Integrated system plan

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Agenda

1. Approach
2. Context
3. Approach and inputs
4. Renewable Energy Zones
5. Integrated system plan
6. Creating an actionable ISP

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Energy mix and infrastructure are transforming

A profound transition of the NEM is underway:

FROM

A static world:

- Predictable demand growth
- Predominantly based on coal and gas resources
- A power system designed around bulk energy transport on main highways from major (synchronous) gen centres

TO

Rapidly changing world:

- Consumption flat, but demand peaks even more pronounced under extremes
- Supplies involve geographically dispersed, technologically diverse resources
- Requiring:
  - flexible dispatchable plant
  - energy storage
  - visibility and controllability of resources, including embedded
  - Efficient re-configuration of the transmission system to support

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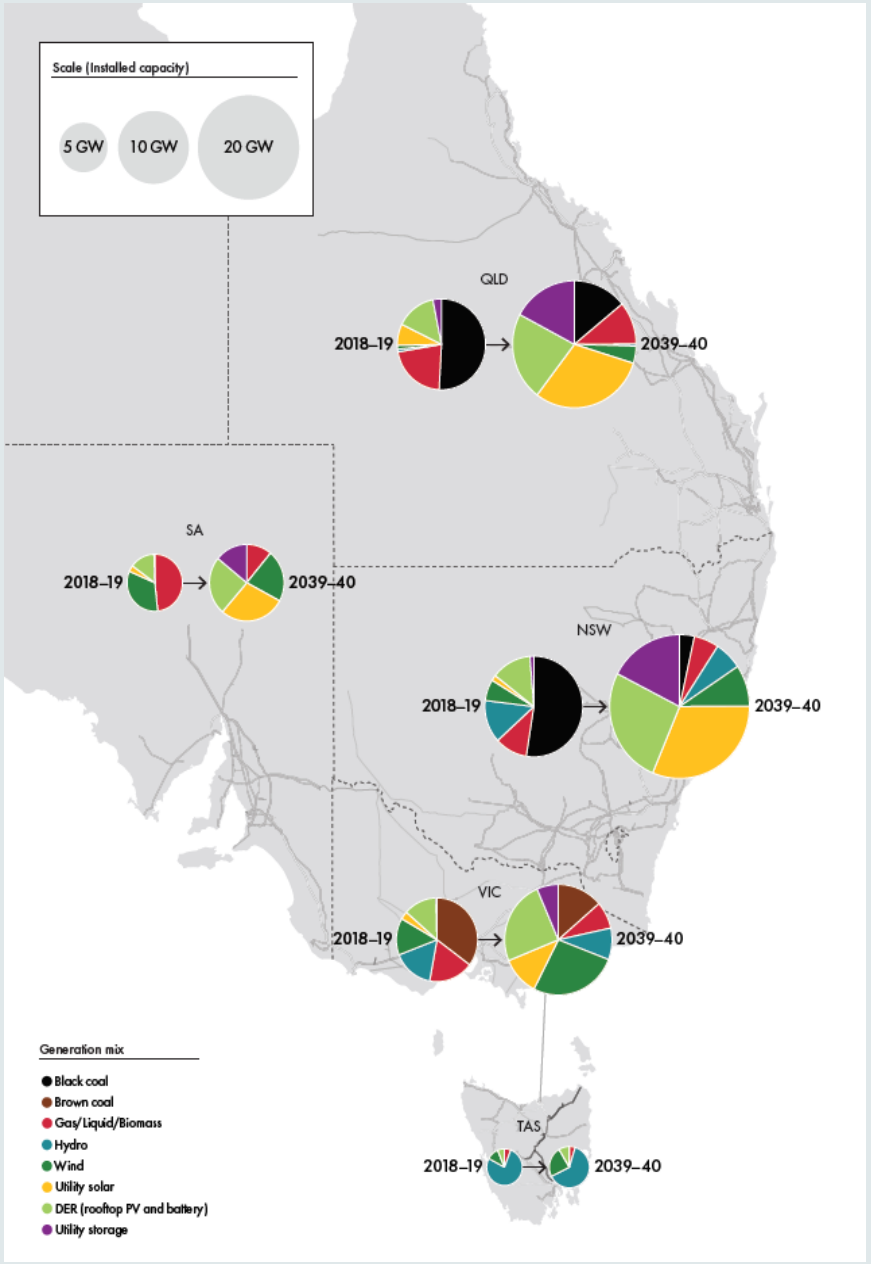
Why do we need system-wide planning?



- Changing supply mix means greater need to share reserves to
  - Manage variability
  - Access reliability and economic diversity benefits
  - Optimise assets
  - Increase resilience
- Changes role of transmission, and increases the value it provides
- Changes the balance of cost and benefits between local and system wide planning

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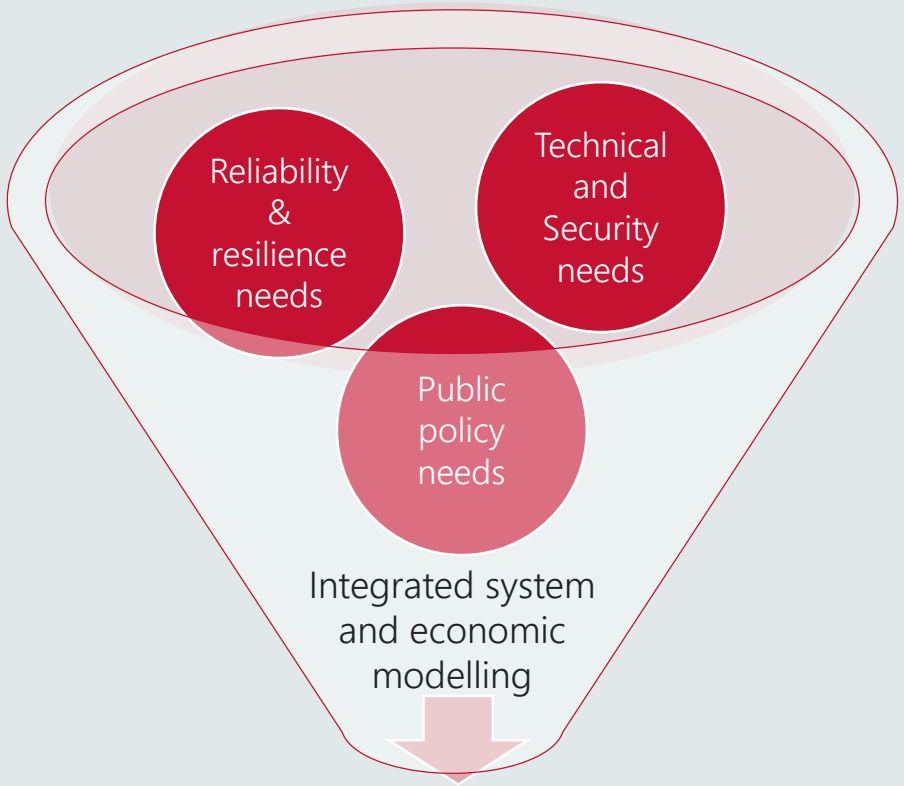
What is system-wide planning?



Integrated system plan

- *Relevant information is assimilated and optimised to form holistic plan using a systems approach across the NEM*
- Identify needs –
  - TNSPs - local technical and reliability/security needs
  - AEMO – power system reliability/security and resilience needs
  - Governments - regional policy needs
- Identify credible network & non-network options that address the need
  - AEMO determines range of options in collaboration and consultation with networks and wider industry
- Identify developments that efficiently meet identified needs
  - AEMO undertakes integrated power system and economic modelling
  - Systems approach that optimises overall outcomes
  - Identify the combinations of projects that result in secure, reliable and operable power system with greatest net market benefits

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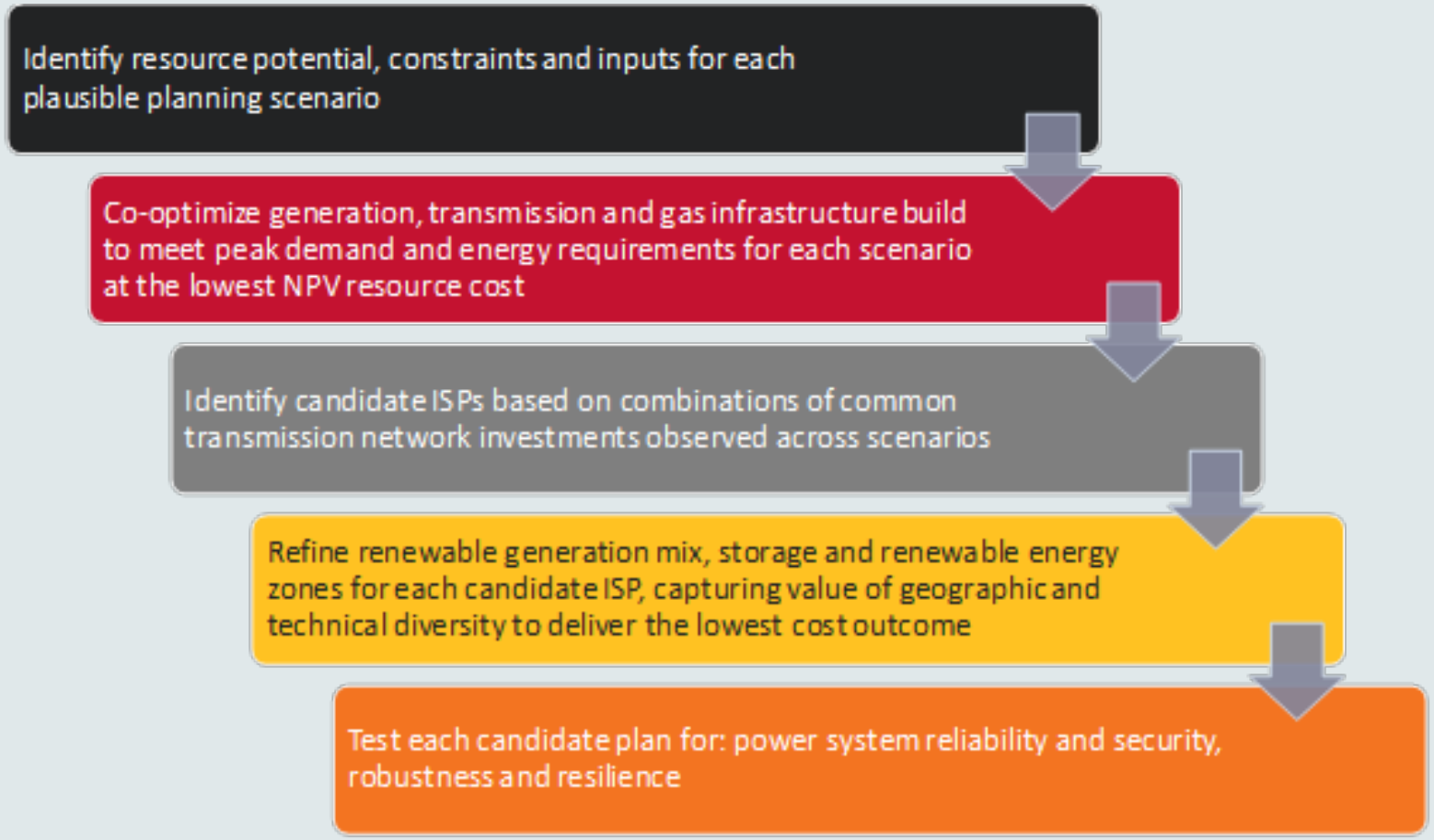
The systems approach to planning



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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 unplanned exit of coal-fired generation*

Key inputs

Resource Quality

- Wind resource data from DNV-GL

Benchmarked against existing projects to validate

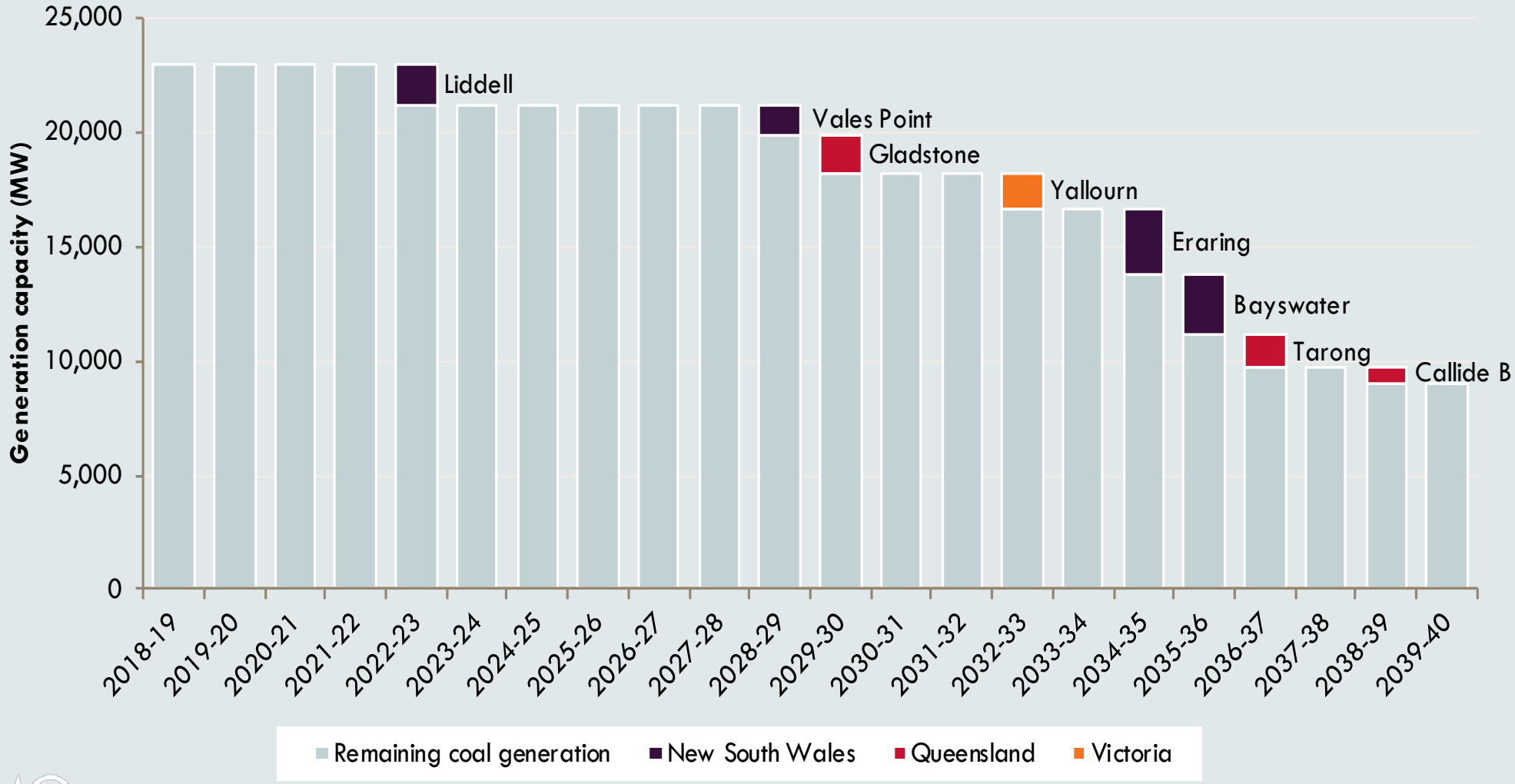
Technology

- Technology costs and forward projection of costs primarily from CSIRO – confirmed by AEMO work and stakeholder consultation
- Pumped storage costs from ANU study
- Gas prices from Core Energy adjusted in early years to market prices
- Coal prices from Wood McKenzie, adjusted to reflect recent trends

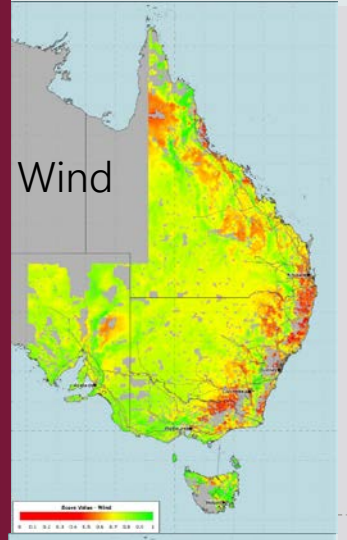
Price relativities appear consistent with observed behaviour and investor interest

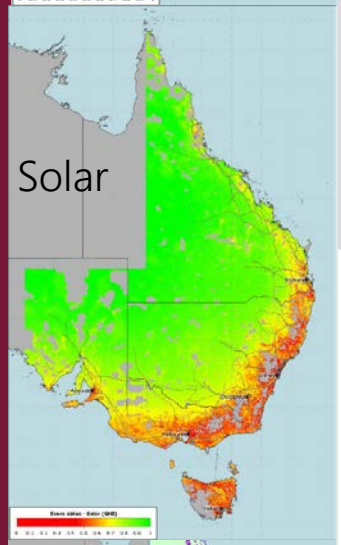
Key Inputs – NEM Energy Consumption

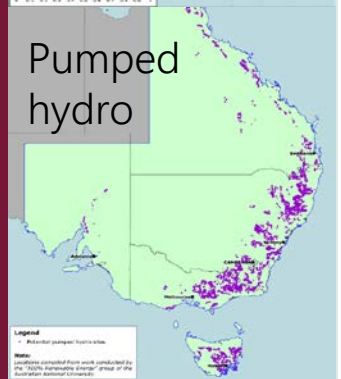
Key Inputs – Coal fleet operating life

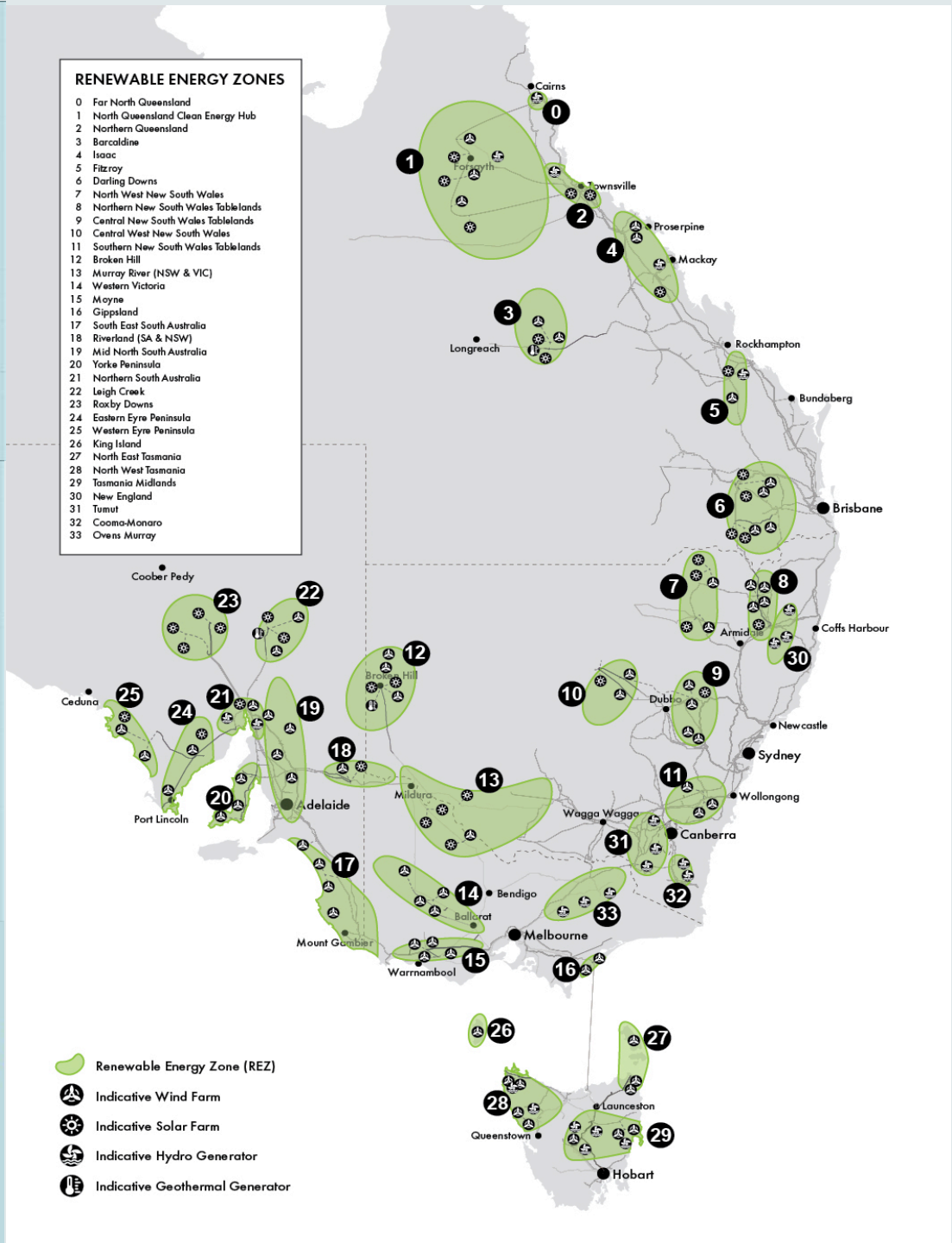


Renewable energy zones analysed









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Considerations

Benchmarking the attributes of potential REZ in the ISP

REZ Report Card Details

Priority Level

Based on ISP modelling, indicates areas where generator connections are most likely to proceed over the coming 10 years. A number of factors unknown to AEMO, such as local community support, may affect this priority.

1	2	3	Low
Immediate priority	High priority	Medium priority	Low priority

Renewable Resources

Map Legend

Indicative generation is shown based on connection interest in the REZ.

Wind	Solar	Hydro	Geothermal
			

Resource Quality

Solar Global Horizontal Irradiance (kw/m²) annual average, median value within REZ

≥ 2000	≥ 1900	≥ 1800	≥ 1700	< 1700
A	B	C	D	E

Wind Speed (m/s) at 150m from ground level modelled by DNV GL, 10% PoE within REZ.

≥ 8.4	≥ 7.2	≥ 6.6	≥ 6.0	< 6.0
A	B	C	D	E

Potential (MW)

Estimated potential REZ size (MW) based on the geographical size and resource quality in the REZ.

Diversity

Diversity describes whether the REZ resources are available at the same time as each of the other REZs or at different times, using a statistical correlation factor. A low correlation gives a better score.

≤ 0.1	≤ 0.2	≤ 0.3	≤ 0.4	≤ 0.5	> 0.5
A	B	C	D	E	F

The diversity of wind resources with other REZs is presented by state. Solar is not charted, because there is not much diversity between REZs.

Demand Matching

Demand matching describes whether the REZ resources are available at the same time as the regional demand, using a statistical correlation factor. A high correlation gives a better score.

≥ 0.30	≥ 0.15	≥ 0.0	≥ -0.15	≥ -0.30	< -0.30
A	B	C	D	E	F

Network Limitations

Spare Network Capacity

The MW value of additional generation that can be transported from the REZ to the required load centre.

Initial Loss Factor

The average value of the current MLF at connection points inside the REZ.

≥ 1.00	≥ 0.95	≥ 0.90	≥ 0.85	≥ 0.80	< 0.80
A	B	C	D	E	F

Loss Factor Robustness

The sensitivity of MLF to additional generation inside the REZ. The measure used is the additional generation (MW) that can be added before the MLF changes by -0.05.

≥ 1000	≥ 750	≥ 500	≥ 250	< 250	None
A	B	C	D	E	F

Long-Term Market Simulation Scenarios

Generation Built (MW)

The maximum generation that is built throughout the 25-year market simulation period. If the generation built exceeds the existing network capacity, then the study has found benefit in augmenting the transmission network to the REZ.

Timing

The year in which the generation built in the REZ exceeds the existing network capacity.

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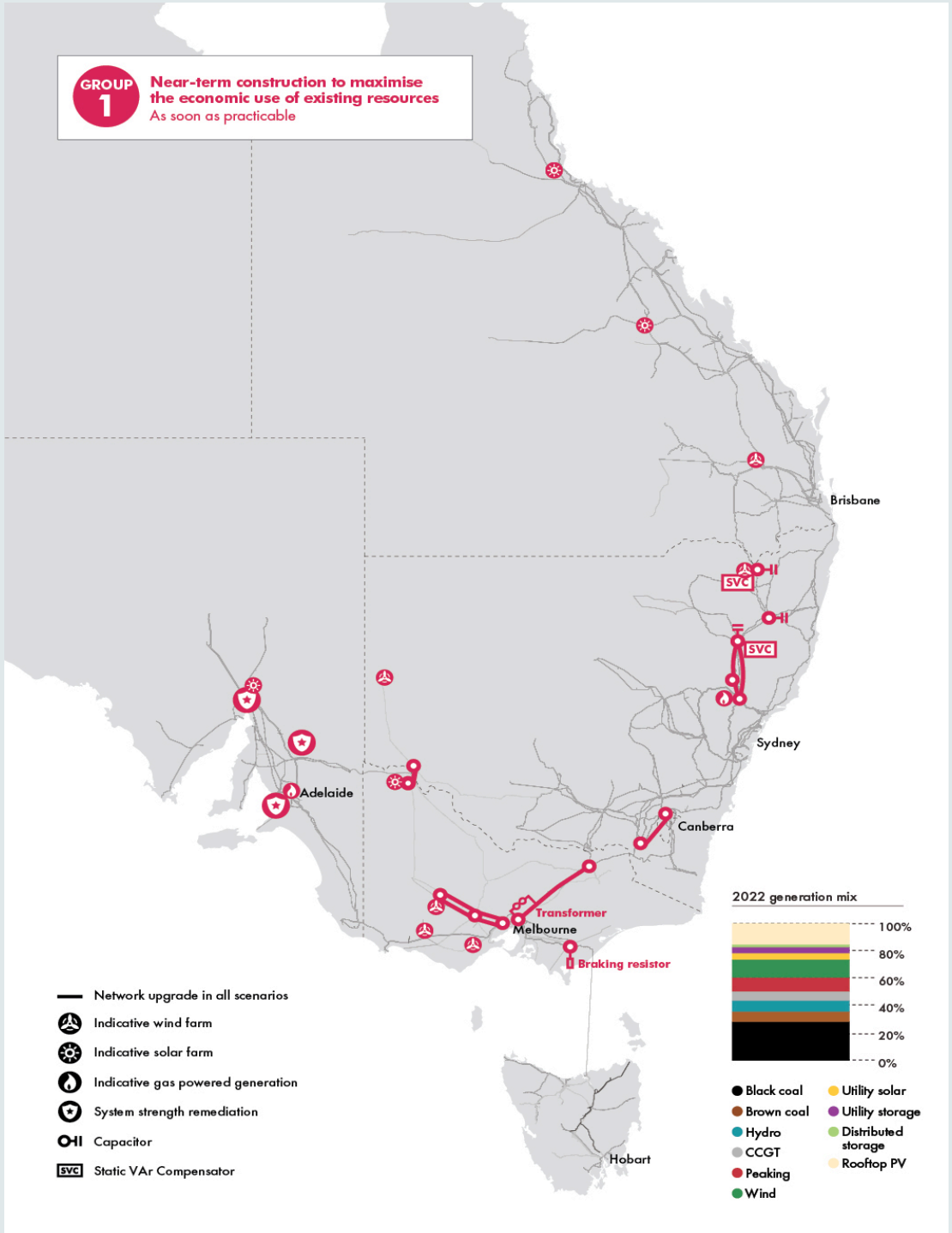
Wider considerations for REZ development – the need for integrated planning on a systems basis

- The objective of the ISP is to identify the development of the power grid which over time achieves reliability, security and sustainability obligations at the lowest resource cost:
  - “Integration” is shown to be key, delivering multiple value streams from major infrastructure
  - Finkel recommendation for orderly transition is also key to ensure we maintain reliability, resilience and operability of the power system through the transition
  - More sophisticated than just the coordination of generation projects
- While the potential benefits are clear, regulatory framework to implement is not.
- Raises all the issues of the COGATI review on access to market, coordination of transmission and generation (storage) investment and who pays for infrastructure

Group 1

Near-term construction

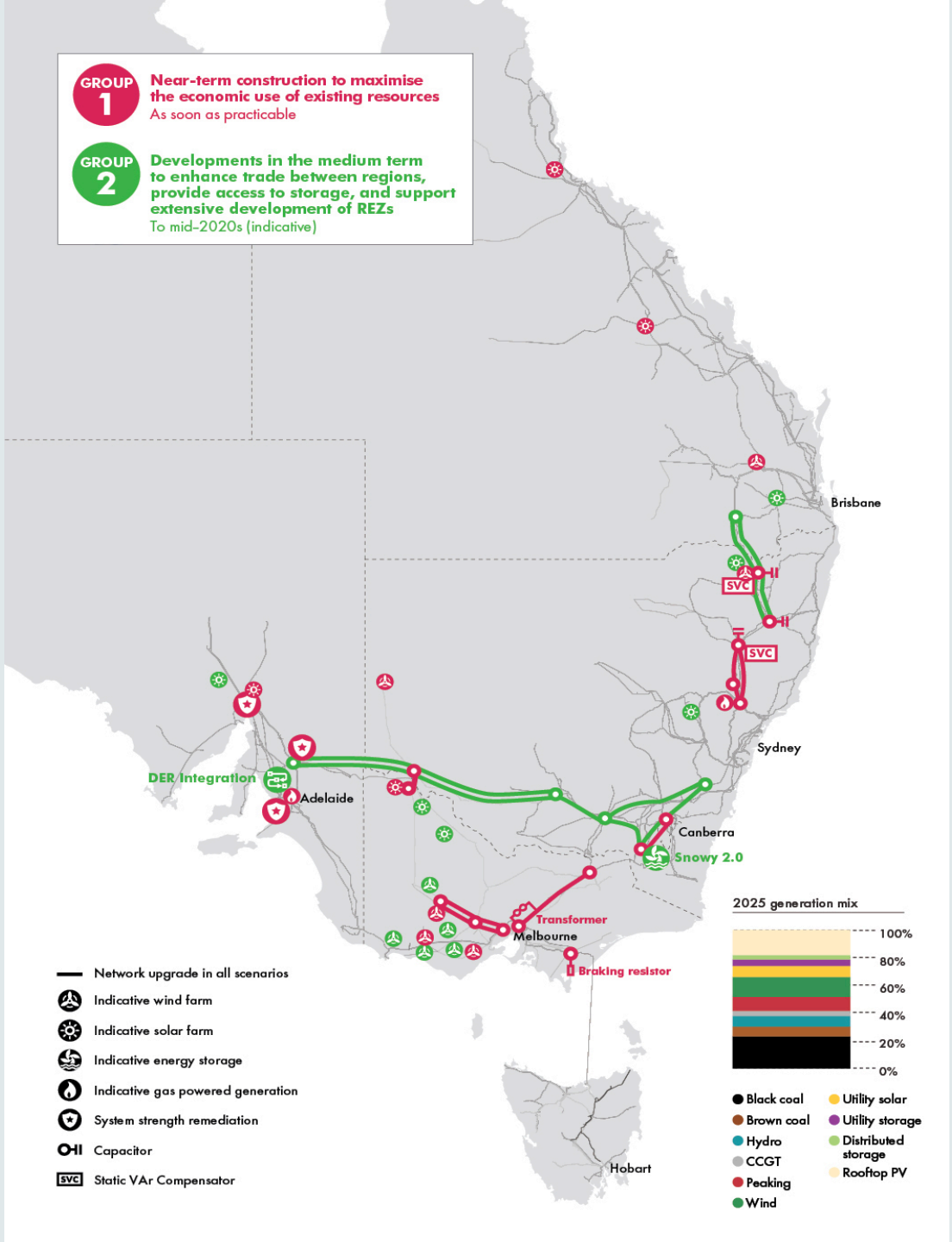
Maximise economic use of existing resources



Group 2

Developments in the medium term

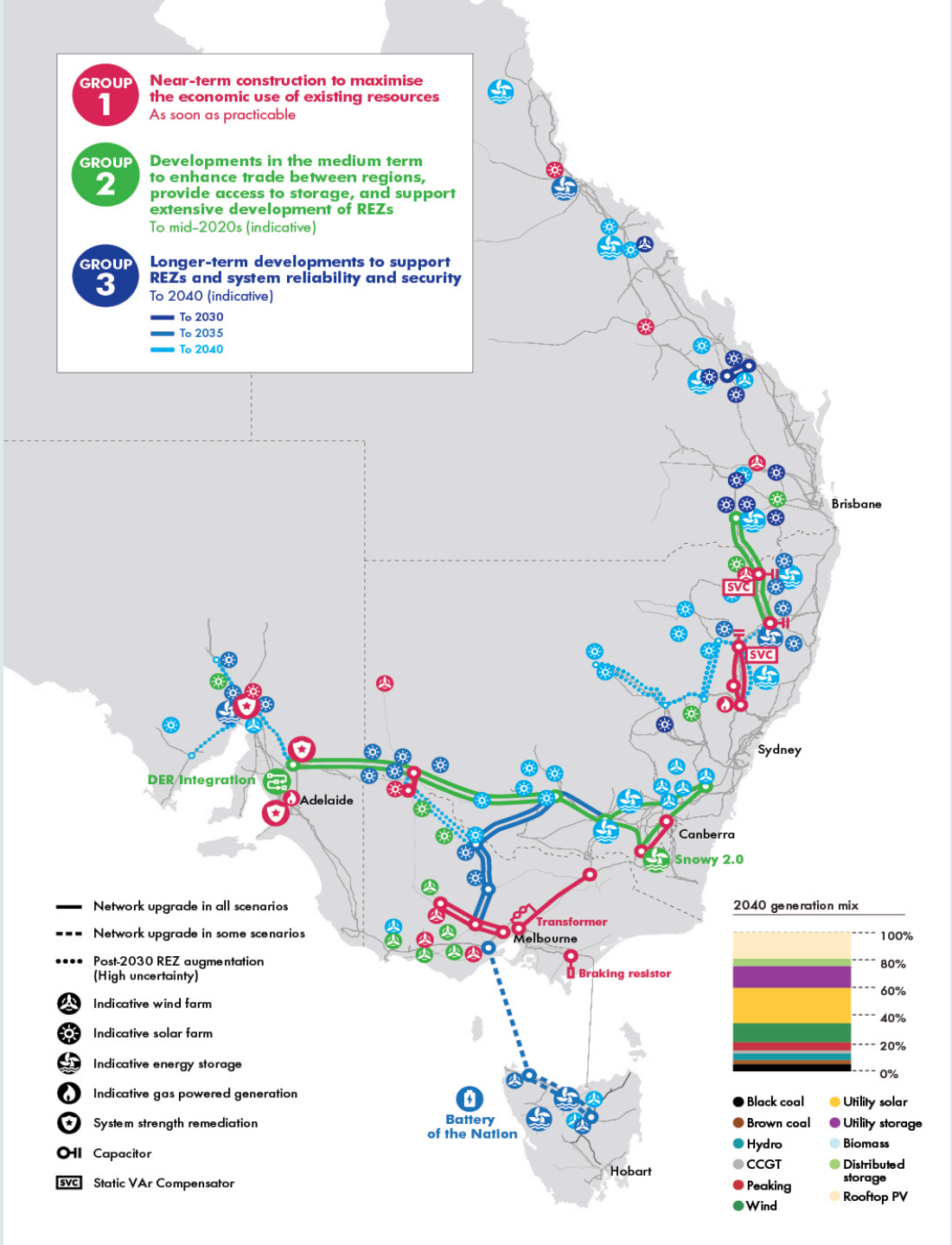
Enhance trade between regions, provide access to storage, and support extensive development of REZs



Group 3

Longer-term developments

Support REZs and system reliability and security



Economic assessments

The ISP base plan delivers value in all scenarios

Net market benefits for plan ($ million NPV)

Scenario	Net benefits ($ million)
Base cases	
Neutral	$1,192
Neutral with storage initiatives	$1,249
Scenarios	
Slow Change	$1,777
Fast Change	$1,499
High DER	$1,985
Sensitivity	
Increased role for gas	$544

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Risks - unexpected early coal station closure

Risk	ISP alternatives	Projected Unserved energy				
		NSW	QLD	SA	TAS	VIC
New South Wales coal power station closure	Base Plan	Medium	Very Low	Very Low	Very Low	Very Low
	Base Plan with SnowyLink	Low	Very Low	Very Low	Very Low	Very Low
	Base Plan with Snowy 2.0 and SnowyLink	Very Low	Very Low	Very Low	Very Low	Very Low
Victorian coal power station closure	Base Plan	Very Low	Very Low	High	Very Low	High
	Base Plan with SnowyLink	Very Low	Very Low	Medium	Very Low	Medium
	Base Plan with Snowy 2.0 and SnowyLink	Very Low	Very Low	Very Low	Very Low	Very Low

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Overall framework for future ISPs

- Currently, the ESB and industry are considering the framework under which ISP's would be made "actionable"
- AEMO supports the development of a new regulatory framework to deliver an actionable ISP
- There is not an appropriate Regulatory framework for the robust development, approval and implementation of such a Plan.
- AEMO is keen to work with others to co-create such a framework.
- Framework could be broadly built on a hybrid of options in the AEMC's COGATI Options paper - submissions close on 19 October ***

Status of Group 1 projects

The 2018 ISP identified a range of modest upgrades (Group 1) which warrant immediate action – demonstrated through robust analysis and with wide consultation.

Delaying the Group 1 projects until the wider framework review is resolved would forego significant benefits.

- **Western Victoria Renewable Integration** – regulatory process underway
- **Queensland to New South Wales upgrade** – engineering work underway, regulatory process yet to commence
- **Victoria to New South Wales upgrade** – assessments underway. Regulatory process about to commence.
- **South Australia System Strength** – To improve system strength in South Australia, removing the need for market intervention and supporting renewable energy development. Project is being implemented using transitional Rules arrangements relating to system strength.

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Need to fast track Group 1 projects