|--------------------------|
|  Project Specification Consultation Report | (PDF, 2 MB) | Download |
|  Fact Sheet - Exploring South Australia's Energy Transformation | (PDF, 980 KB) | Download |
|  Presentation - South Australian Energy Transformation forum | (PDF, 2 MB) | Download |
|  Market Modelling Approach and Assumptions Report | (PDF, 759 KB) | Download |
|  SAET Supplementary Information Paper | (PDF, 670 KB) | Download |

- All information is available at electranet.com.au

Submissions received

Summary of submissions to earlier consultation papers

| From | No. | Topic | No. |
|------------------------------------|-----------|---------------------------------------|-----------|
| Jurisdictional planning bodies | 3 | Network options | 5 |
| Market participants | 14 | Proposals for non-network options | 18 |
| Advisory bodies/ universities | 5 | General feedback on the RIT-T process | 7 |
| Manufacturers and other proponents | 13 | Feedback on market modelling approach | 10 |
| Total submissions | 35 | Total submissions | 40 |

Totals are not the same as some submissions address multiple topics

Why we delayed publication of draft report

Key policy and regulatory developments since release of the PSCR



Draft report findings

- A new high capacity interconnector between South Australia and New South Wales would deliver substantial economic benefits as soon as it can be built
- Our work has been closely coordinated with the development of AEMO's Integrated System Plan
- We have investigated four broad credible options to deliver net market benefits and support energy market transition through:
 - Lowering dispatch costs by increasing access to supply options across regions
 - Improving access to high quality renewable resources across regions
 - Enhancing security of electricity supply
- The recommended option delivers positive net benefits across all reasonable future scenarios

Overview of recommended option

Details

- Location: A new double circuit transmission line between Robertstown in the mid-north of South Australia to Wagga Wagga via Buronga in New South Wales
- Planned capacity: 800 MW
- Voltage: 330 kV
- Length: About 920 km

Delivery

- ElectraNet would partner with TransGrid, the transmission network service provider in NSW
- ElectraNet would fund the capital works in SA and TransGrid would fund the works in NSW

Cost

- Total cost is estimated to be \$1.5bn (SA \$400m and NSW \$1.1bn)

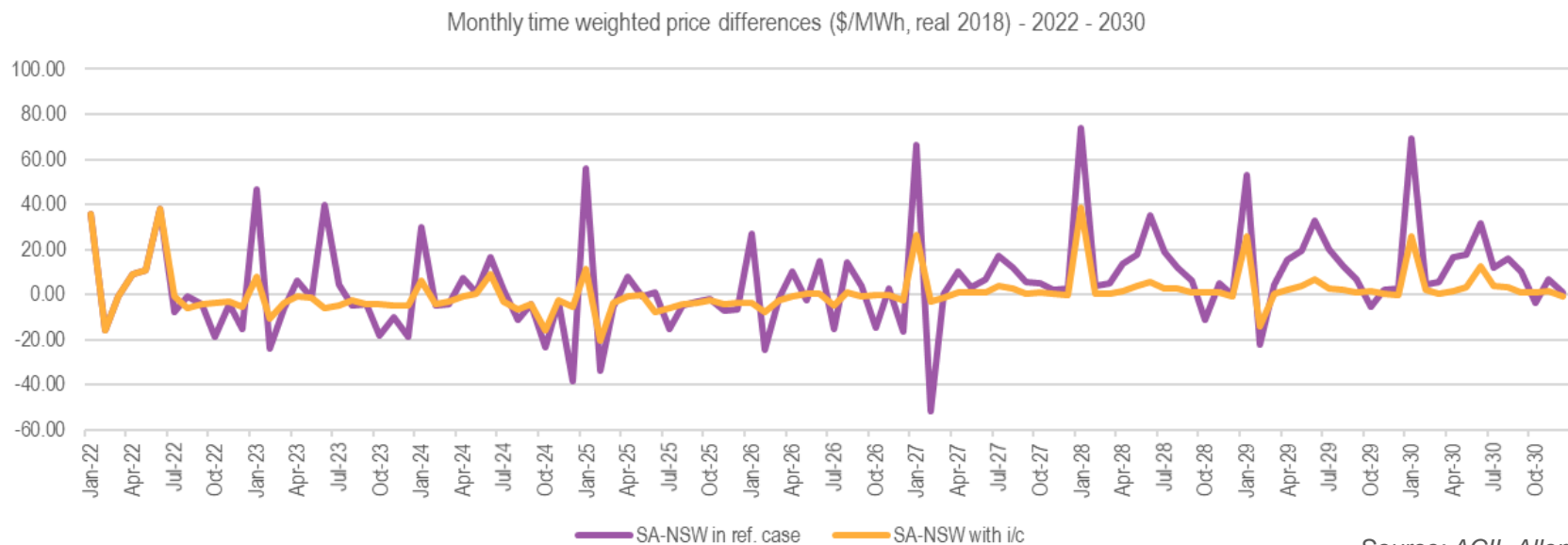
Benefits

- New interconnector is estimated to deliver net market benefits of about \$1bn
- Wholesale market fuel cost savings of \$100m per annum putting downward pressure on electricity prices
- Independent modelling by ACIL Allen estimates that annual residential customer bills would reduce by up to about \$30 in SA and \$20 in NSW

Timing

- Subject to obtaining necessary approvals, the project could be delivered by 2022 to 2024

Interconnector impact on market prices



- The interconnector improves diversity of supply and allows greater sharing of reserves across both South Australia and New South Wales
- This reduces wholesale market price volatility in both regions, which helps pull down retail prices

Benefits for NSW customers

Immediate Benefits

- ACIL Allen estimates annual residential customer bills would reduce by up to \$20 in NSW within the first three years
- Business customer bills to reduce by up to \$50 in this period

Longer term benefits

- Prices remain lower for residential and business customers in both States to end of the forecast period in 2050
- To 2030, wholesale price spikes decrease in NSW due to greater supply diversity, driving wholesale prices lower in most years, pulling down average retail prices over this period
- From 2035 to 2050 average wholesale prices decrease, continuing to pull down retail prices

Maintains current supply mix

- Provides additional source of demand for NSW generation output in the short term
- No discernible impact on NSW plant retirement dates over the longer term











Improves supply security

- Results in deferral of 350MW of gas generation investment in neighbouring States (SA and Vic) while bringing forward investment of 200MW in wind
- Improves diversity of supply and access to more efficient generation mix when NSW coal fleet retires

Price impact analysis has not considered additional renewable generation development that may be unlocked along interconnector path

We welcome feedback on our draft report

Project Assessment Draft Report (PADR) and Associated Reports - June 2018

| | | |
|---|----------------|--------------------------|
|  Project Assessment Draft Report | (PDF, 3 MB) | Download |
|  Information Sheet - South Australian Energy Transformation | (PDF, 3 MB) | Download |
|  Basis of Estimate for PADR | (PDF, 1 MB) | Download |
|  Network Technical Assumptions | (PDF, 617 KB) | Download |
|  SA NSW Interconnector - Preliminary Projected Impact on Electricity Prices (ACIL Allen) | (PDF, 342 KB) | Download |
|  Gas Price Forecast Review | (PDF, 134 KB) | Download |
|  Consolidated Non-Interconnector Option | (PDF, 1 MB) | Download |
|  Market Modelling Report | (PDF, 1 MB) | Download |
|  Market Modelling and Assumptions Data Book | (XLSX, 213 KB) | Download |
|  RIT-T Market Modelling High Level Review (Oakley Greenwood) | (PDF, 182 KB) | Download |

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Next steps

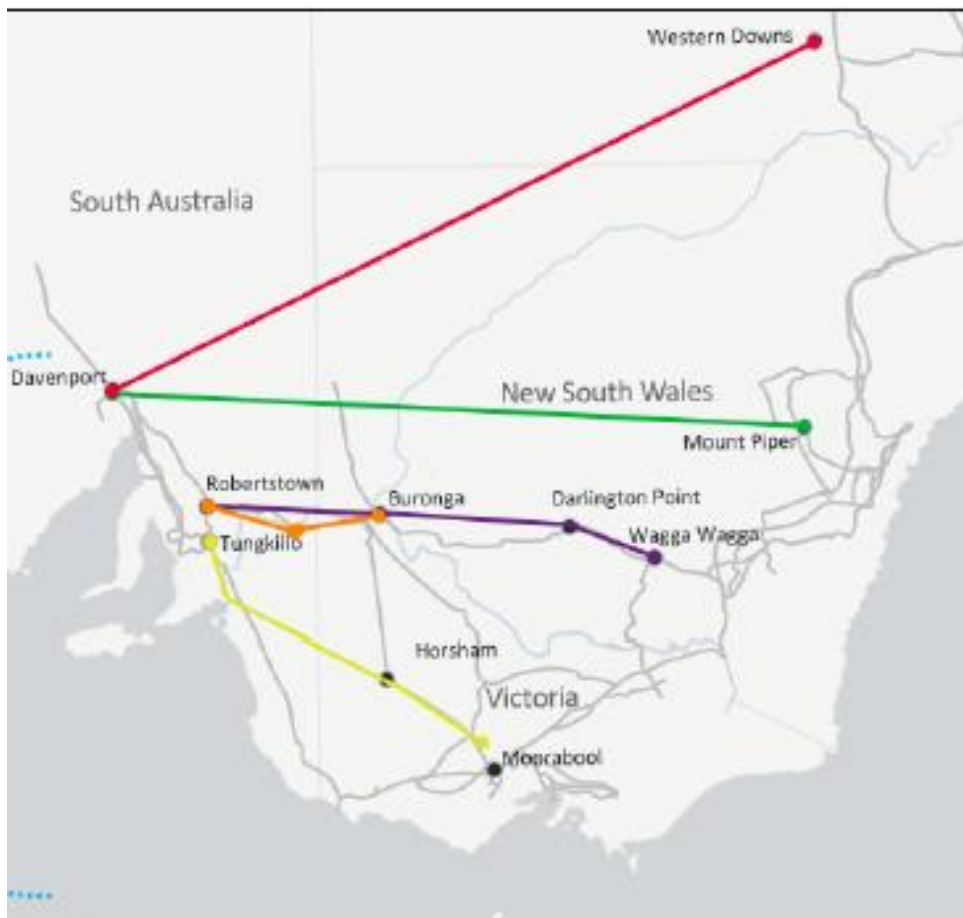
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| Draft report (PADR) published | 29 Jun 2018 |
| Public forum (Adelaide) | 18 Jul 2018 |
| Public forum and technical deep dive modelling workshop (Sydney) | 16 Aug 2018 |
| Technical deep dive modelling workshop (Adelaide) | 17 Aug 2018 |
| Submissions due on PADR | 24 Aug 2018 |
| Further work to respond to AEMO Integrated System Plan and stakeholder submissions | Aug to Oct 2018 |
| Final report (PACR) | End Nov 2018 |
| AER makes ruling on final report | By April 2019 |

Options considered

Rainer Korte, Executive Manager Asset Management



Network options



Options and transfer capability

| Description | Distance (approx. km) | Nominal Capacity (MW) | Combined Import limit into SA (MW) | Combined Export limit out of SA (MW) |
|------------------------------|-----------------------|-----------------------|------------------------------------|--------------------------------------|
| SA to Queensland | 1450 | 750 | 1300 | 1300 |
| SA to NSW | 370 - 1200 | 300 - 1000 | 800 - 1300 | 900 - 1450 |
| SA to NSW (preferred option) | 920 | 800 | 1300 | 1450 |
| SA to Victoria | 420 | 650 | 1100 | 1200-1350 |

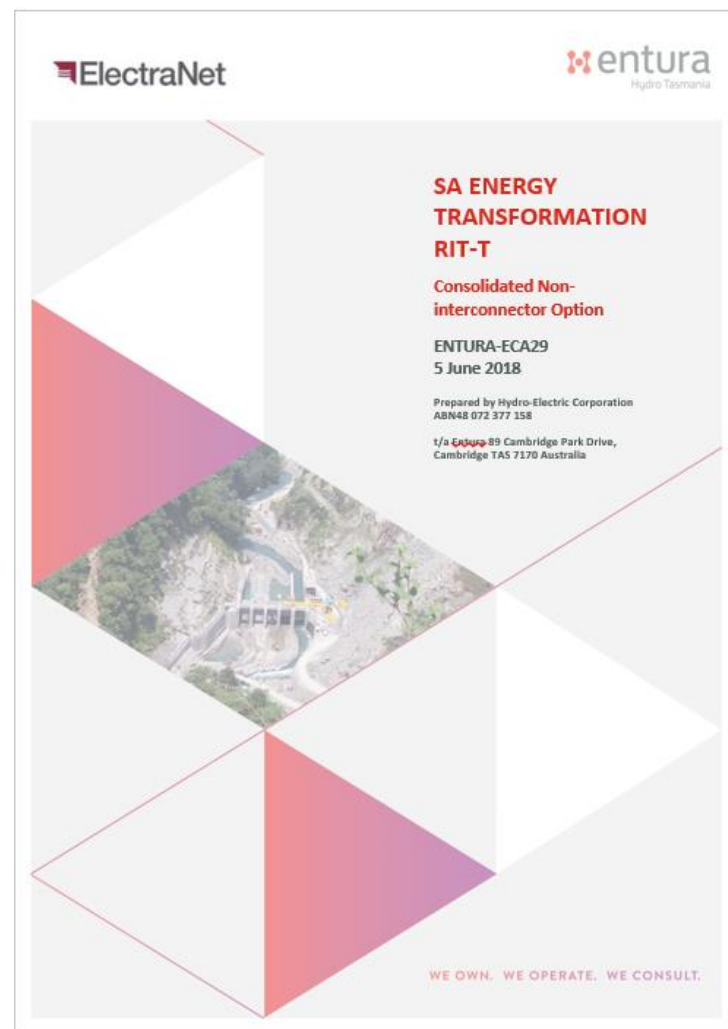
Notes

1. Combined limits are the total allowed power transfer across the Heywood interconnector and the new interconnector
2. Combined capacity is lower than aggregate of the two interconnector capacities
3. Export capability is generally higher than import, as it is easier to manage

Non-network option approach

- Technical criteria defined in the PSCR and associated supplementary report
- Design principles:
 - Same base case for the non-interconnector as well as interconnector options
 - Performance must meet at least the minimum system security requirements
 - Performance for credible contingencies should be comparable to interconnector options in managing the non-credible loss of the Heywood interconnector
- Considered technical criteria over time frames to: Survive (seconds), Stabilise, Steady (< 1 hour), Sustain (days)

PSCR – Project Specification Consultation Report



Next steps

- Optimise scope of the preferred option:
 - Based on feedback
 - Implication of series compensation for future connectivity (line cut-in)
 - Explore opportunities to enhance transfer capabilities further (to deliver greater value)
- Other options will be further optimised if new information comes to light that could change the relative ranking of options
- Review system strength requirements in line with new rules and guidelines and whether there is value in providing additional system strength to ensure that existing and new generation is not constrained

Market benefits assessment

Brad Harrison, Principal Energy Market Analyst

Market benefits and the RIT-T



Market benefits and the RIT-T

- Categories of market benefits considered
 - Avoided fuel costs (first order)
 - Avoided generator and storage capital expenditure (second order)
 - Avoided transmission network capital expenditure (Renewable Energy Zone) (second order)
 - Avoided transmission network capital expenditure (Committed project)
 - Avoided generator fixed costs (second order)
 - Avoided voluntary load curtailment
 - Avoided unserved energy (involuntary load curtailment)
 - Renewable Energy Target penalty

Scenarios

| Variable | High | Central | Low |
|--|---|---|---|
| Weighting | 25% | 50% | 25% |
| Electricity demand (including impact from distributed energy resources) | AEMO 2018 EFI strong demand forecasts plus potential SA mining load development of 345 MW | AEMO 2018 EFI Neutral demand forecasts | AEMO 2018 EFI Weak demand forecasts |
| Gas prices – long term | \$11.87 GJ in Adelaide (\$1.68/GJ higher than the AEMO ISP strong forecast) | \$ 8.40/GJ (AEMO 2017 GSOO Neutral forecast; \$0.77 lower than AEMO ISP Neutral forecast) | \$7.40/GJ (\$0.62/GJ lower than the AEMO ISP weak forecast) |
| Emission reduction renewables policy – in addition to Renewable Energy Target (RET) | Emissions reduction around 45% from 2005 by 2030 (Federal opposition policy) | Emissions reduction around 28% from 2005 by 2030 (Federal Government policy) | No explicit emission reduction beyond current RET |
| Jurisdictional emissions targets | VRET 25% by 2020 and 40% by 2025 QRET 50% by 2030 | VRET 25% by 2020 and 40% by 2025 QRET 50% by 2030 | VRET 25% by 2020 and 40% by 2025 QRET 50% by 2030 |
| SA inertia requirement – RoCoF limit for non-credible loss of Heywood Interconnector | 1 Hz/s (International standard) | 3 Hz/s (current SA Government requirement) | 3 Hz/s (current SA Government requirement) |
| Capital costs | 15% higher than central scenario | AEMO 2016 NTNDP with some updates from 2018 ISP . | 15% lower than central scenario |

Approach

- Simplifications are required, where made these have tended to reduce benefits
- Some of these simplifications include...
 - Least cost 'linear' generator expansion
 - Security constrained economic dispatch
 - Hourly dispatch (not five minutes)
 - 50% POE Demand
 - Average heat rates
 - Minimum up and down times to manage dispatch inflexibilities
 - Deterministic model
 - Partial ISP alignment

System Strength

- Current arrangement

- Synchronous floor

AEMO constrain on or direct synchronous generators to meet the minimum system strength requirement

- Low non-synchronous cap

If the synchronous floor is met but not exceeded, a **low** cap is applied to non-synchronous generators

- High non-synchronous cap

If the synchronous floor is met and exceeded, a high cap is applied to non-synchronous generators

- Assumed base case

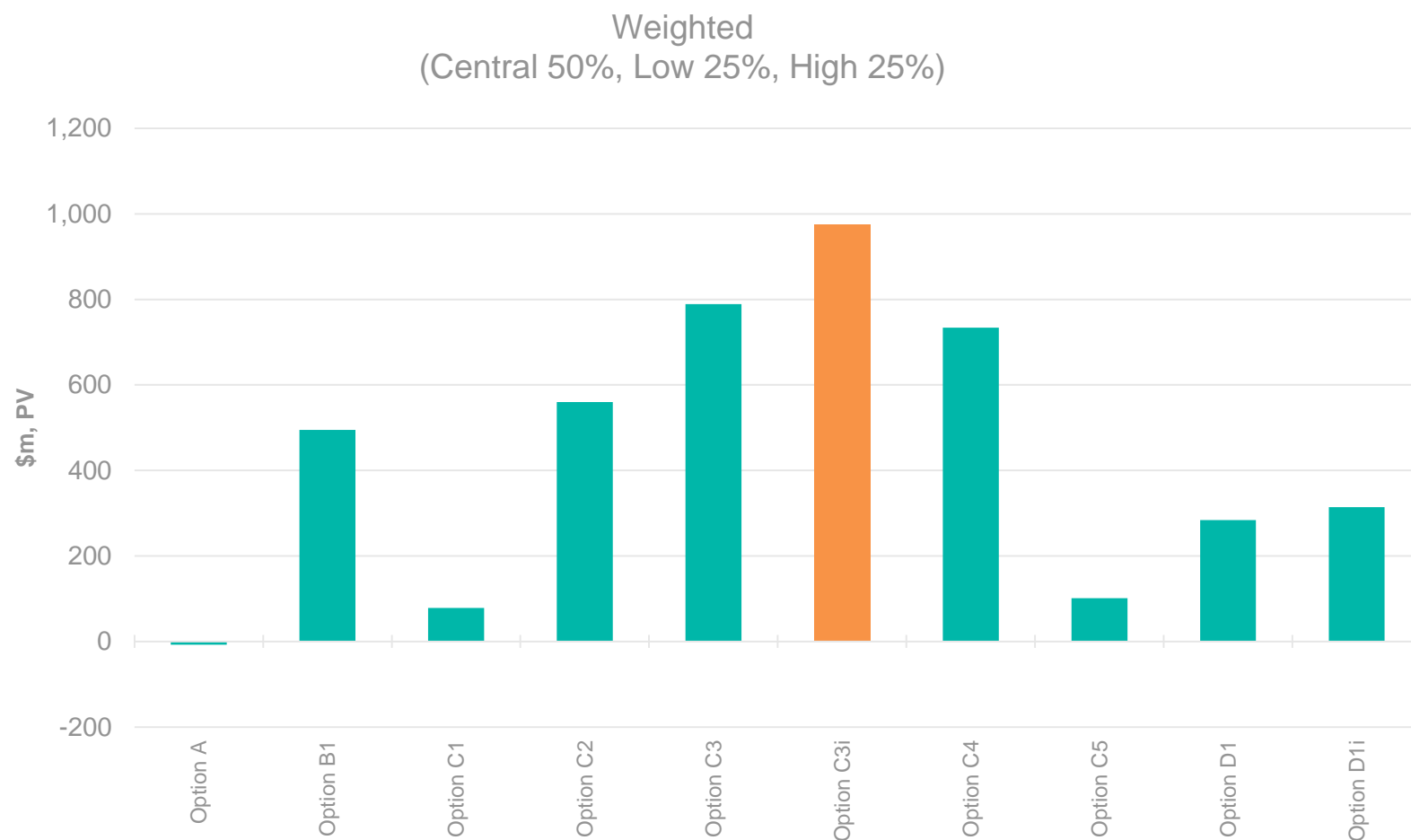
- High non-synchronous cap
 - 2,400 MWs of inertia is provided by synchronous condensers

Network options

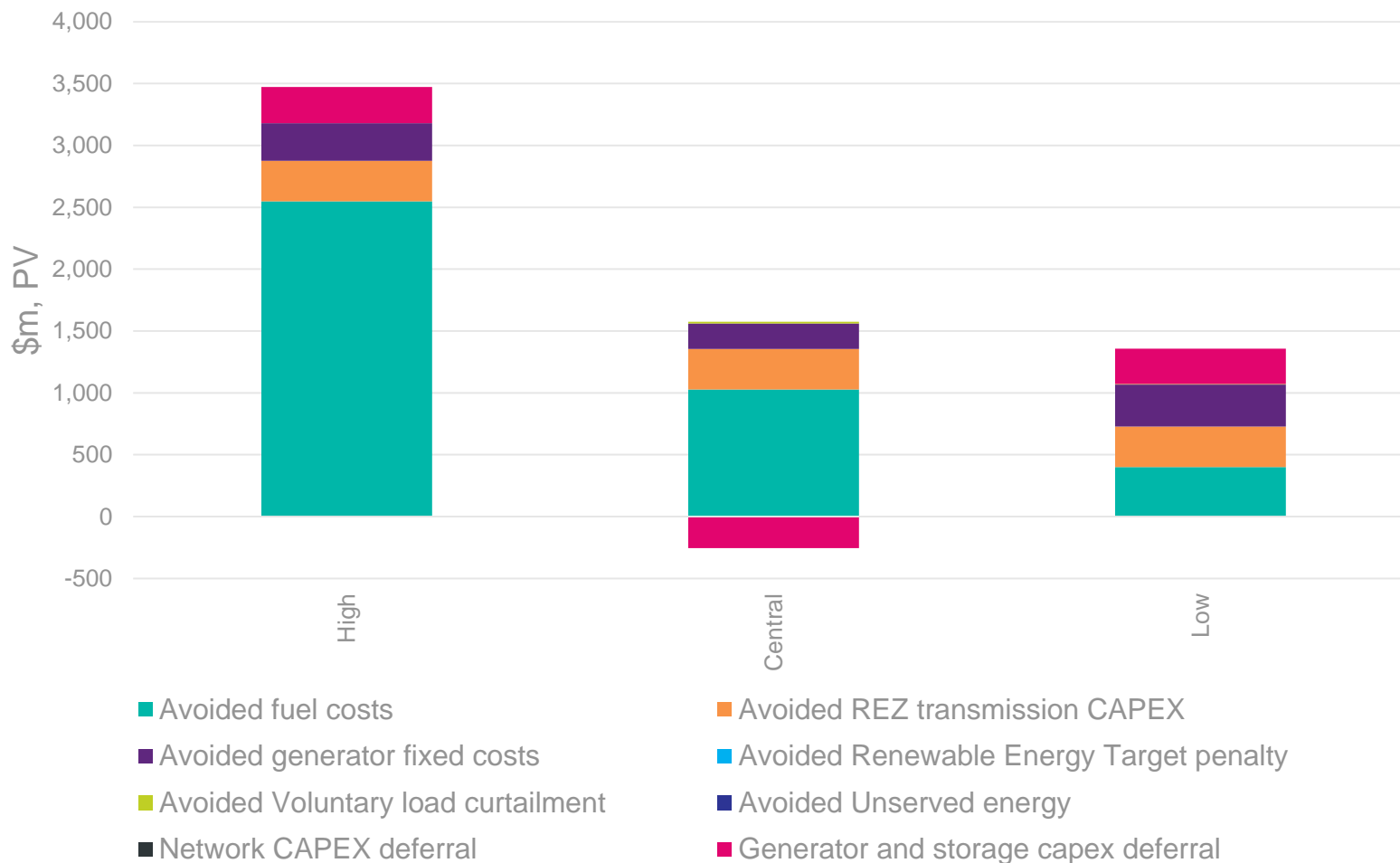
| Option | Description | Capital Cost (\$2018 billion) |
|-------------------|---------------------------------|-------------------------------|
| Option A | Non-interconnector ¹ | \$0.13 p.a. |
| Option B | Qld HVDC | \$1.8 |
| Option C1 | NSW HVDC | \$0.8 |
| Option C2 | NSW 275 kV | \$1.0 |
| Option C3 | NSW 330 kV via Buronga | \$1.4 |
| Option C3i | C3 + series compensation | \$1.5 (NPV ~\$0.9) |
| Option C4 | NSW 330 kV Buronga by pass | \$1.3 |
| Option C5 | NSW 500 kV | \$2.9 |
| Option D1 | Victoria 275 kV | \$1.2 |
| Option D1i | D1 + series compensation | \$1.2 |

Note 1: Per annum opex cost

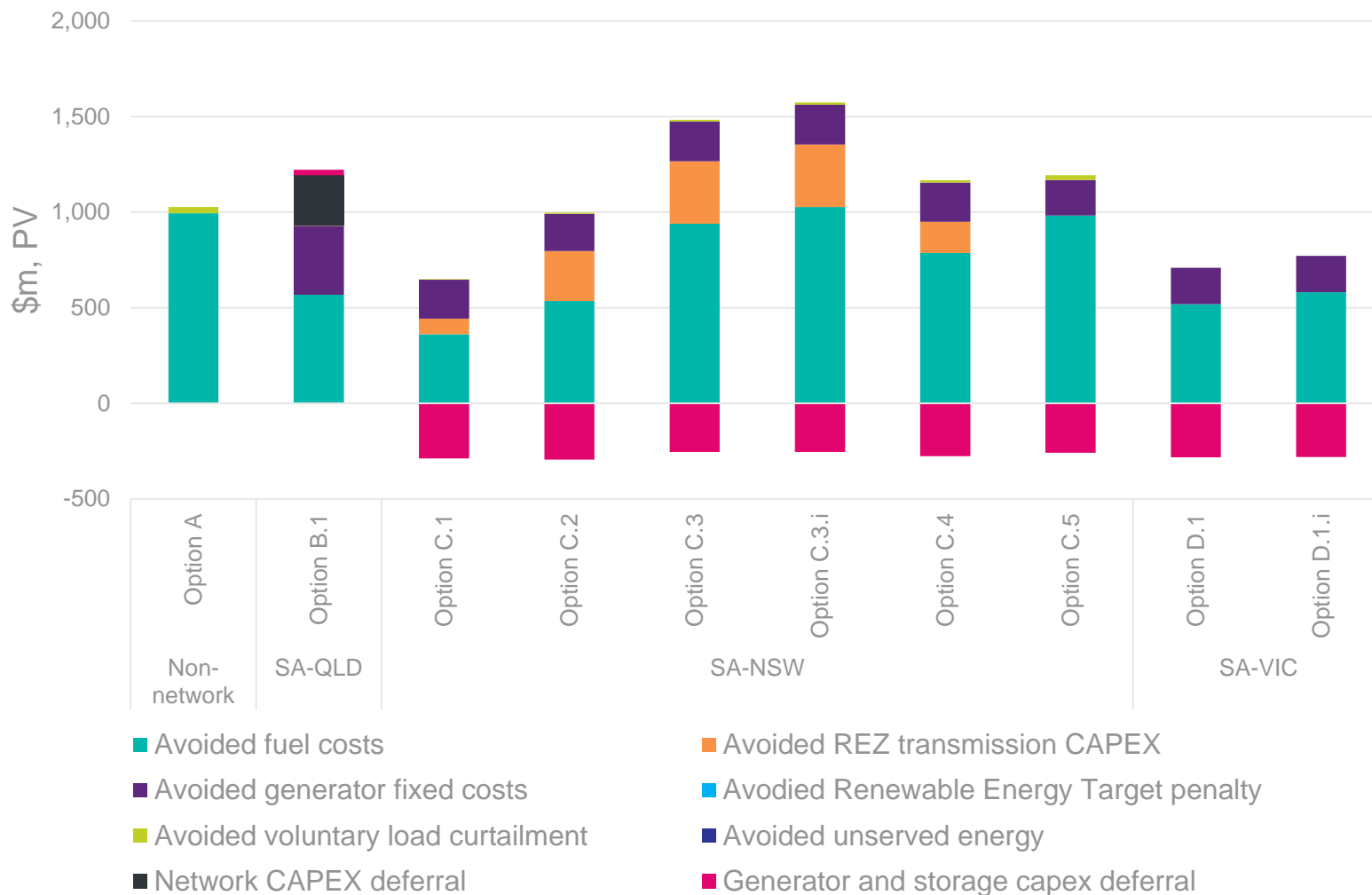
Weighted net market benefits



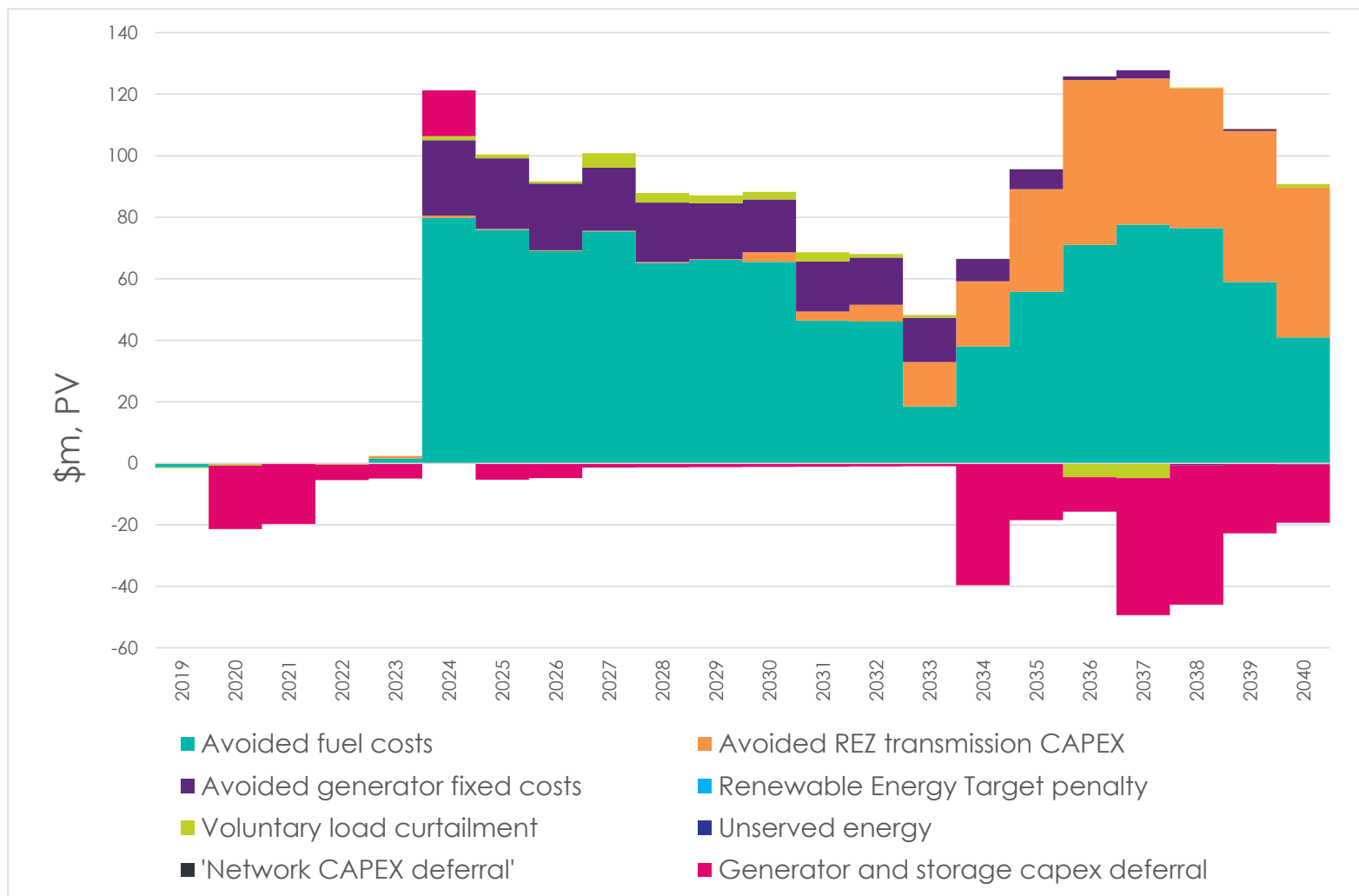
Gross market benefits – preferred option



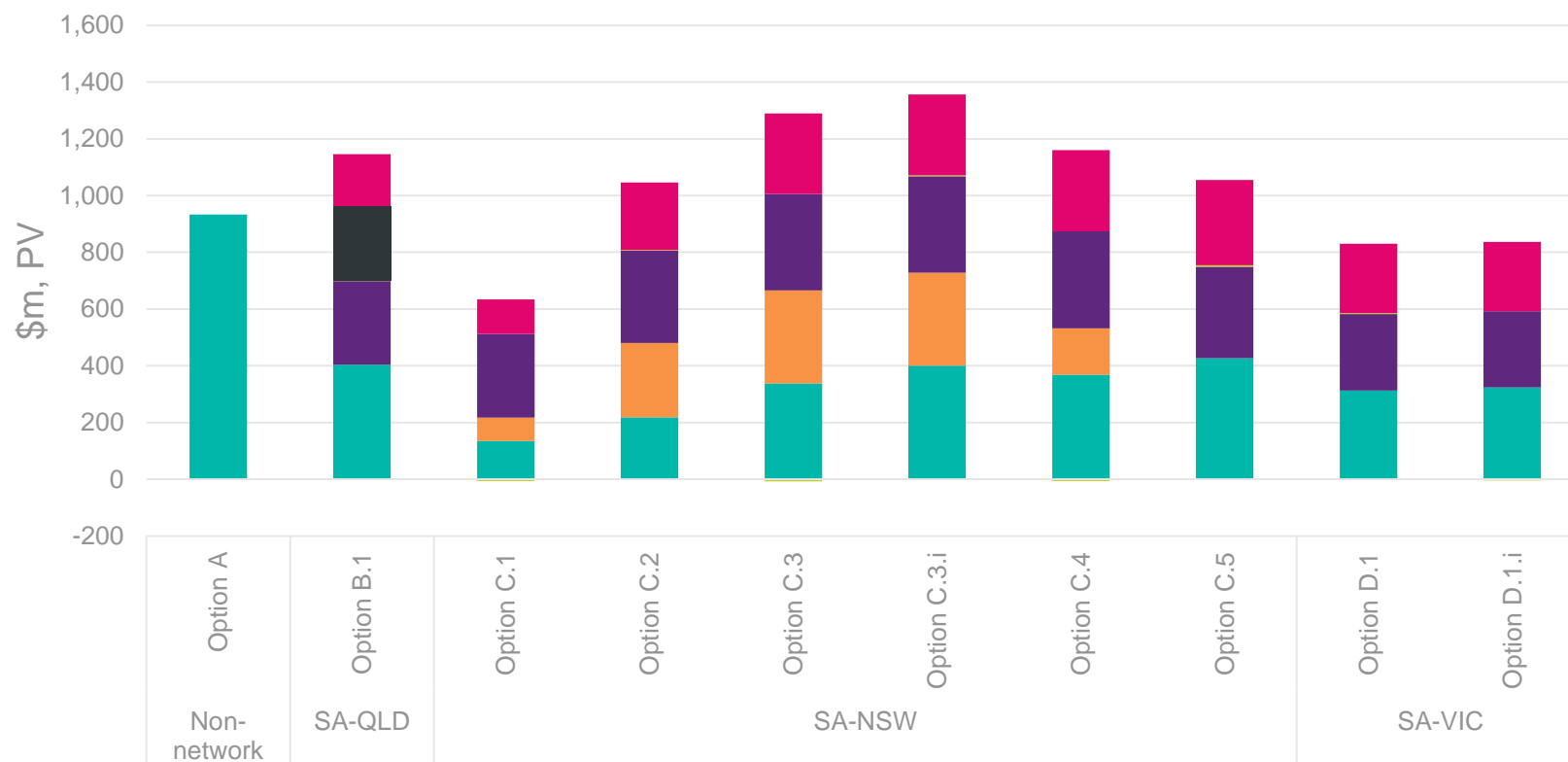
Central scenario – gross market benefits



Central – preferred option – gross benefits

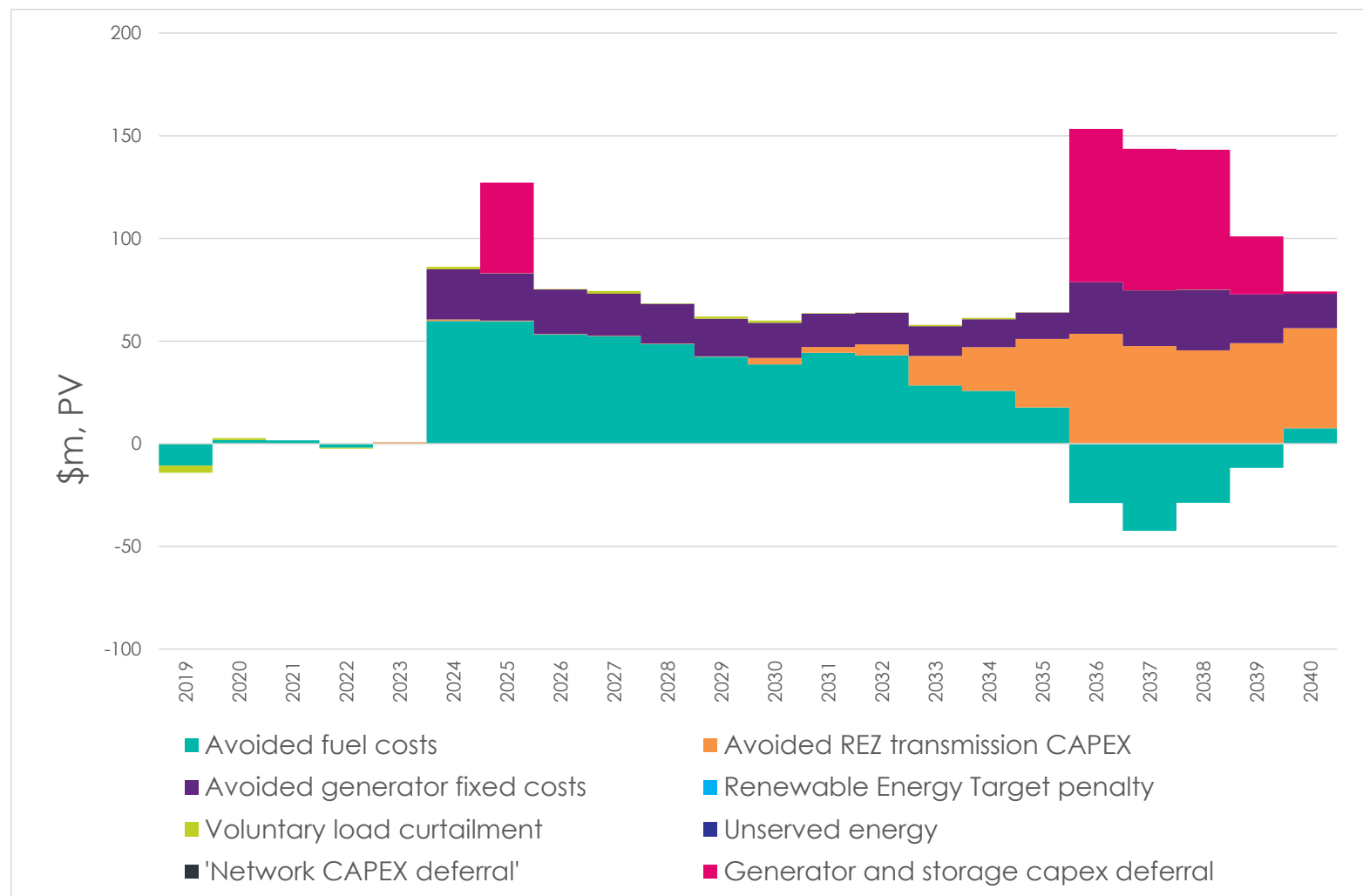


Low scenario – gross market benefits

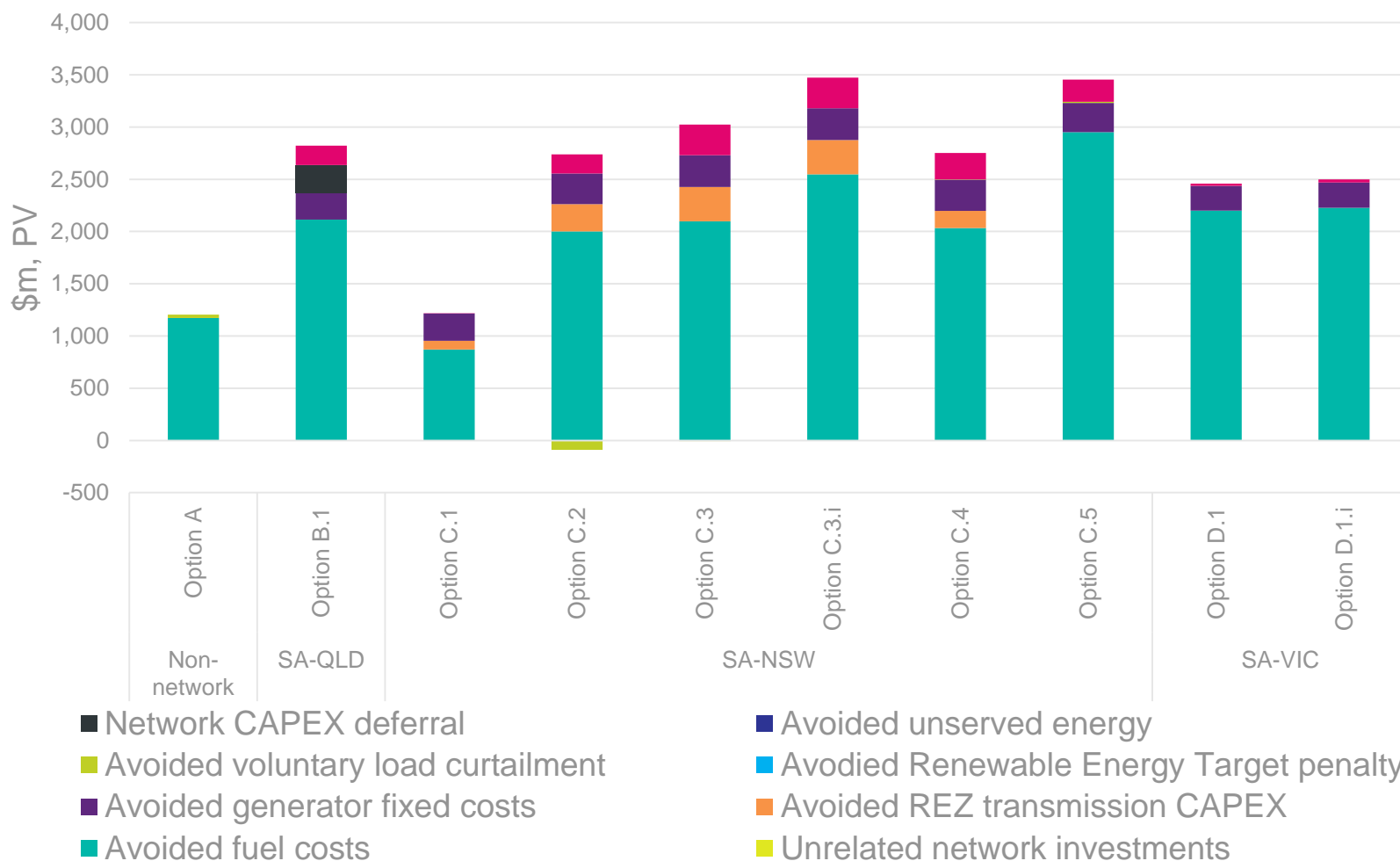


- Avoided fuel costs
- Avoided generator fixed costs
- Avoided voluntary load curtailment
- Avoided network CAPEX deferral
- Avoided REZ transmission CAPEX
- Avoided Renewable Energy Target penalty
- Avoided unserved energy
- Generator and storage capex deferral

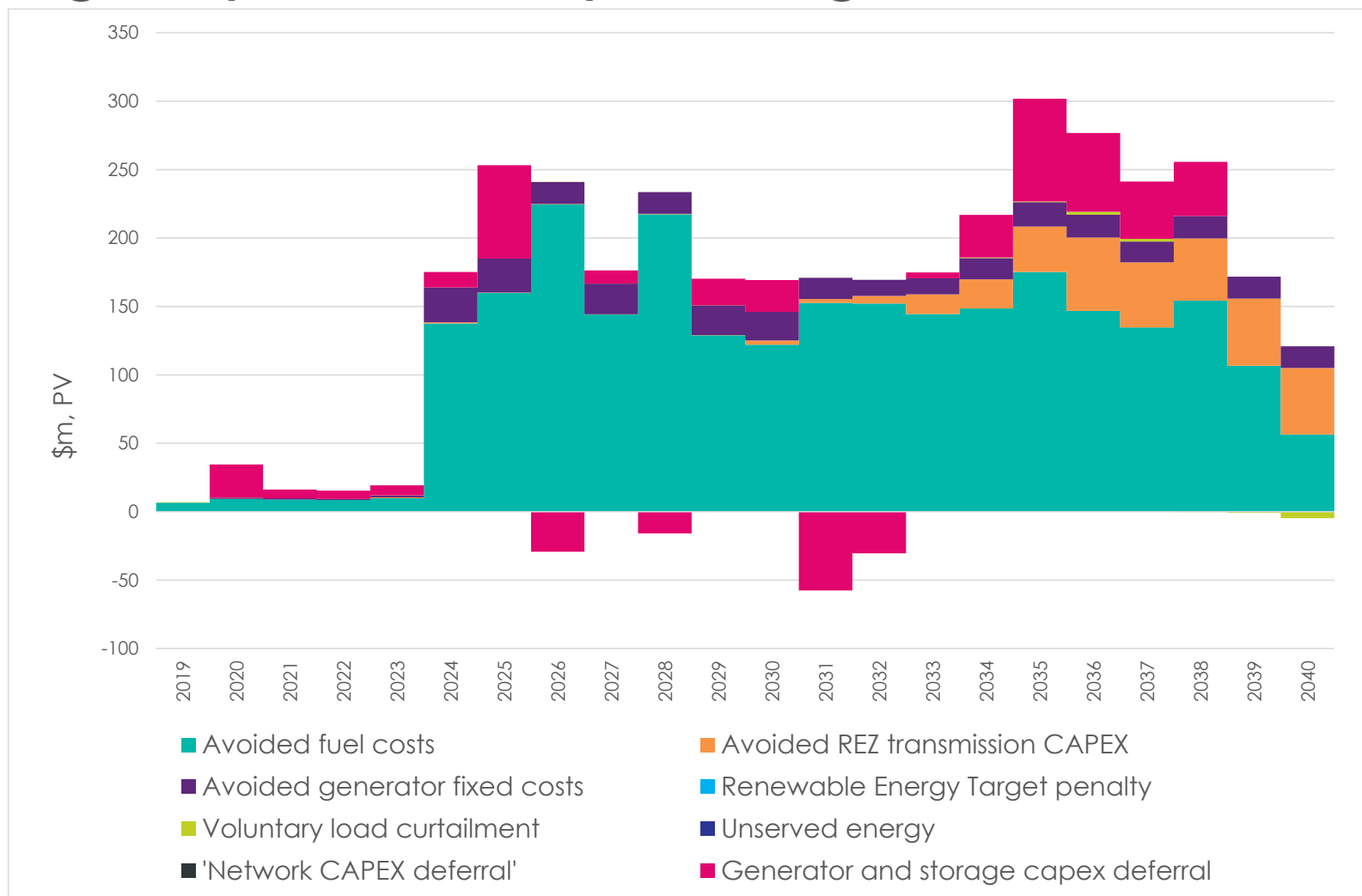
Low – preferred option – gross benefits











High scenario – gross market benefits



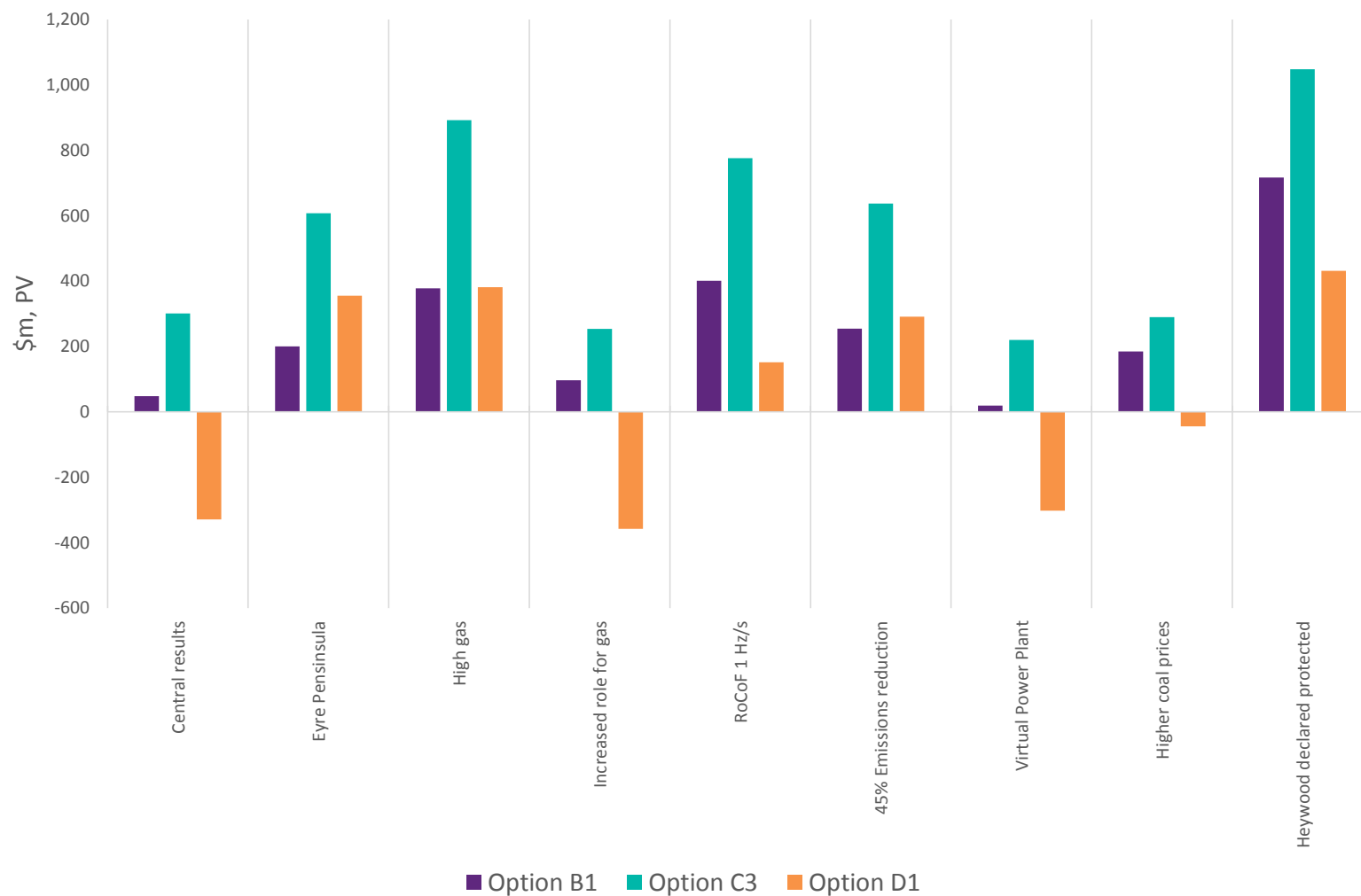
High – preferred option – gross benefits



Sensitivities

| Option | Description | Impact |
|---|--|--|
| Eyre Peninsula | Central demand with SA load increased by 345 MW mining load |  |
| High gas | High scenario gas price applied to the central scenario ~ \$11.87/Gj |  |
| Increased role for gas | Gas price of \$5.91/Gj applied to central scenario |  |
| RoCoF 1 Hz/s | Onerous RoCoF limit applied to the central scenario |  |
| 45% emission reduction | Onerous emissions reduction applied to central scenario |  |
| Virtual Power Plant | 450 MW virtual power plant assumed from 2020 in metro Adelaide |  |
| Coal prices | Cost of black coal across the eastern seaboard increased by 30 per cent. |  |
| Heywood Interconnector declared protected | Loss of Heywood interconnector declared a credible event. Heywood Interconnector limited to 250 MW in the base case. |  |

Sensitivities



What's next

- Alignment with ISP input assumptions
 - Wider gas spread will be retained
- ESOO update expected in late August
- Deep dive ~ mid August to inform submissions
 - Please indicate your desire to attend.
 - Nominate any issues you would like covered

Integrated System Plan

South Australia Energy Transformation Workshop

Craig Price

16 August 2018

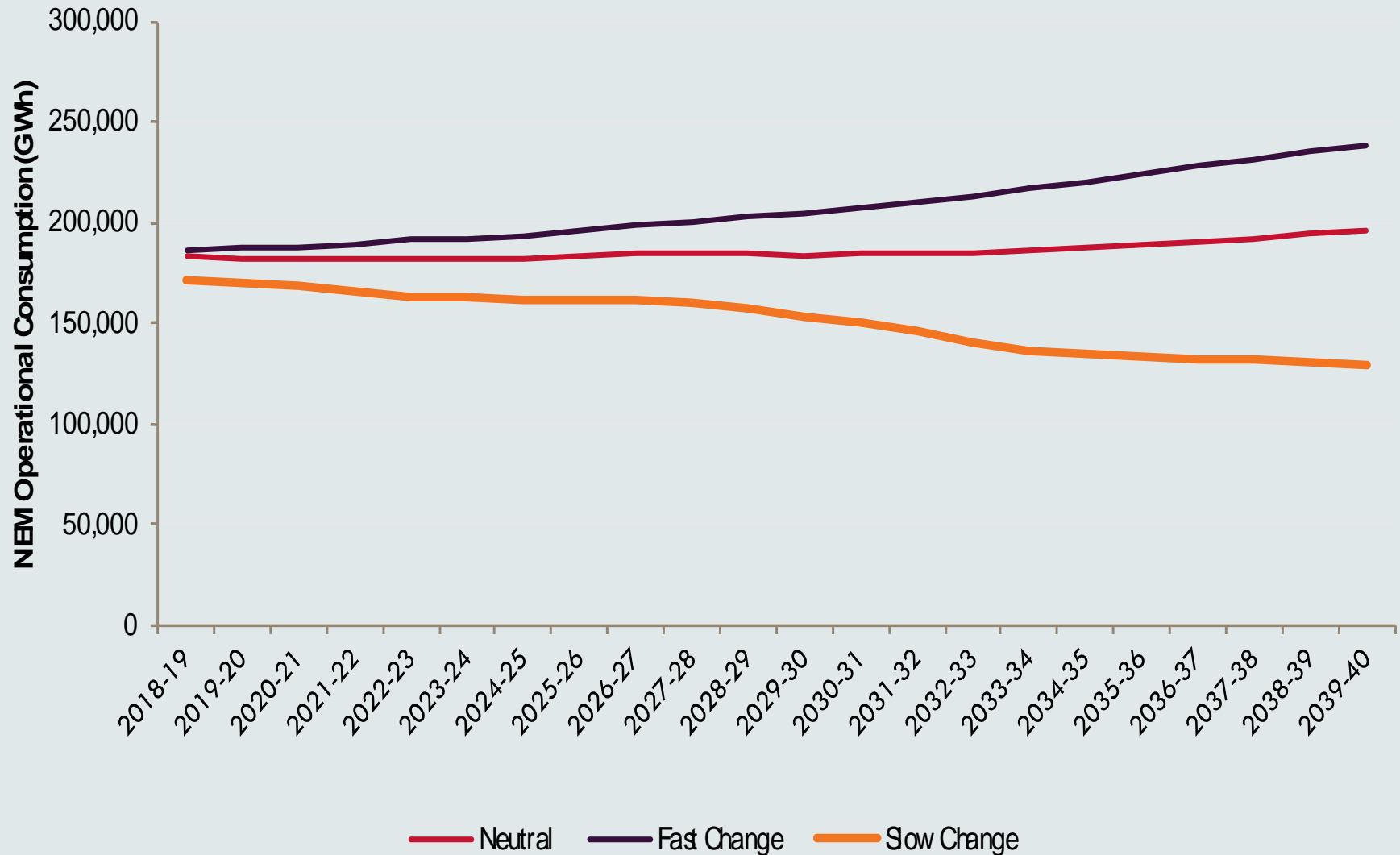
Agenda

1. Context
2. Key Observations
3. Energy Outlook
4. Renewable Energy Zones
5. Integrated development plan
6. Way forward

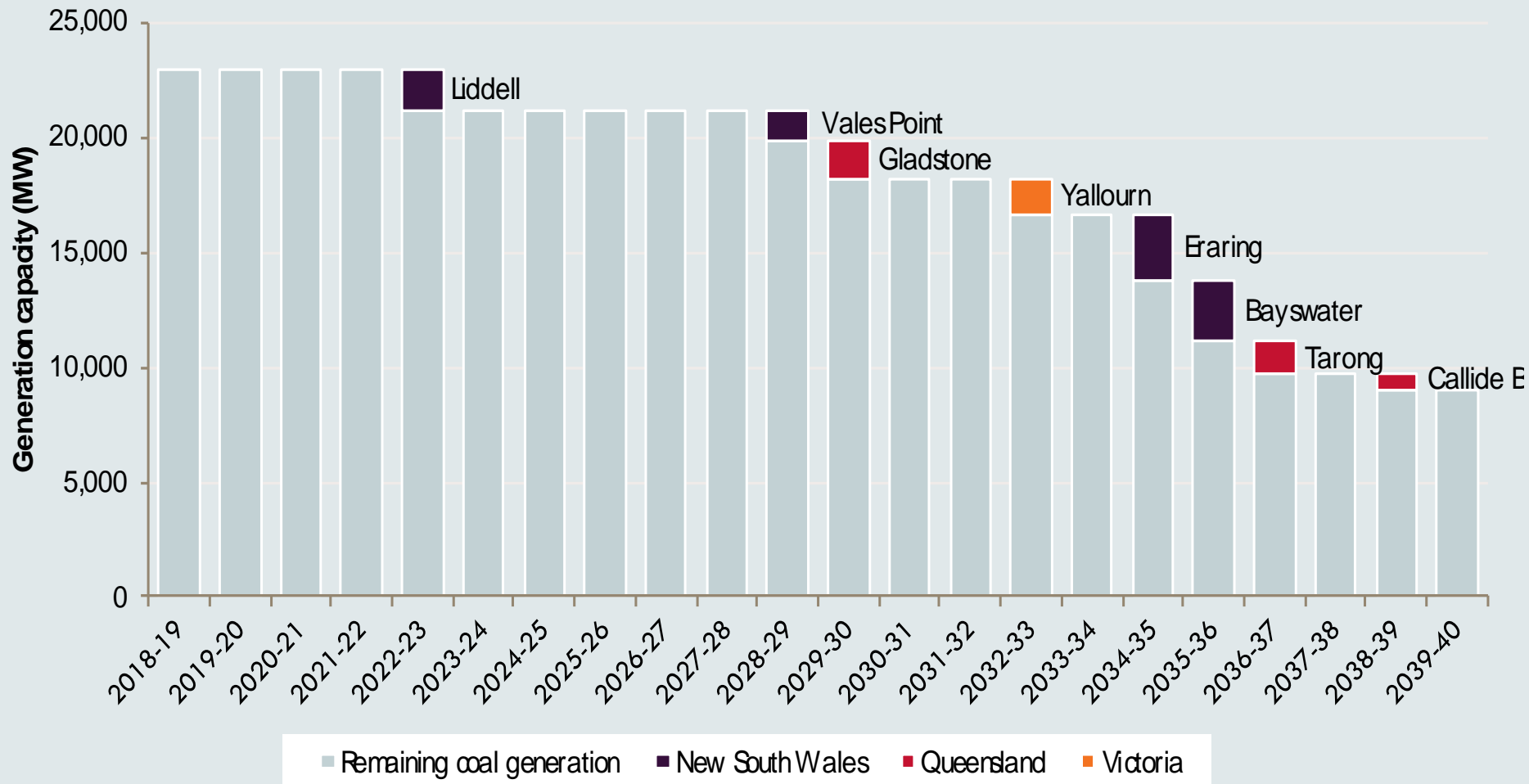
Context

- The National Electricity Law establishes AEMO as the national transmission planner, requiring AEMO to:
 - develop a National Transmission Network Development Plan
 - provide advice on the development of the grid or projects that could affect the grid;
 - provide a national strategic perspective for transmission planning and coordination;
- The Finkel review recommended AEMO develop and *Integrated Grid Plan* as part of *Better system planning*, one of the pillars to deliver the key outcomes.

Key Inputs – NEM Energy Consumption



Key Inputs – Coal fleet operating life



Energy mix and infrastructure transforming

A profound transition of the NEM will occur over the next two decades

Predominantly:

- ❑ Coal and gas resources
- ❑ Transmission system based on thermal generation

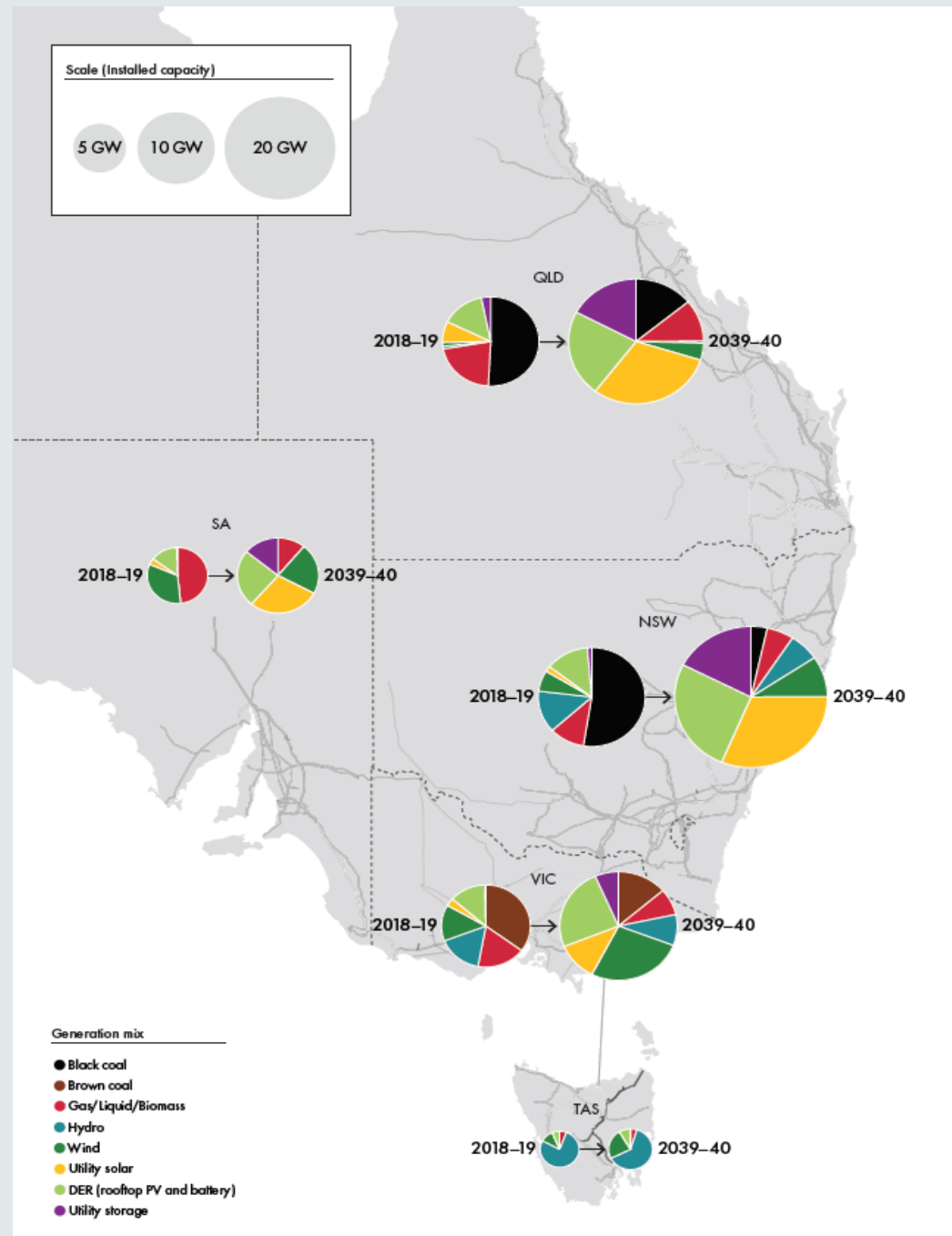


Portfolio of:

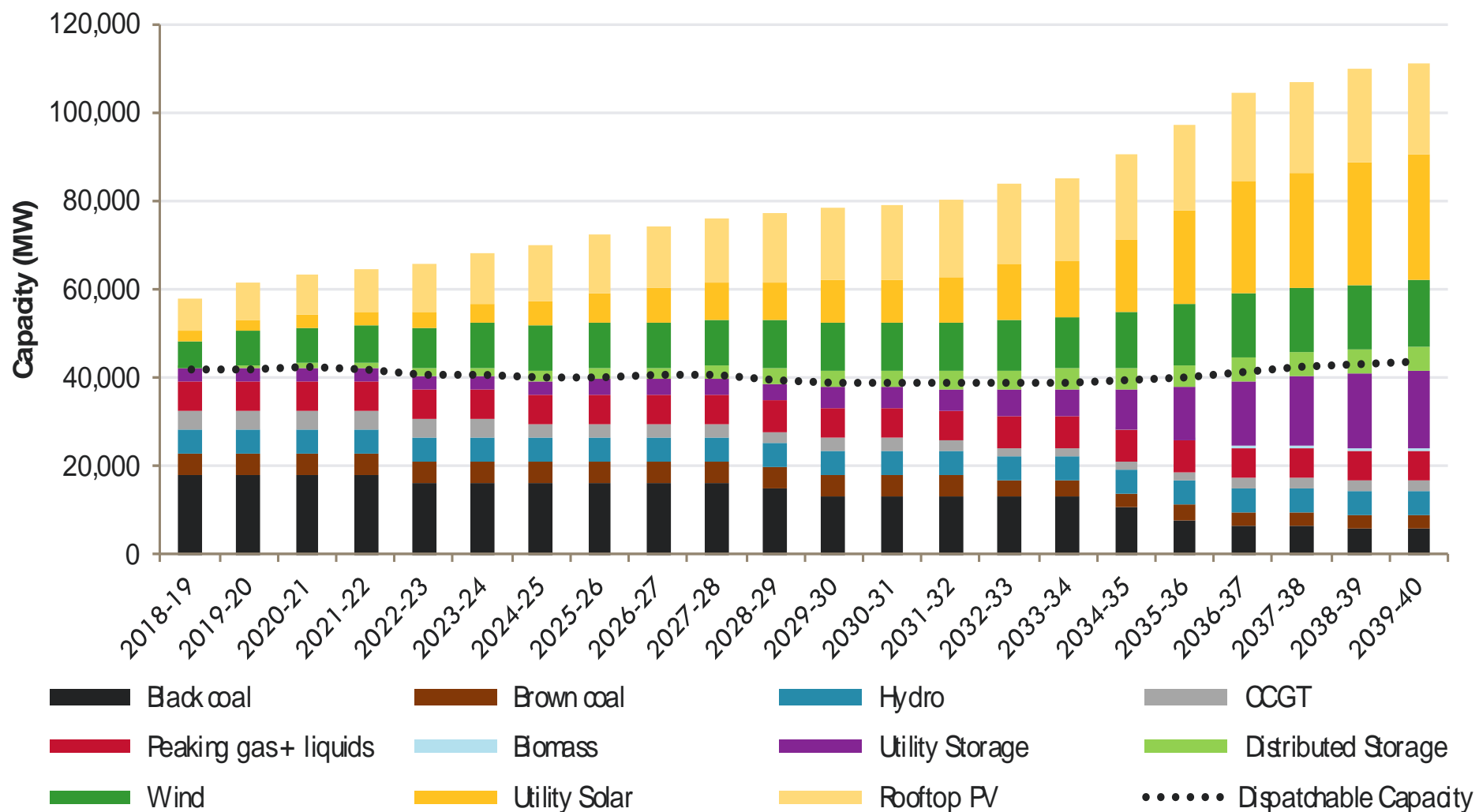
- ❑ technologically and geographically diverse renewables, supported by
 - ❑ flexible thermal plant
 - ❑ energy storage
 - ❑ transmission

Projected change in resource mix

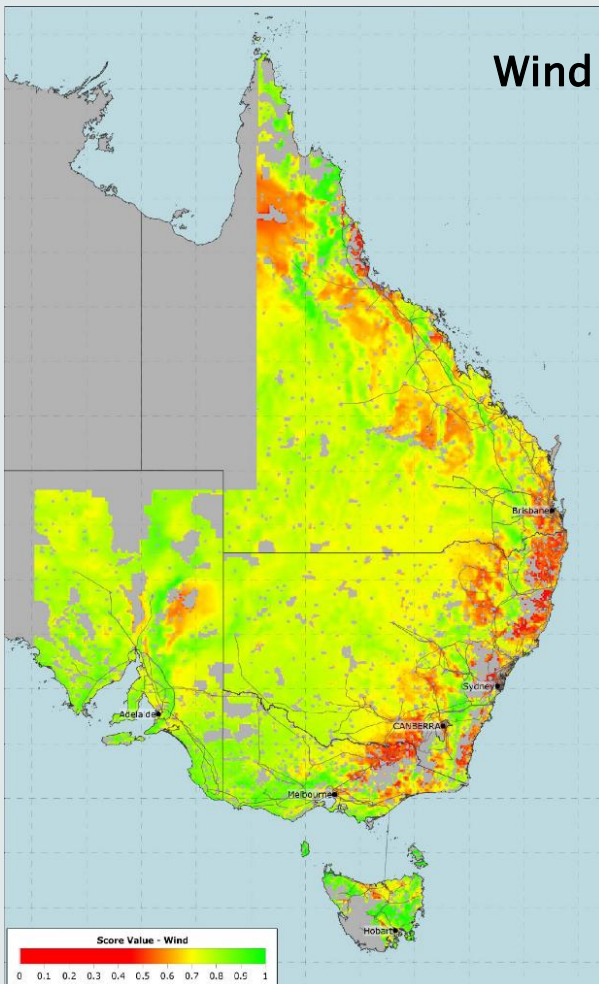
Installed capacity by NEM region over the 20-year plan horizon



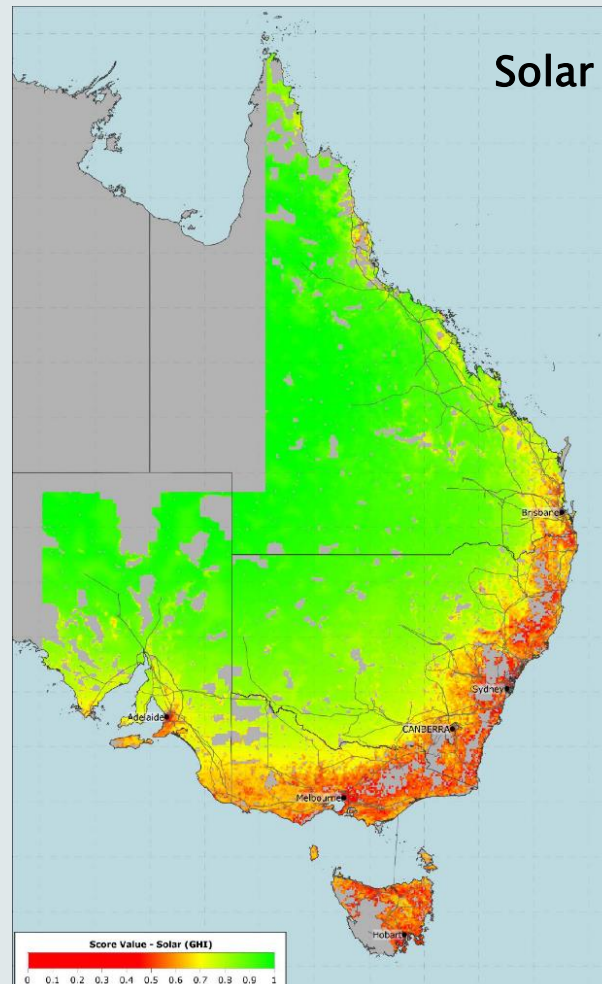
NEM Energy Outlook (Results)



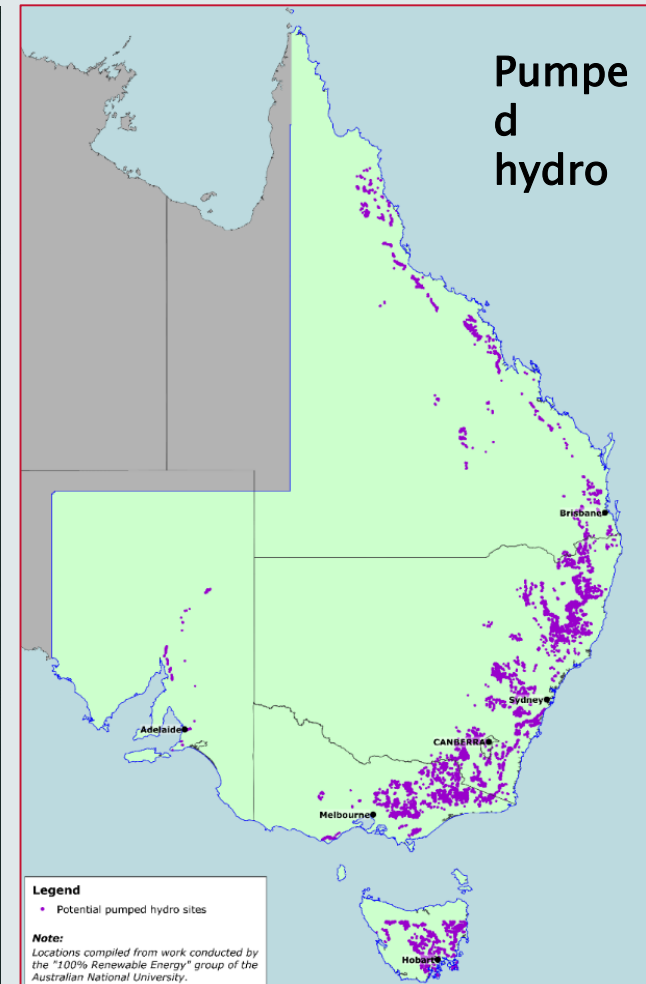
Renewable resource mapping



Source: DNV-GL

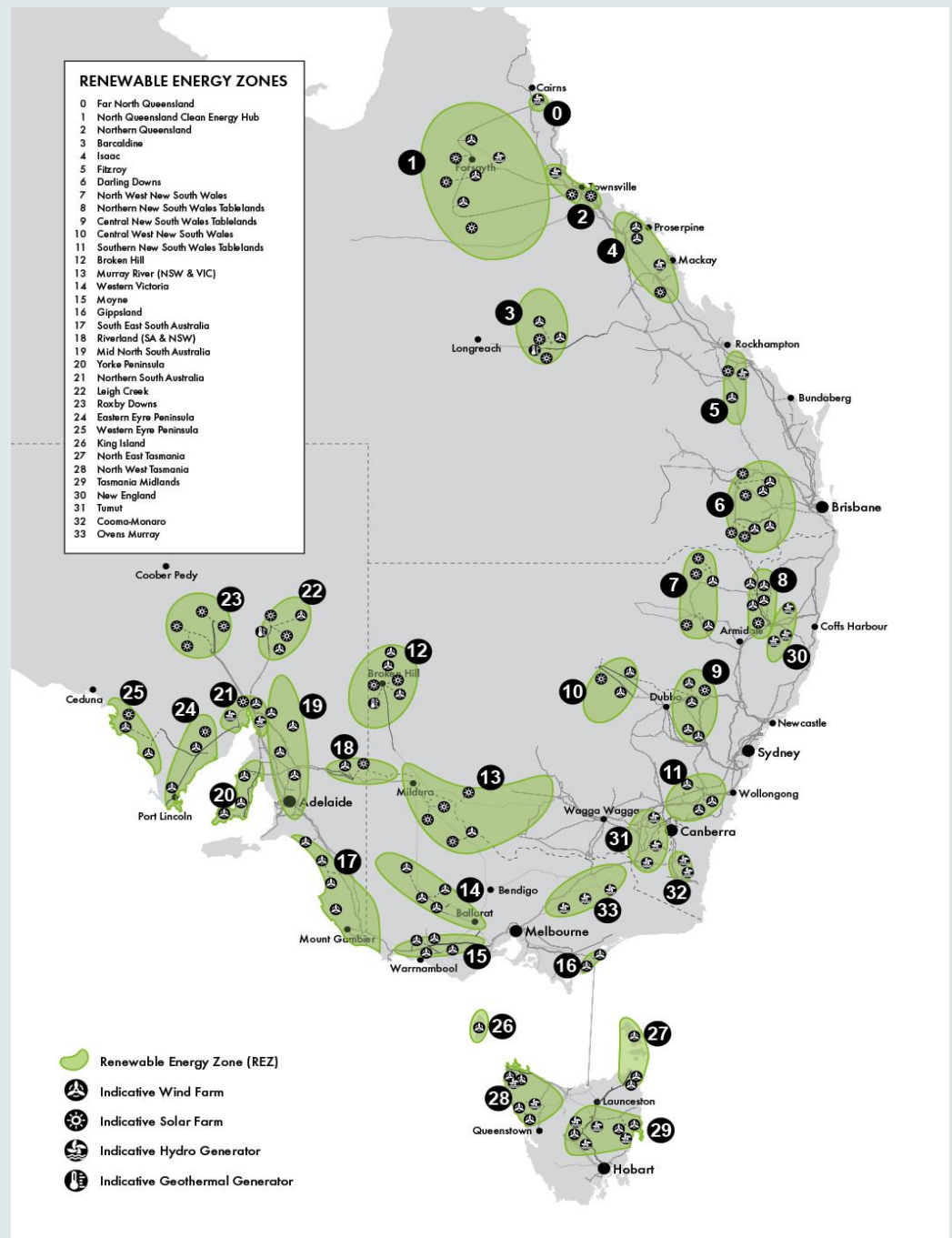


Source: DNV-GL



Source: ANU

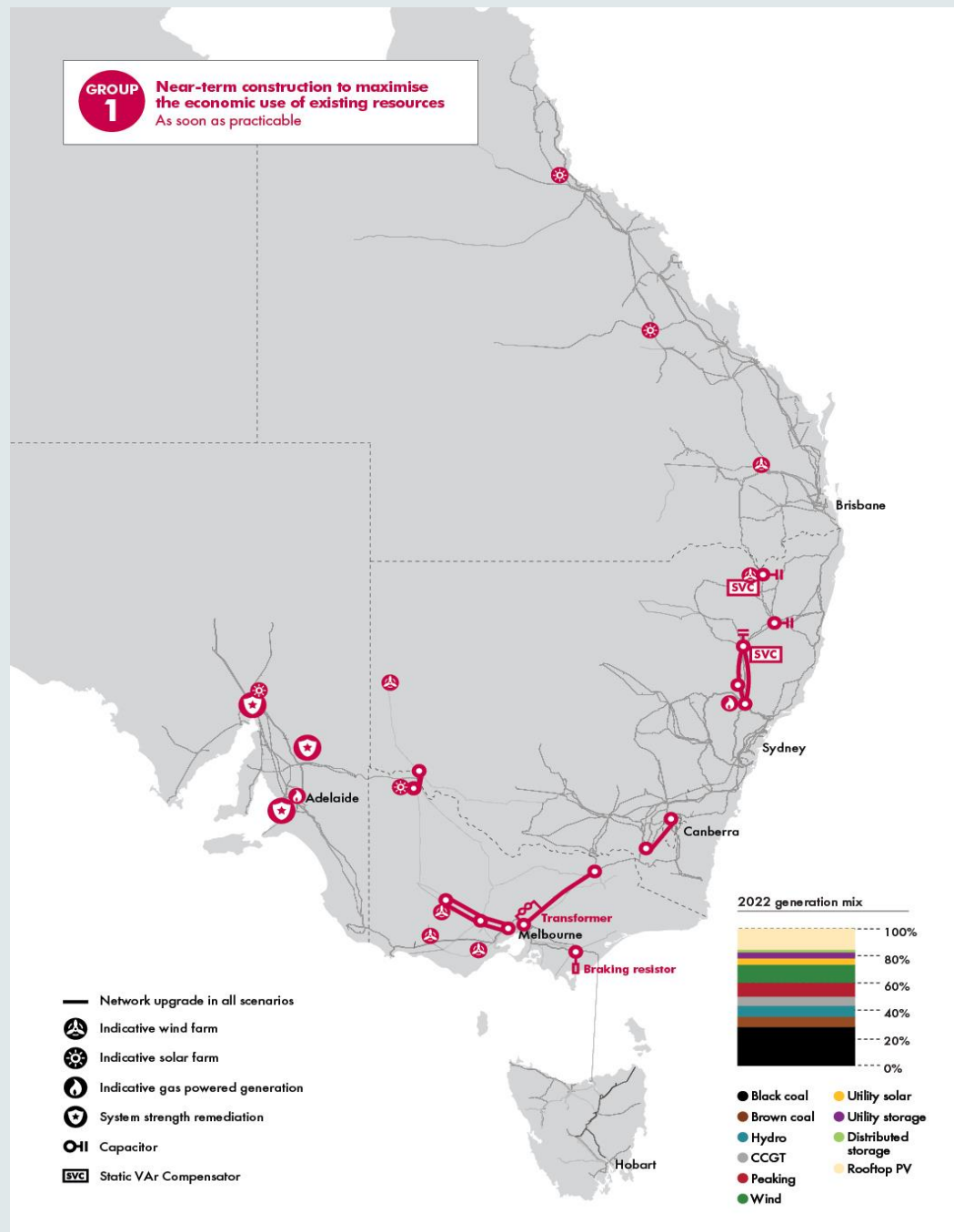
Renewable energy zones studied



Group 1

Near-term construction

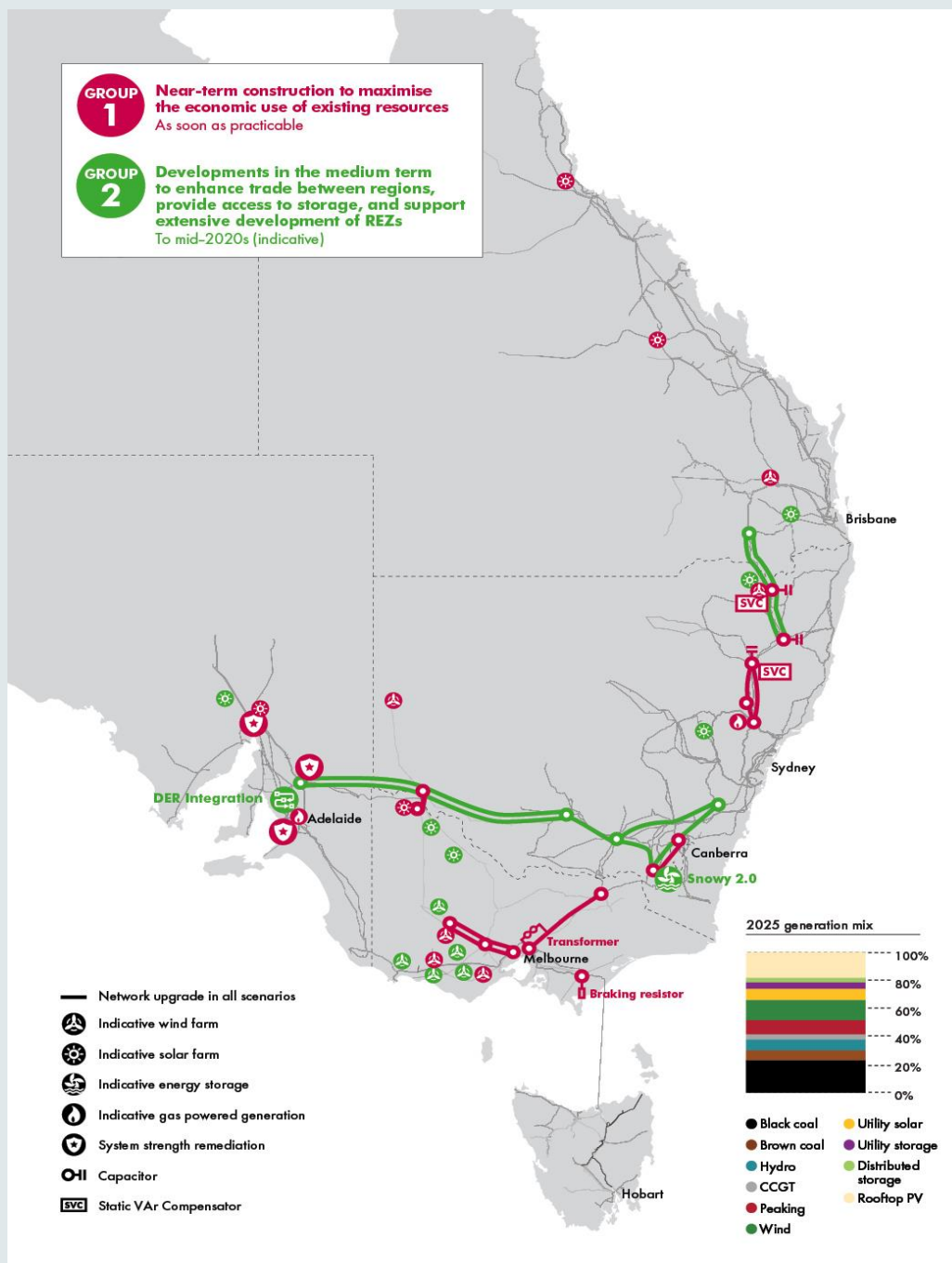
Maximise economic use of existing resources



Group 2

Developments in the medium term

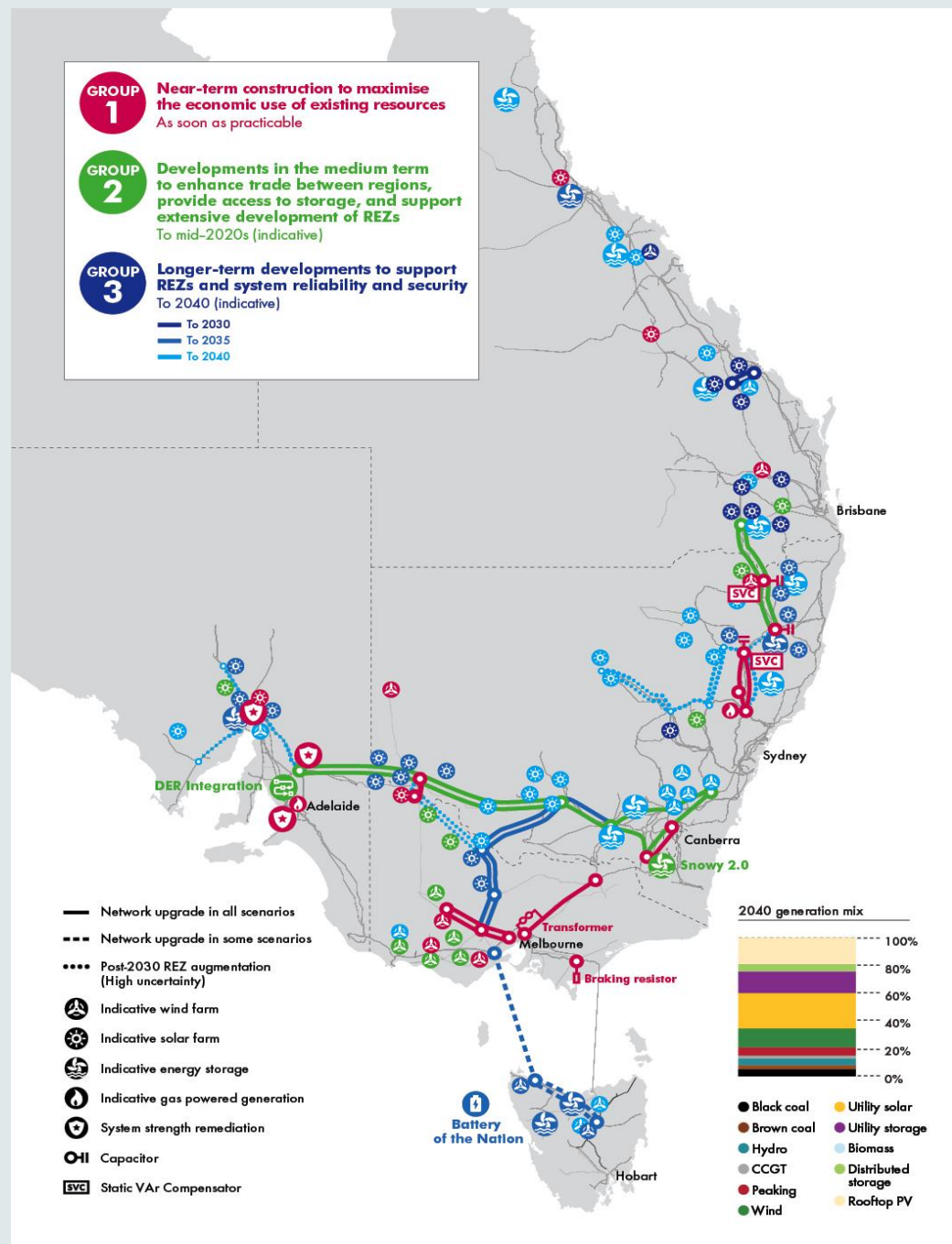
Enhance trade between regions, provide access to storage, and support extensive development of REZs



Group 3

Longer-term developments

Support REZs and system reliability and security



7 scenarios/sensitivities

Two base cases

- *Neutral, and Neutral with storage initiatives*

Three additional scenarios

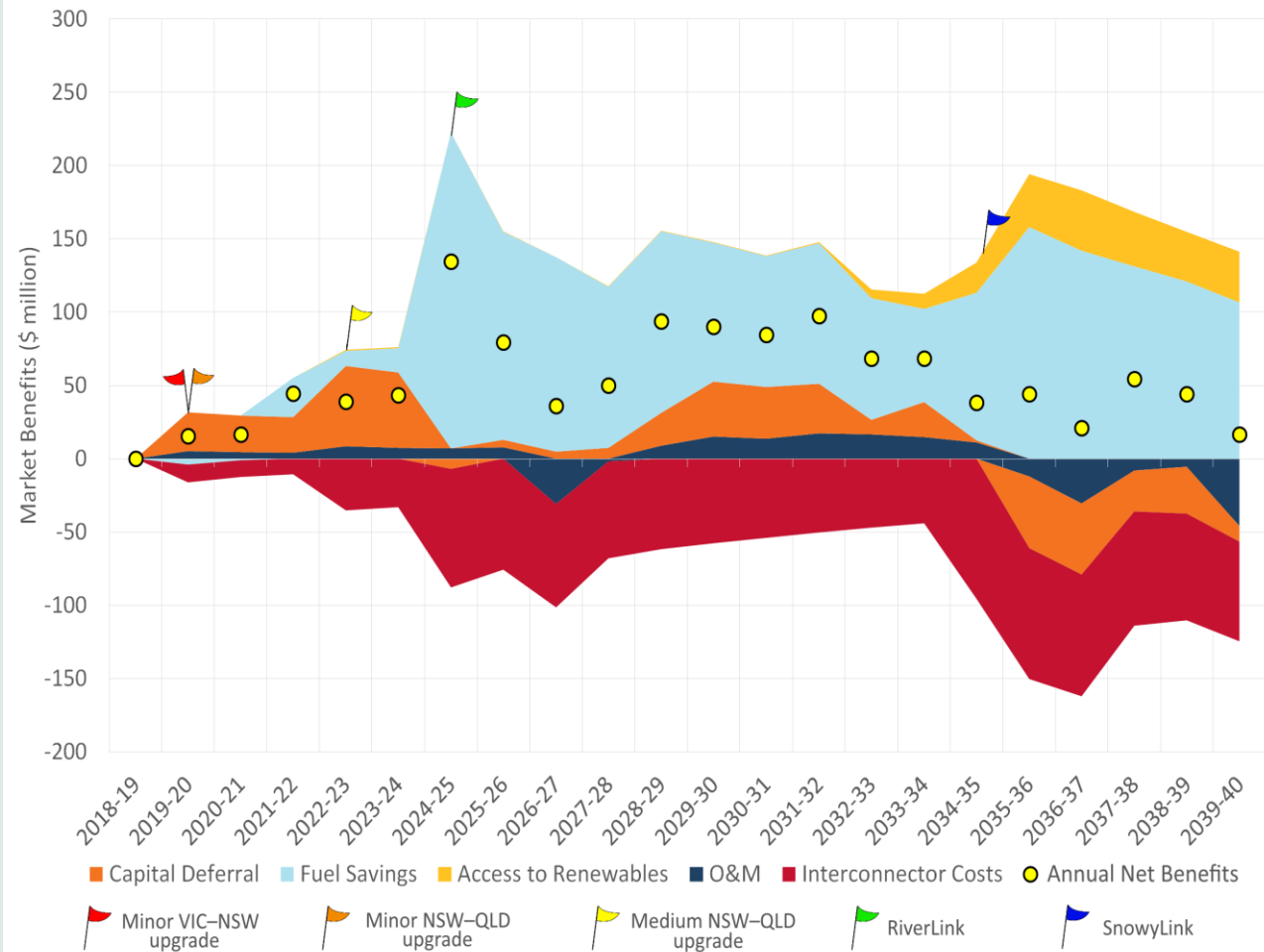
- *Slow change, Fast change, High distributed energy resources*

Two additional sensitivities to explore key opportunities and risks

- *Increased role for gas, and early exit of coal-fired generation*

Market benefits for base development plan

Net market benefits positive across entire planning period



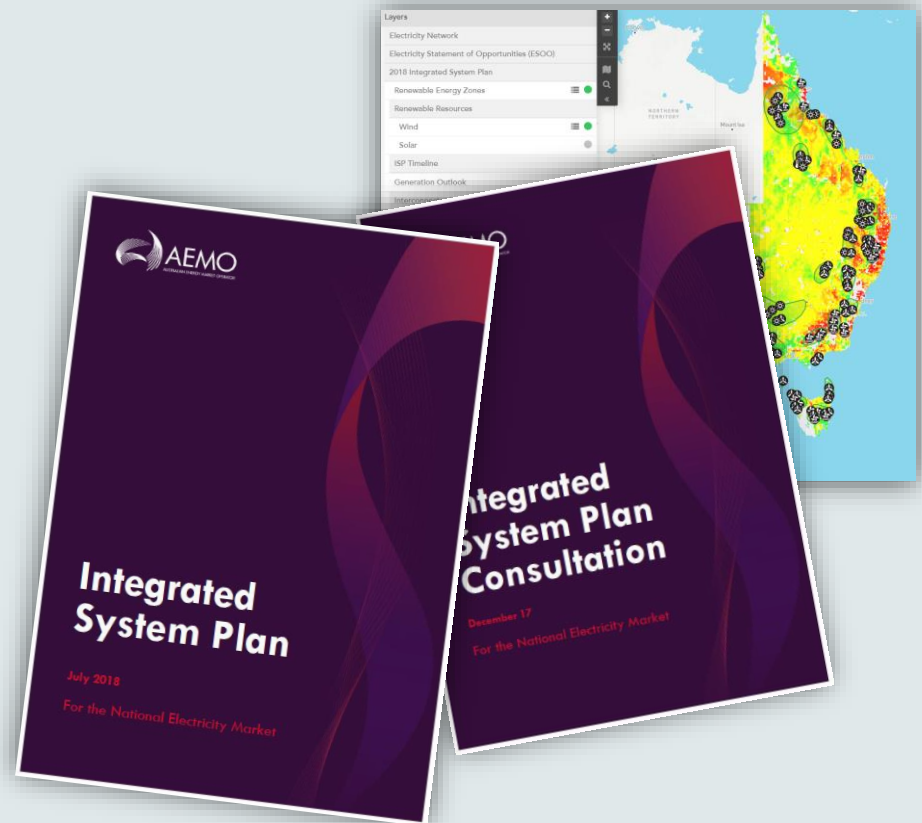
ISP and data available online

Previously published:

- Consultation Paper
- Consultation submissions & summary
- Assumptions workbook

Published July 2017:

- ISP report with Appendices
- ISP database – input data and results
- Interactive map



Way forward

Implementation

- TNSPs to commence RIT-Ts on strategic developments identified in group 1 and commence work on group 2 projects.

AEMO's next steps over next 6–12 months

- Manage next summer
- Collaborate with TNSPs on detailed design of Group 1, 2 and 3 proposals
- Enhance modelling capabilities further.
- Collaborate with ENA on *Open Energy Networks*.
- Collaborate with CSIRO and BOM on climate change modelling
- Continued engagement with industry on the ISP, and to develop future scenarios, key inputs, and consult on forecasts.
- Support reviews by market bodies

Market bodies' reviews

- AEMC – COGATI review
- AER – RIT-T application guidelines
- ESB – *Report to the December 2018 COAG meeting* on:
 - how the **Group 1 projects** identified in the ISP can be implemented and delivered as soon as practicable and with efficient outcomes for customers.
 - how the **Group 2 projects** will be reviewed and progressed
 - any modifications that may be needed to existing processes for these projects to be delivered to be identified and a way forward recommended.

Questions

Next steps

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