# Stakeholder Council Mtg Agenda: May 8, 2019

- Welcome & Introductions
- Recap of Resiliency session & IGP resources
- The Energy Trilemma, Elijah Pack

  **Break and pick up lunch (11:45pm –12pm)**
- ISP: Energy Mix & Infrastructure
- Break Considerations/Discussion
- Workgroup Status Updates
- Next Steps and Closing

# IGP INFORMATION RESOURCES

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Home > Clean Energy Hawaii > Integrated Grid Planning > Stakeholder Engagement > Stakeholder Council

## Integrated Grid Planning

- Integrated Grid Planning
- Stakeholder Engagement
- Stakeholder Council
- Working Groups
- Technical Advisory Panel

### What is Integrated Grid Planning?

Get a quick overview with our IGP handout. **Learn more >**

Share

## Stakeholder Council

The Stakeholder Council represents our customers and broad stakeholder interests in Hawaii. The Stakeholder Council is a key element of and one of the several stakeholder groups in the overall stakeholder engagement process essential for IGP success.

The Stakeholder Council helps ensure alignment of Hawaiian Electric's plans with customer and stakeholder interests and facilitates the development of broadly supportive action plans. The Stakeholder Council consists of one member from the following representative stakeholder interests (in alphabetical order):

- City/County representative (one from each county)
- Community delegate (one from each island)
- Consumer Advocate
- Demand Response
- Electric Vehicles
- Energy Efficiency
- Energy Storage
- Environmental Advocate

# AEMO ISP – Integrated System Plan

# Power System Planning Challenges & Opportunities

Elijah Pack – Manager National Planning (AEMO)

May 2019

# The Energy Transition

- **Changing supply technologies** – Environmental sustainability, renewables boom, ageing infrastructure, decreasing need for baseload power, growing need for energy storage and peaking.
- **Evolving consumer needs** – Rooftop PV, electric vehicles, energy storage, flat / negative demand growth, affordability.
- **The grid** – Adapting to changing needs on both sides of the supply chain
- **Structural change** – regulatory liberalisation and competitive energy markets.

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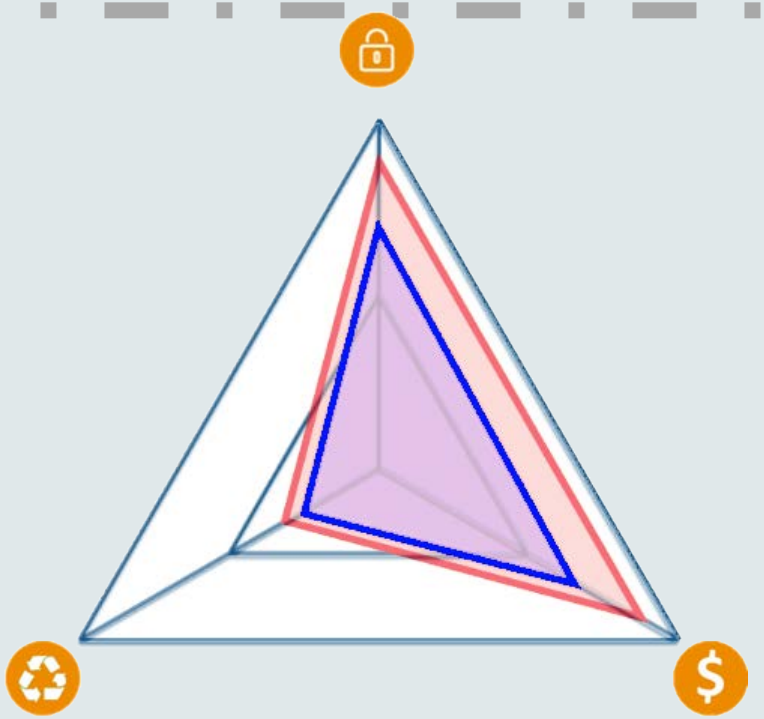
# The User Requirement: The Energy "Trilemma"

Achieve a balance of:

- Reliability and security
- Affordability (Energy Equity)
- Environmental Sustainability

| | AUS | USA |
|---|---|---|
| Reliability and security | B | A |
| Affordability (Energy Equity) | B | A |
| Environmental Sustainability | D | C |



Source: World Energy Council†

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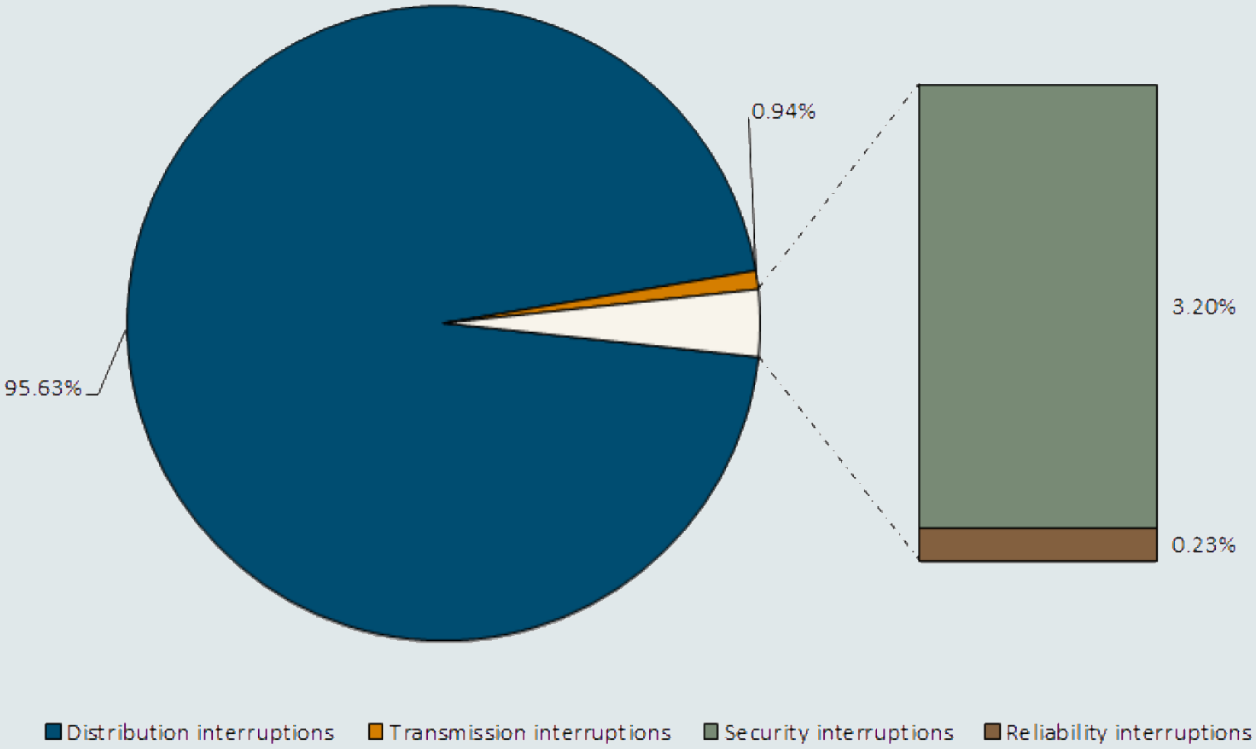
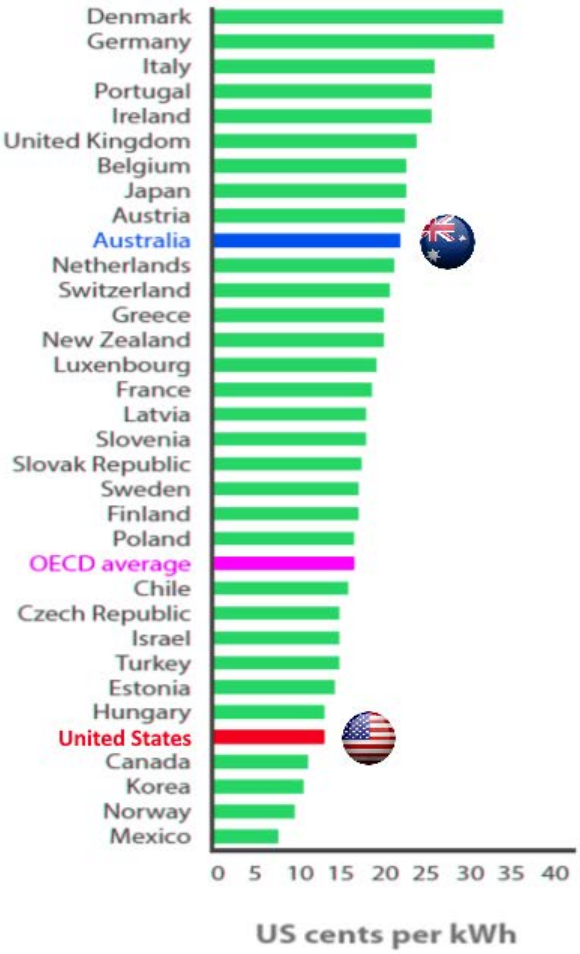
# Reliability & Security – Supply interruptions

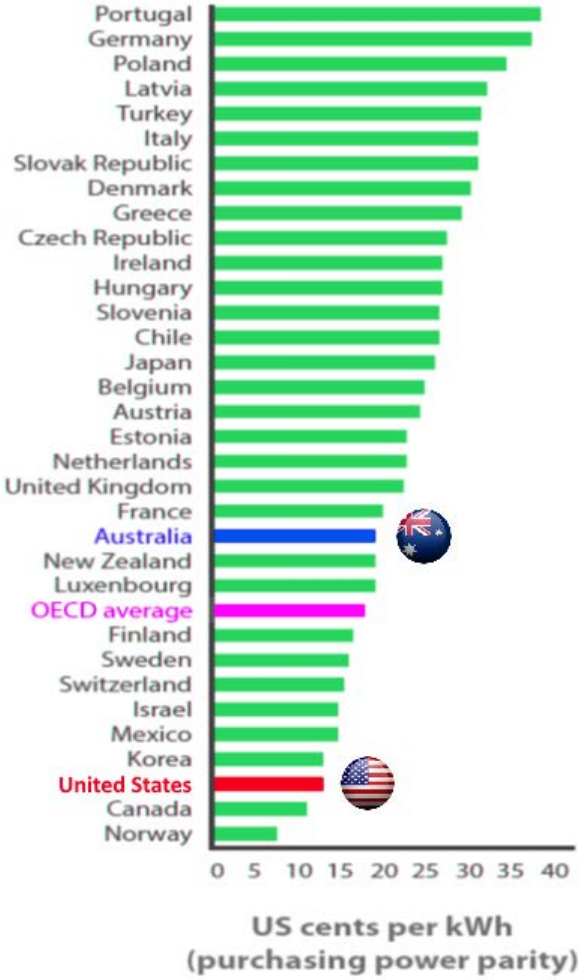



*Source: Reliability Panel AEMC Final Report - Reliability standard and settings review 2018. Data represents 2007/08 to 2016/17*

# Affordability

Source: International Energy Agency, Energy Prices and Taxes 2016.

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# Electricity Bill Components


Source: AEMC, 2016 residential electricity price trends, final report.

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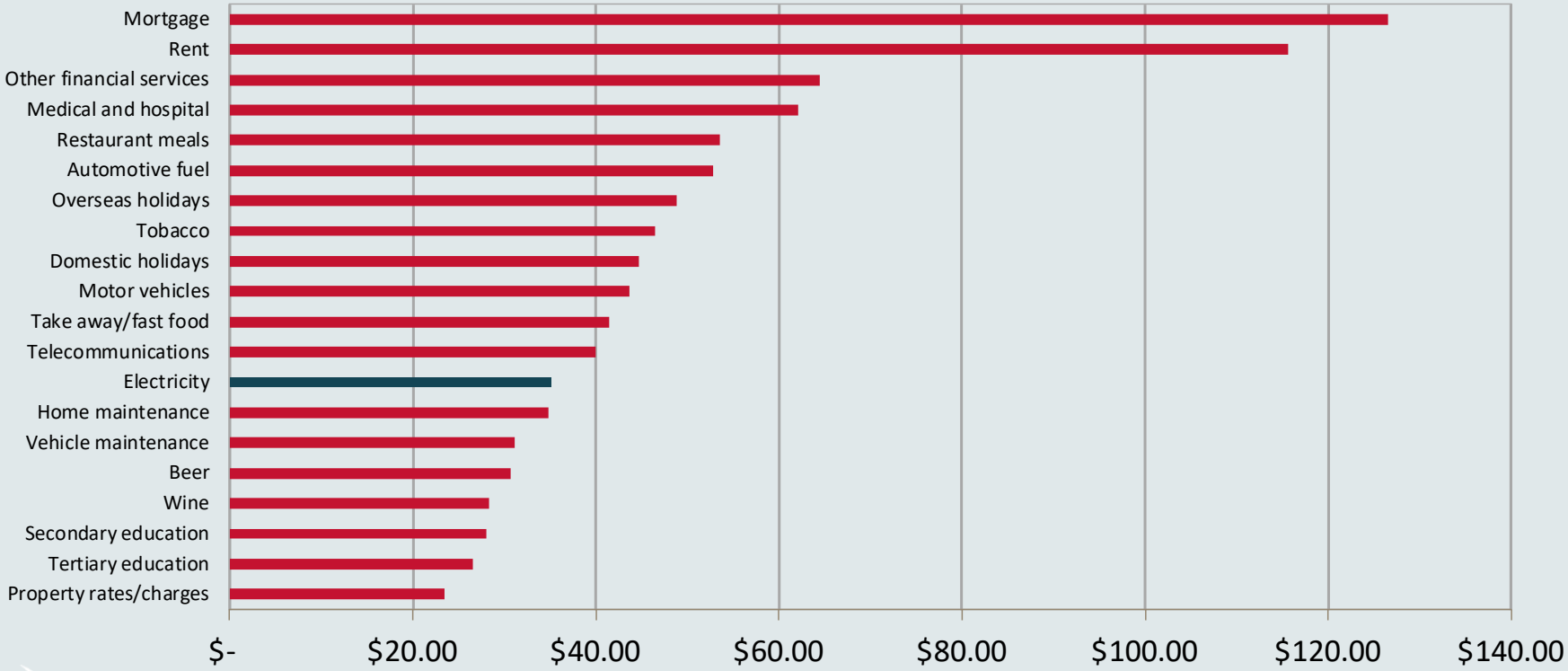
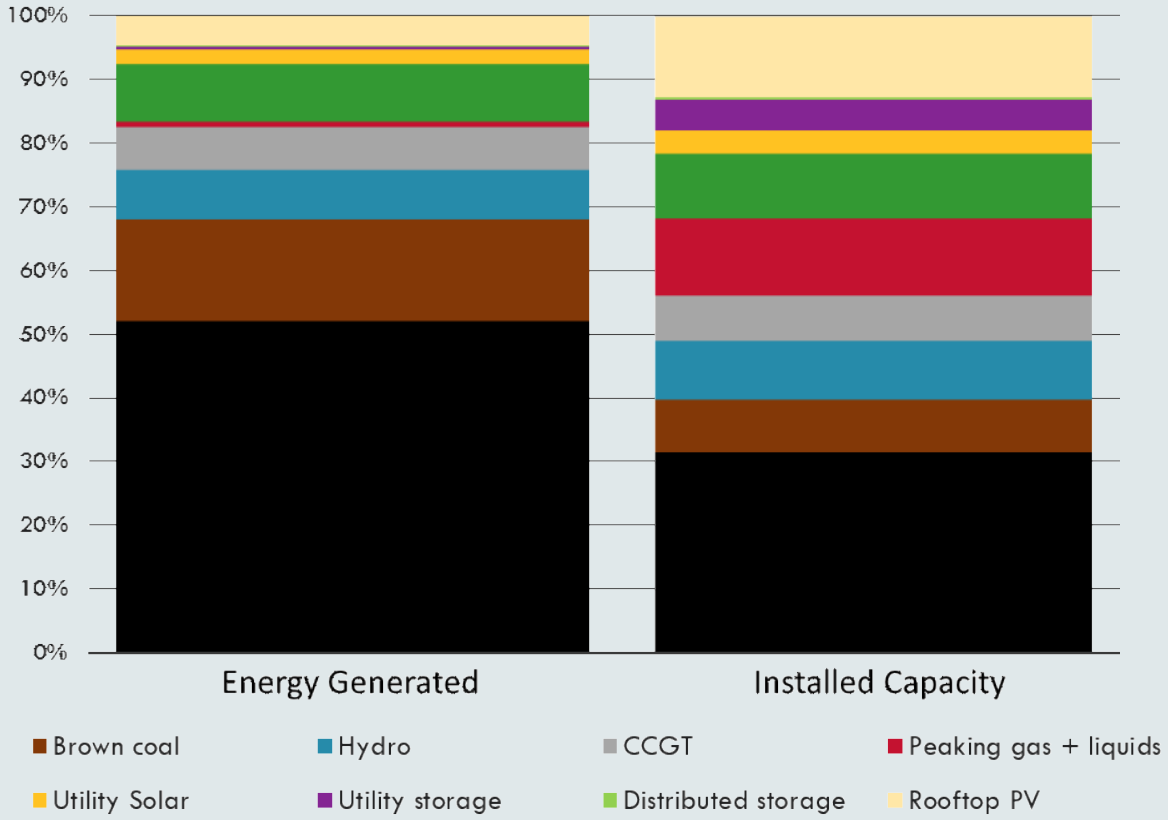
# Affordability – Average weekly household costs



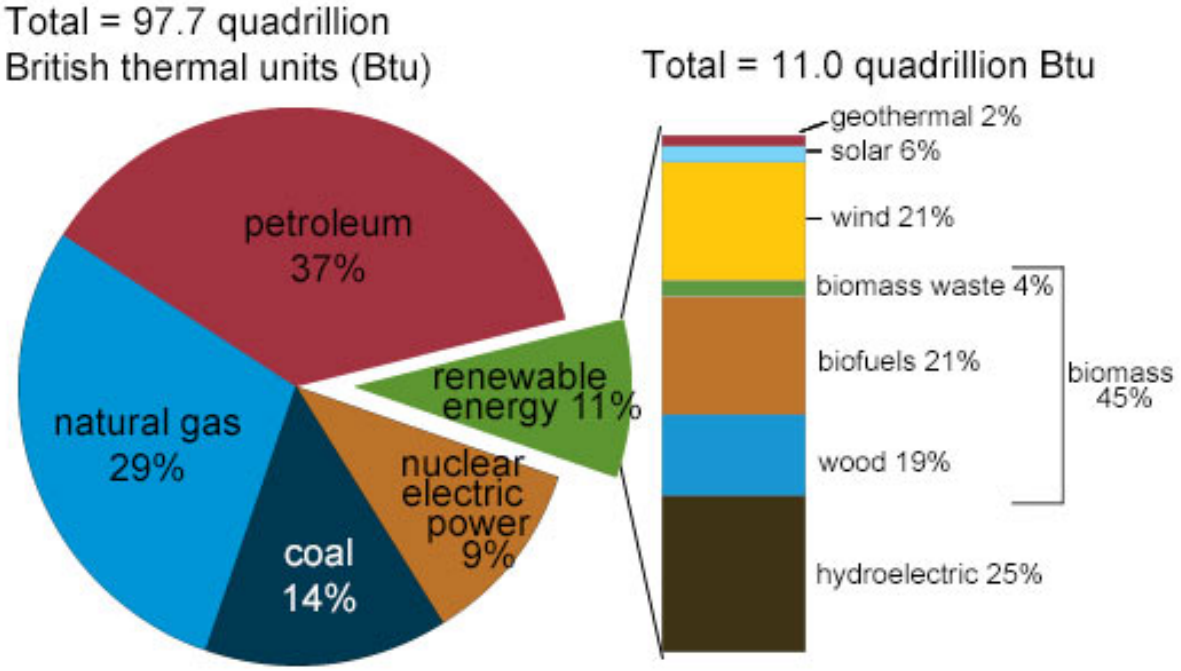

Source: Australian Bureau of Statistics

# Sustainability

- LRET Target
- Paris commitment
- State based RETs
- 6.5 solar panels installed per minute
- Policy uncertainty
- Reliance on coal for baseload power



# U.S. energy consumption by energy source, 2017




Note: Sum of components may not equal 100% because of independent rounding.
Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 1.3 and 10.1, April 2018, preliminary data

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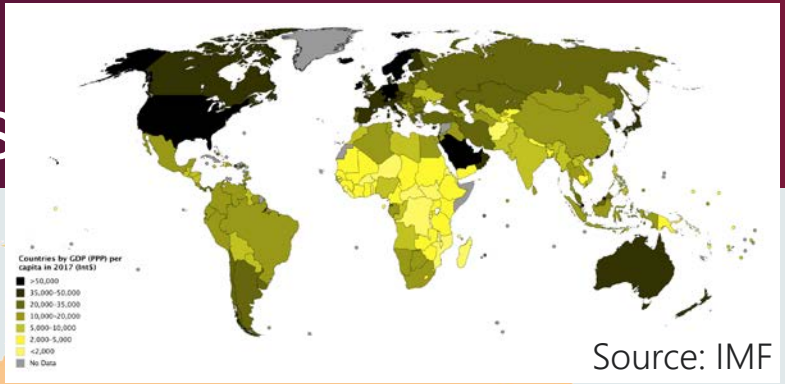
Source: US Energy Information Administration

# Global trilemma rankings




Source: IMF

Source: World Energy Council

| Energy Performance | Top 25% | 25%-50% | 50%-75% | Lower 25% |
|---|---|---|---|---|

# External trilemma influencers

- Geographic size
- Wealth (GDP)
- Education
- Natural resources
- Electrical neighbours
- Reliance on fuels
- Climate complexity
- Policy certainty


Source: Australian Government

# 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)

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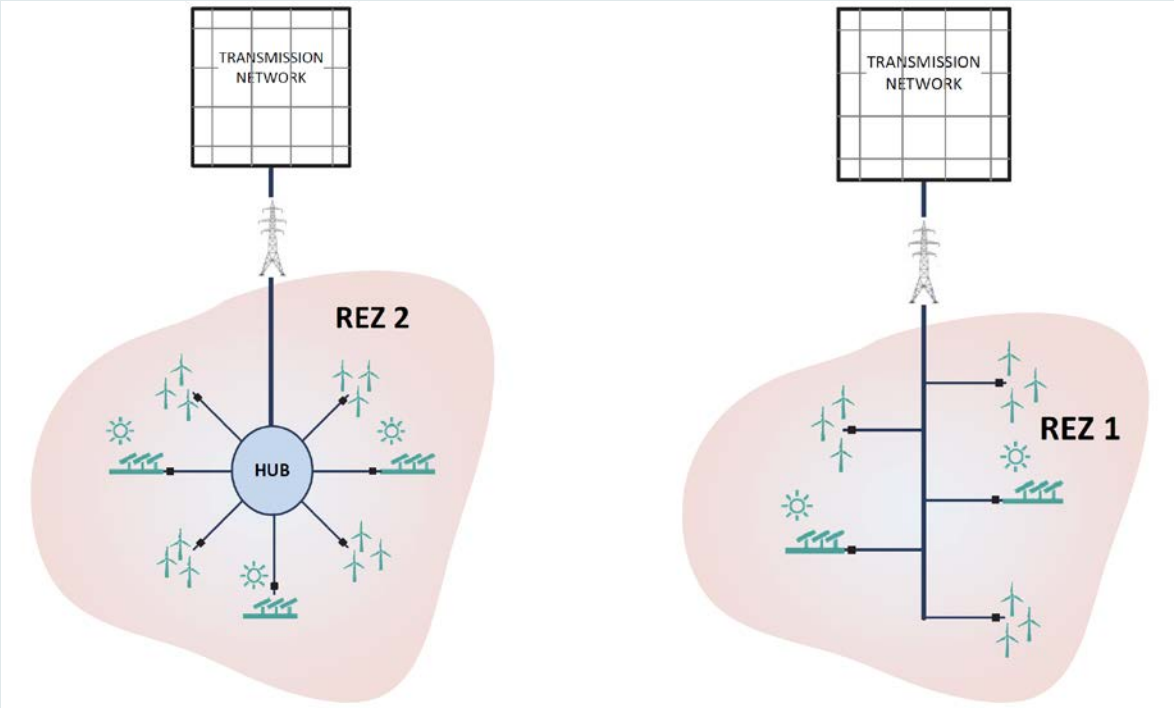
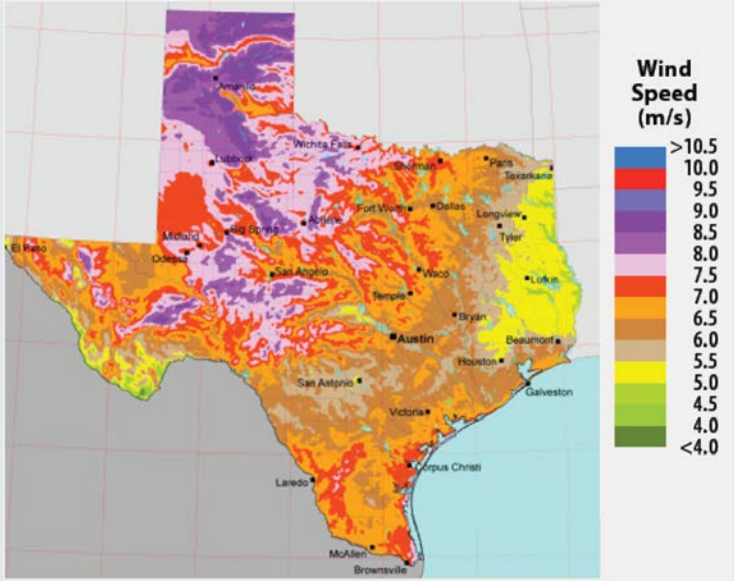
# Renewable Energy Zone Concept

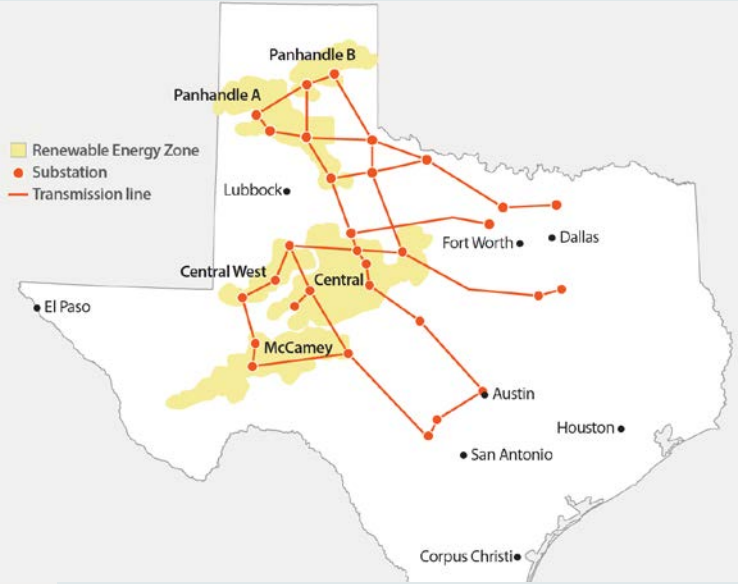



*Source: Powerlink, 2018 Transmission Annual Planning Report*

# 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.




*Source: NREL, Renewable Energy Zones: Delivering Clean Power to Meet Demand*

# Candidate REZ Identification

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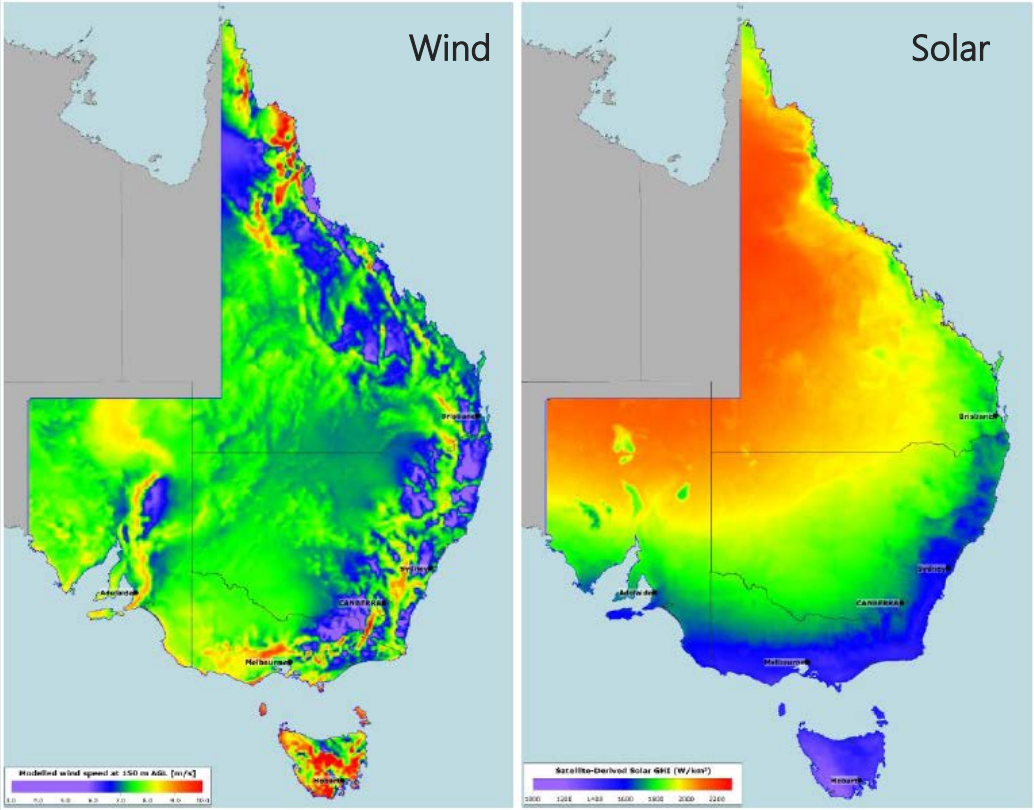
# Renewable Energy Zone (REZ) Candidate Identification




Source: DNV-GL

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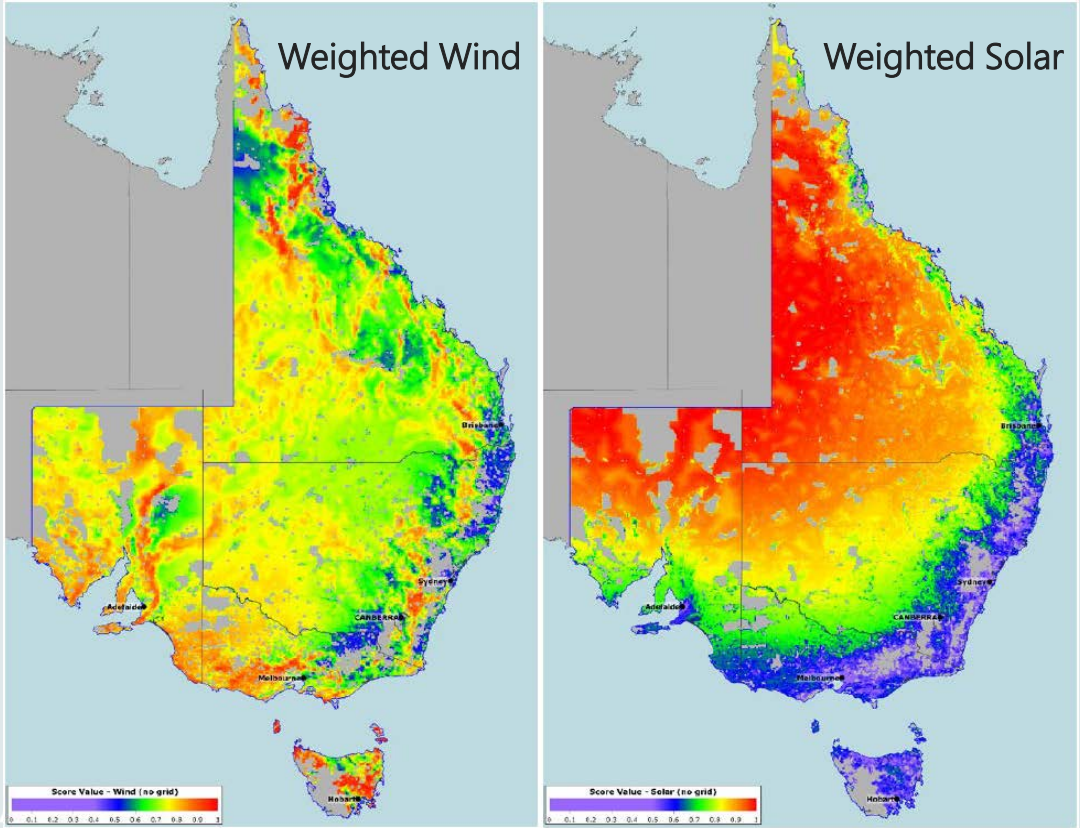
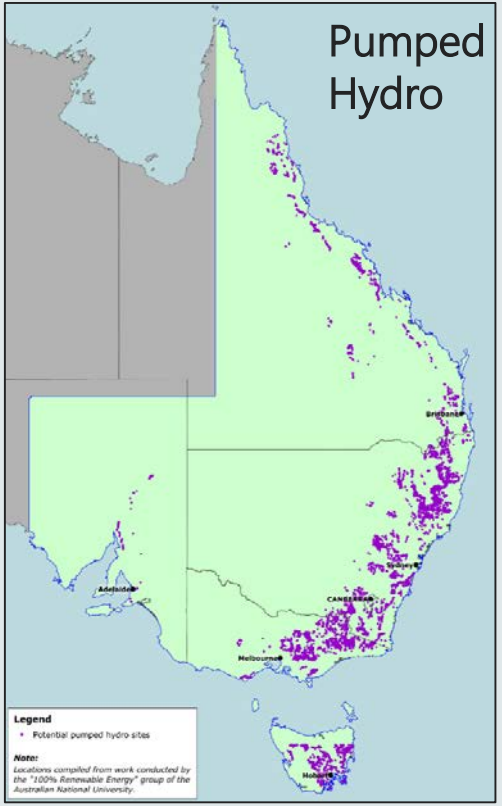
# Renewable Energy Zone (REZ) Candidate Identification



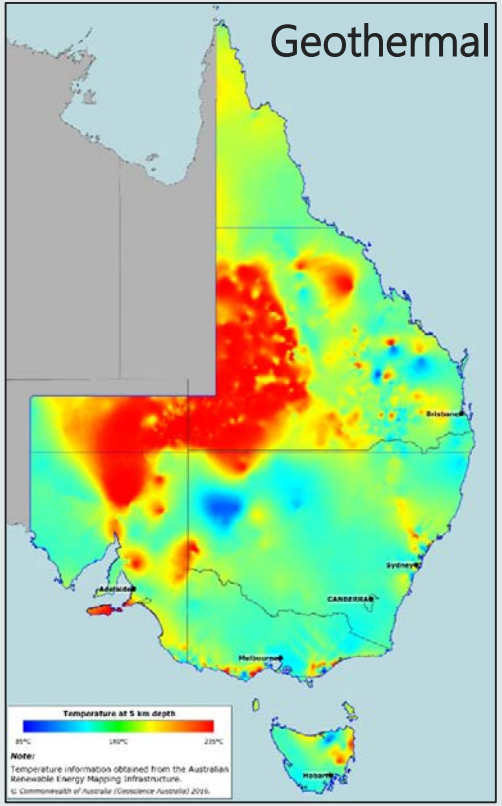

Source: DNV-GL

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

# Renewable Energy Zone (REZ) Candidate Identification




Source: ANU




Source: Geoscience Australia

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# REZ Identification

10 constraints for REZ identification – including resource quality

| Constraint | Weighting for score | | |
|---|---|---|---|
| | Wind | Solar | Hybrid |
| Wind resource | 35% | - | 30% |
| Solar resource | - | 30% | |
| Demand matching | 5% | - | 5% |
| Electrical network | 10% | 10% | 10% |
| Cadastral parcel density | 10% | 10% | 10% |
| Land cover | 5% | 10% | 10% |
| Roads | 5% | 5% | 5% |
| Terrain complexity | 10% | 15% | 10% |
| Population density | 10% | 10% | 10% |
| Protected areas | 10% | 10% | 10% |

Source: DNV GL Report

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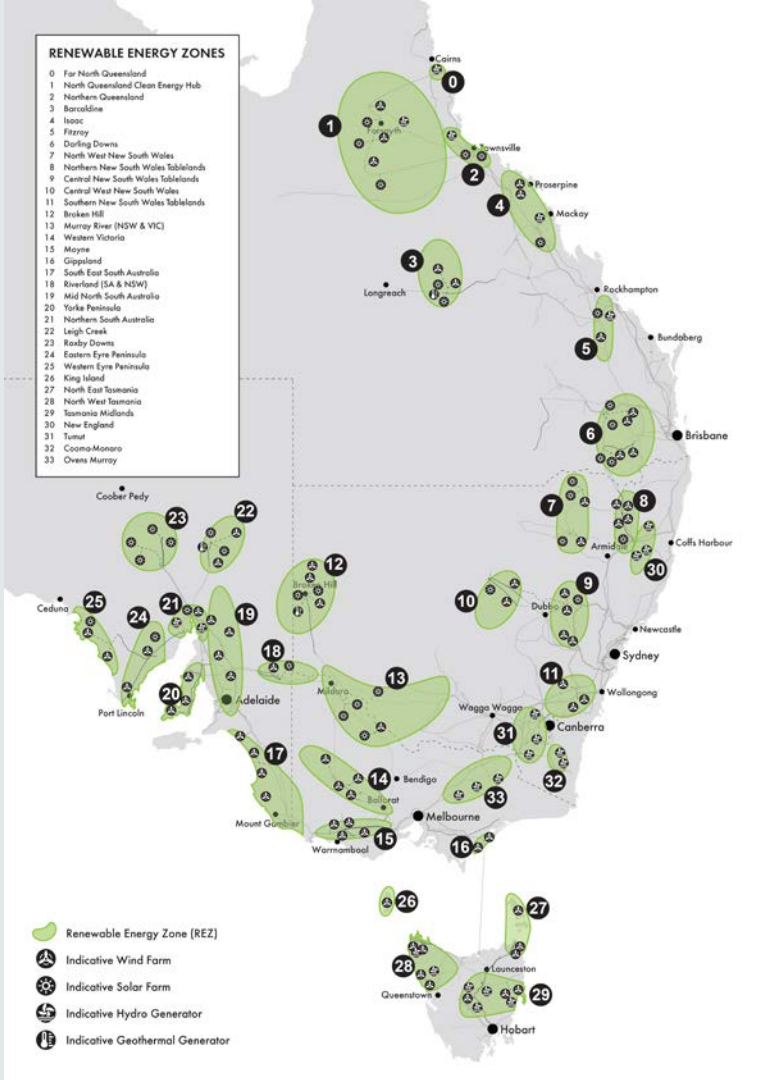
# REZ Candidates

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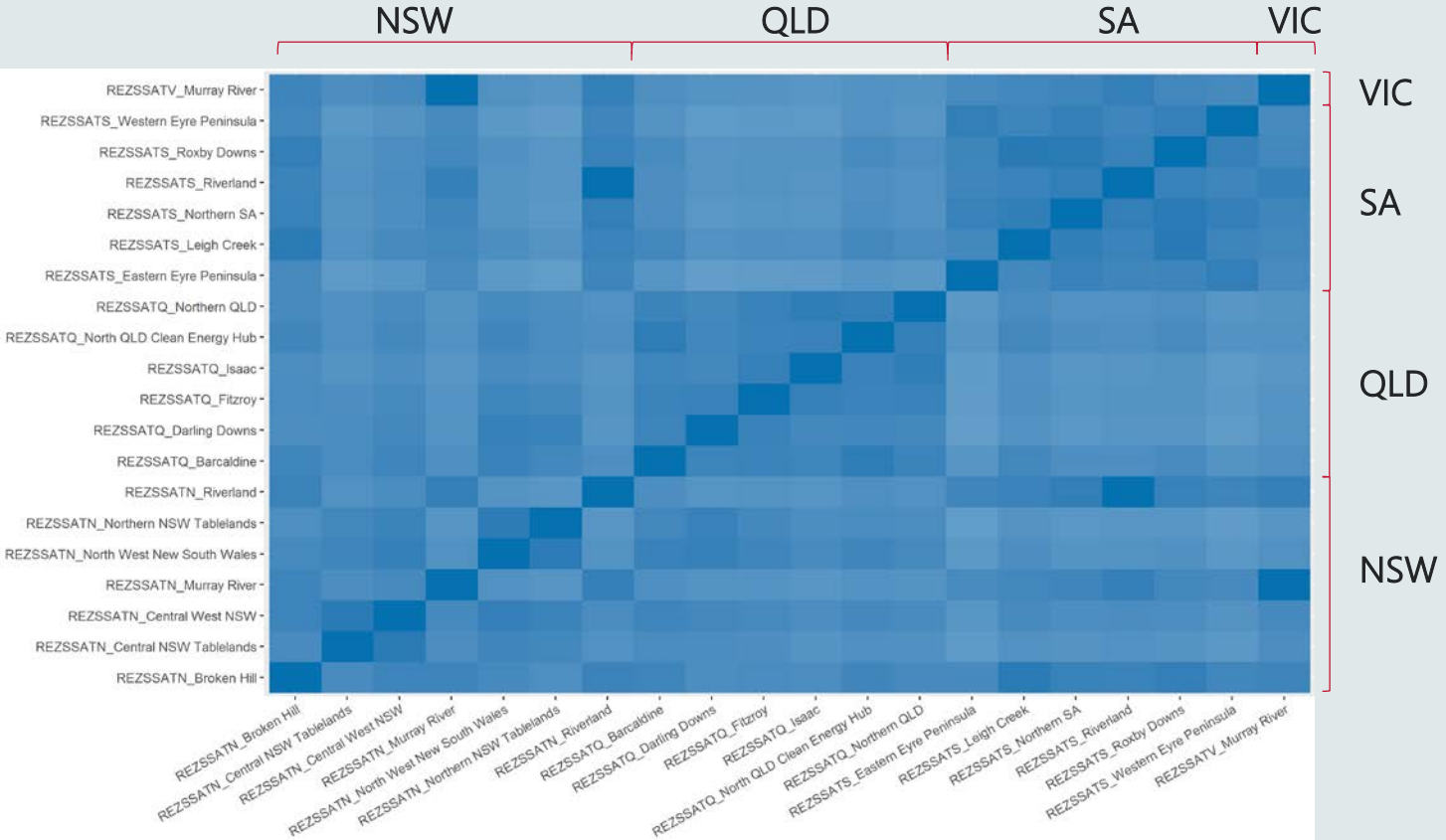
# Selection – Wind correlation

# Selection – Solar correlation



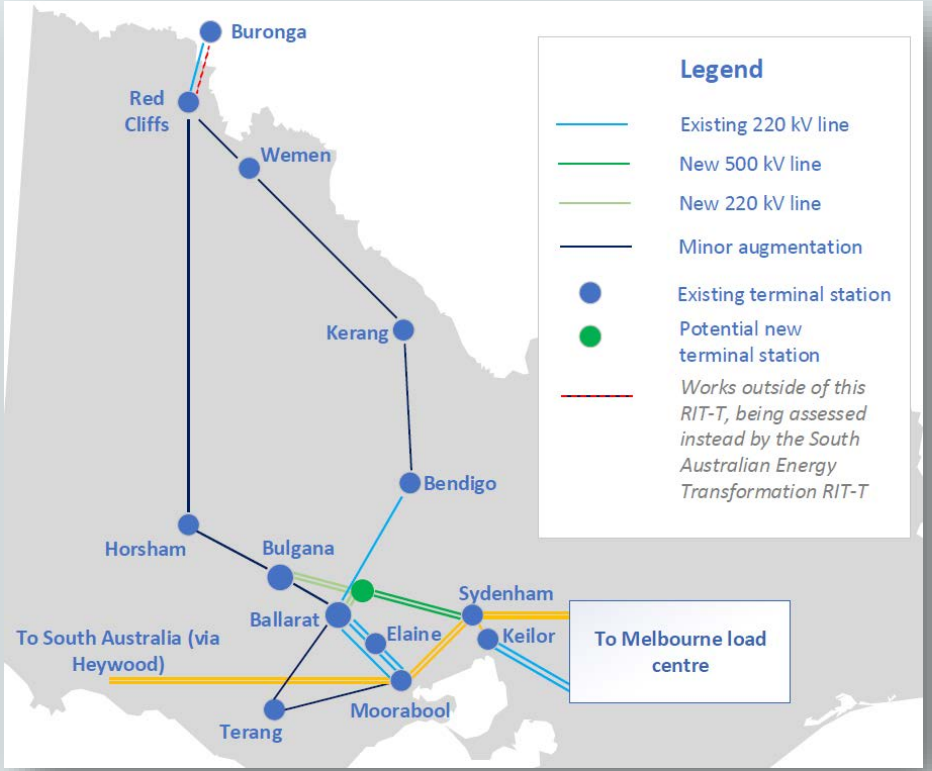
# Western Victoria REZ

## Short term: present to 2021.

- Minor transmission line upgrades on the Red Cliffs to Wemen to Kerang to Bendigo, and Moorabool to Terang to Ballarat, 220 kV transmission lines.

## Medium term: 2021 to 2025.

- The following major transmission network augmentations (staged):
  - **By 2024:** New 220 kV double circuit transmission lines from Ballarat to Bulgana.
  - **By 2025:** New 500 kV double circuit transmission lines from Sydenham to Ballarat connecting two new 1,000 MVA 500/220 kV transformers at Ballarat.

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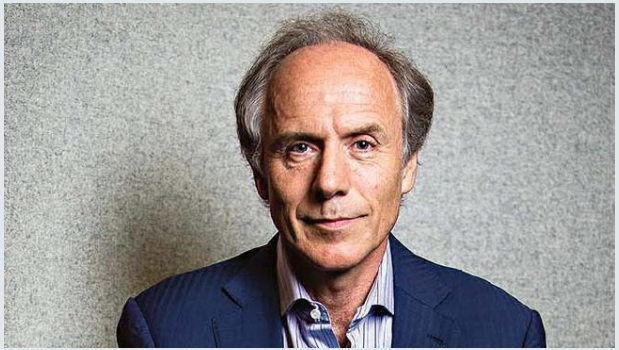
# Integrated System Plan

Elijah Pack – Manager National Planning (AEMO)

May 2019

# The Finkel Review

- Independent Review into the Future Security of the National Electricity Market
- 49 out of 50 recommendations accepted by COAG
- Clean Energy Target still being debated
- 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.

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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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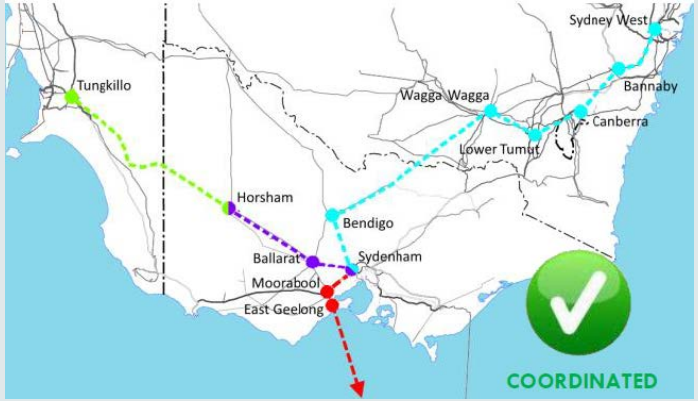
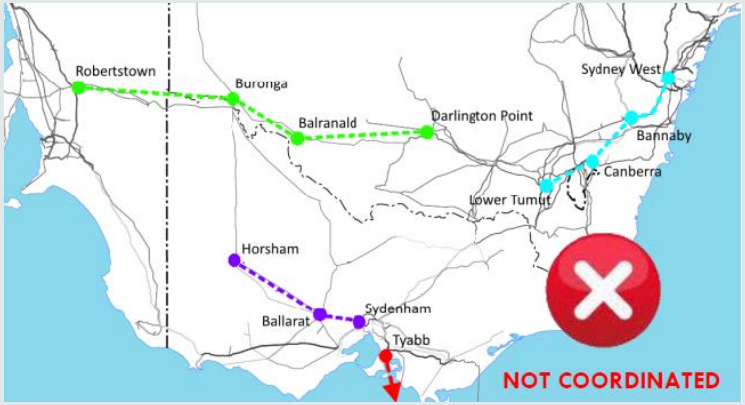
# Jurisdictional Planning Coordination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# Power System Requirements

## Operability

- Dispatchability
  (Controllability, Firmness, Flexibility)
- Predictability

## Technical

- Resource adequacy and capability
- Frequency management
- Voltage management
- System restoration


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# Technical Requirements

“

*Modern power systems are giant, multi-faceted machines. To operate the complex ‘system of systems’ in Australia’s National Electricity Market (NEM), AEMO oversees in aggregate millions of separate electricity supply and demand decisions in real time, all day, every day.*

– Power System Requirements (AEMO)

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# Where can these system services come from?

| Service description | | | | Supply side | | Network | | | | | | Demand side | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Centralised generation | | Transfer between regions | | Transfer within regions | Stabilising devices | | | Load | Decentralised resources | |
| System Attribute | Requirement | Service | Spatial level of need | Synchronous generator | Non-synchronous generator | DC interconnection | AC interconnection | Transmission and distribution networks | Grid reactor, grid capacitor, static VAR compensator | Static synchronous compensator | Synchronous condenser [1] | Large industrial, residential, commercial | Solar PV | Battery storage |
| Resource adequacy | *Provision of sufficient supply to match demand from customers* | Bulk energy | System wide | ● | ● | ➔ | ➔ | ➔ | ○ | ○ | ○ | ● | ● | ● |
| | | Strategic reserves | System wide | ● [2a] | ◐ [3a] | ➔ | ➔ | ➔ | ○ | ○ | ○ | ● | ◐ [3b] | ◐ [3b] |
| | *Capability to respond to large continuing changes in energy requirements* | Operating reserves | System wide | ● [2b] | ◐ [3a] | ➔ | ➔ | ➔ | ○ | ○ | ○ | ● | ◐ [3b] | ◐ [3b] |
| | *Services to transport energy generated to customers* | Transmission & distribution services | Local | ● [4] | ● [4] | ● | ● | ● | ● | ● | ● | ● [4] | ◐ | ◐ |
| Frequency management | *Ability to set frequency* | Grid formation | Regional | ● | ◐ [5] | ⇨ [5] | ● | ● | ○ | ○ | ○ | ○ | ○ | ◐ [5] |
| | *Maintain frequency within limits* | Inertial response | Regional | ● | ◐ [6] | ◐ [6] | ➔ | ➔ | ○ | ◐ [7] | ● | ○ [8] | ○ | ◐ [6] |
| | | Primary frequency control | Regional | ● | ● [9] | ➔ | ➔ | ➔ | ○ | ○ | ○ | ● | ● | ● [9] |
| | | Secondary frequency control | Regional | ● | ● [9] | ➔ | ➔ | ➔ | ○ | ○ | ○ | ● | ● | ● [9] |
| | | Tertiary frequency control | Regional | ● | ● [9] | ➔ | ➔ | ➔ | ○ | ○ | ○ | ● | ● | ● [9] |
| Voltage management | *Maintain voltages within limits* | Fast response voltage control | Local | ● | ● | ● | ○ | ○ | ● | ● | ● | ● | ◐ | ● |
| | | Slow response voltage control | Local | ● | ● | ● | ○ | ○ | ● | ● | ● | ● | ◐ | ● |
| | | System strength | Local | ● | ○ | ○ | ⇨ | ➔ | ○ | ○ | ● | ○ | ○ | ○ |
| System restoration | *Ability to restore the system* | System restart services | Local | ● | ◐ [10] | ◐ [10] | ● | ➔ | ○ | ○ | ○ | ○ | ○ | ◐ [10] |
| | | Load restoration | Local | ● | ● | ● | ● | ⇨ | ● | ● | ● | ● | ◐ | ◐ |

# Scenarios and sensitivities

The ISP focuses on seven scenarios/sensitivities:

- **Two base cases**:
  - Neutral, and Neutral with storage initiatives.
- **Three additional scenarios**:
  - Slow change, Fast change, and High DER.
- **Two additional sensitivities** to explore key opportunities or risks:
  - Increased role for gas, and Early exit of coal-fired generation.

# Key inputs

## Resource Quality

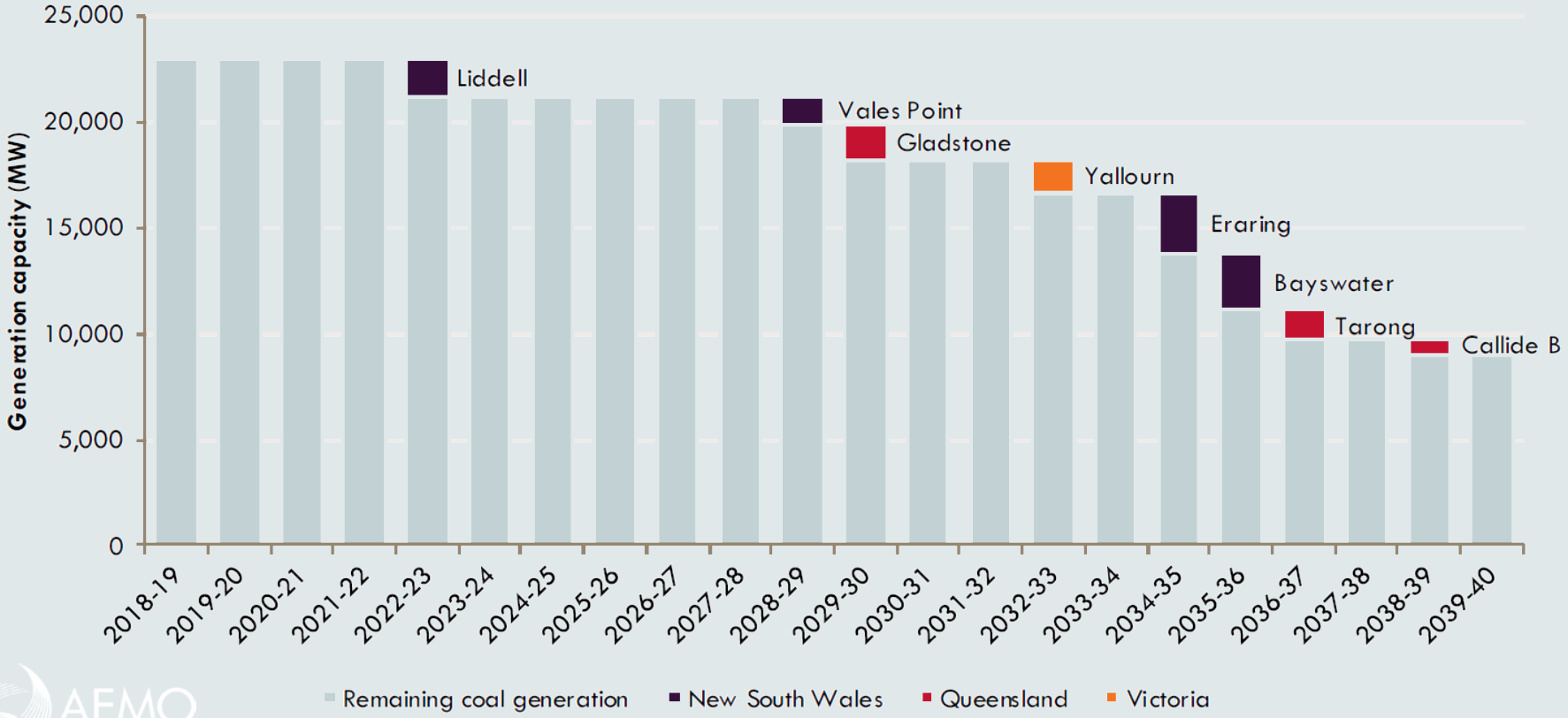
- Wind and solar resource data from DNV-GL

## 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

# Key Inputs – NEM Energy Consumption

# Key Inputs – Coal fleet operating life




*Note: Data is based on announced closure dates, assumption based on age and coal type, and mine rehabilitation guarantees.*

# Network constraints

Network limits

- Thermal capacity
- Voltage stability
- Transient stability
- Oscillatory stability
- Rate of change of frequency
- System strength and fault levels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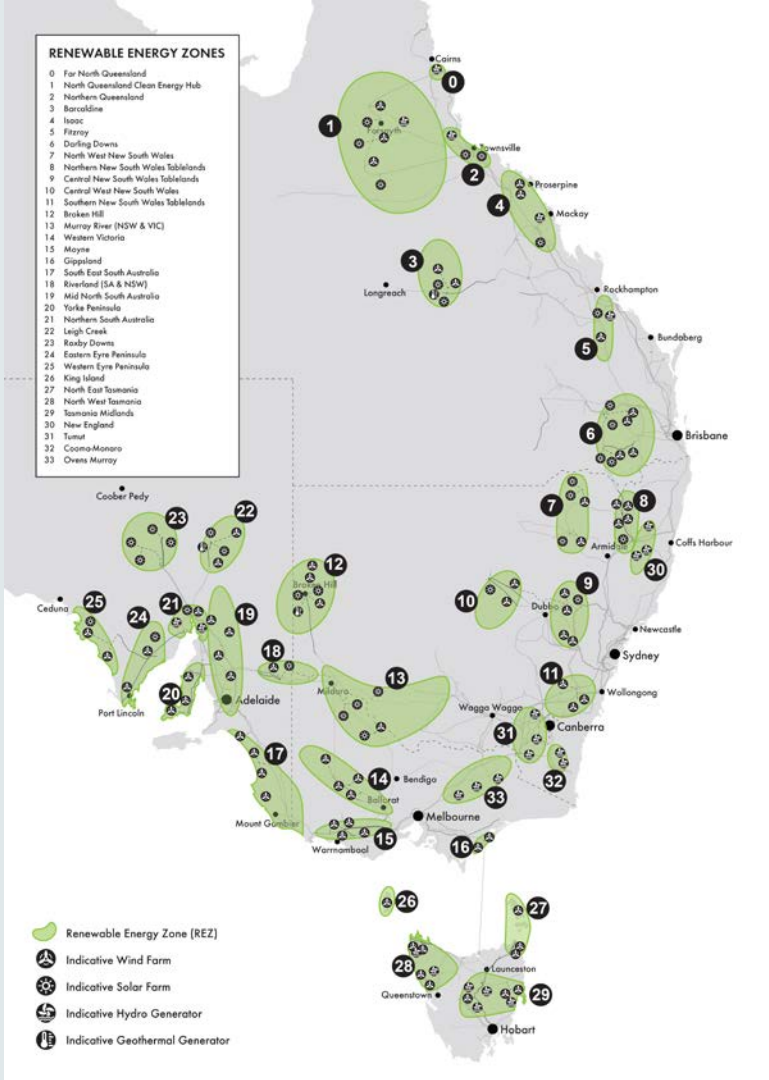
# REZ Candidates

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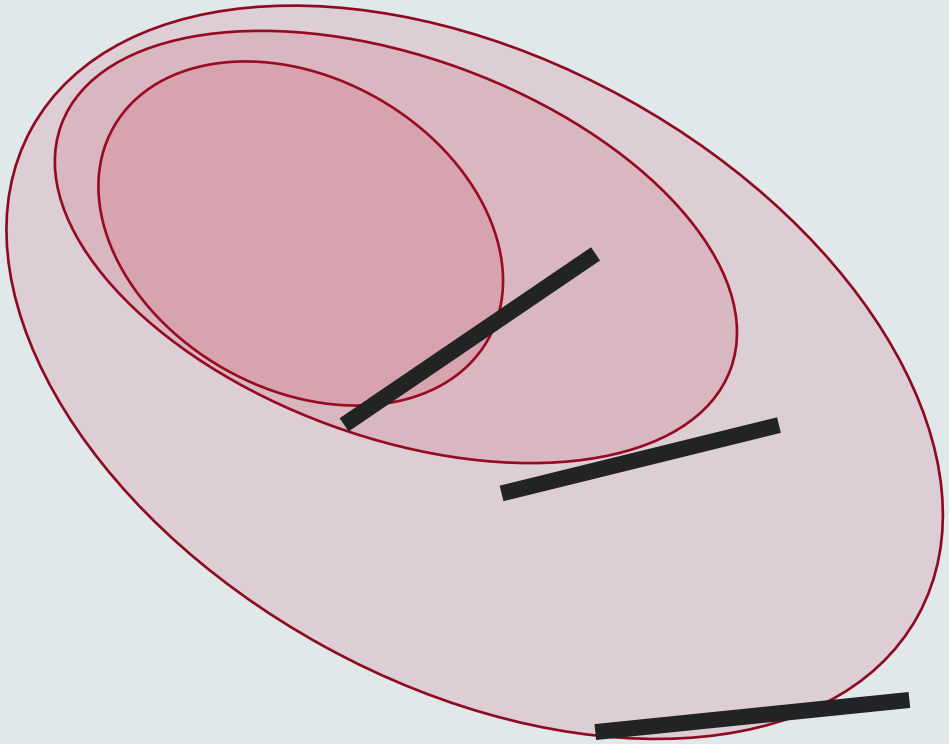
# Scale – deep network upgrades

**RENEWABLE ENERGY ZONES**

0 Far North Queensland
1 North Queensland Clean Energy Hub
2 Northern Queensland
3 Barcaldine
4 Isaac
5 Fitzroy
6 Darling Downs



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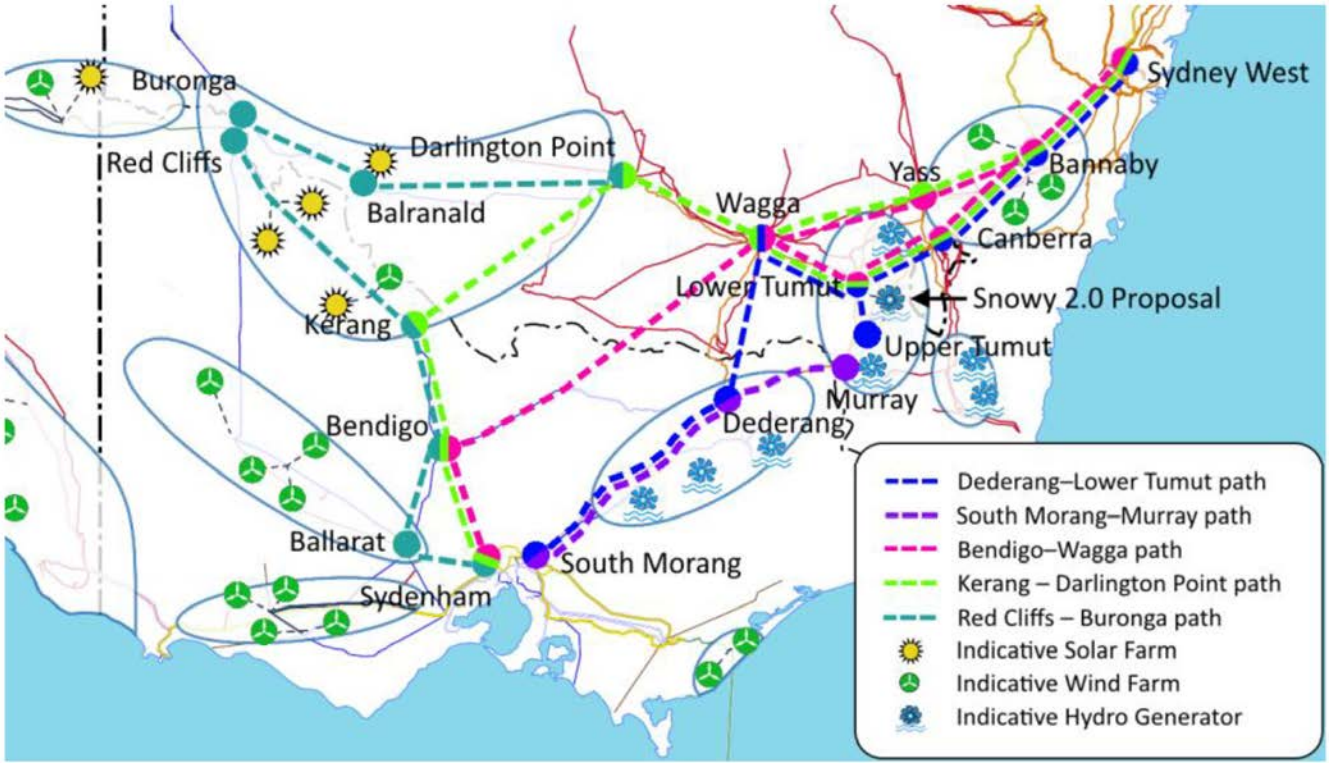
# Victoria to NSW options

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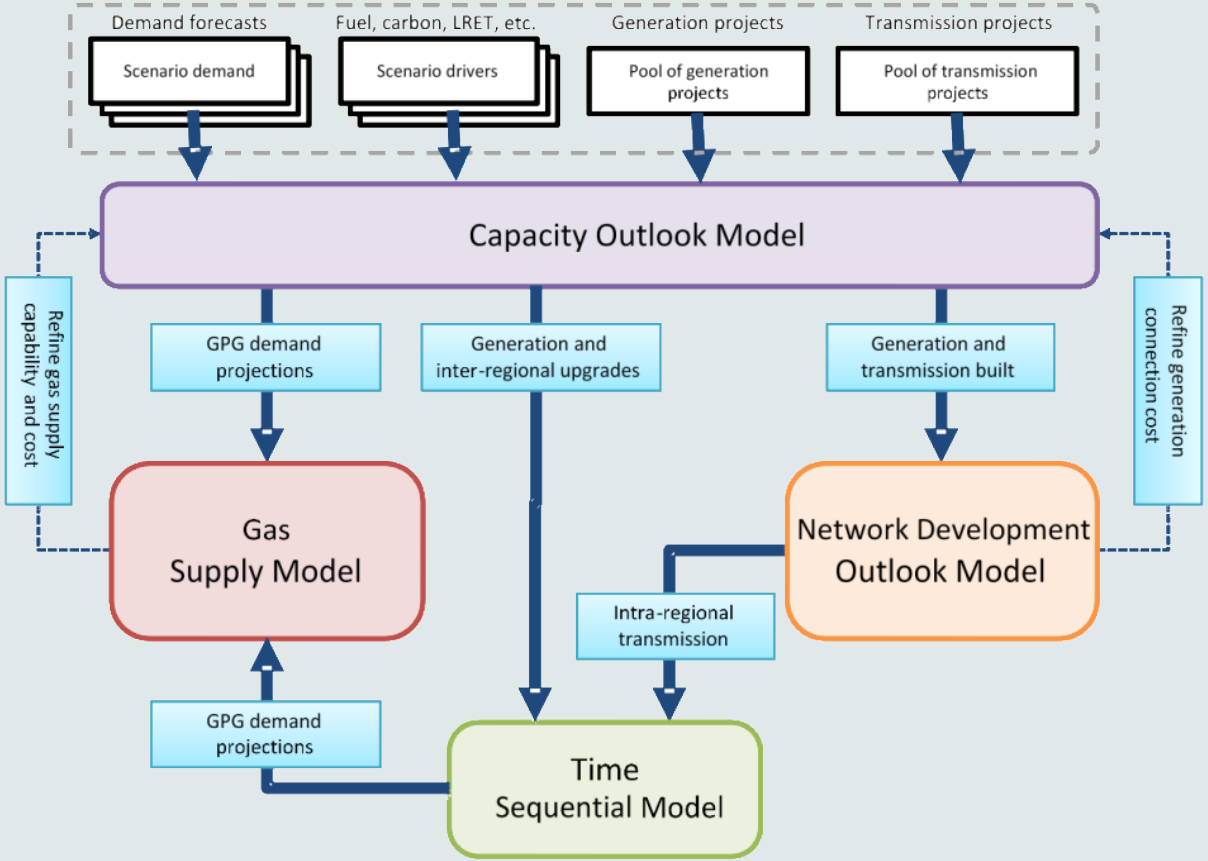
# ISP modelling process

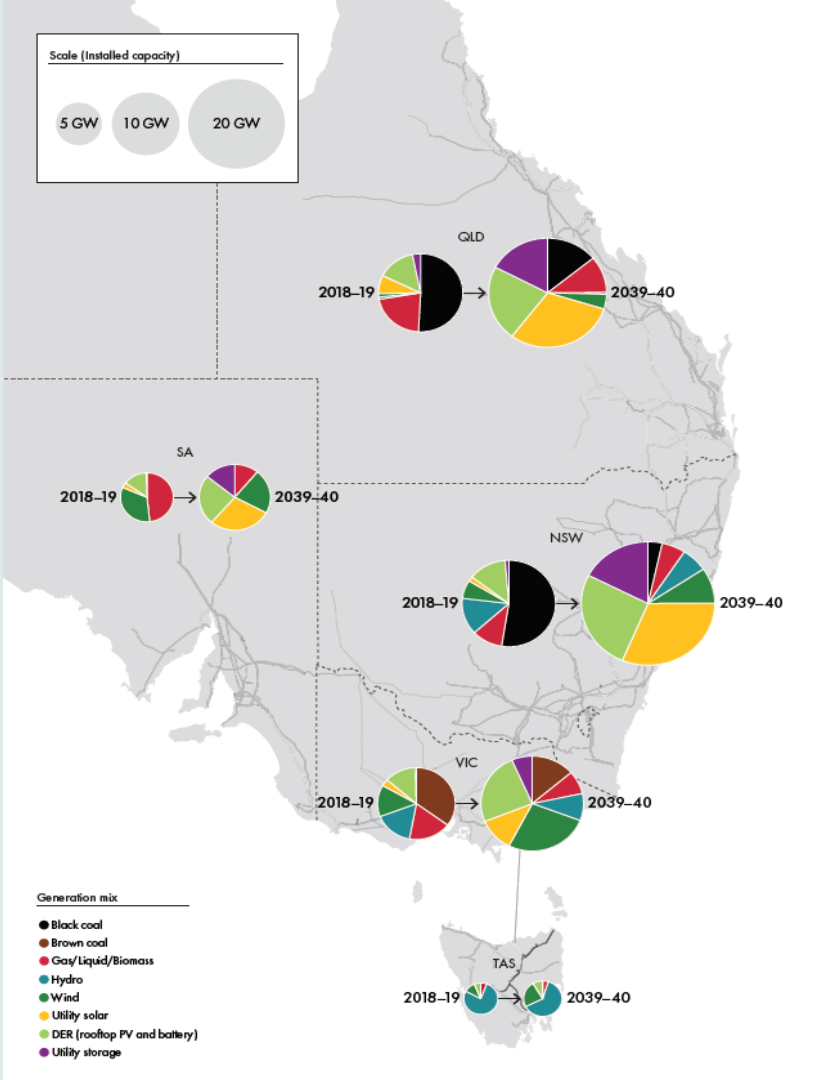


# A few key insights

- 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.

# Projected change in resource mix

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

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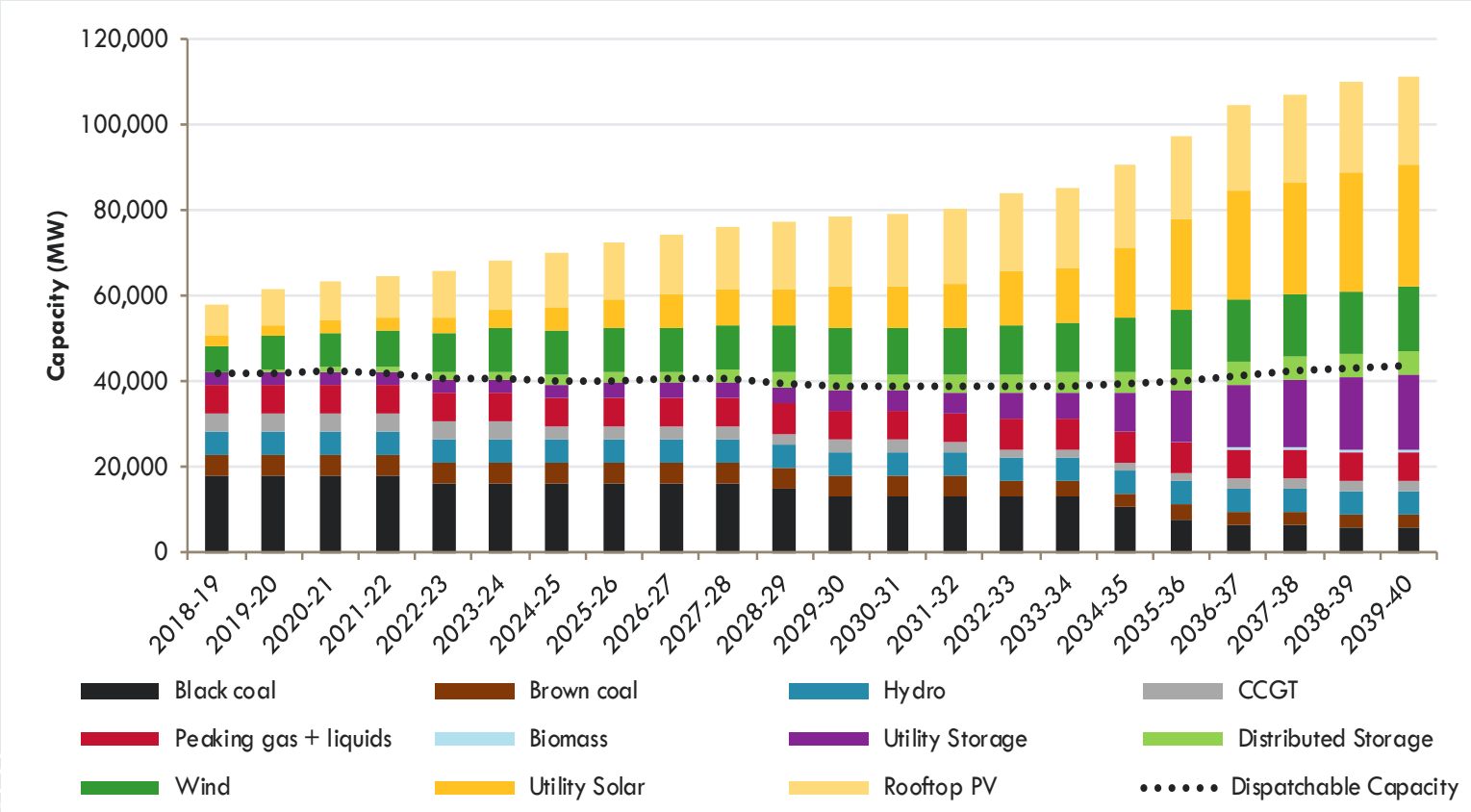
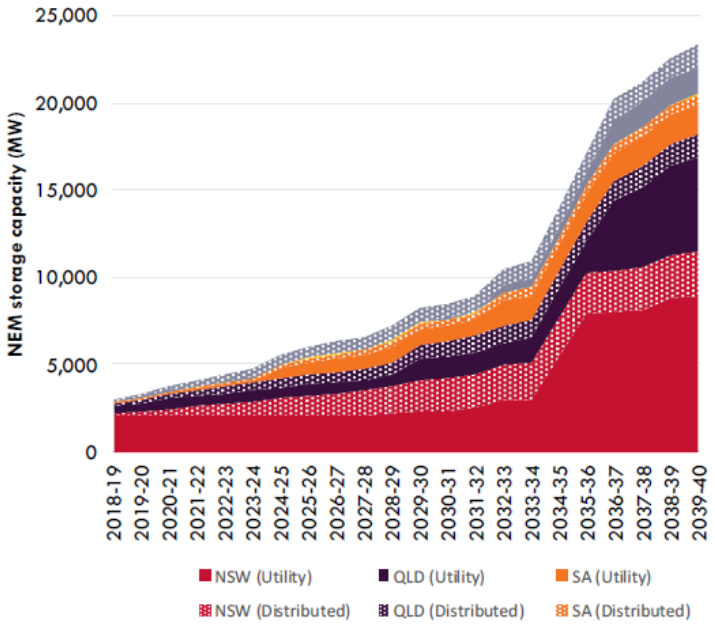
# NEM Energy Outlook (Results)

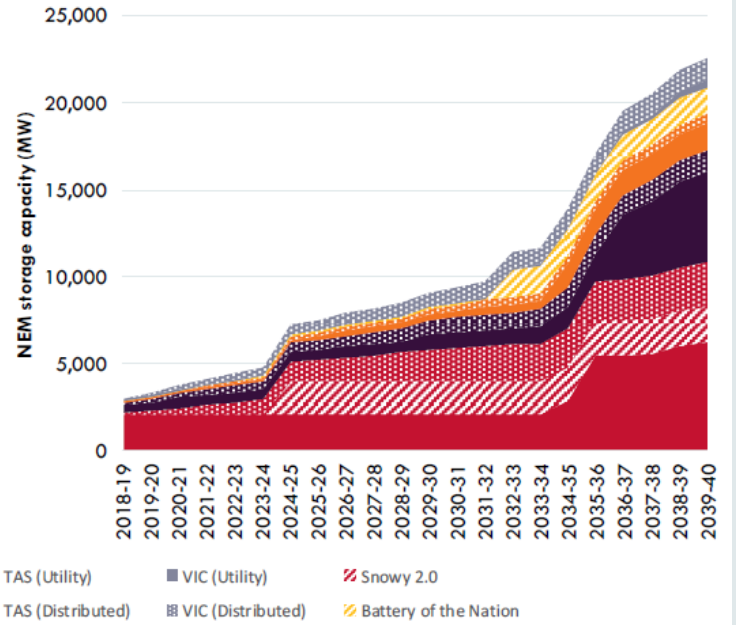


# Growing need for energy storage

Neutral




Neutral with Storage Initiatives

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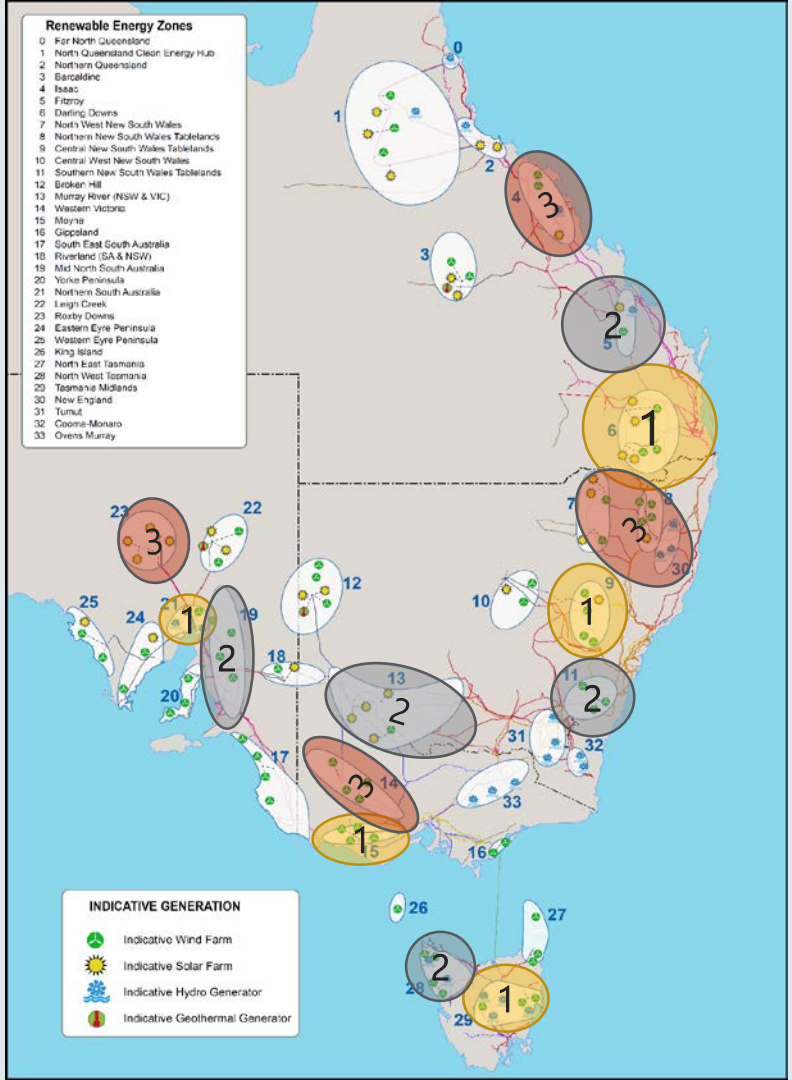
# Selection – REZ Priority Assessments

Candidate REZs for prioritisation

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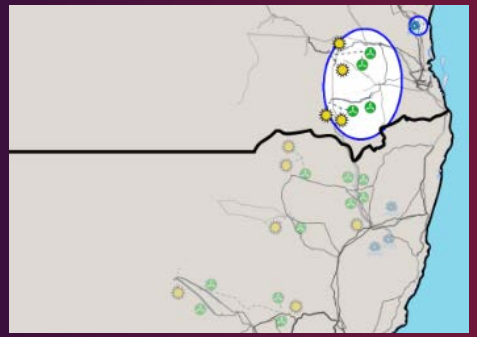
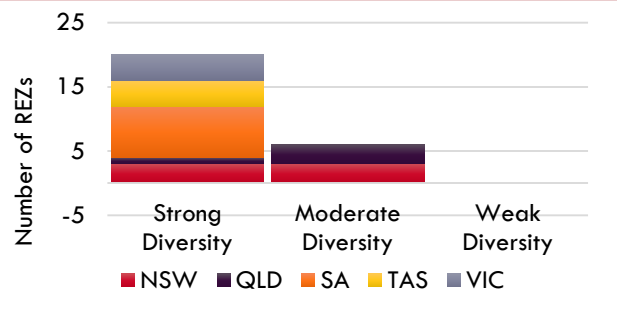
# Example – Darling Downs



The Darling Downs REZ covers a wide area of South West Queensland (SWQ). The existing network is strong and could support around 3,000 MW of new generation without requiring major upgrades. The MLFs are robust.

| Renewable Resources | Solar | Wind | Diversity of Wind with other REZs |
|---|---|---|---|
| Resource Quality | C | B |  |
| Potential (MW) | 4,000 | 2,785 | |
| Diversity | F | B | |
| Demand Matching | | | |
| Now | D | D | |
| 2030 | F | B | |
| 2040 | F | B | |



| Network Limitations | Existing | Upgraded | Network Description |
|---|---|---|---|
| Network Capacity (MW) | 3,000 | - | The existing network is strong and around 3,000 MW of new generation could be connected without requiring major upgrades. The MLFs are robust compared to the other Queensland REZs, because this REZ is located near the 330 kV interconnector to New South Wales and the South East Queensland load centre. Long-term modelling identified retirement of 1,400 MW of coal-fired generation in the SWQ zone from 2037. This would enable additional solar generation to connect in Darling Downs REZ within the existing transmission capacity. |
| Initial Loss Factor | B | - | |
| Loss Factor Robustness | A | - | |

| Long-Term Market Simulation Scenarios | Neutral | Neutral with Storage | Slow | Fast | High DER |
|---|---|---|---|---|---|
| Generation Built (MW) | 3,400 | 3,400 | 2,700 | 4,700 | 3,000 |
| Timing | >2040 | >2040 | >2040 | >2040 | >2040 |

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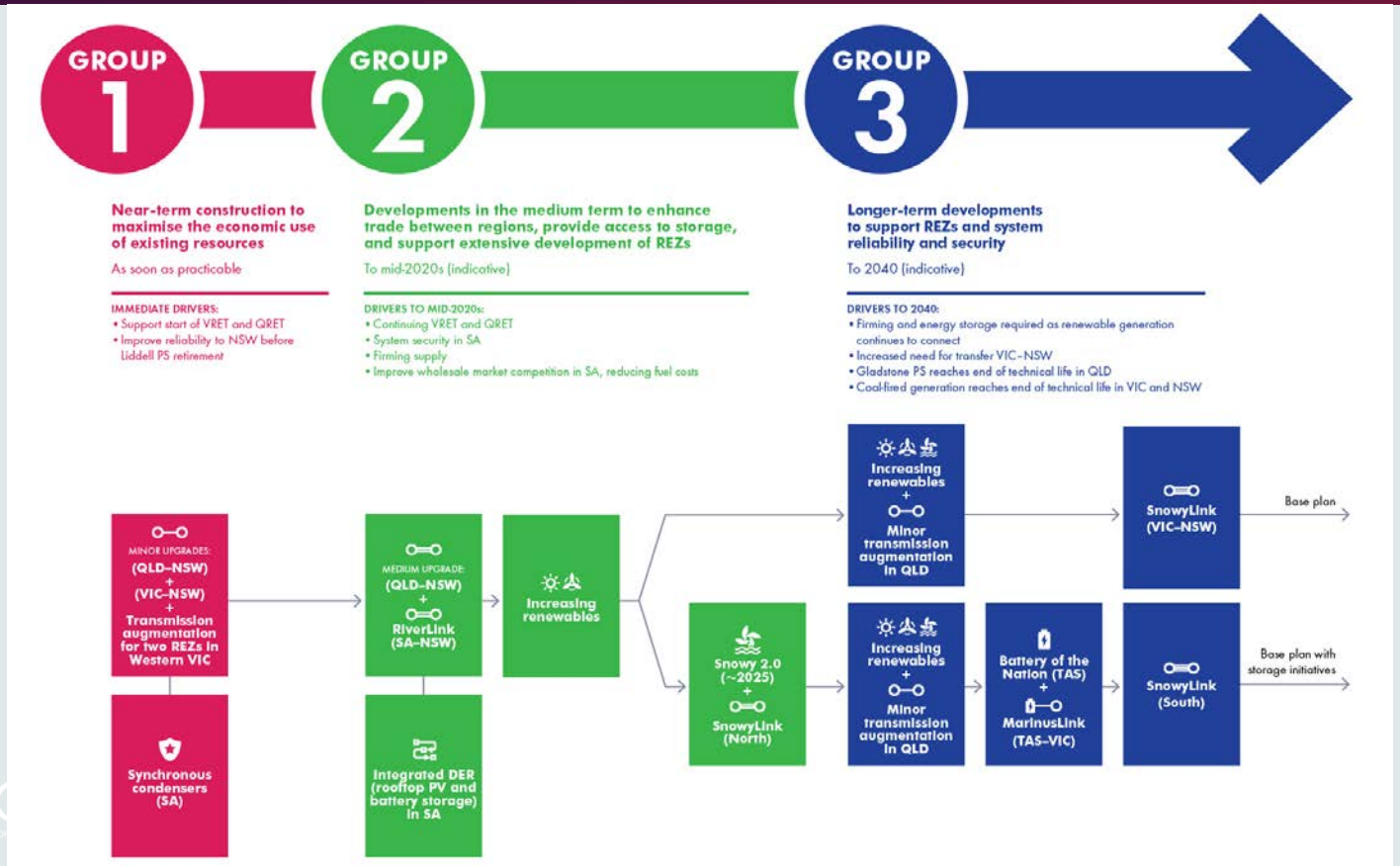
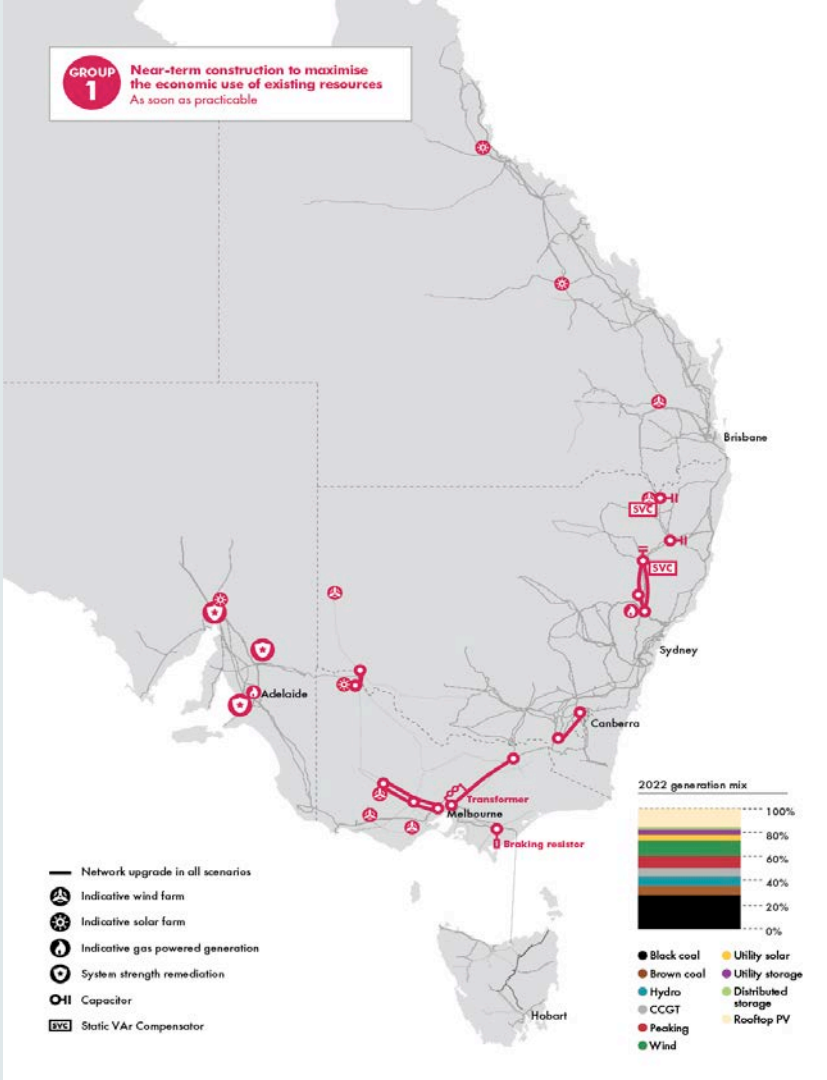
# 20 year integrated development plan



# Group 1

## Near-term construction

Maximise economic use of existing resources

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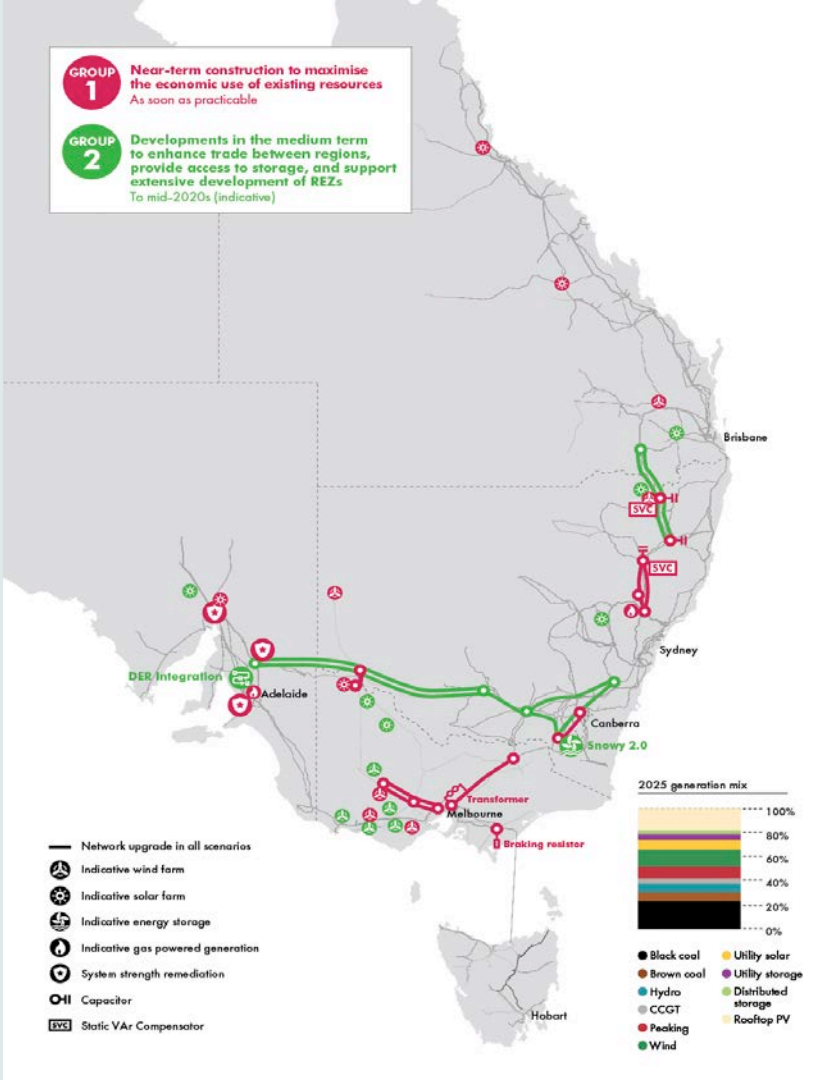
# Group 2

## Developments in the medium term

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

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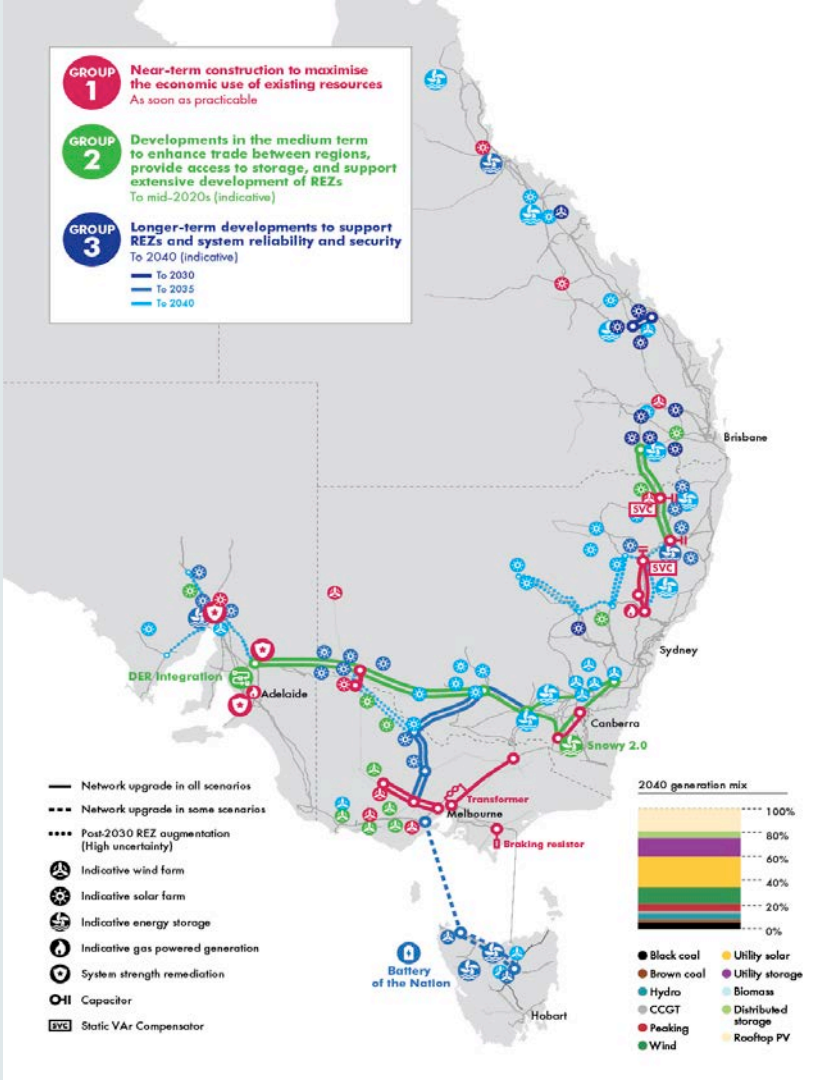
# Group 3

## Longer-term developments

Support REZs and system reliability and security

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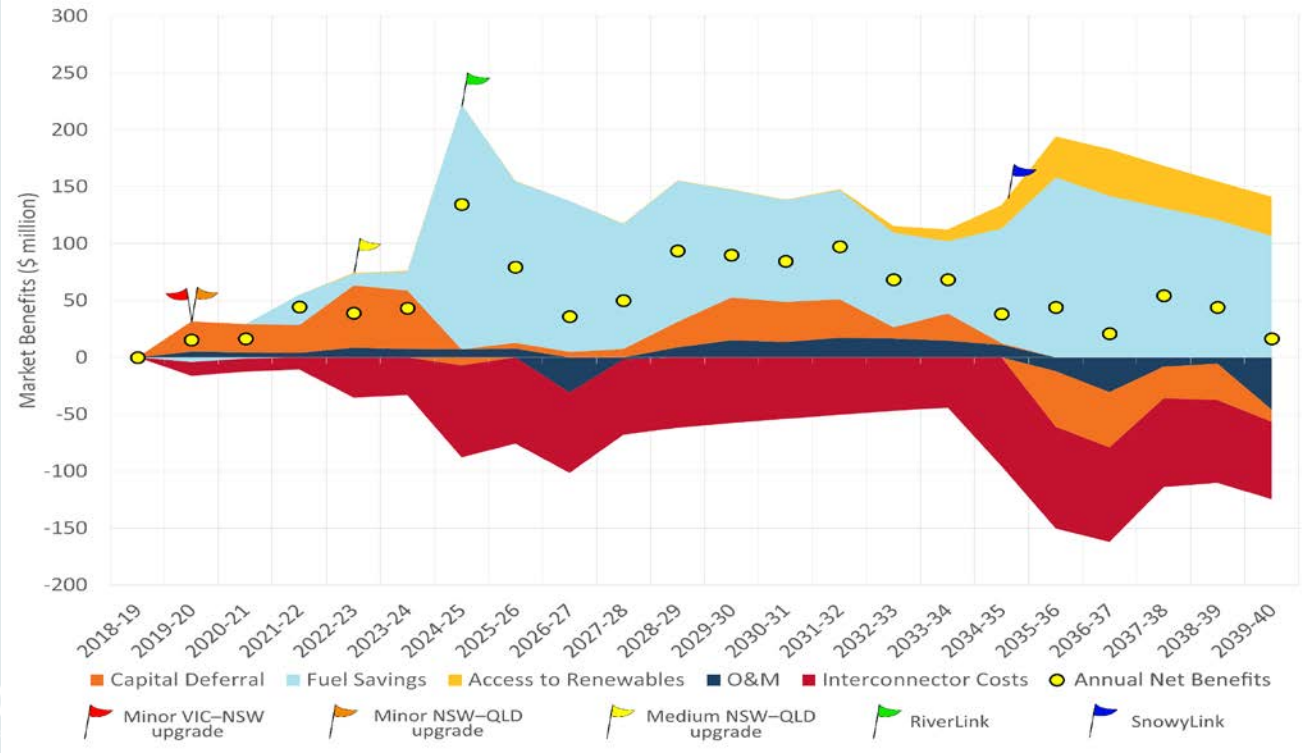
# Economic assessment - Neutral

Present value of market benefits for Base development plan (Neutral)



# Early coal exit

| Risk | Interconnector upgrades | 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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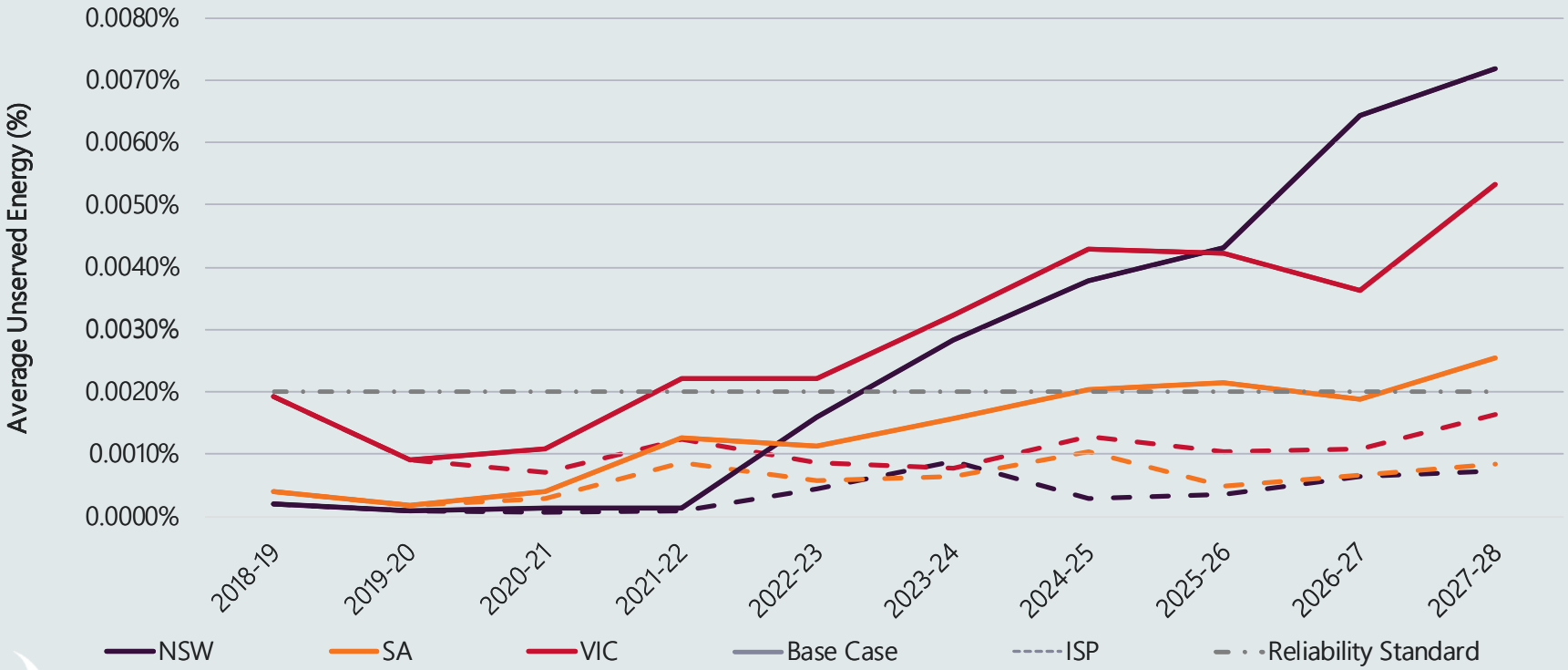
# Reliability outlook



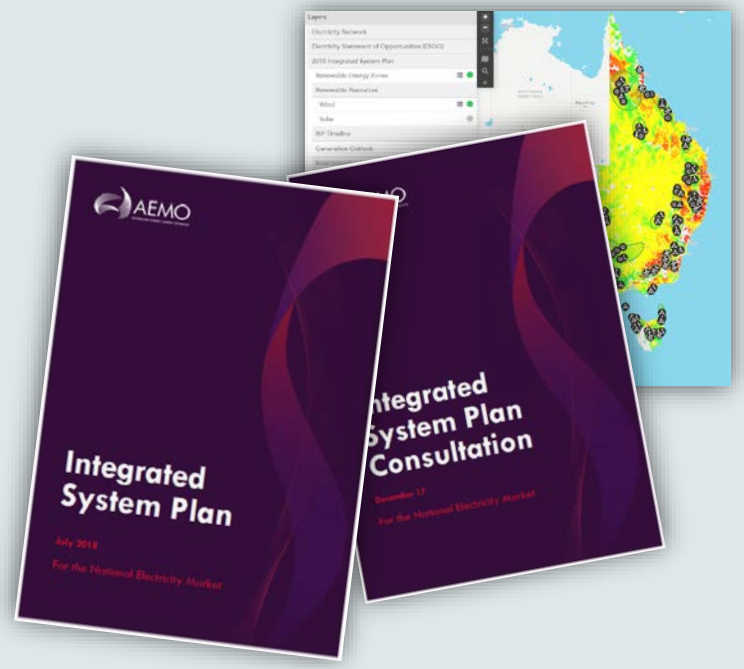
# ISP Published

**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



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# Status Update on IGP Working Groups

***SCWG – Model GSPA filed on March 29, 2019 for Commission approval.***

***CPWG Meeting 2 – April 16, 2019:***

*CPWG Scope, Deep Dive on Current Procurement Processes, examine examples of other utility competitive procurement processes; identify any "best practices" trends and learning*

***Upcoming CPWG Meeting 3 – June 25, 2019 morning:***

*Examine and discuss relevant feedback and learnings from other Working Groups; Deeper discussion of Competitive Bidding Framework*

***Upcoming SEOWG Meeting 1 – May 9:***

*Kick-off Meeting & Overview of IGP, SEOWG challenges and key issues, prioritization of topics*

# Status Update on IGP Working Groups

***Upcoming FAWG Meeting 2, 3 – May 22-23, 2019:***

*Panel discussion on DER, EoT, energy efficiency and demand response to support the development of assumptions*

***Upcoming Resilience WG Meeting 1 – end of May/early June:***

*Kick-off Meeting, working group purpose and composition, overall schedule*

***DPWG Meeting 3 – April 25, 2019 morning: Joint with GSWG regarding Soft Launch***

*Presentation of NWA analysis and the opportunity that will be made available through the soft launch RFP*

***Upcoming DPWG Meeting 4 – May 30, 2019: Joint with GSWG regarding Soft Launch***

*Review of the soft launch RFP with stakeholders*

# Next Steps

- Next meeting – August 21, 2019
- Follow-up questions …
  - Email: IGP@hawaiianelectric.com
  - Colton Ching @ 543-7986 or Lisa Giang @ 543-7982

# Mahalo!


Hawaiian Electric
Maui Electric
Hawai'i Electric Light