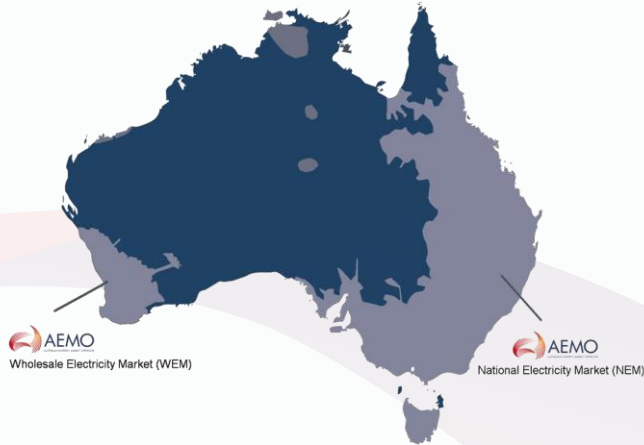


Integrated System Plan

Elijah Pack – Manager National Planning (AEMO)

June 2019

About AEMO



We operate Australia's National Electricity Market and power grid in Australia's eastern and south-eastern seaboard, and the Wholesale Electricity Market and power grid in south-west WA.



Both markets supply more than 220 terawatt hours of electricity each year.



We also operate retail and wholesale gas markets across south-eastern Australia and Victoria's gas pipeline grid. We also plan the future system and oversee grid connections.



Collectively traded more than A\$20 billion in the 2017/18 Financial Year.



Ownership

40%

Market participants

60%

Governments of Australia

The transition will continue to accelerate and expand

**6.5 solar panels
are being installed
every minute in
Australia**



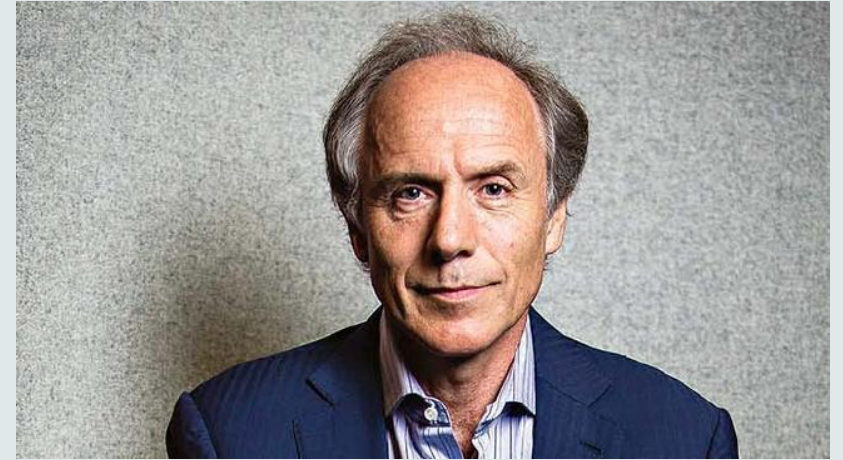
In **2013** there were
22 active projects totaling
1,231 megawatts

In **2018** there were over **136 connection
requests** totaling **19,507 megawatts**

- Connected **3 gigawatts (GW)** of new large-scale renewable energy project last year alone
- Added **1.4 GW of distributed solar** last year, taking the total installed base of rooftop PV systems to just below **8 GW across over 2 million systems** (Source: AEC Solar Report Jan 2019)
- **Virtual power plants** are already in trials in various states
- Completed nearly **50 GPS agreements** with a combined 4.2 GW in January alone ahead of the 1 Feb end of the transition period
- Working with projects representing **18 GW of capacity** during the advanced stages of the connection process
- Supporting projects representing **a further 78 GW** during the pre-feasibility and enquiry stage

The Finkel Review

- Independent Review into the Future Security of the National Electricity Market
- 49 out of 50 recommendations accepted by COAG



Recommendation 5.1:



By mid-2018, the Australian Energy Market Operator, supported by transmission network service providers and relevant stakeholders, should develop an integrated grid plan to facilitate the efficient development and connection of renewable energy zones across the National Electricity Market.

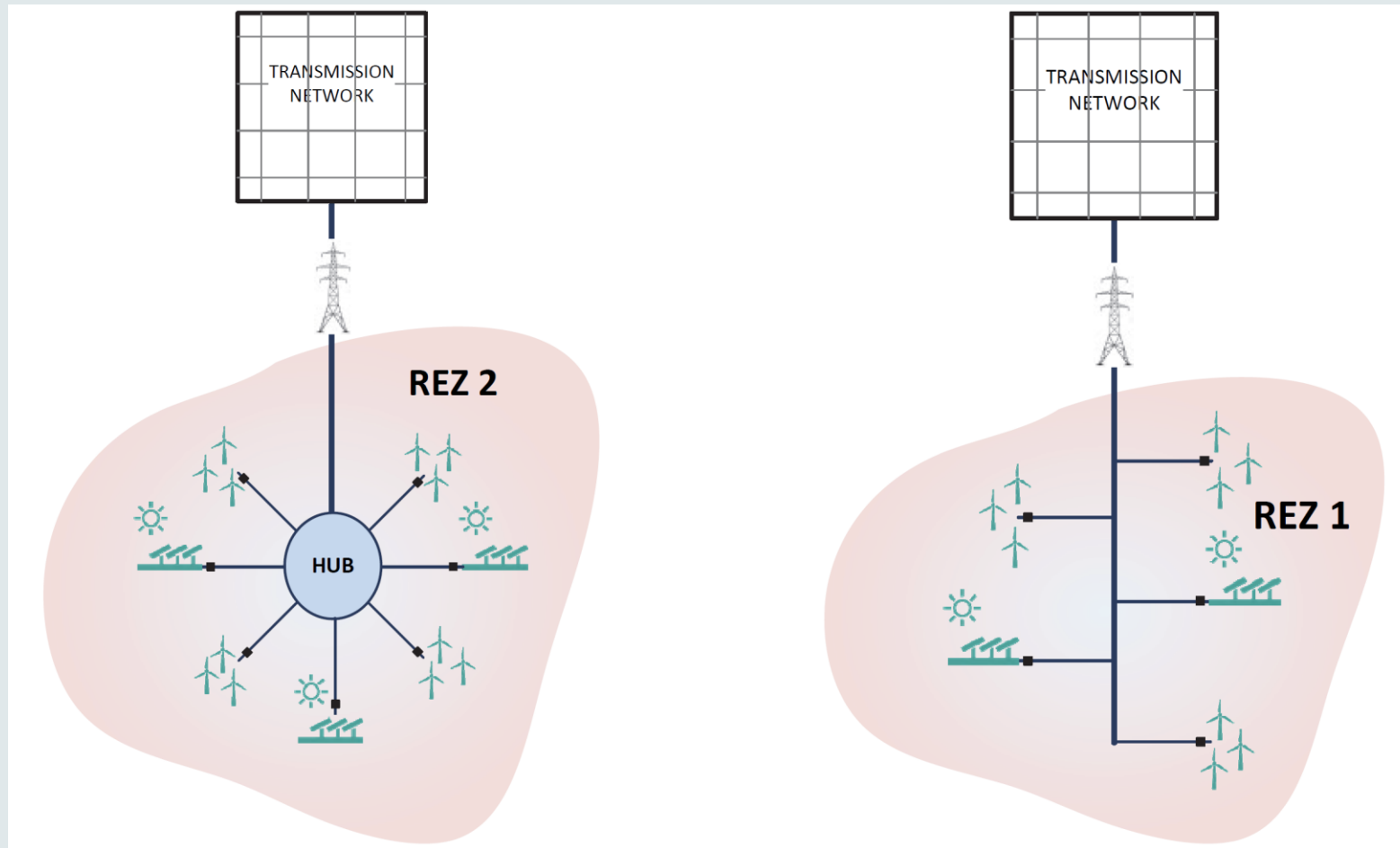
Renewable Energy Zones – “REZs”



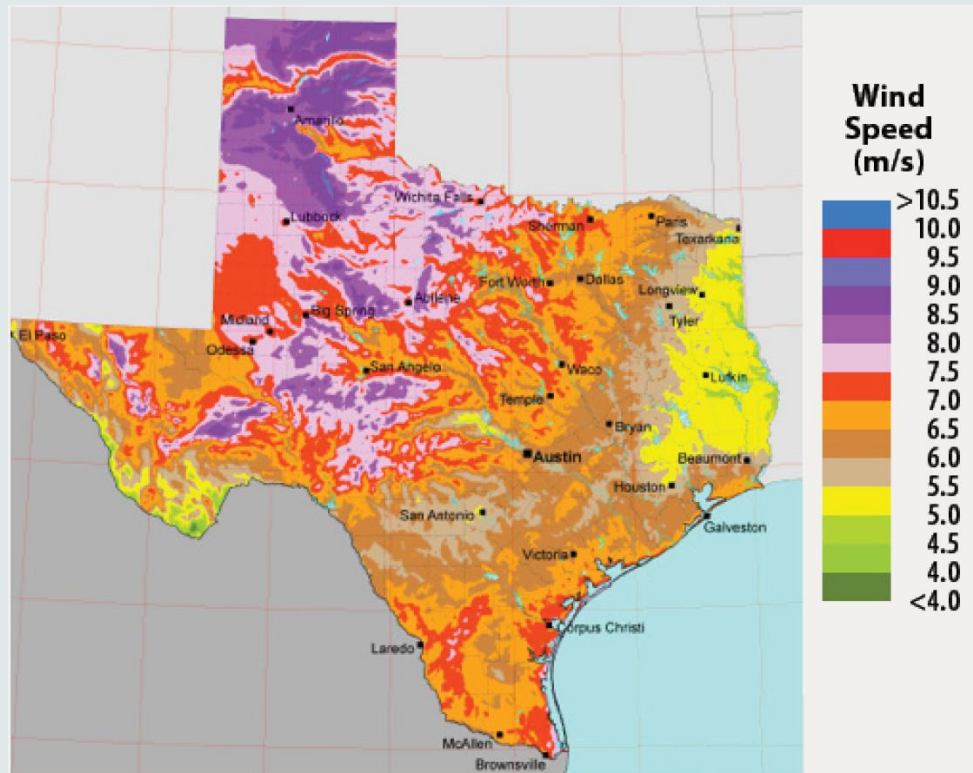
REZs are areas in the NEM where clusters of large-scale renewable energy can be developed to promote economies of scale in high-resource areas and capture geographic and technological diversity in renewable resources.

– ISP Consultation Paper
(AEMO)

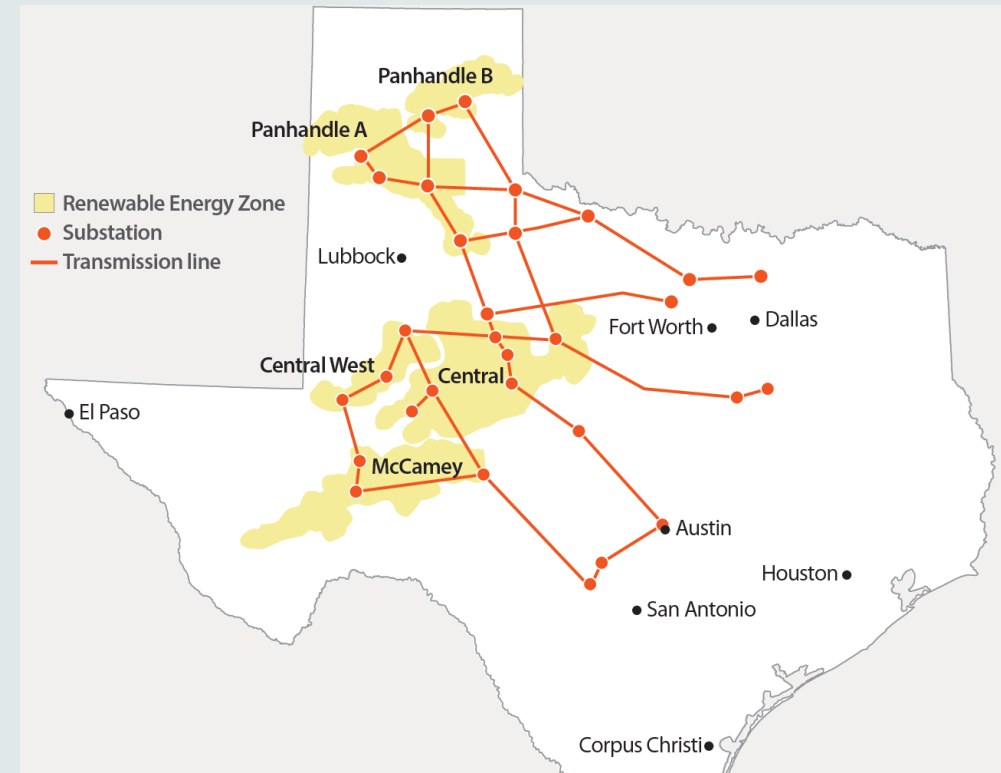
Renewable Energy Zone Concept



Real REZ example - Texas



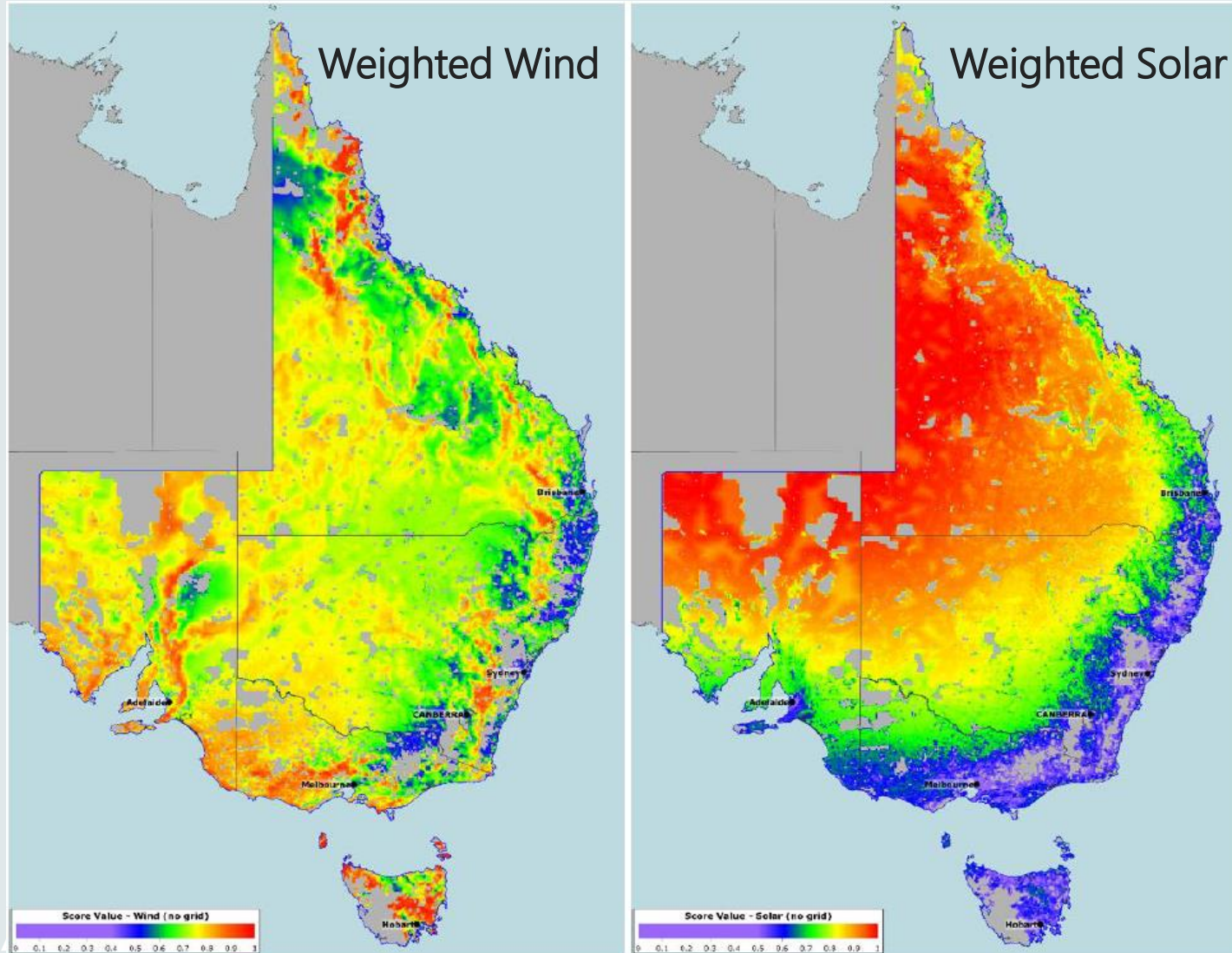
Wind map: Wind resource estimates developed by AWS Truepower, LLC for windNavigator Web: windnavigator.com awstruepower.com. Spatial resolution of wind resource data: 2.5 km. Projection: UTM Zone 14 WGS84.



Candidate REZ Identification



Renewable Energy Zone (REZ) Candidate Identification



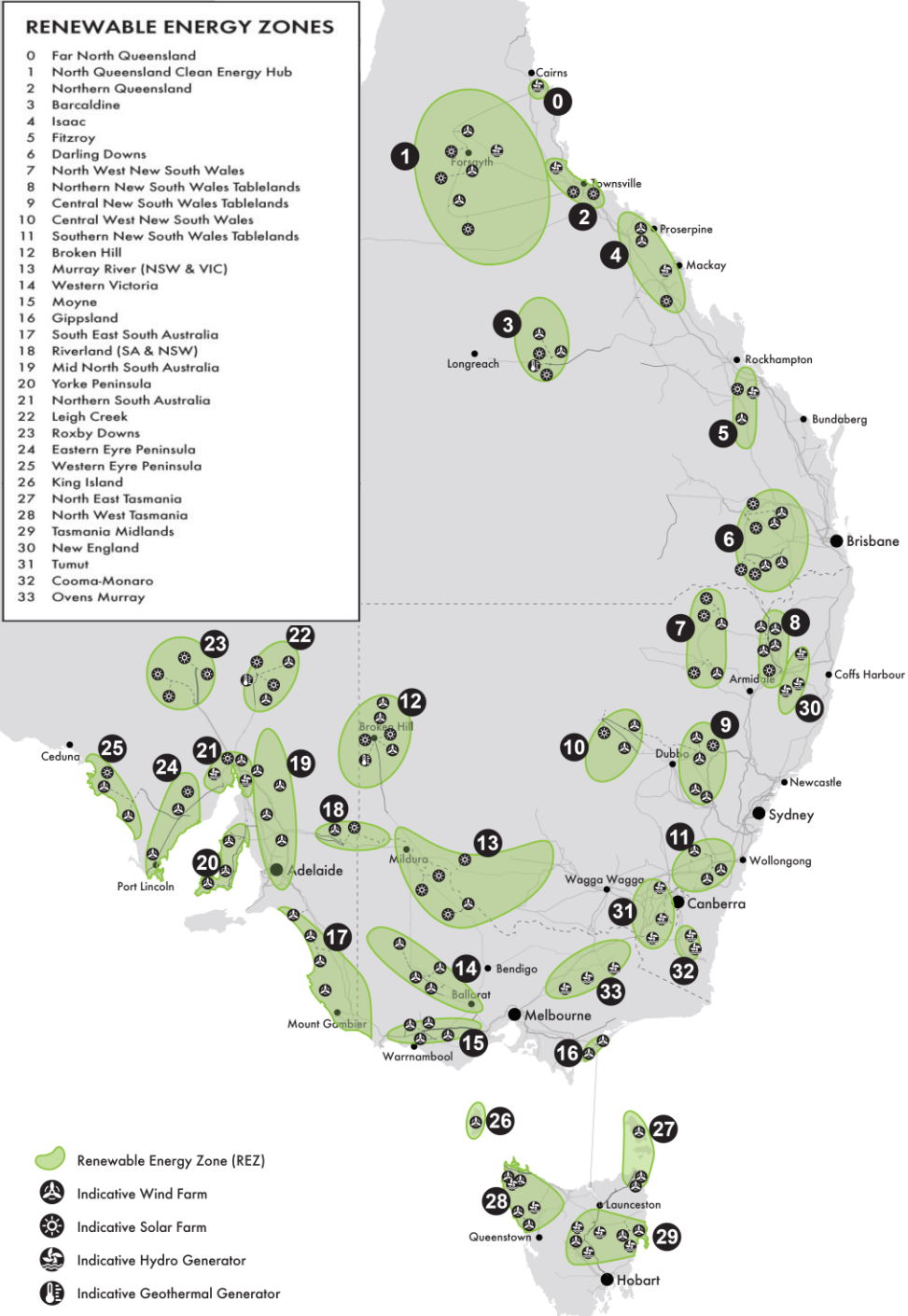
- Resource quality
- Correlation with demand
- Land parcel density
- Land cover
- Road access
- Terrain complexity
- Population density
- Protected areas
- Electricity network



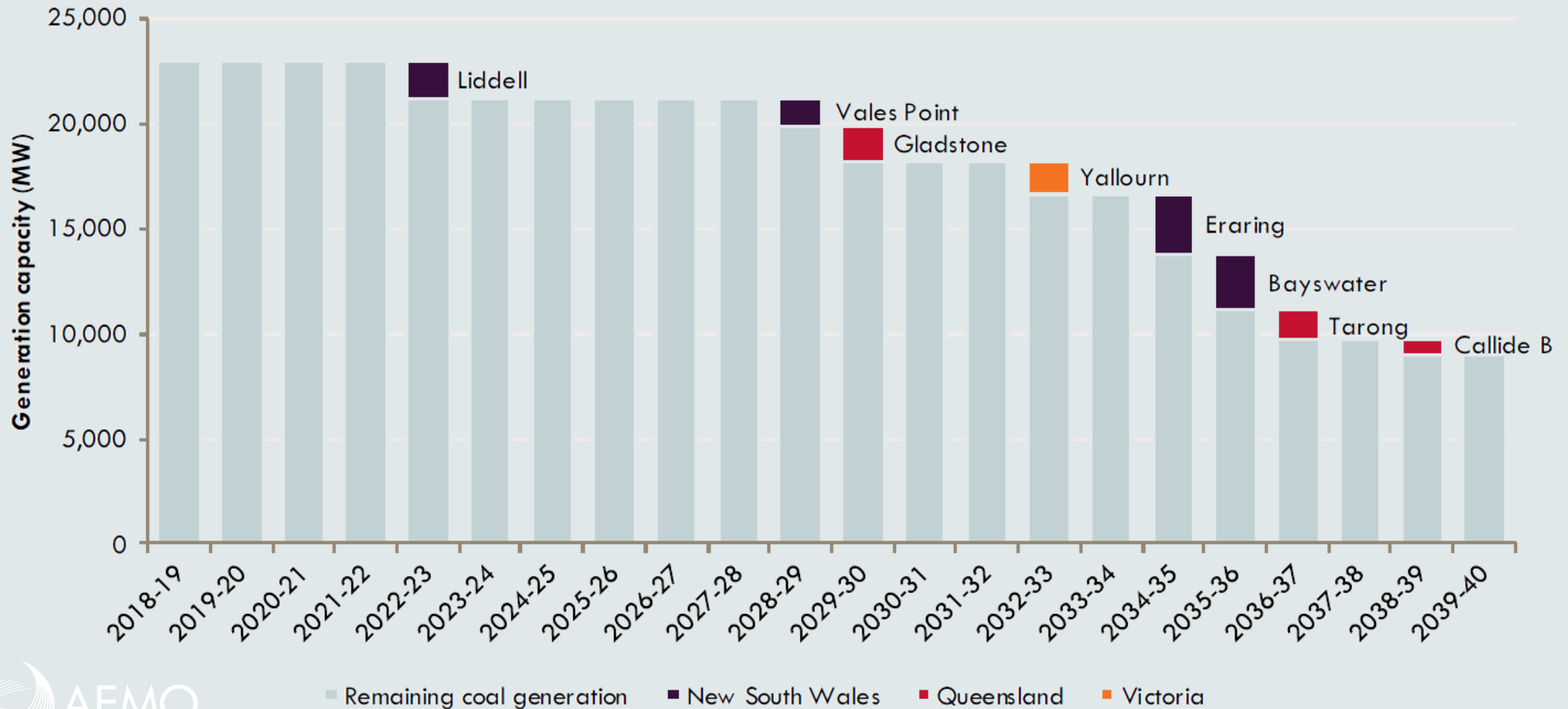
AUSTRALIAN ENERGY MARKET OPERATOR

Source: DNV-GL

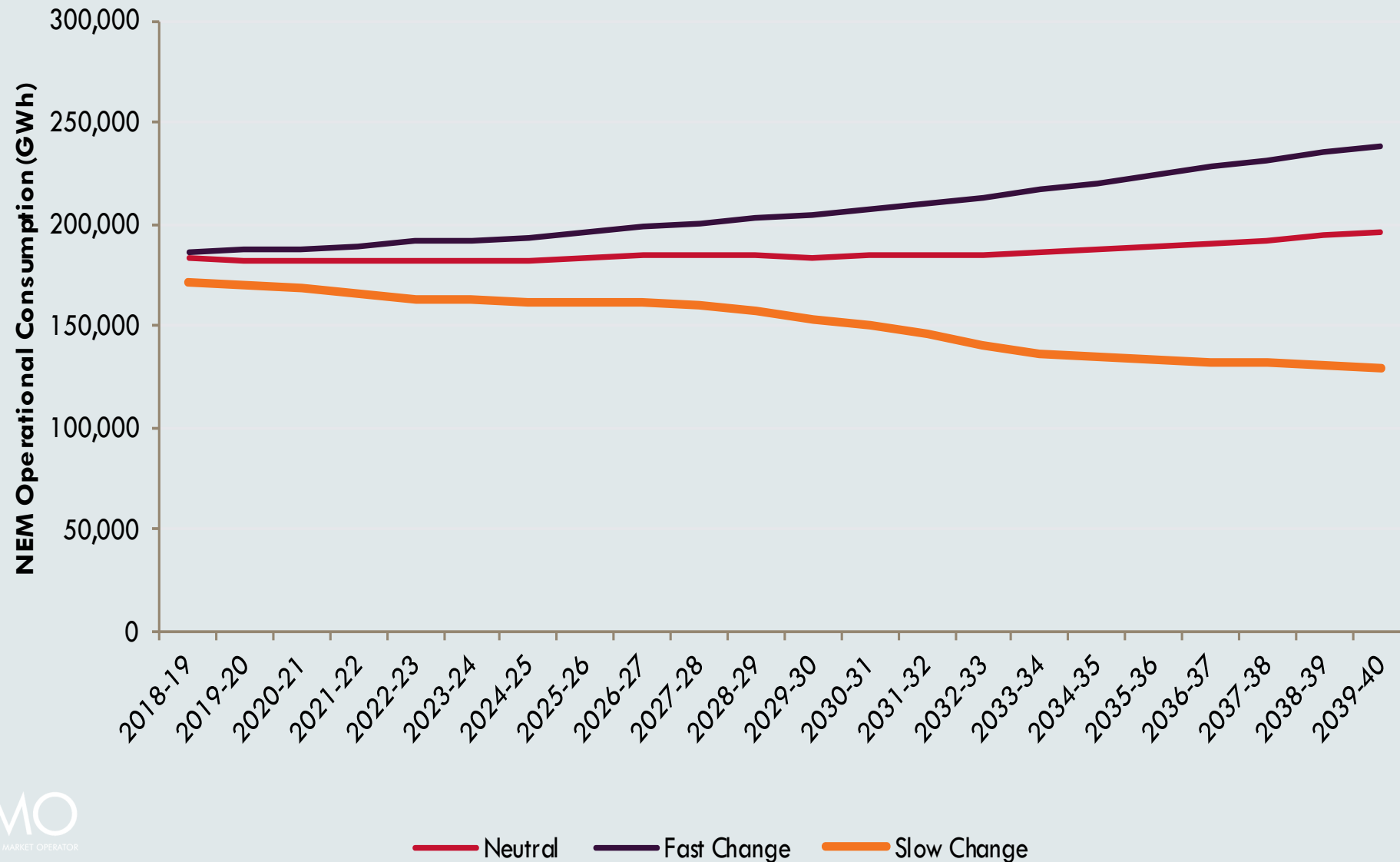
REZ Candidates



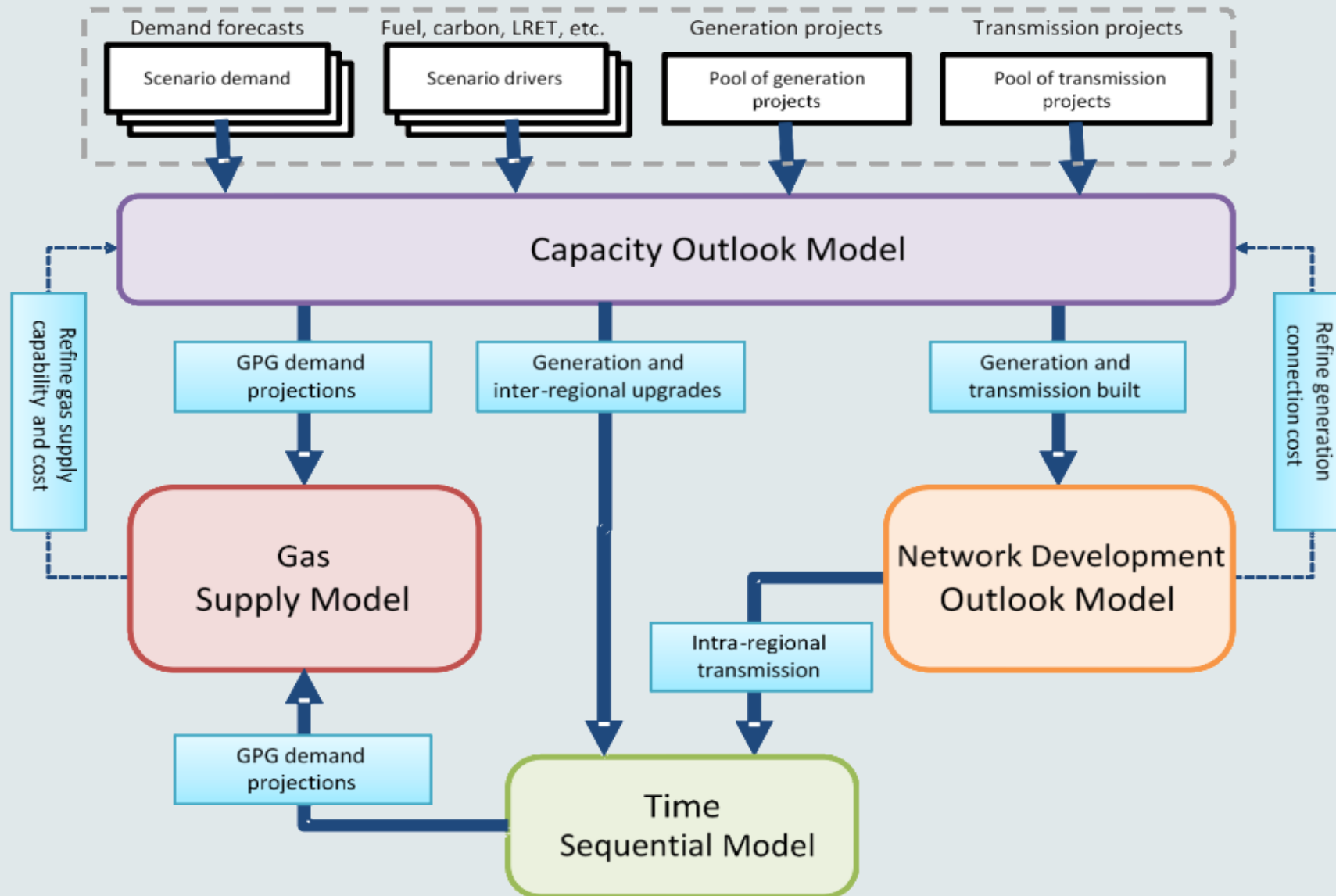
Key Inputs – Coal fleet operating life



Key Inputs – NEM Energy Consumption



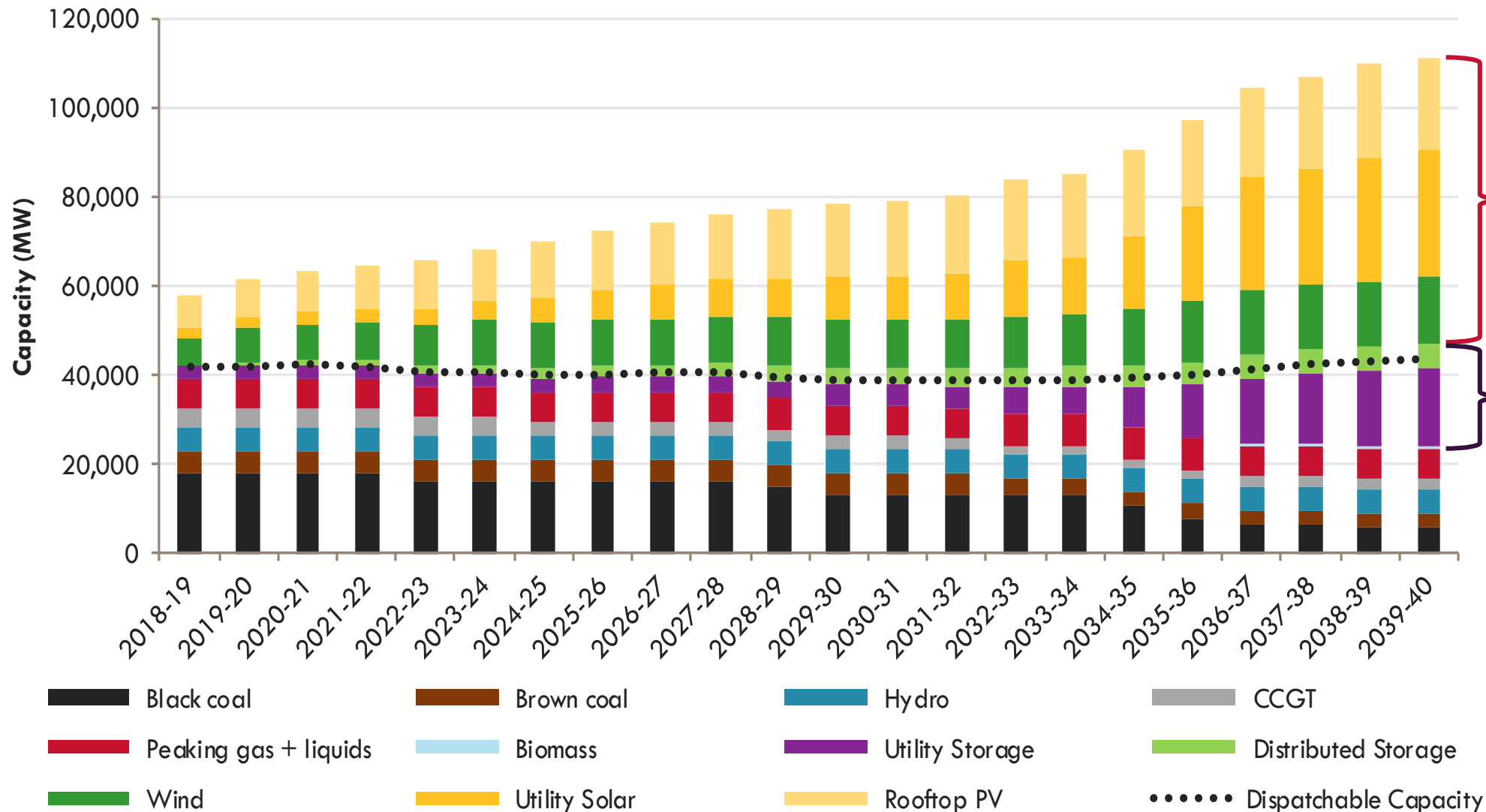
ISP modelling process



A few key insights

- Maintaining existing coal-fired generation up to the end of its technical life is a key element of a least-cost approach.
- A portfolio approach to replacing thermal generation:
 - Utility-scale renewable generation, energy storage, distributed energy resources (DER), flexible thermal capacity including gas-powered generation (GPG), and transmission.
- The crucial role of transmission to connect geographically dispersed renewable generation, establish REZs, and share surplus energy across the NEM
- DER can greatly reduce the total cost of supply, and will benefit from more interconnection.
- Focus on event-based timing and managing risks of unplanned events.

2018 NEM Energy Outlook



High penetration of variable renewable energy is creating a strong need for storage.

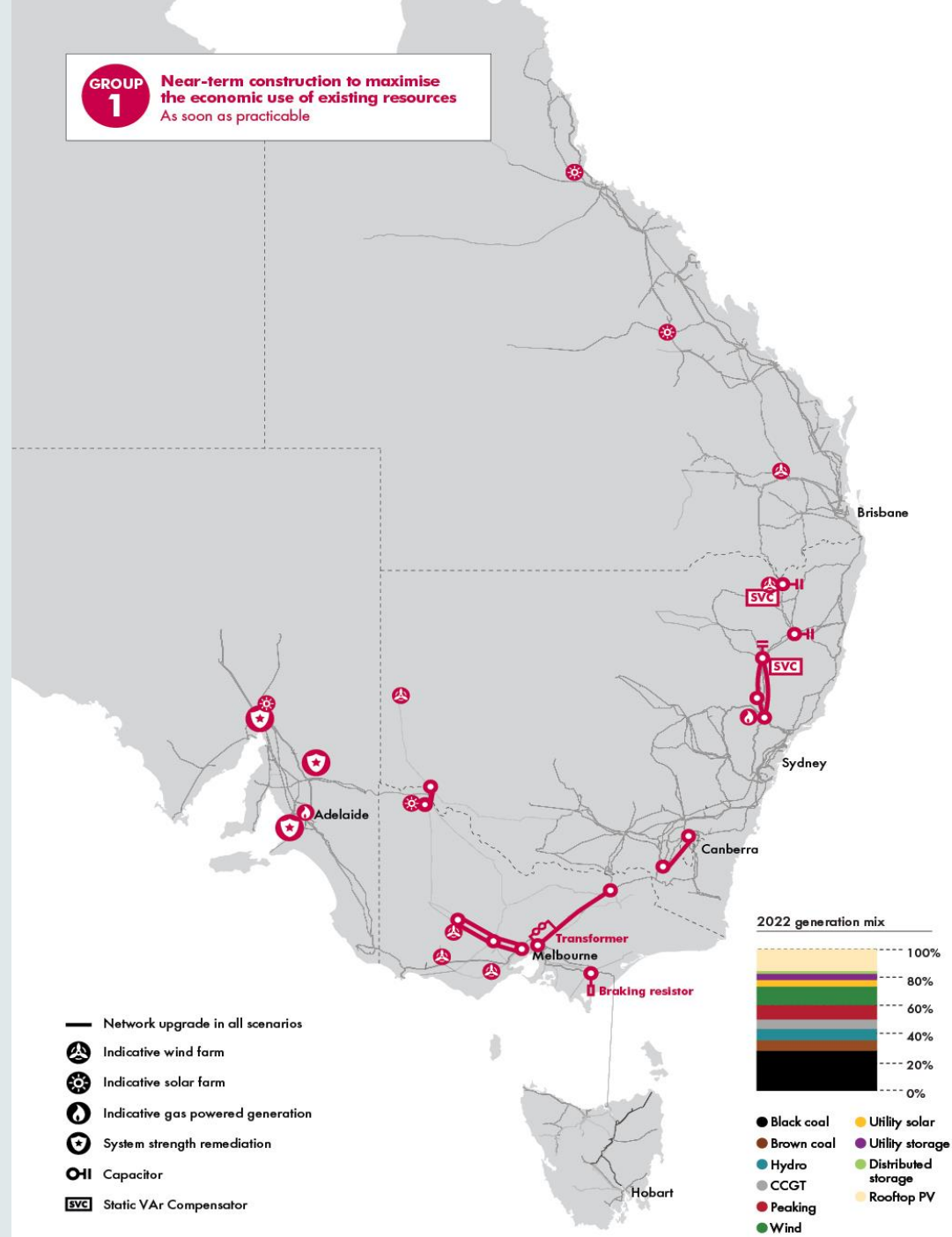
A mix of storage technologies, locations and sizes will be needed to efficiently balance renewable generation

Source: 2018 ISP – Forecast NEM Generation Capacity in Neutral Scenario

Group 1

Near-term construction

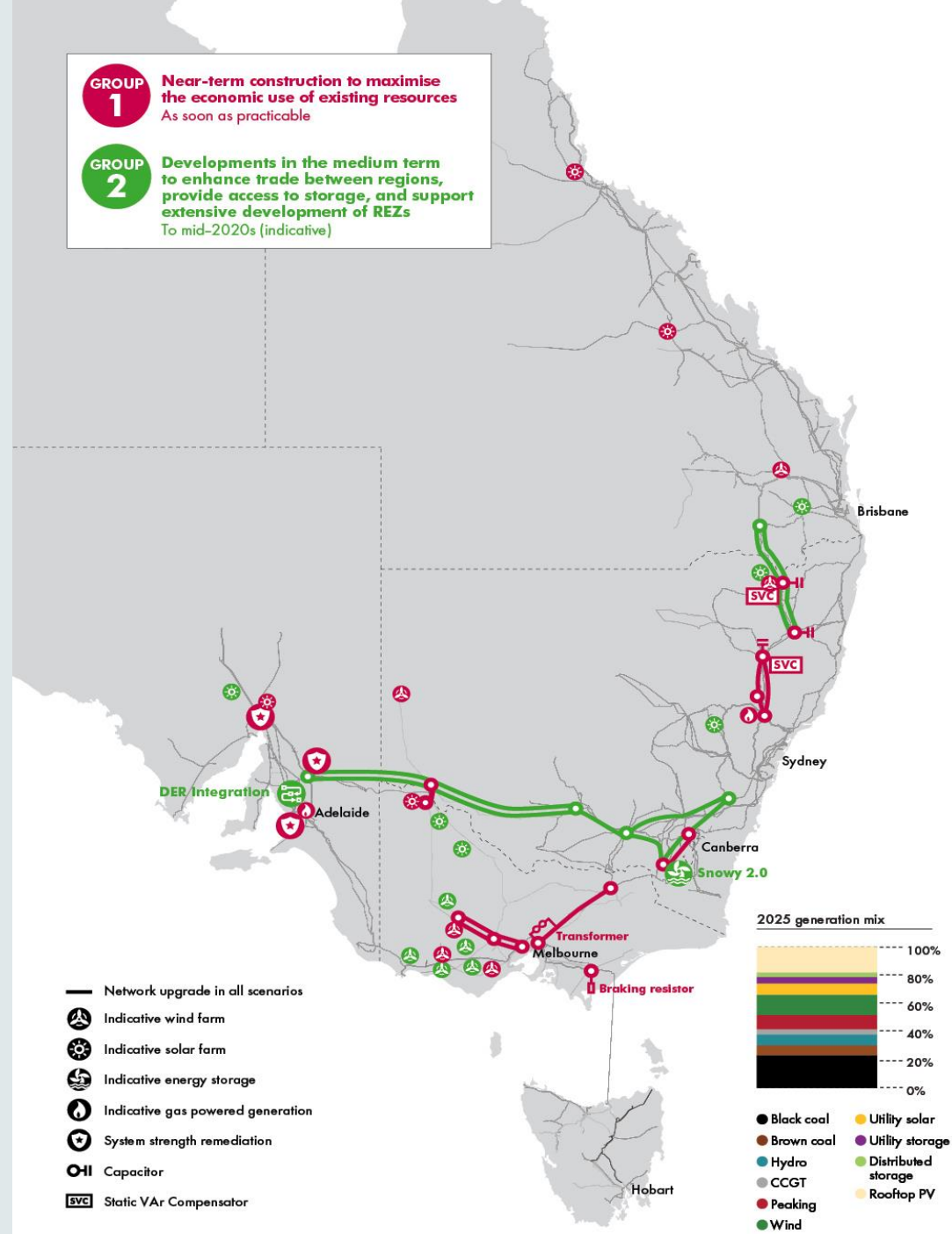
Maximise economic use of existing resources



Group 2

Developments in the medium term

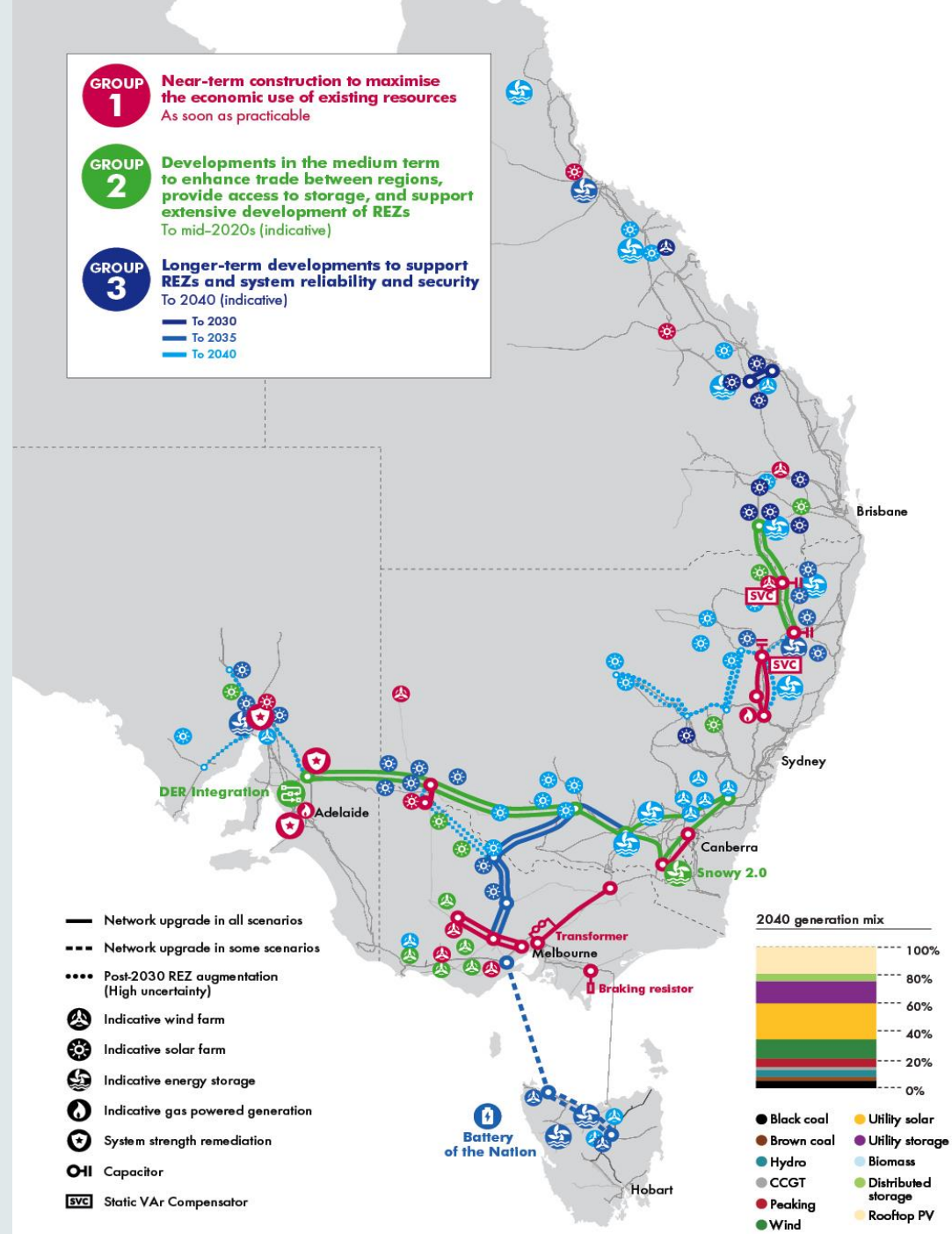
Enhance trade between regions, provide access to storage, and support extensive development of REZs



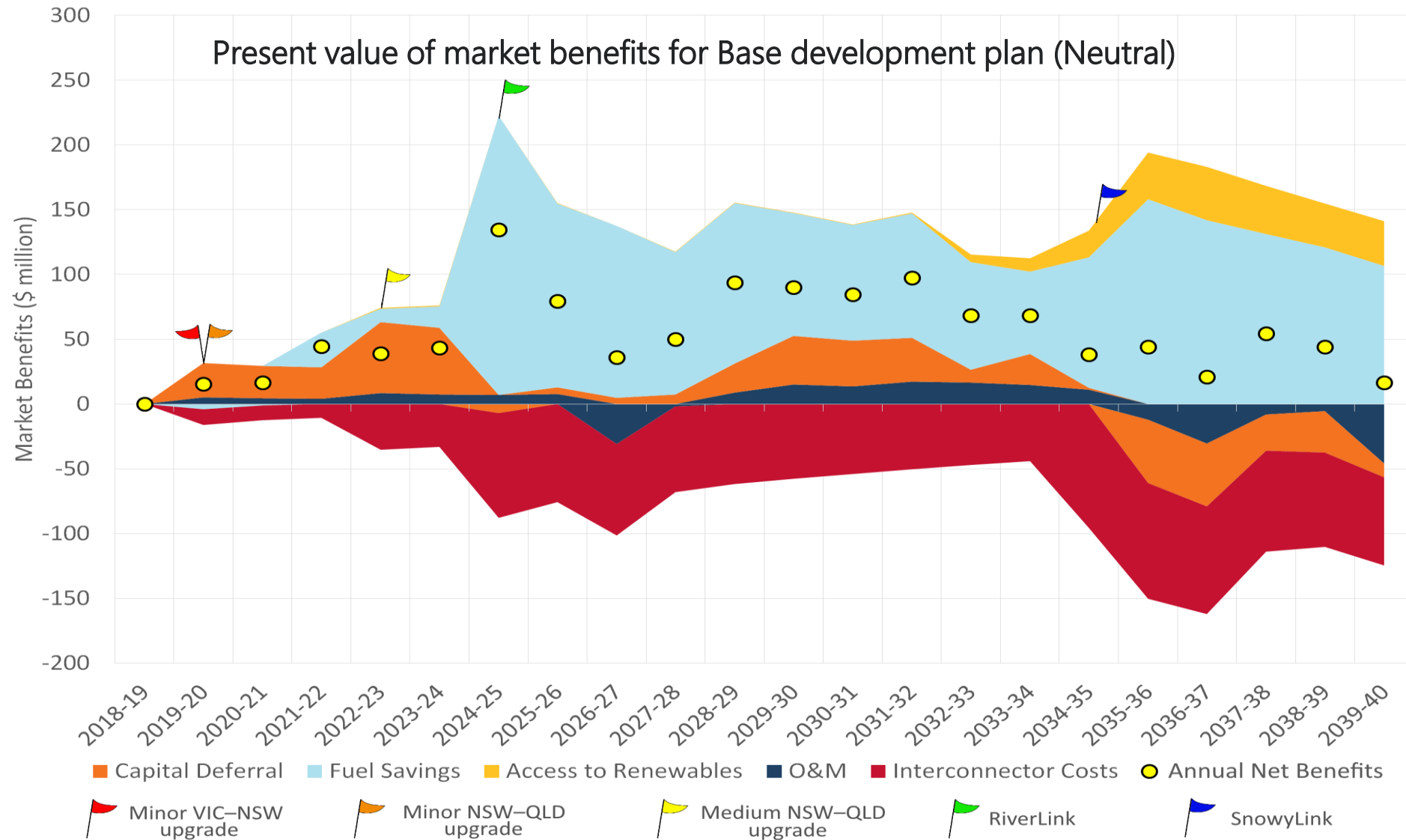
Group 3

Longer-term developments

Support REZs and system reliability and security



Economic assessment - Neutral



ISP Published

Published during project:

- Consultation Paper
- Consultation submissions & summary
- Assumptions workbook

Published in July 2018:

- ISP report with Appendices
- Methodology
- Input data and results
- Interactive map



Integrated System Plan 2019

Accurately predicting the future is harder than ever

Sudden, rapid, and disruptive changes are now a part of the planning landscape

Investments need to be robust to increasing uncertainties
So how do you do make a decision?

Scenario planning

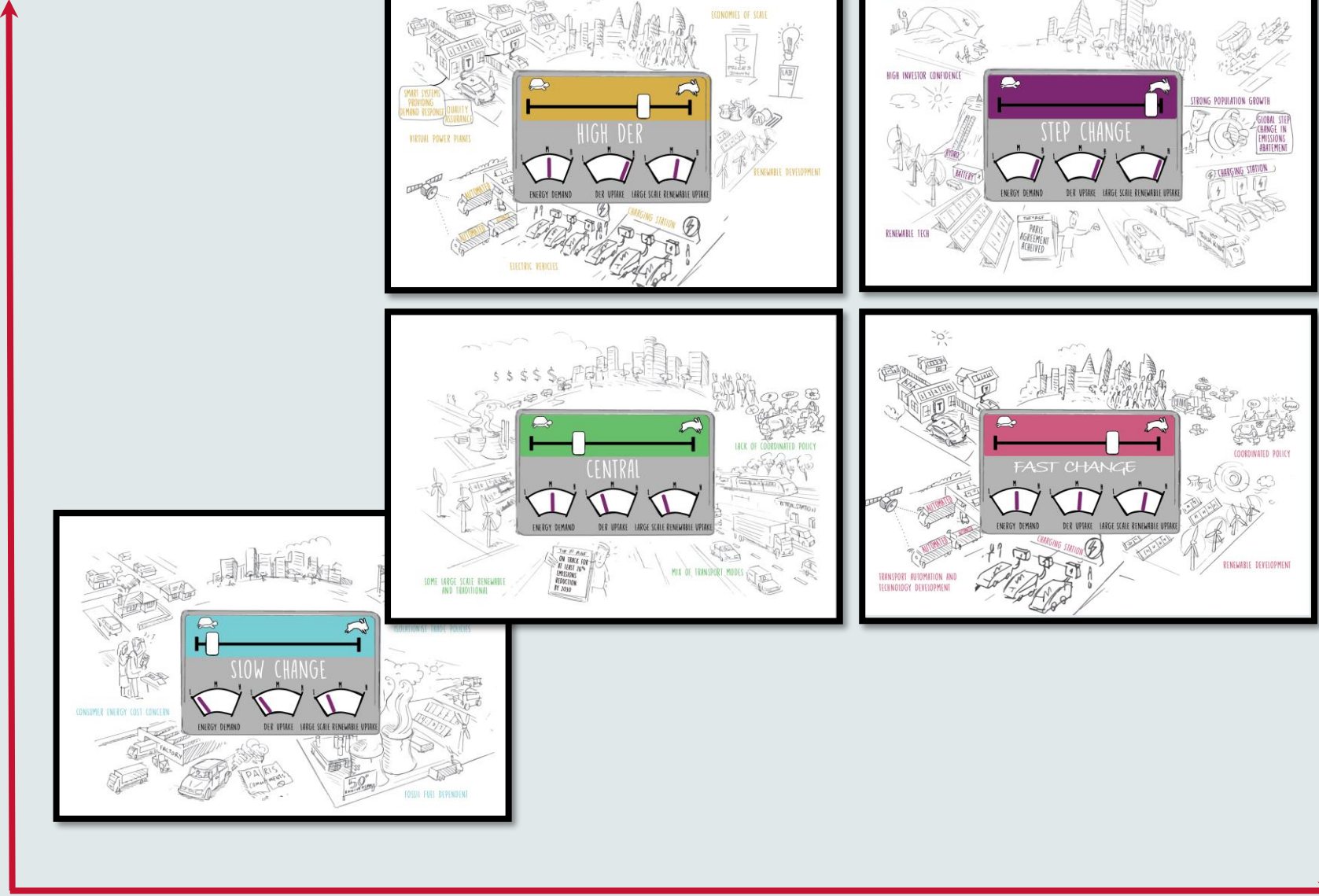
Developments that are robust across a wide range of uncertainties

Use “Scenario Bookends”, that aren’t forecasts, but contain the possible even if unlikely futures

The 2019-20 Integrated System Plan will investigate five scenarios capturing key potential directions...

Storage of all forms will play a large and increasing role in each of these futures.

Decentralisation



Decarbonisation

The 2019-20 ISP will further refine the national roadmap

- Understand in finer detail the requirements for resilience under alternate future pathways
- Enhanced understanding of storage opportunities
- Improved analysis of opportunities from cost, storage, lead time and demand management assumptions
- Identify opportunities to enhance power system security and resilience and enable the transition
- Incorporate early considerations of Virtual Power Plants and other DER opportunities
- Commence tri-sector integration of electricity, gas and transport
- Stretch goal: Develop early views on potential impact of transition to a hydrogen economy

Plan for 2019 ISP



AEMO is nearing completion of consultation on scenarios, inputs and assumptions for this year's ISP

Modelling will commence imminently

Draft ISP end of year

Final ISP by mid 2020



