Integrated System Plan:

Preliminary modelling outcomes workshop

10 October 2019

Workshop Agenda

Welcome & Overview **35 min**

- Context for developing the Integrated System Plan
- Purpose and approach for today's workshop
- Overview of stakeholder engagement

Update & Workshop 1 **95 min**

- What's changed since 2018 ISP
- Changing energy resources
- Group activity and report back

Morning tea break **20 min**

Update & Workshop 2 **75 min**

- Preliminary Grid Outcomes
- Group activity and report back

Final feedback and Next steps **10 min**

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Welcome & Overview

- Context
- Purpose and objectives
- Recap of the 2019-20 ISP work program

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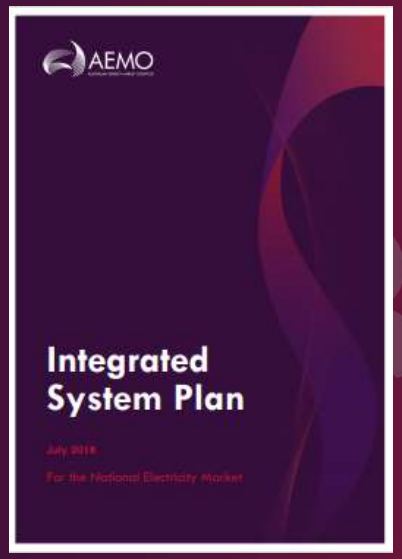
Integrated System Plan



The 2020 Integrated System Plan (ISP) will provide actionable roadmap for navigating Australia's secure and reliable energy future. Its objectives are to*:*

1. **Maximise value to energy customers** by designing a future-oriented system that minimises total system-cost, enhances optionality to manage key risks and uncertainties and to adapt to possible policy choices.

2. **Leverage existing technologies and emerging innovations** in customer-owned distributed energy resources (DER), virtual power plants (VPP), large-scale generation, energy storage, networks, and coupled sectors such as gas, water and the electrification of transport

3. **Inform and engage** policy makers, investors, customers, researchers and other energy stakeholders in navigating the transition of Australia's future system.

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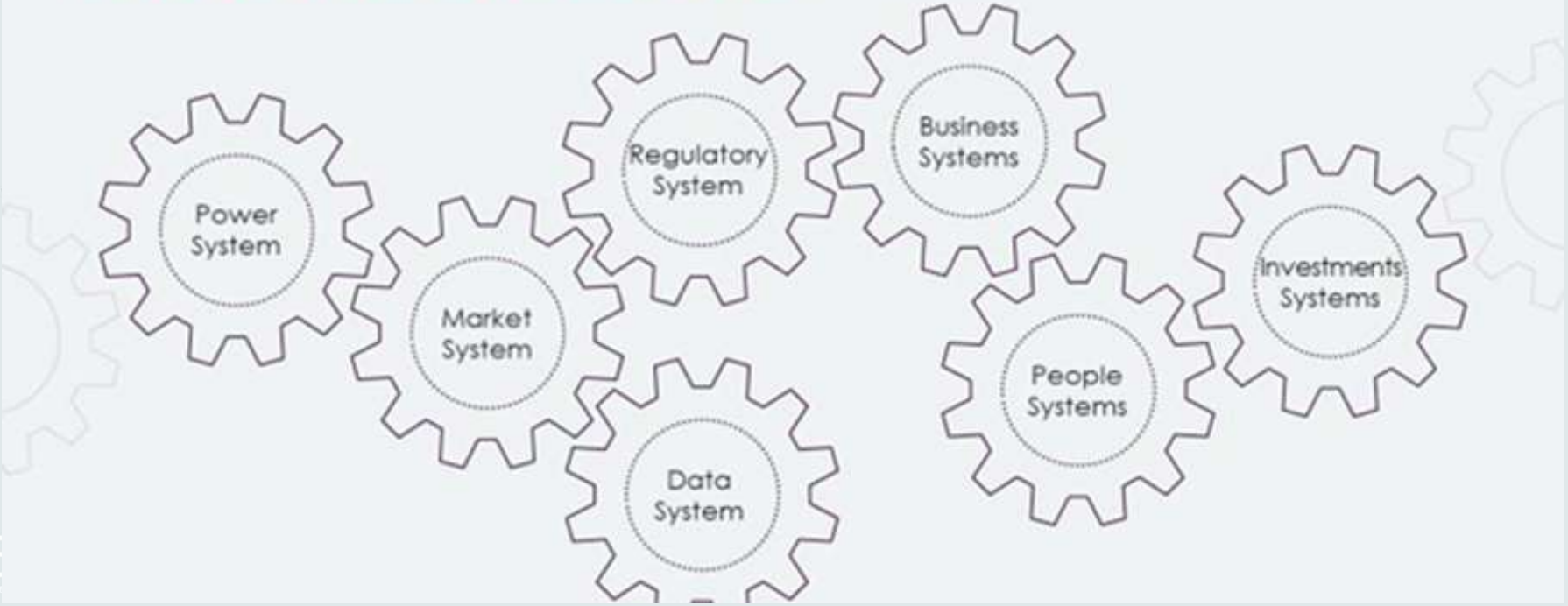
A whole of system plan

Applying 4th revolution approaches

Adopting a system of systems approach



Workshop Objectives

Important part of the enhanced stakeholder engagement for this ISP (across AEMO sites):

- Provide stakeholders an overview of **preliminary outcomes** to date.
- Explore potential **gaps**, **inconsistencies** and **opportunities to improve**; seek **stakeholder input to modelling**.
- Invite stakeholder feedback on mechanisms for **maximising their informed engagement** through to the Final report in mid-2020.

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Workshop Logistics

With over 100 participants located across AEMO offices in Brisbane, Sydney, Melbourne and Adelaide (and some via VC), our approach:

- Will focus on **2 x update presentations** of the early stage modelling outcomes
- Each update will be followed by **breaking-out into workshop mode** at each of the individual sites (and online)
- Following each workshop session there will be a **national report back** from each site
- Due to logistics and time constraints, AEMO staff will endeavour to **answer questions locally** during the breakout sessions.

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Workshop Protocols

1. Be **future-oriented**: think with a 10-year+ perspective (i.e. avoid short-termism).
2. Engage as **Australians**: transcend purely proprietary interests.
3. Monitor your **mental models**: our patterns of thinking can unintentionally cripple creativity.
4. Provide **focused critique**: the modelling outcomes are preliminary and necessarily imperfect – AEMO wants your early feedback.
5. Focus in on the early **modelling outcomes** rather than inputs and scenarios developed with stakeholders over the last six months
6. Exercise **mutual respect**: diversity of perspective is critical to development of a robust 2020 ISP.

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Maximising your feedback

You should all have access to:

- An emailed copy of the slides
- A personal reflections / questions sheet

Please feel free to:

- Take a moment to familiarise yourself with the reflections / sheet now;
- Identify the workshop option you want to participate in (either A or B); and,
- During the presentations make notes on your observations that arise.

Please leave them on your table if you're happy for us collect them in between sessions.

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Stakeholder Engagement

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Recent Stakeholder Feedback

Recent feedback from a range of stakeholders:

- It's important to present the results relative to the 2018 ISP i.e. What's changed and why?
- Illustrate intra-day behaviour of storage usage, charging/discharging patterns
- Some perceived the 2018 ISP to be very transmission-centric and suggested greater prominence to storage, REZs and DERs.
- There is a desire to show timing of the projects in the 2020 ISP, or a range of timing across the scenarios
- A separate summary for policy makers would be welcomed
- The ISP development process can seem to some like a 'black box' and is not always well understood

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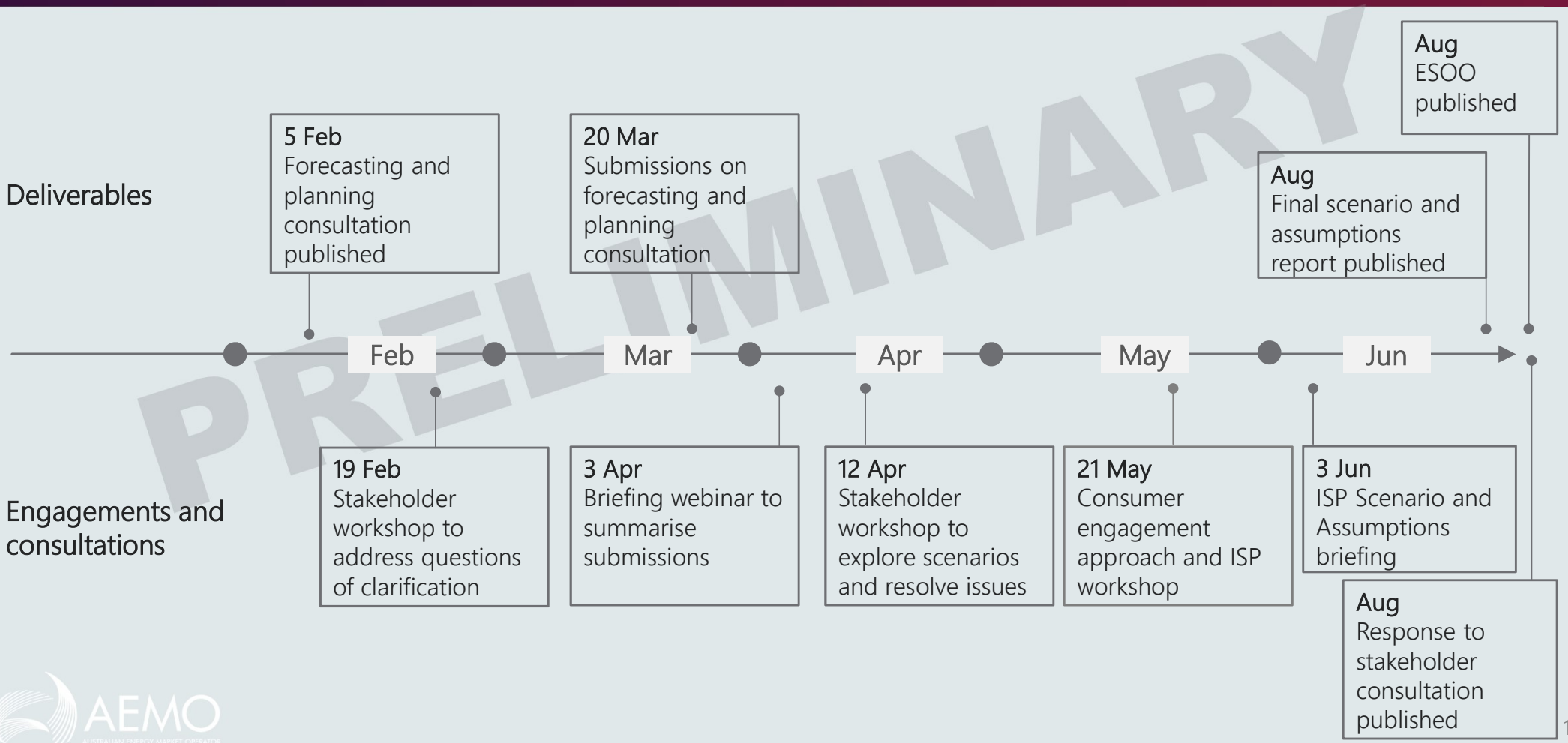
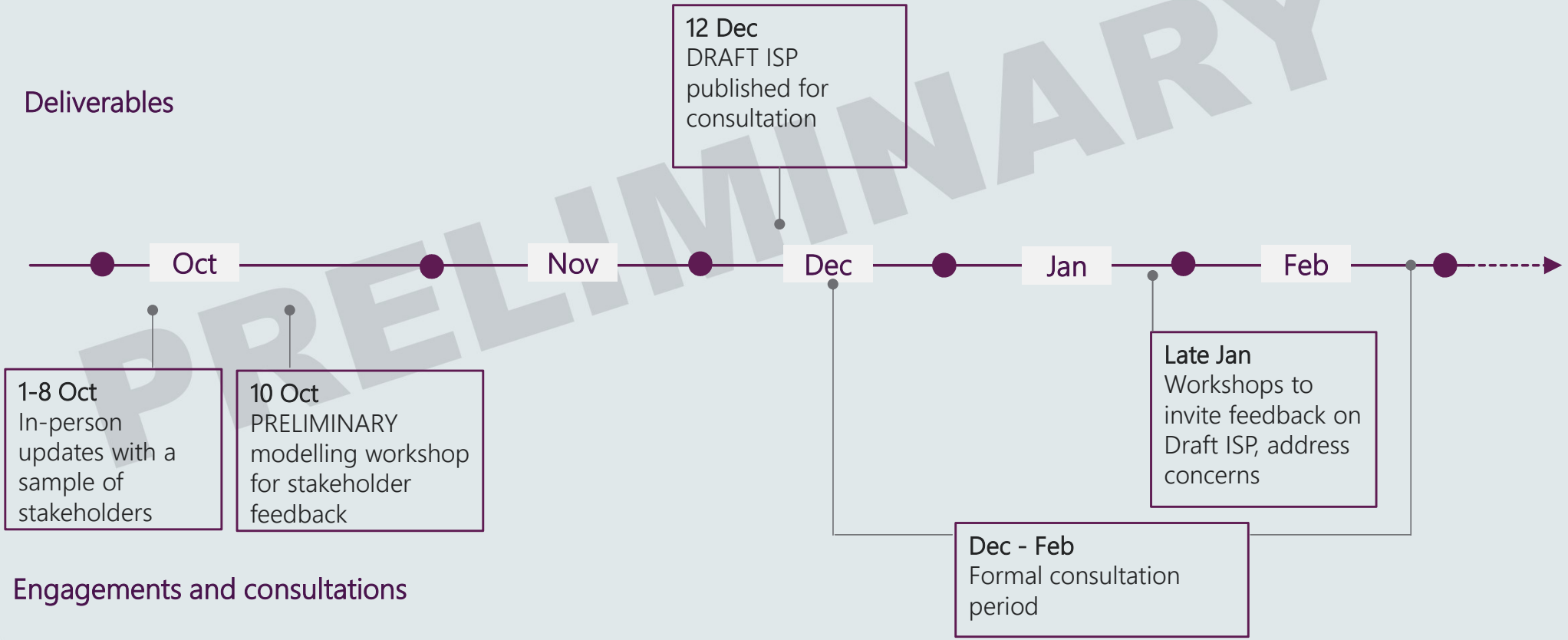
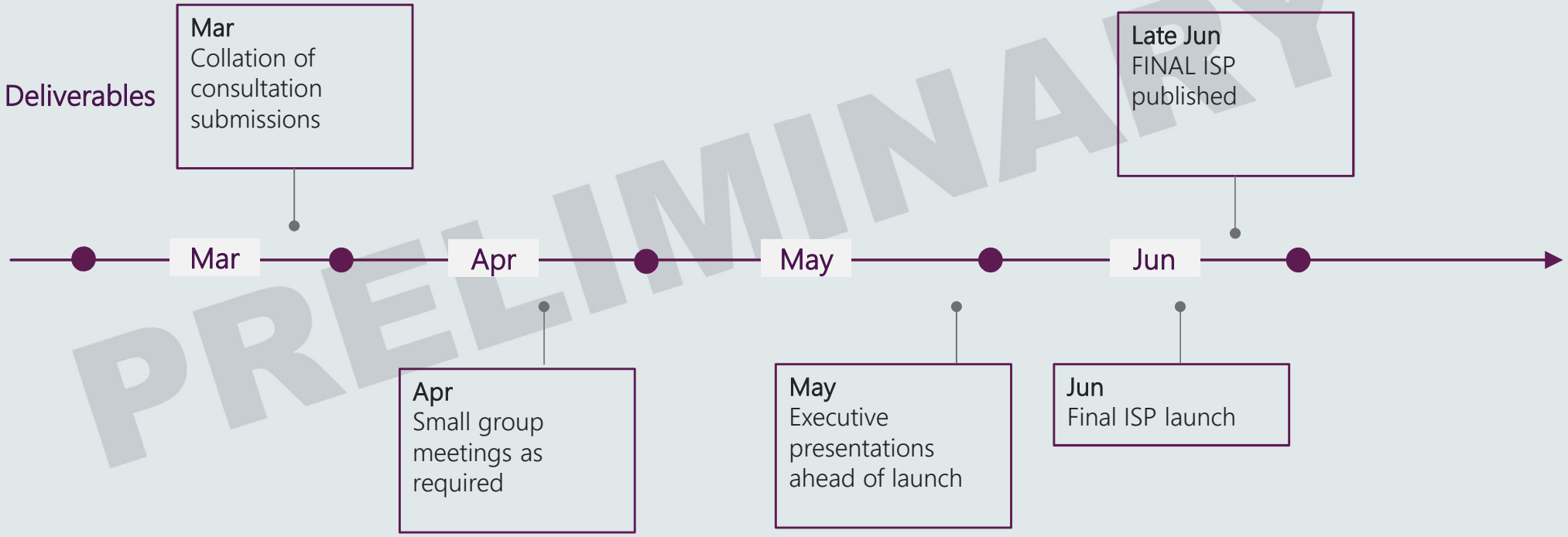
Stakeholder engagement and consultation process to date



2020 ISP stakeholder engagement plan – Events Oct 2019 to Feb 2020



2020 ISP stakeholder engagement plan – Events Mar – Jun 2020



Engagements and consultations

Update & Workshop 1:

- What has changed since the 2018 ISP?
- The changing energy resources of a future NEM

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Preliminary nature of the outcomes

- Our stakeholder engagement process strives for early and ongoing collaboration with a diverse range of national stakeholders throughout ISP development.
- The modelling presented is *early stage* and *preliminary*, and therefore subject to change.
- Your collaboration is essential to develop better outcomes for the draft ISP.

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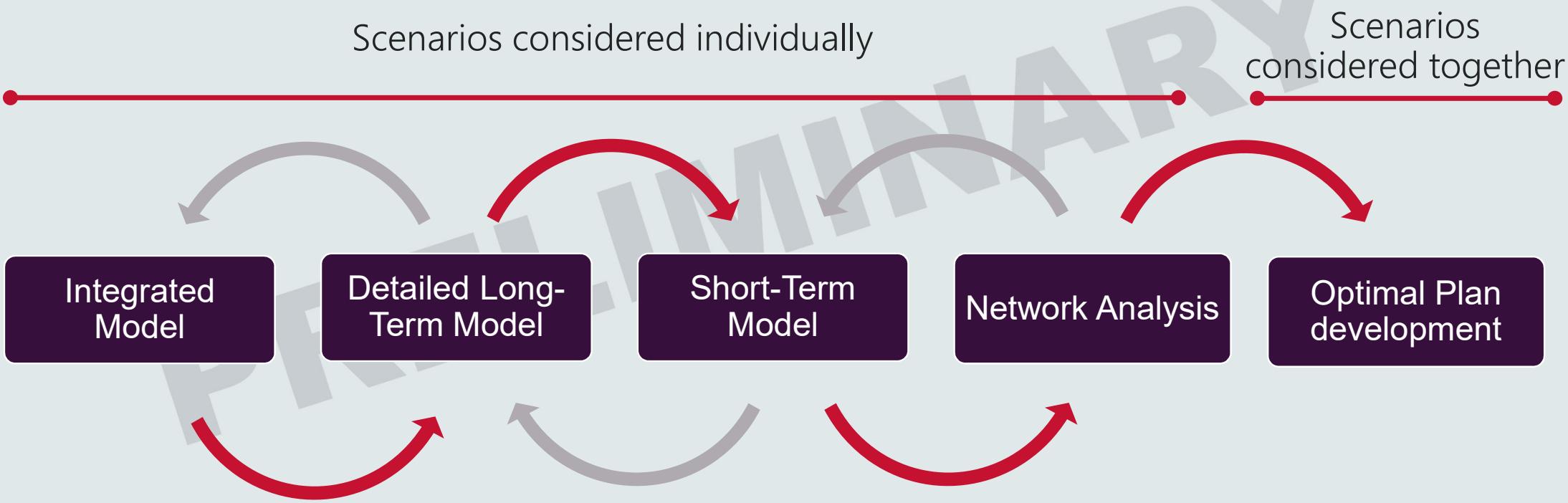
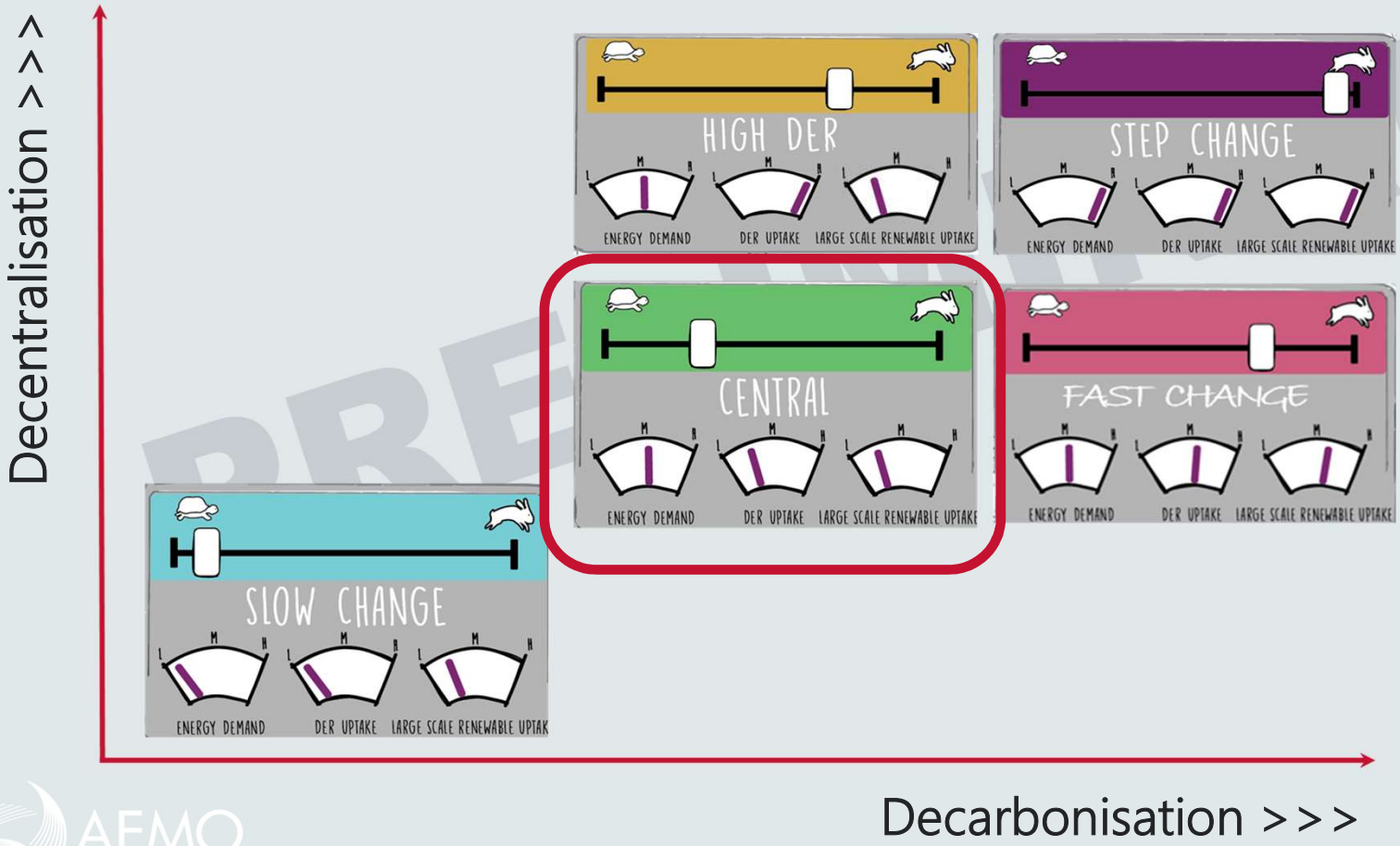
Modelling Stages



Iterative process required to **maximise value to energy customers** by designing a future-oriented system that minimises total system-cost and enhances optionality to manage key risks and uncertainties and to adapt to possible policy choices.

Five scenarios reflecting different rates of Decentralisation and Decarbonisation



Today's workshop focuses primarily on Central scenario

In ISP, there will be a strong focus on using scenarios and sensitivities to provide information on risks, resilience, and trade-offs

What's changed since the 2018 ISP?

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Key changes from 2018

1. Growth in demand for electricity
2. Broader DER considerations
3. Generator retirements
4. Technology costs

For comparison of demand forecasts:

- The 2018 ISP is based on 2017 Electricity Forecasting Insights (March Update)
- The 2019 ISP is based on the 2019 ESOO

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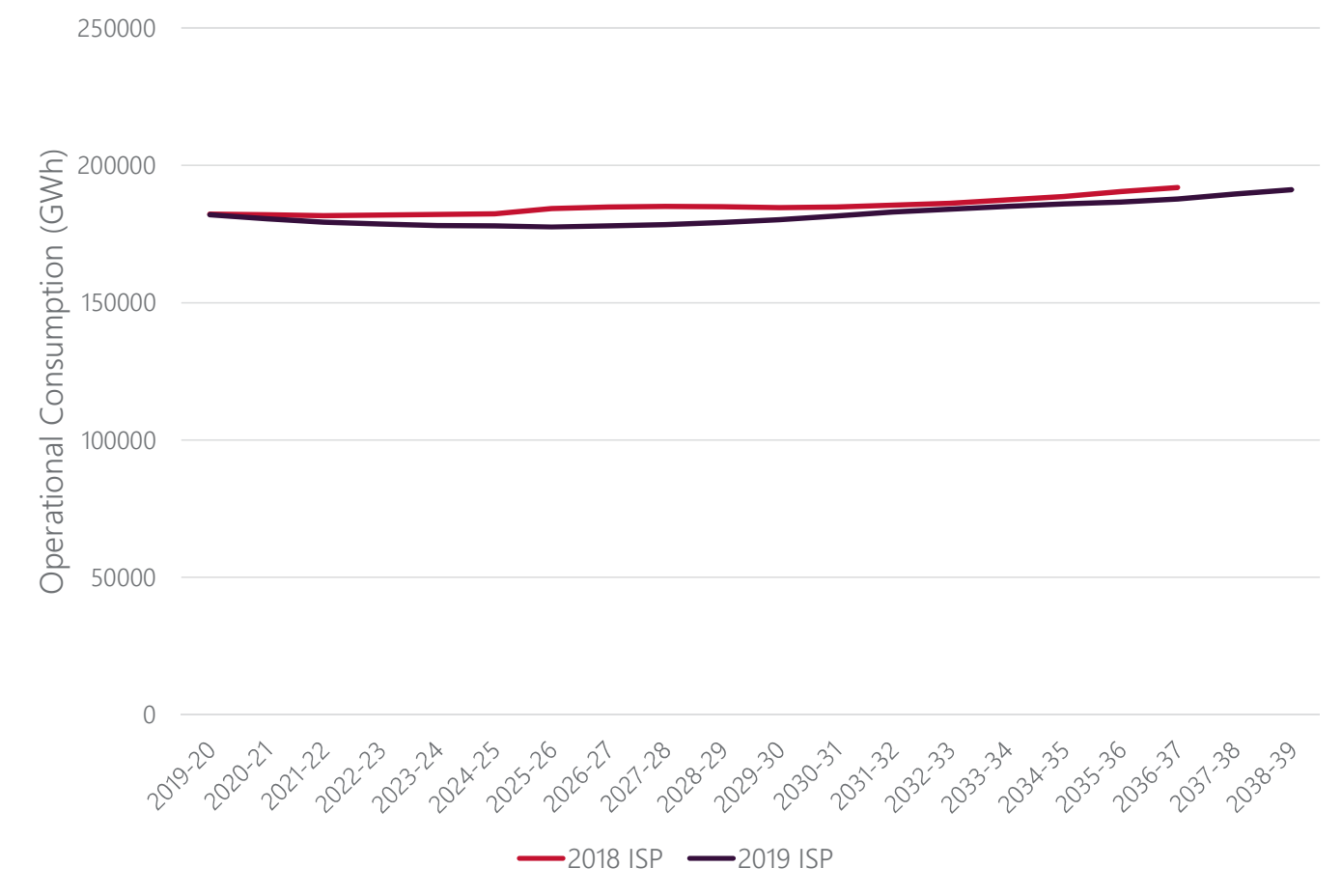
Energy conservation and efficiency has flattened the expected energy consumption



Generally, consumption and peak demand are no longer the drivers of future investment

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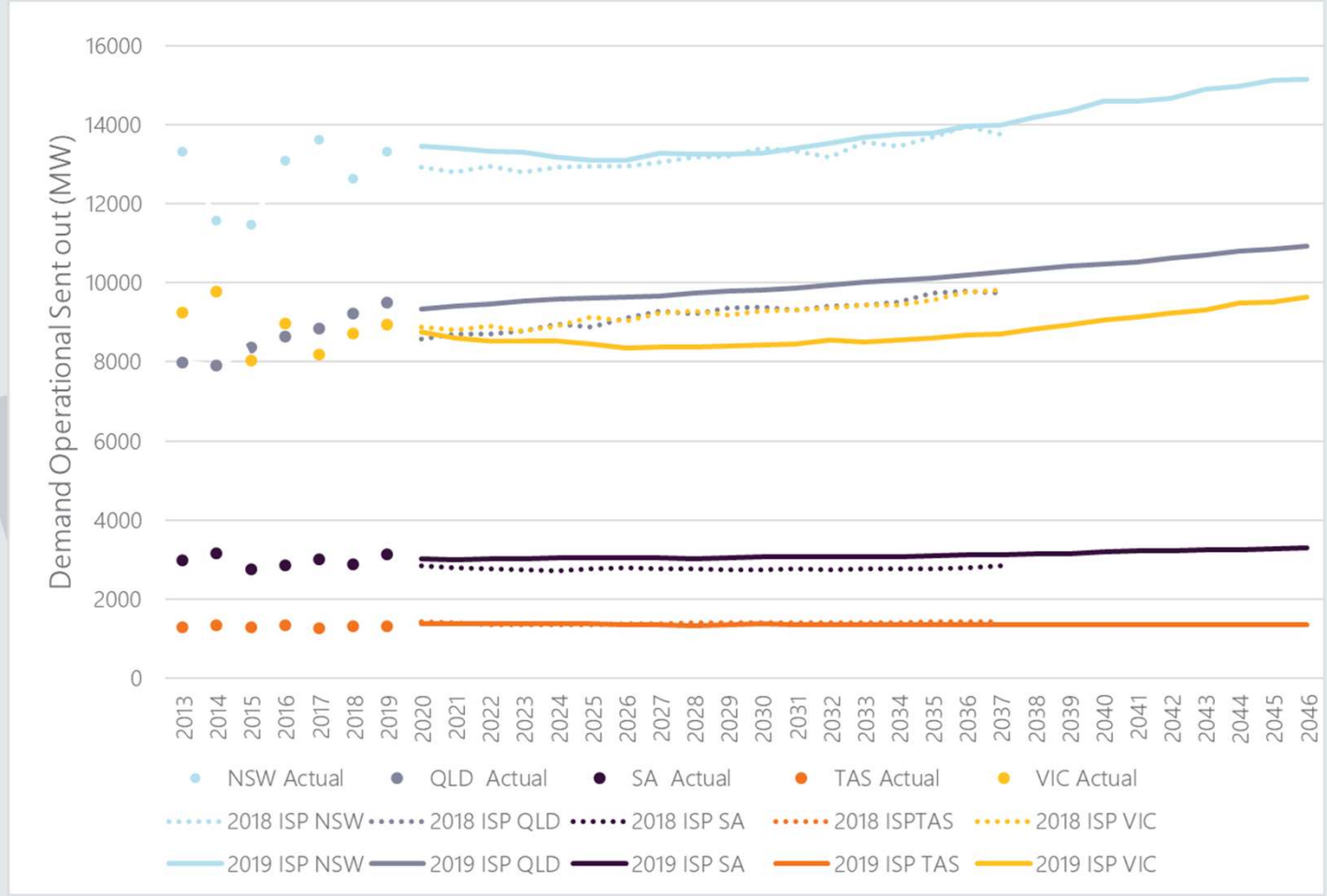
Peak demand and minimum demand expectations have shifted



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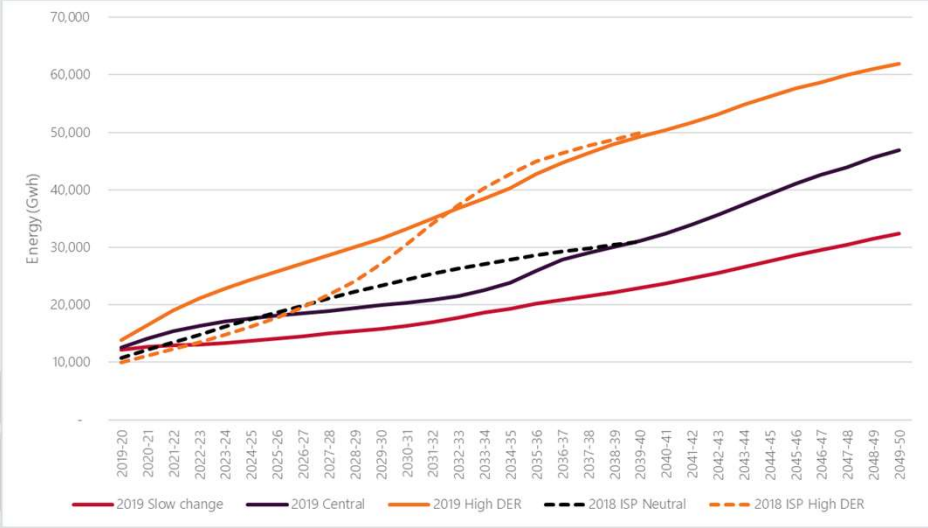
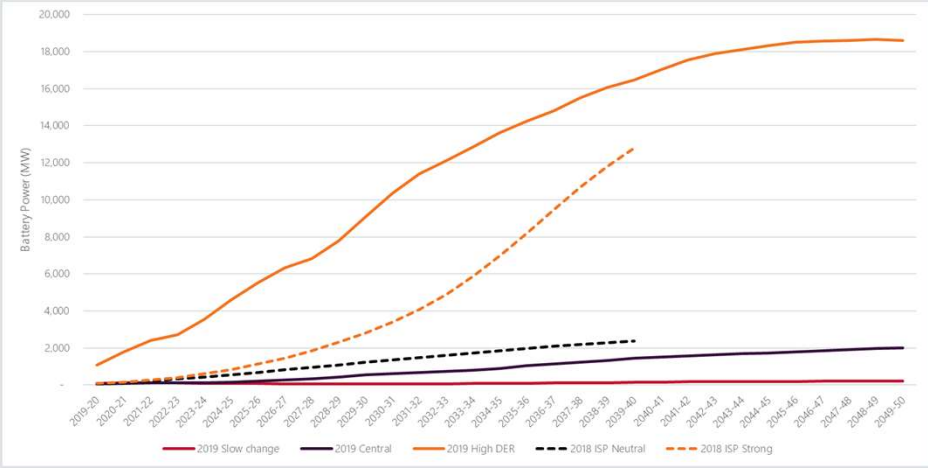
A wider range of DER uptake than 2018 will be investigated across the ISP scenarios

Rooftop PV reflects higher start but slower development in the medium term in the Central Scenario:



Slightly lesser battery storage capacity in Central:



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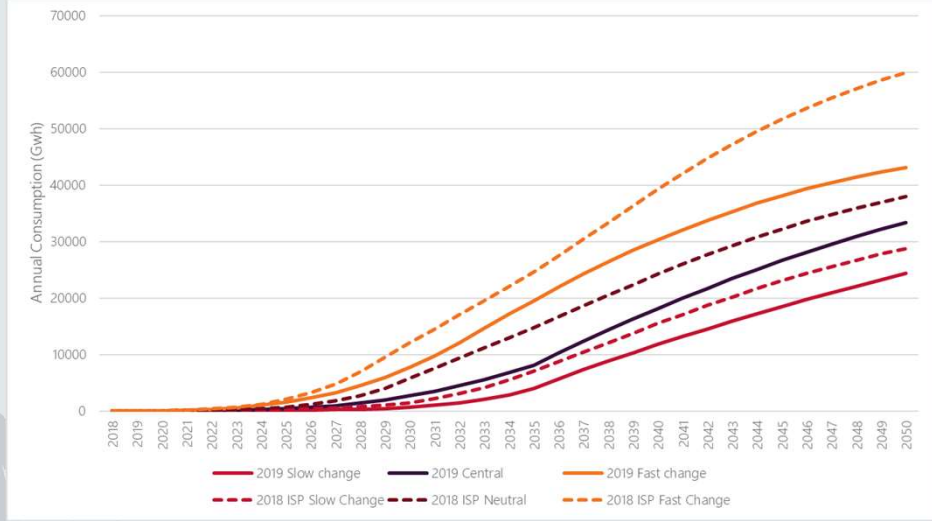
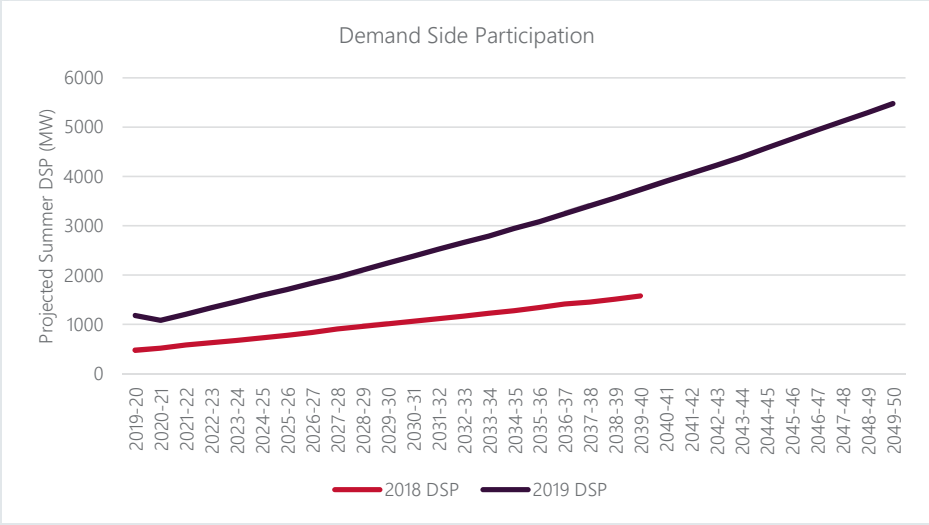
The effect of DER on the power system will consider a wider range of DER uptake levels than 2018

Slower EV developments in Central



DSP expectations are higher, potentially lowering grid peak requirements



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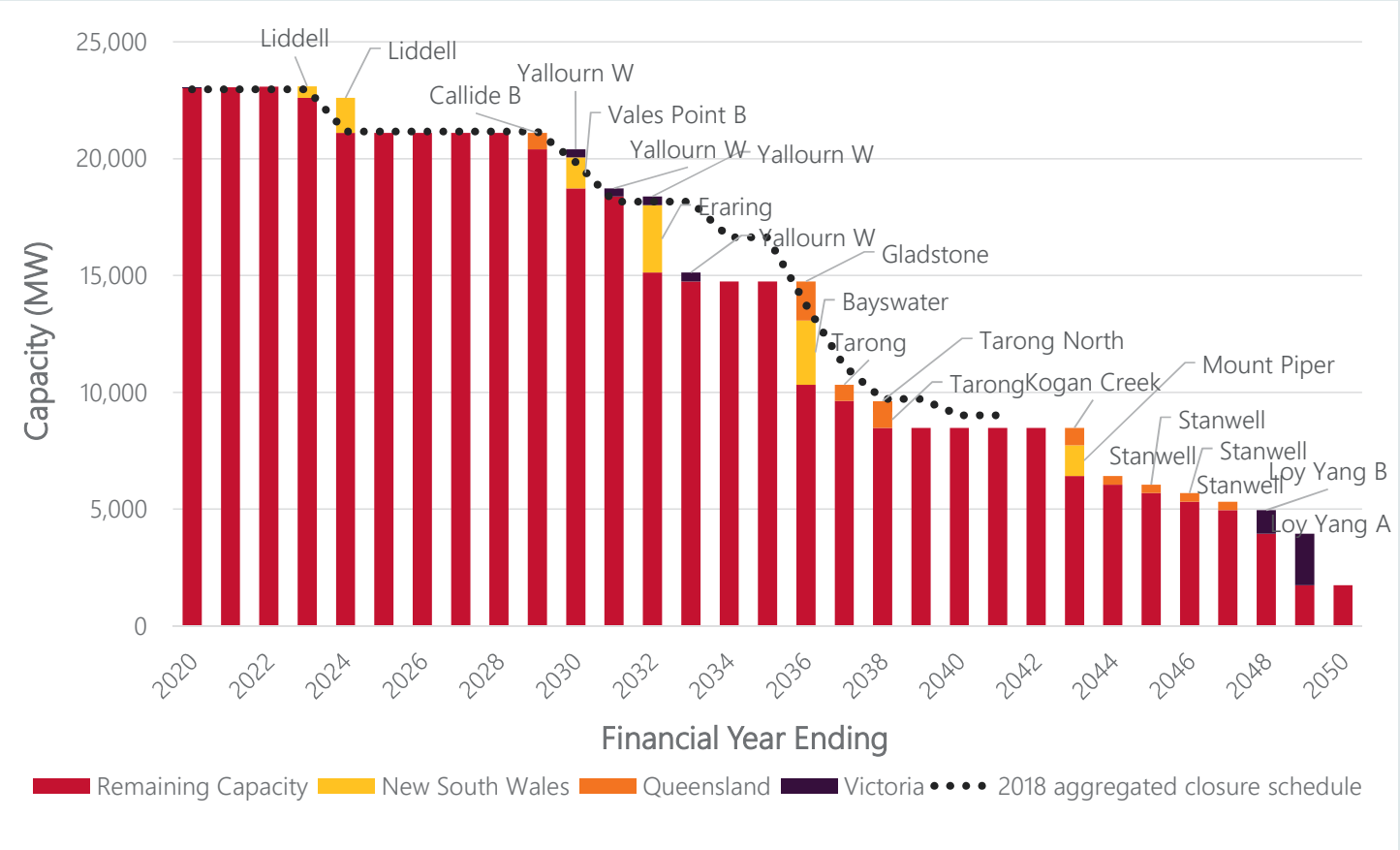
Coal generators may leave more rapidly than assumed in 2018*

*2019 closures based on expected closure dates provided by generators



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Estimated costs of generation technologies have moved

* Generation installation costs now consider regional cost variances. Regional cost factors not applied to this comparison.

Refer GenCost

Generation cost change:

1. Gas generation – slightly lower cost than 2018
2. Renewable generation – slightly lower cost than 2018
3. Energy storages – slightly higher cost than 2018 (now using Entura cost projections)
4. Transmission costs –
   - some evidence of minor cost reductions (intra-regional transmission),
   - some inter-regional transmission costs have increased slightly

Changing energy resources

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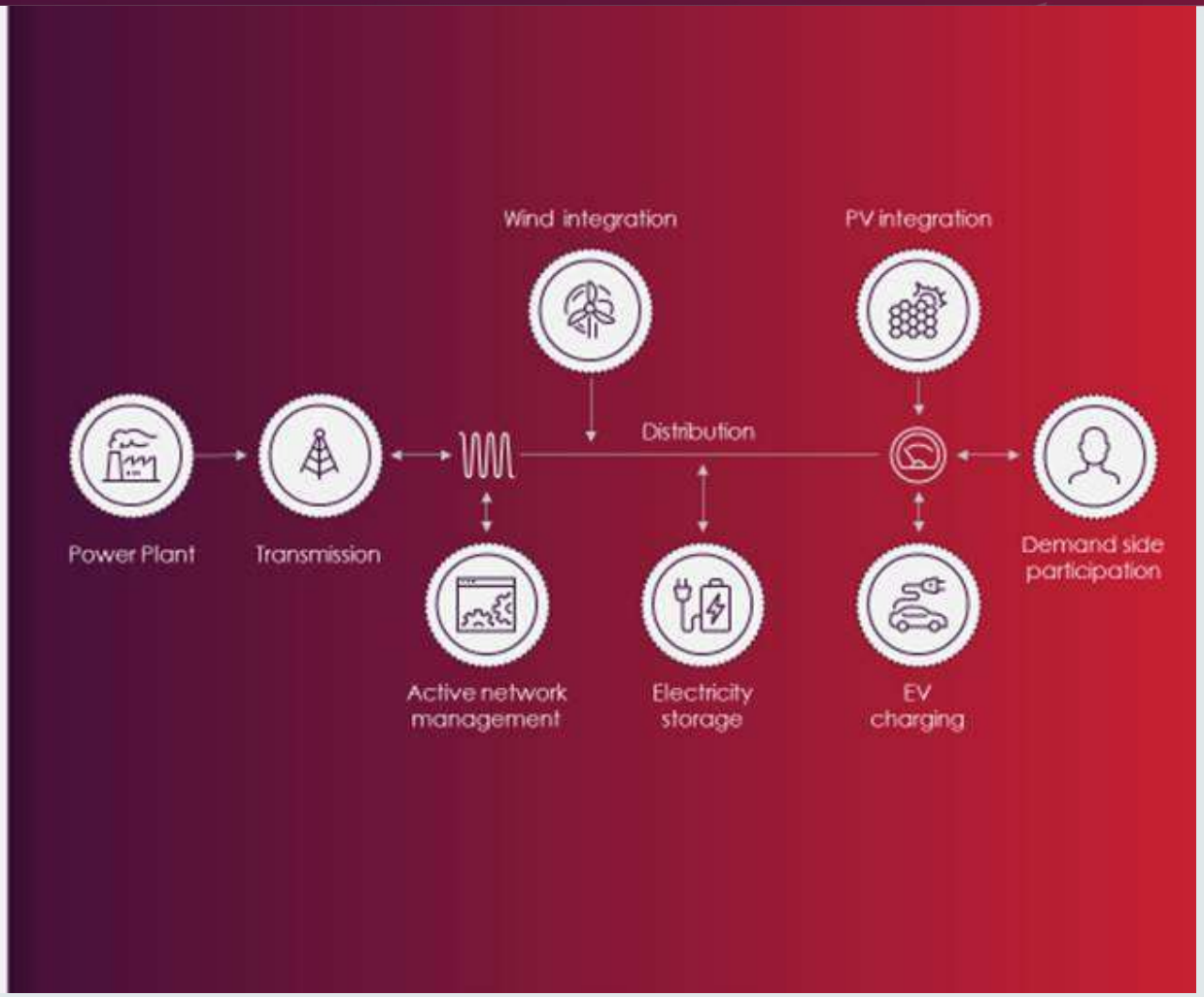
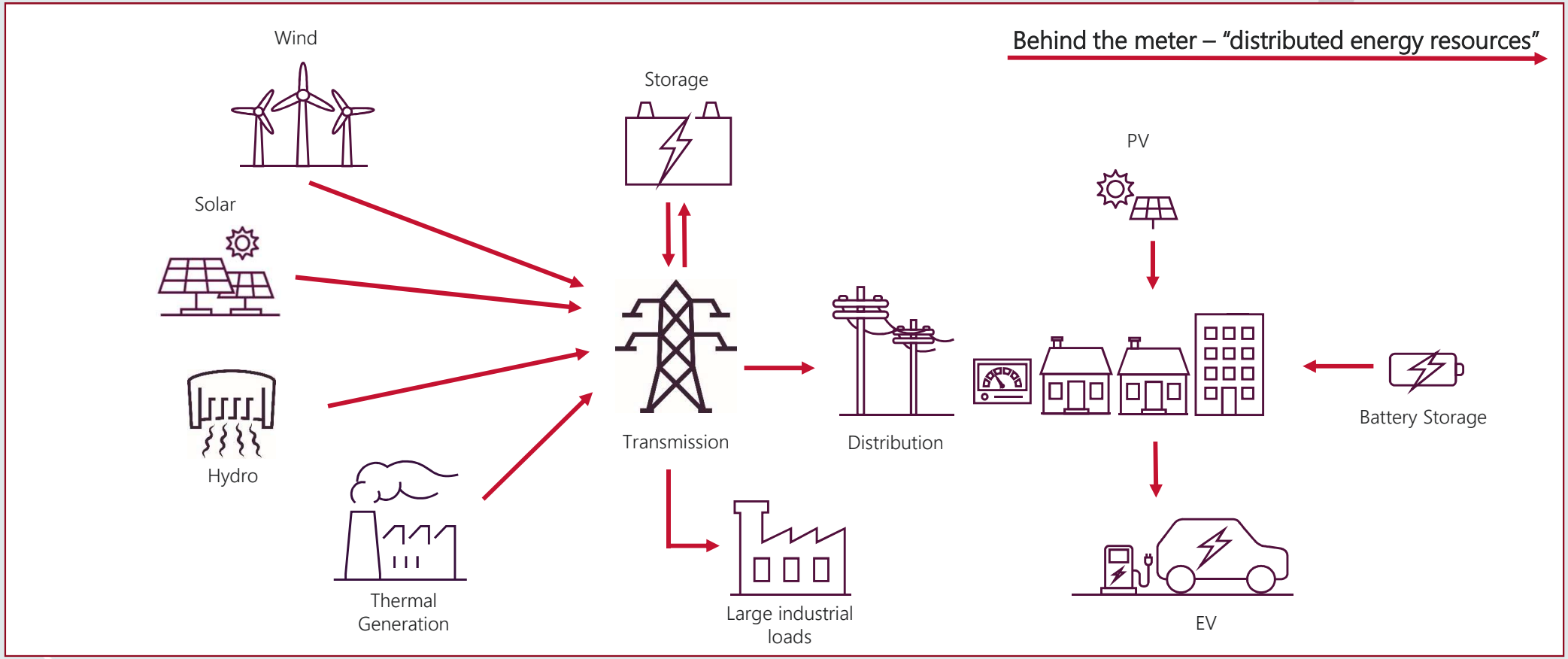
Evolving power system needs

Power system

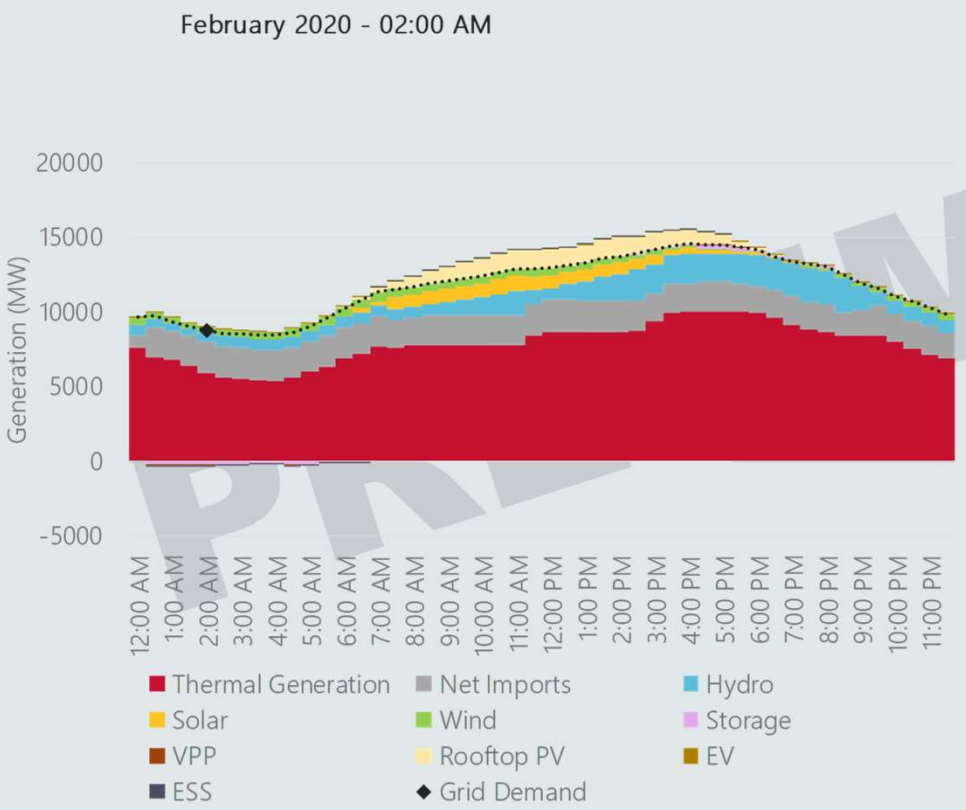
- Huge computational models for forecasting
- Multiple data inputs from more sources
- Digitalisation allows value to be determined at more granular level
- Optimisation of entire supply chain

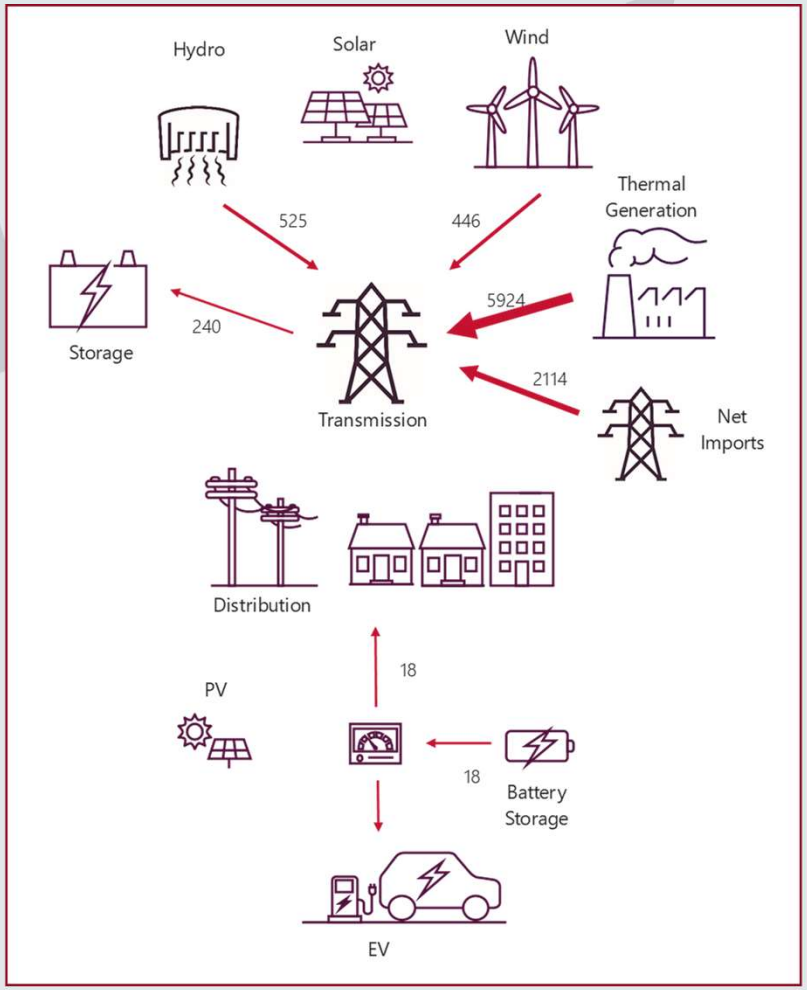


Intra-day demand and supply patterns



Changing load patterns will impact the need for traditional baseload, mid-merit and peaking generation





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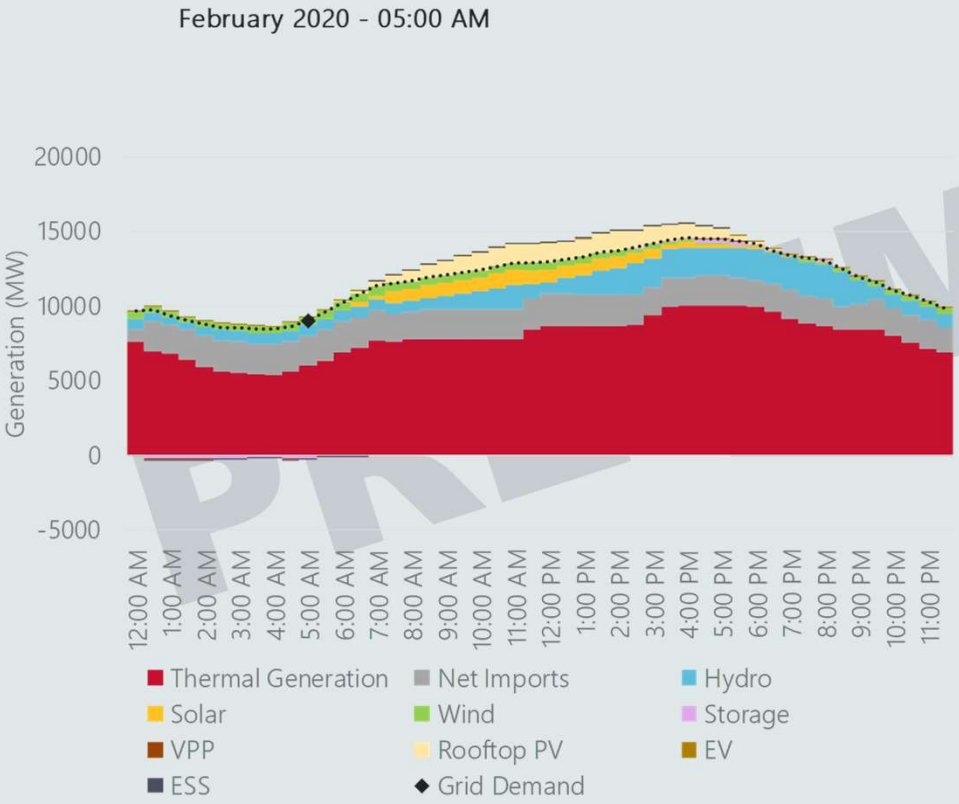

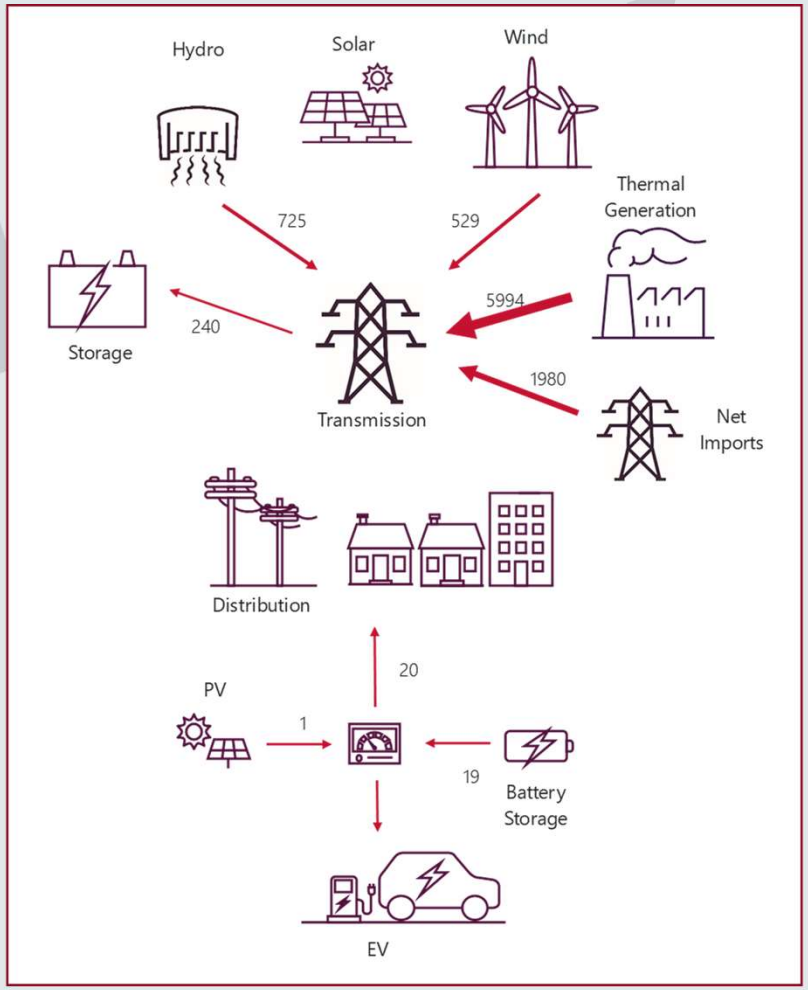

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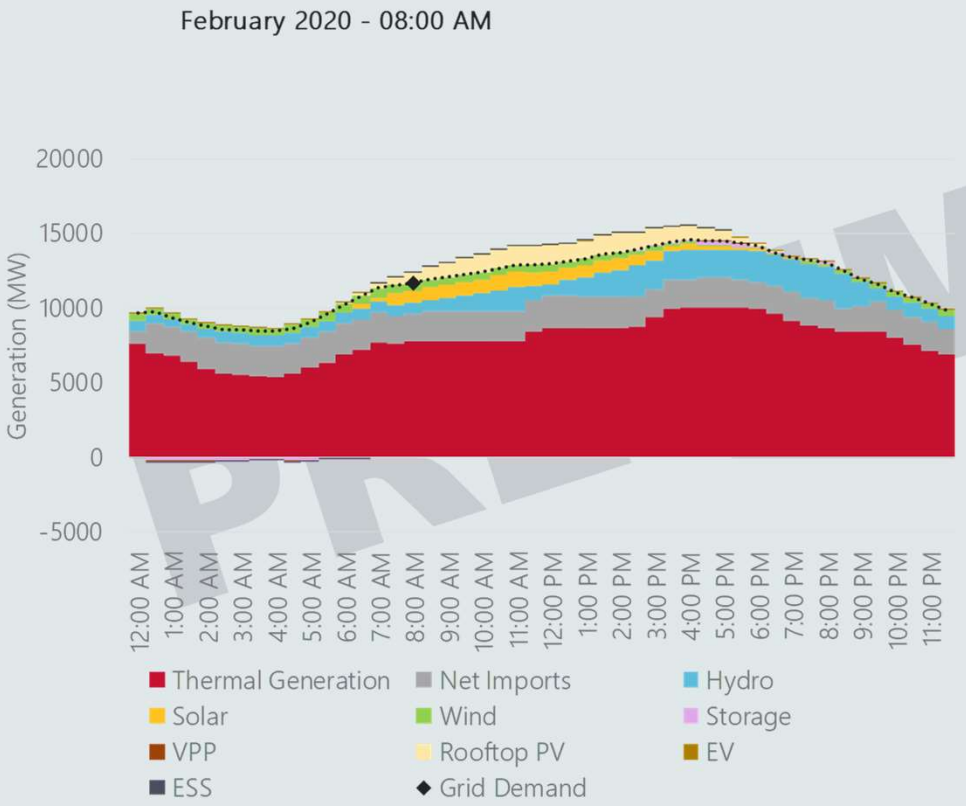

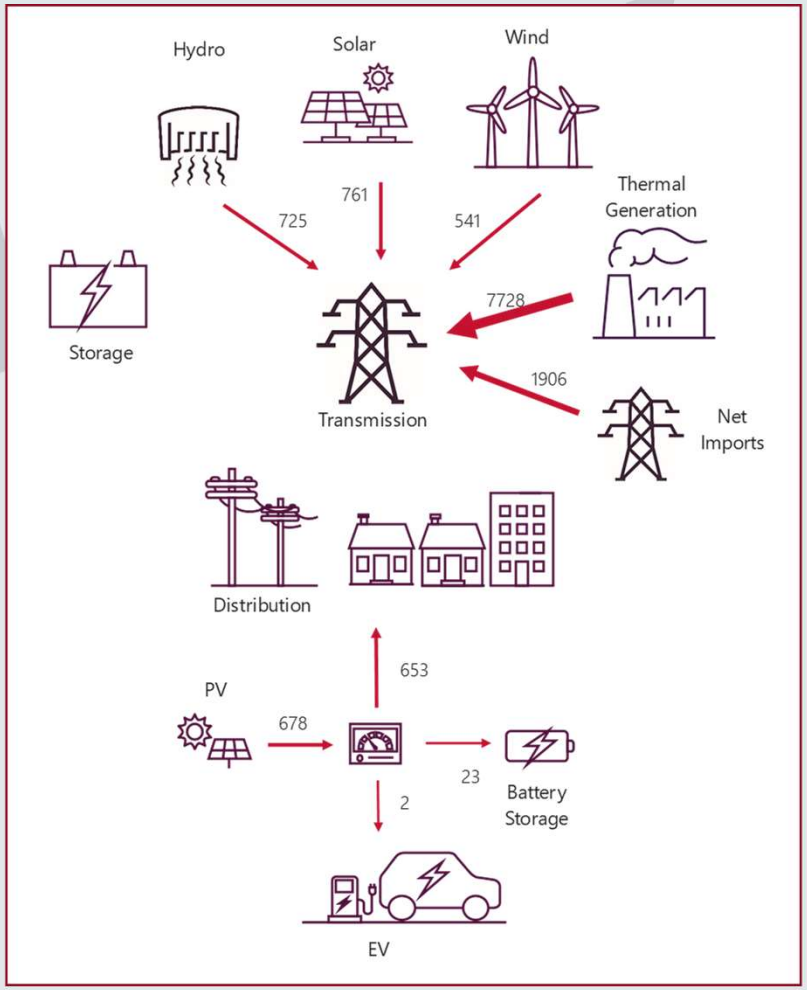

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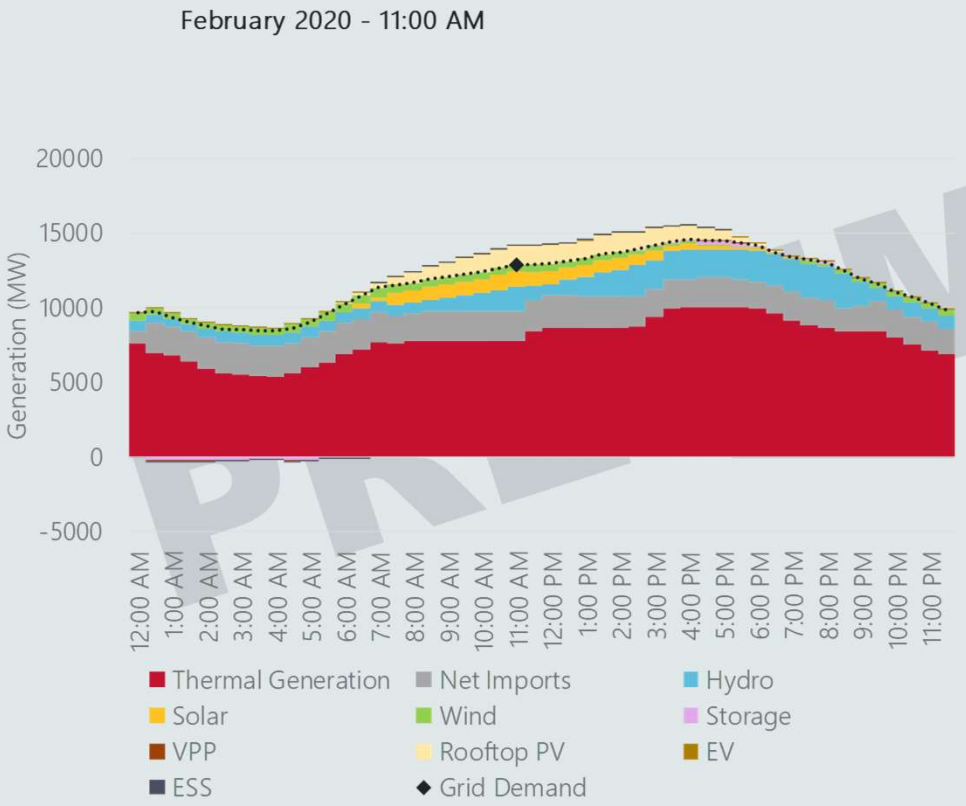

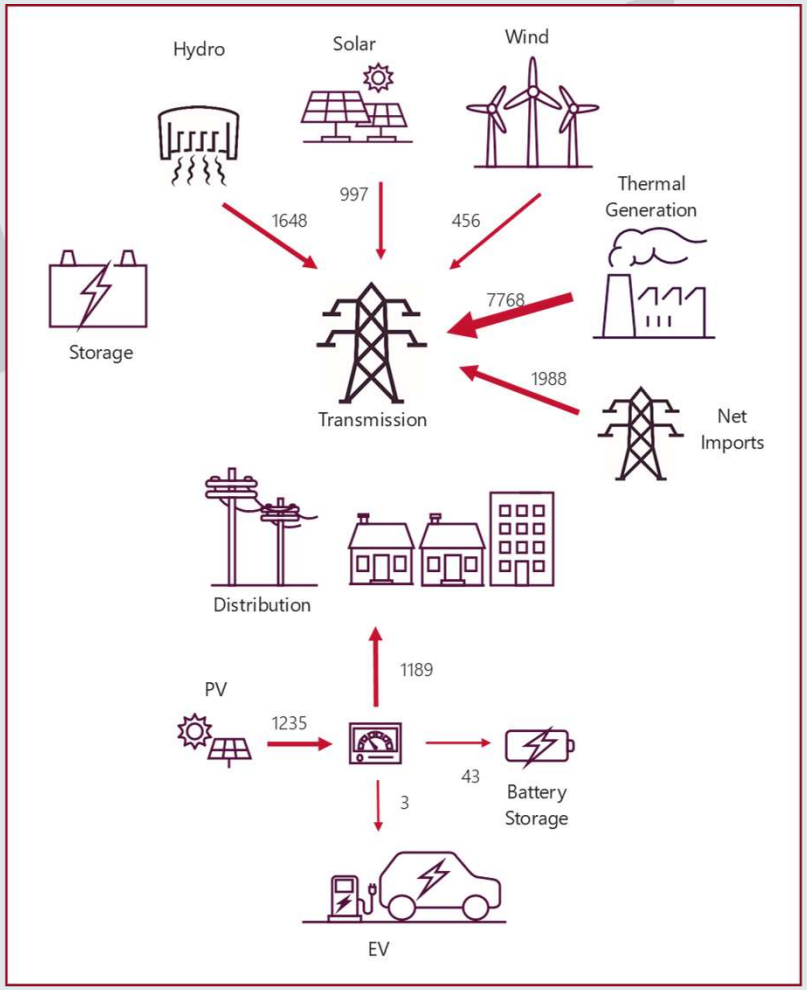

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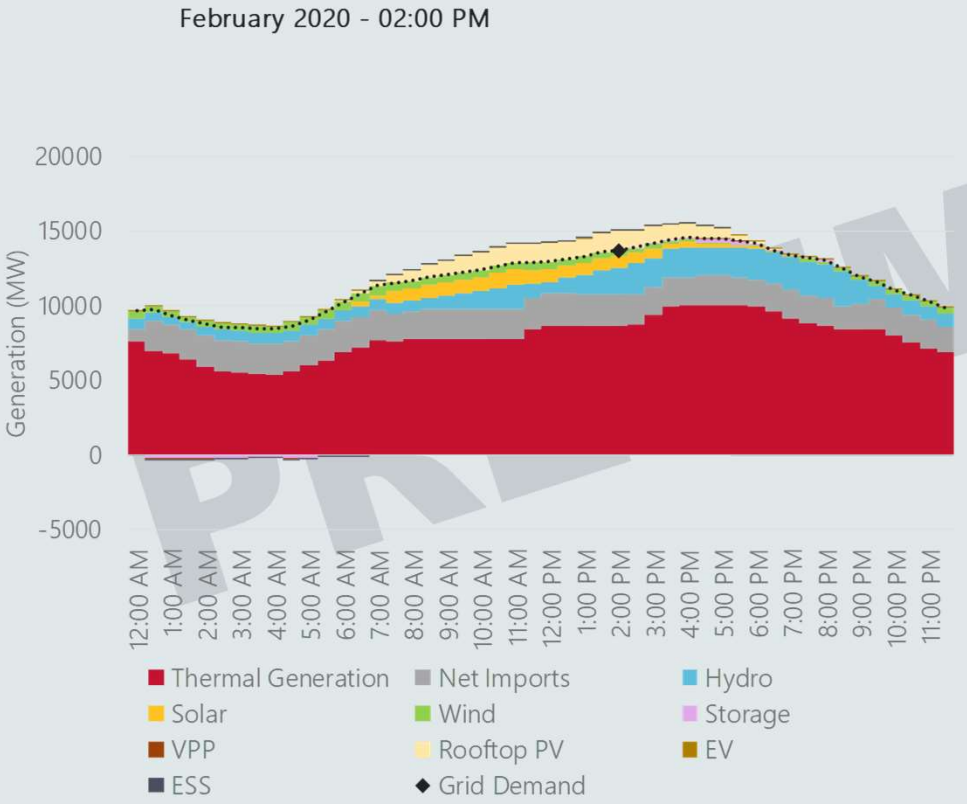

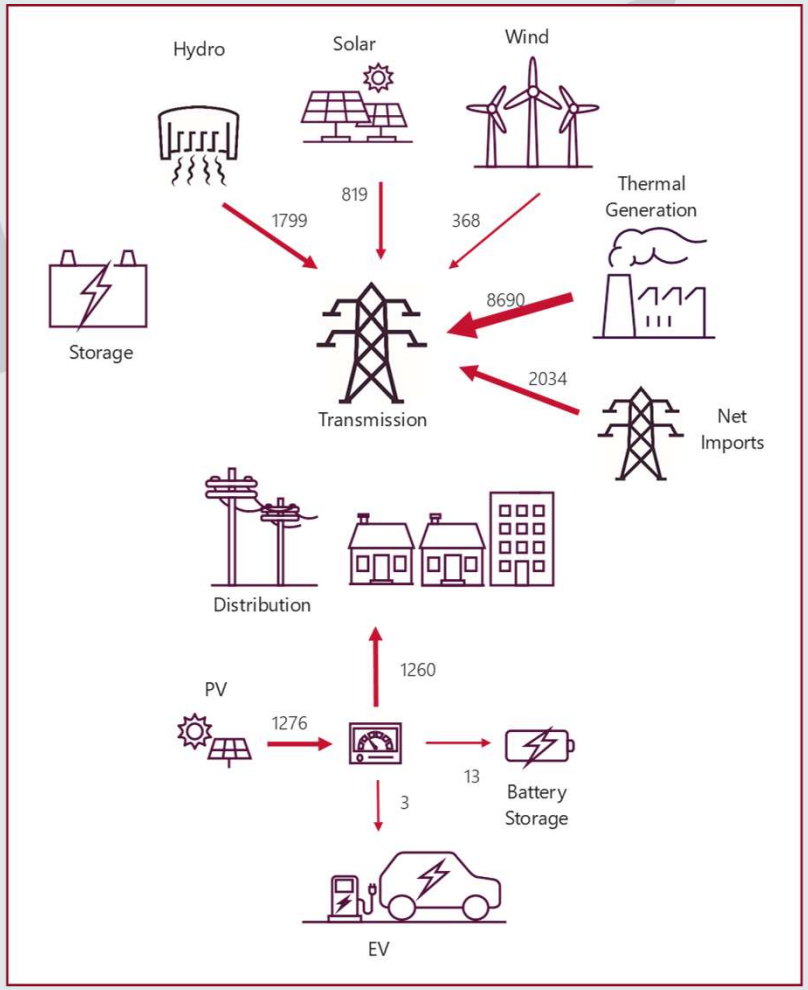

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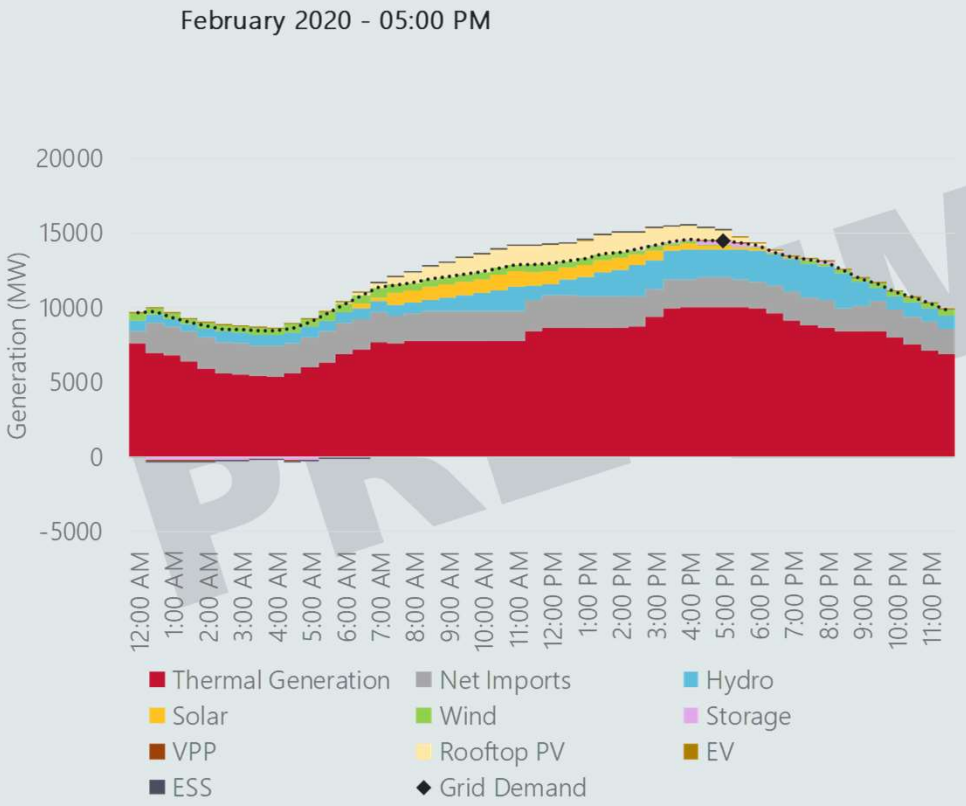

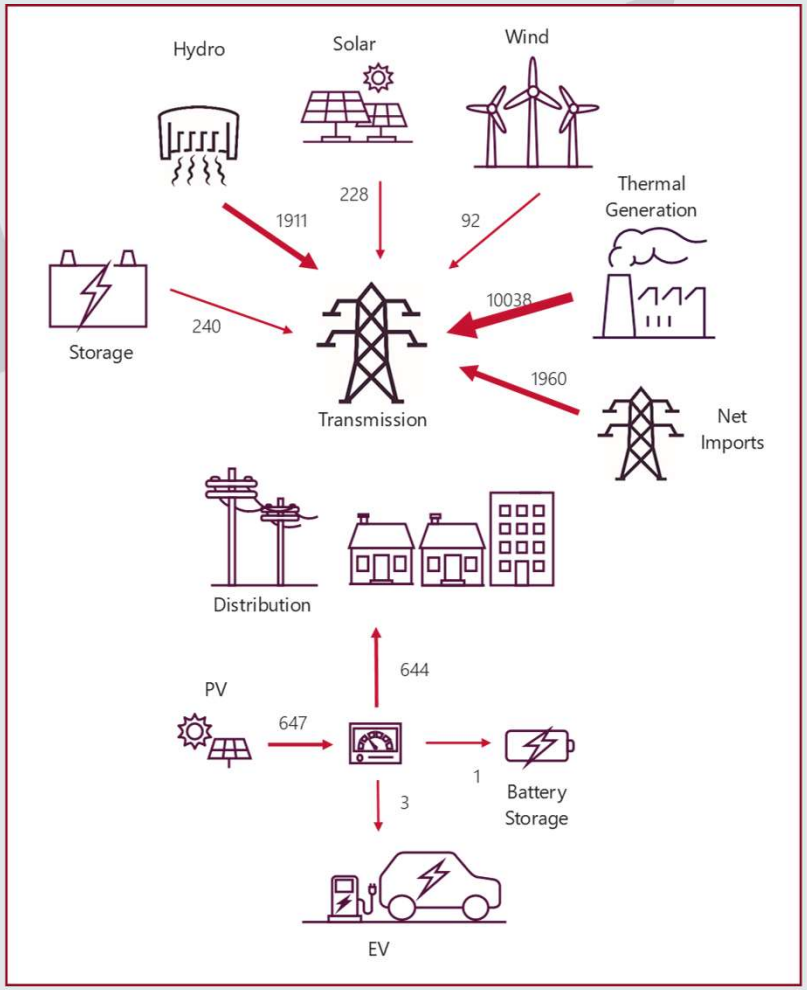

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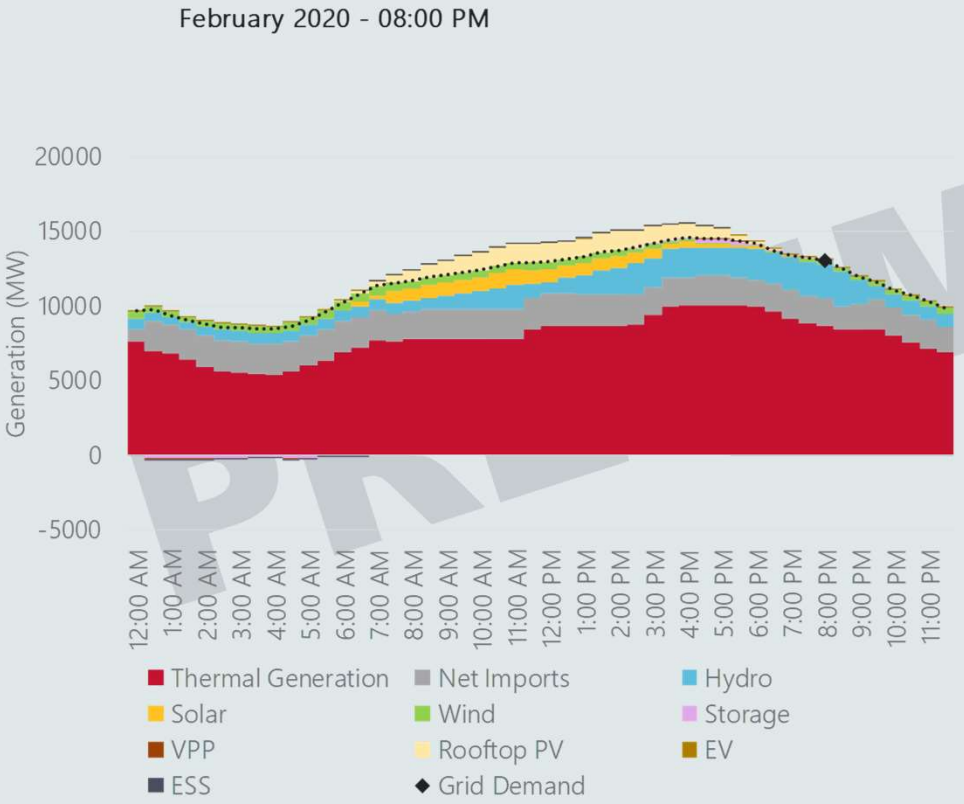

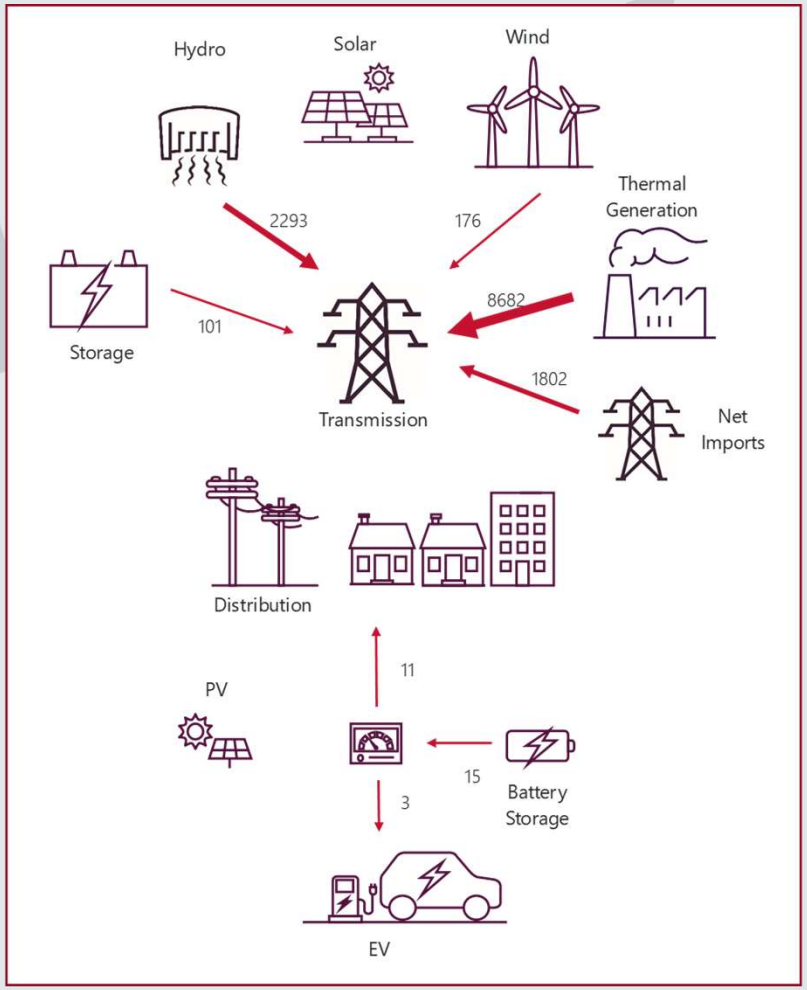

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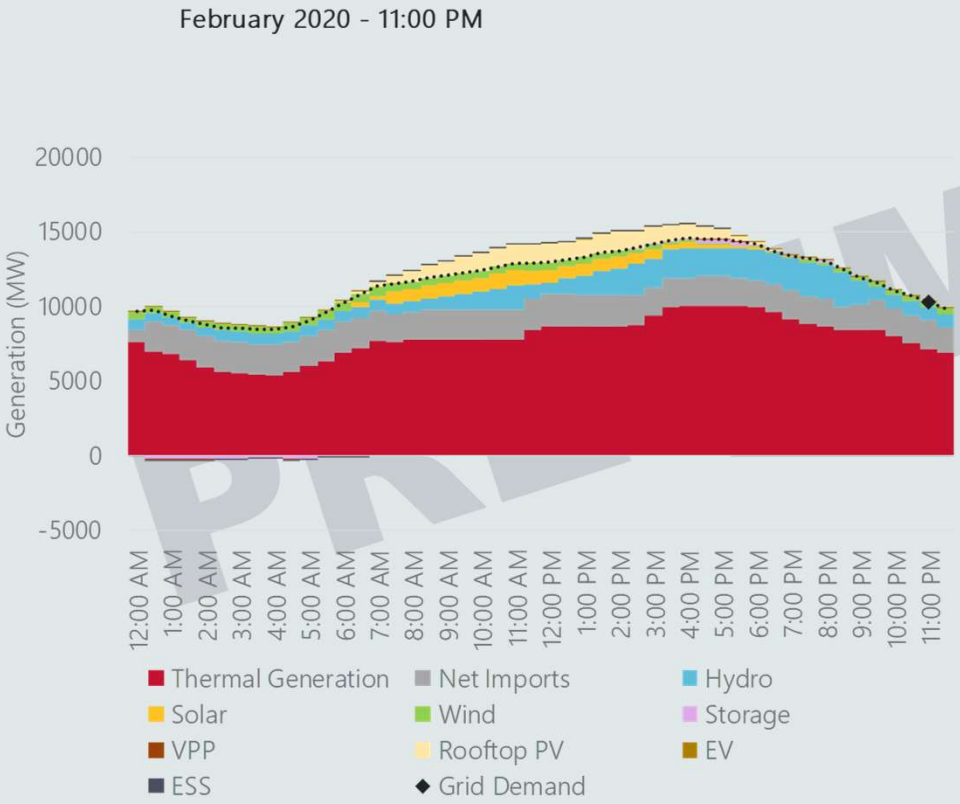

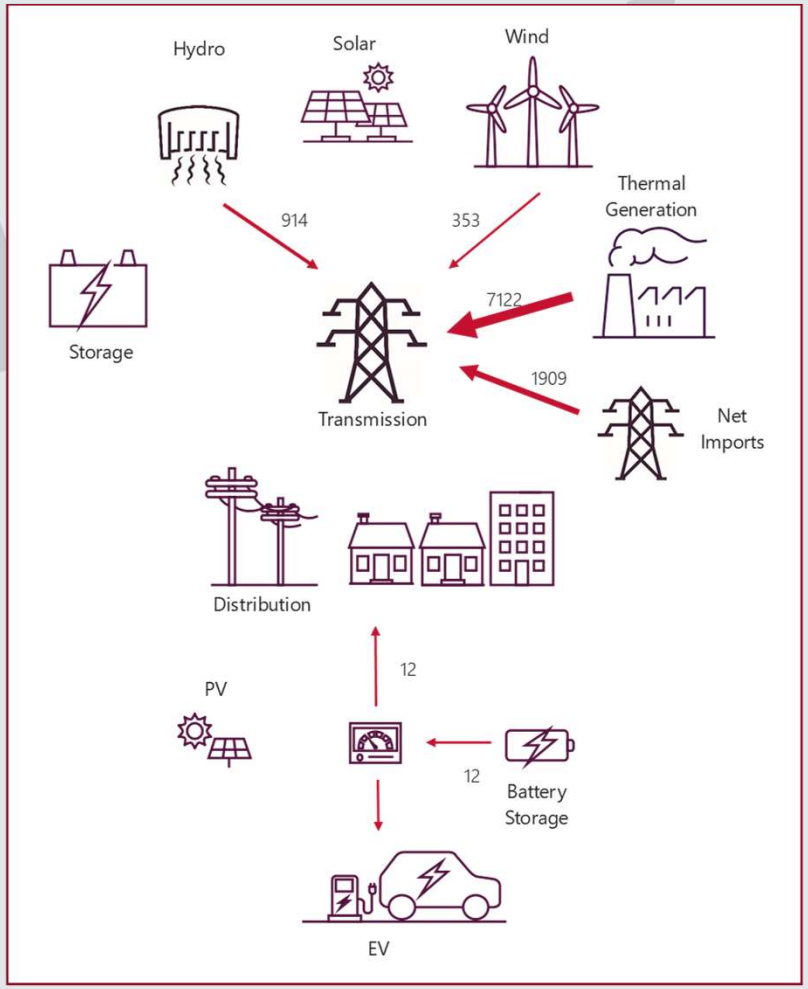

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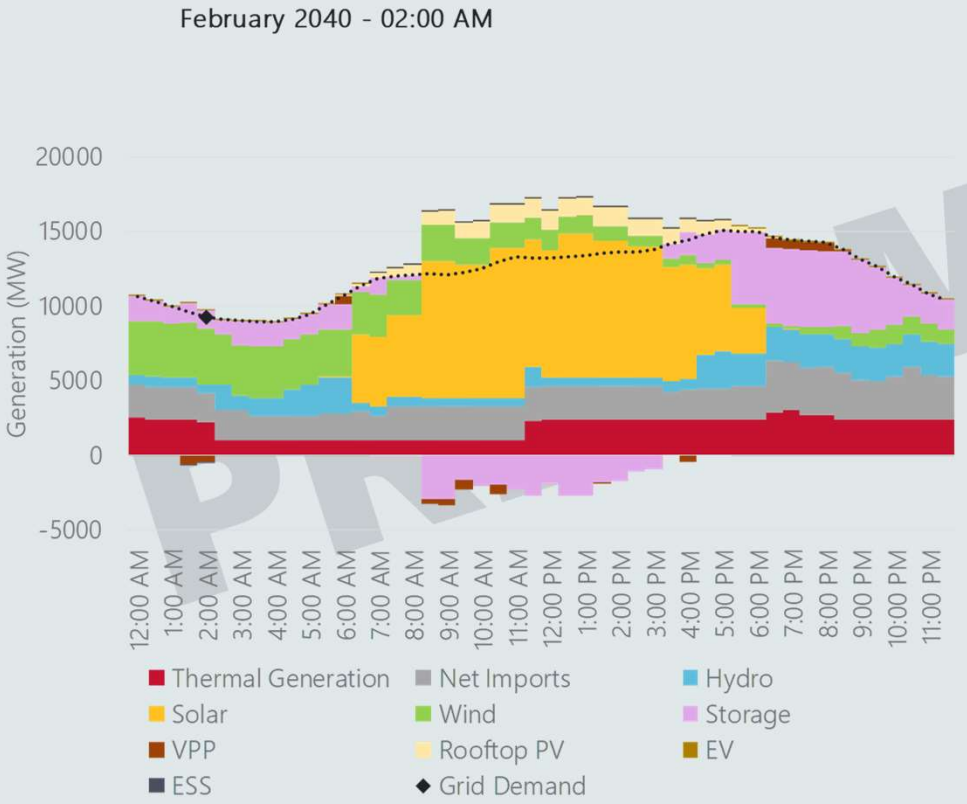

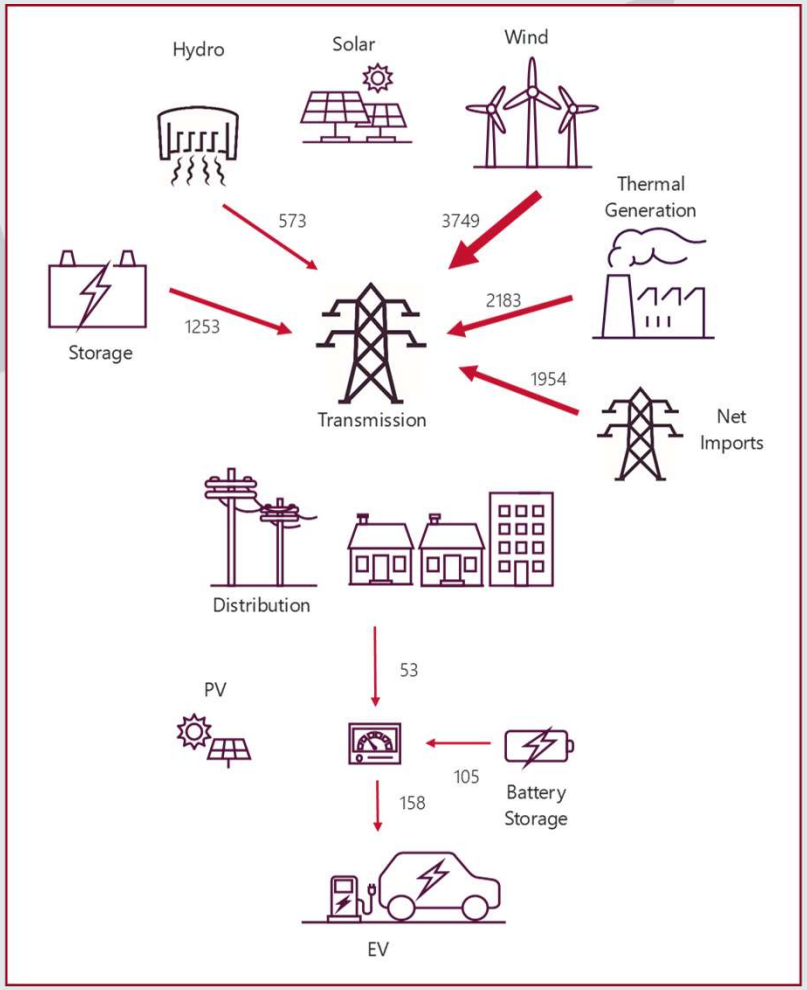

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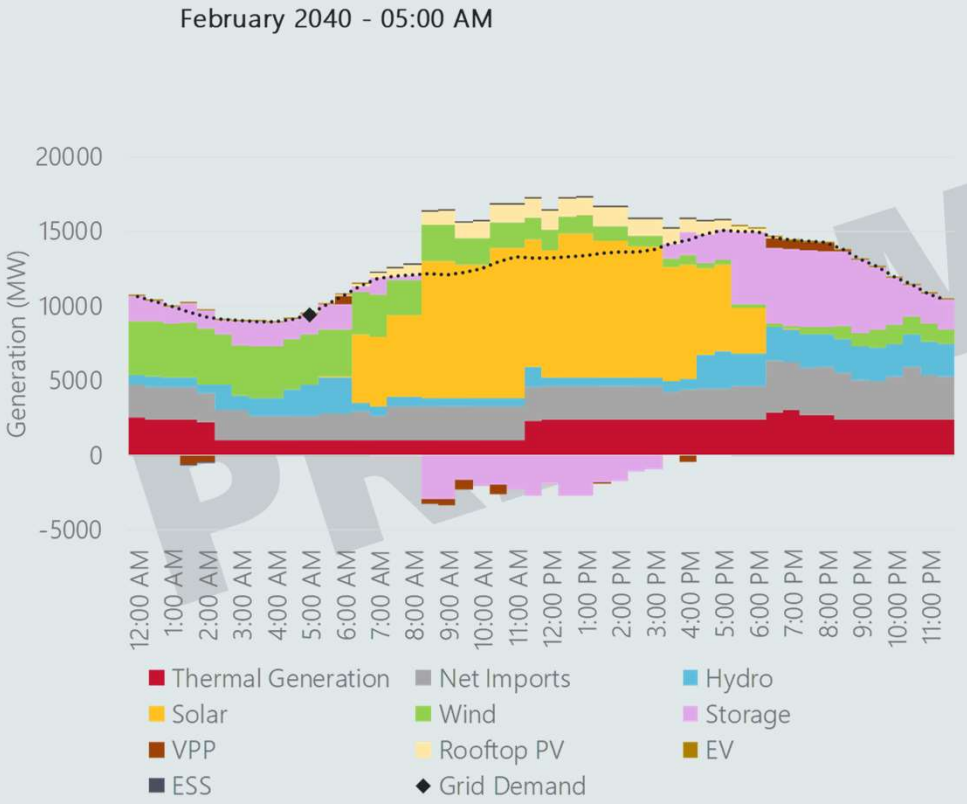

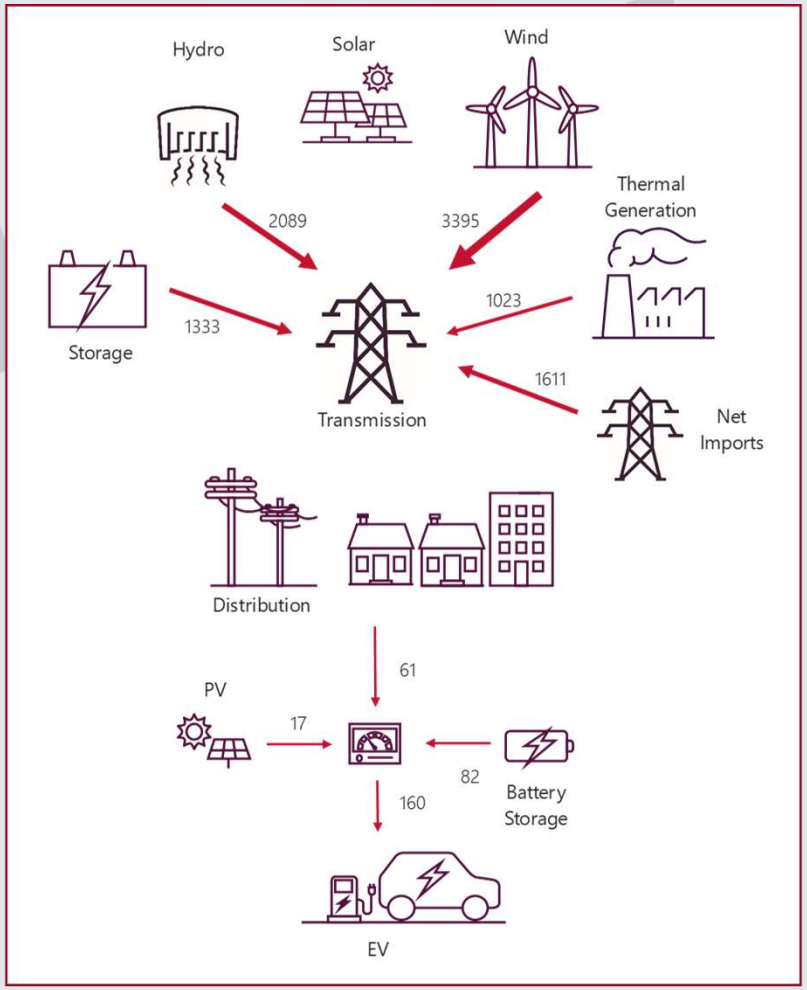

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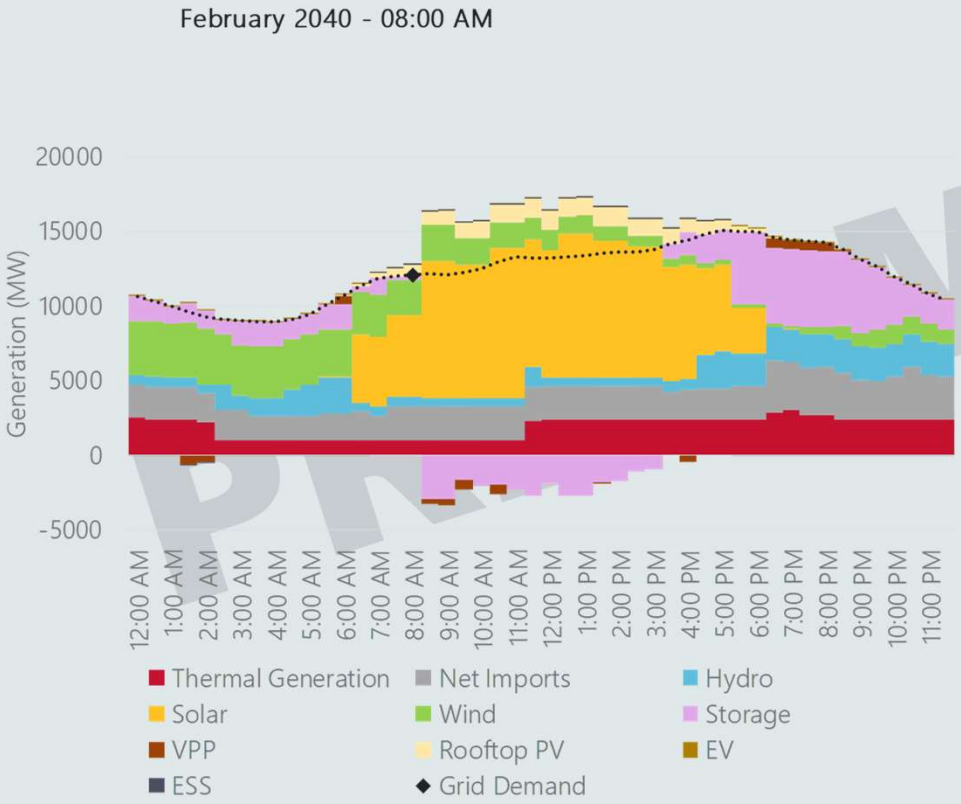

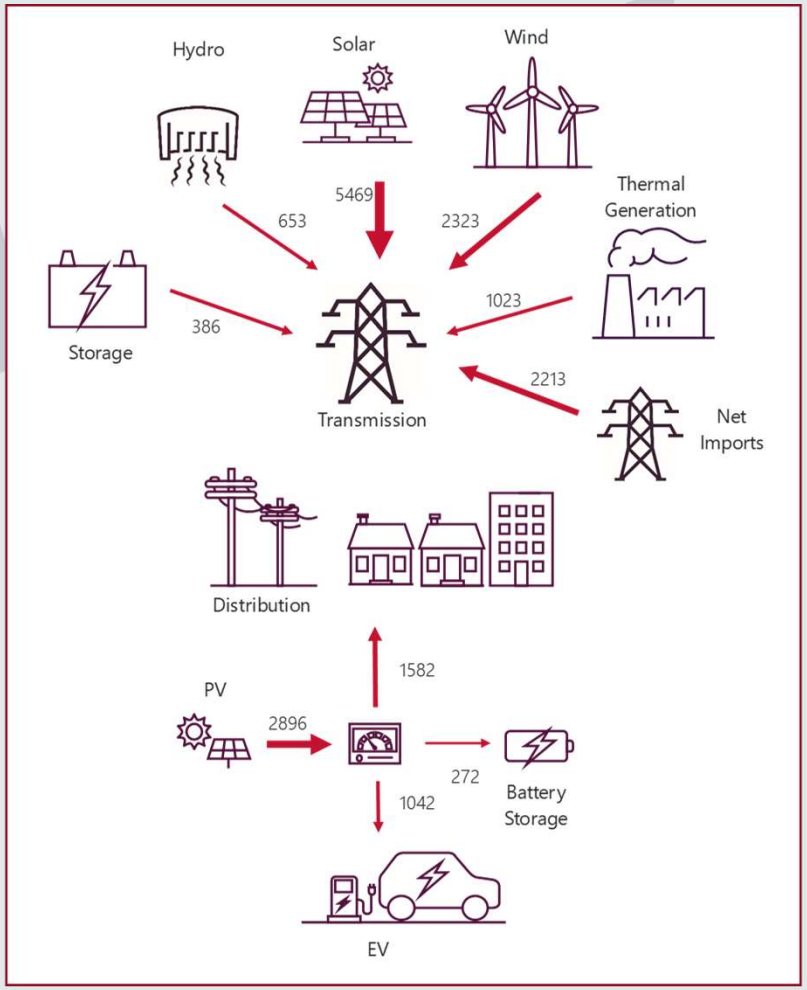

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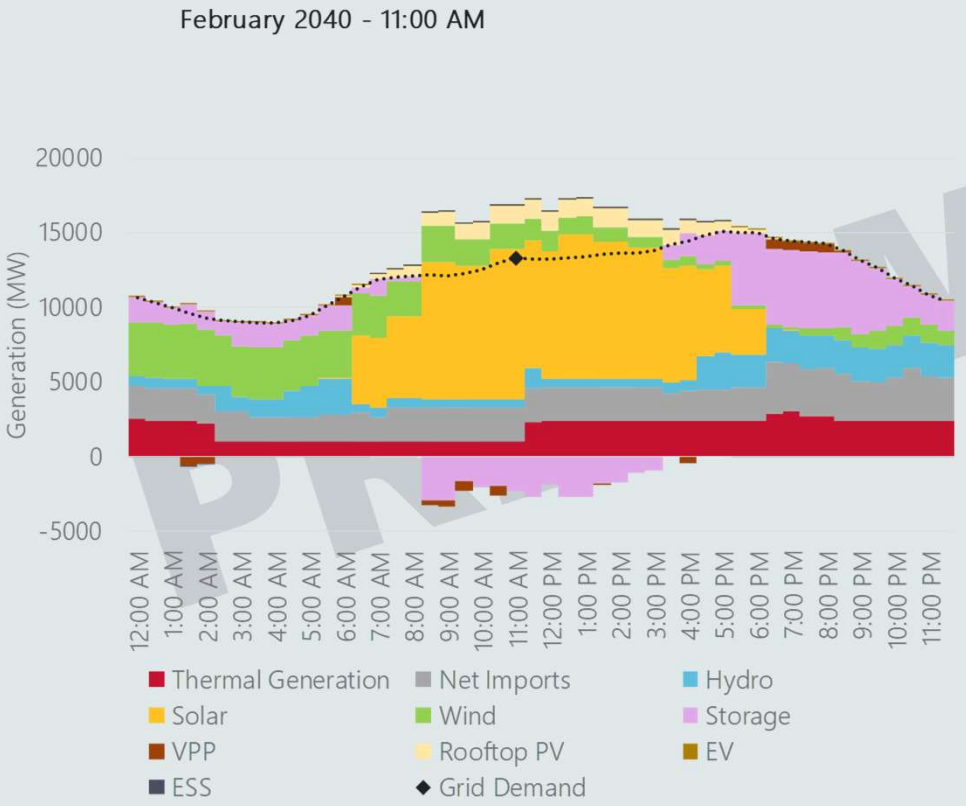

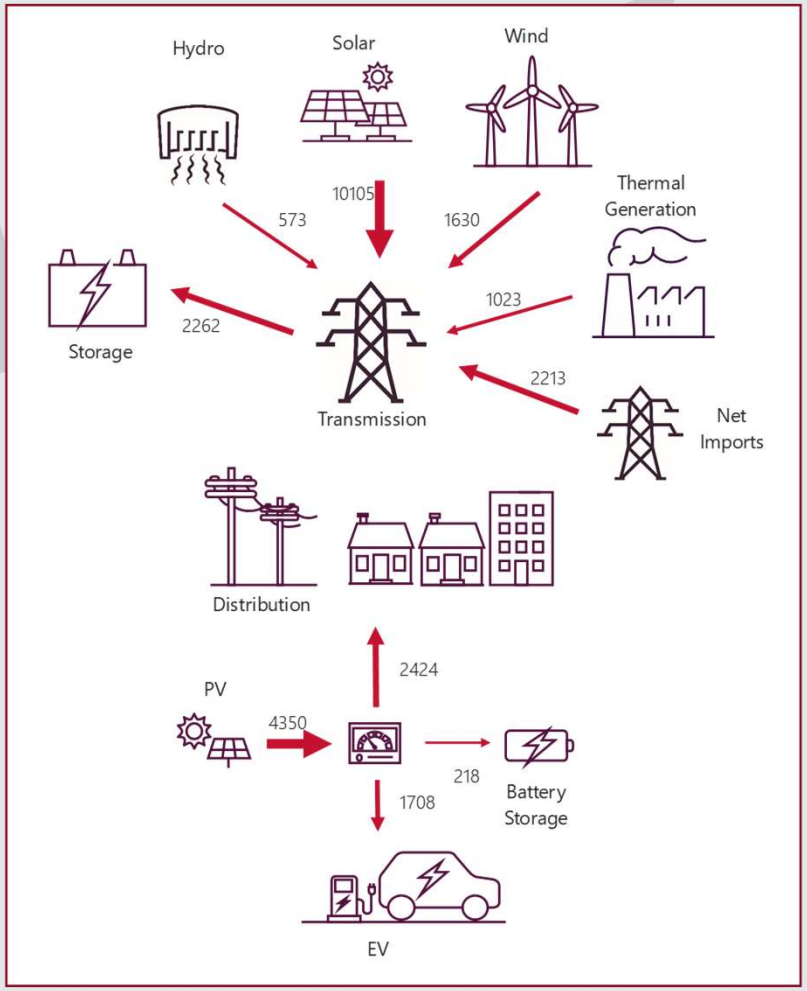

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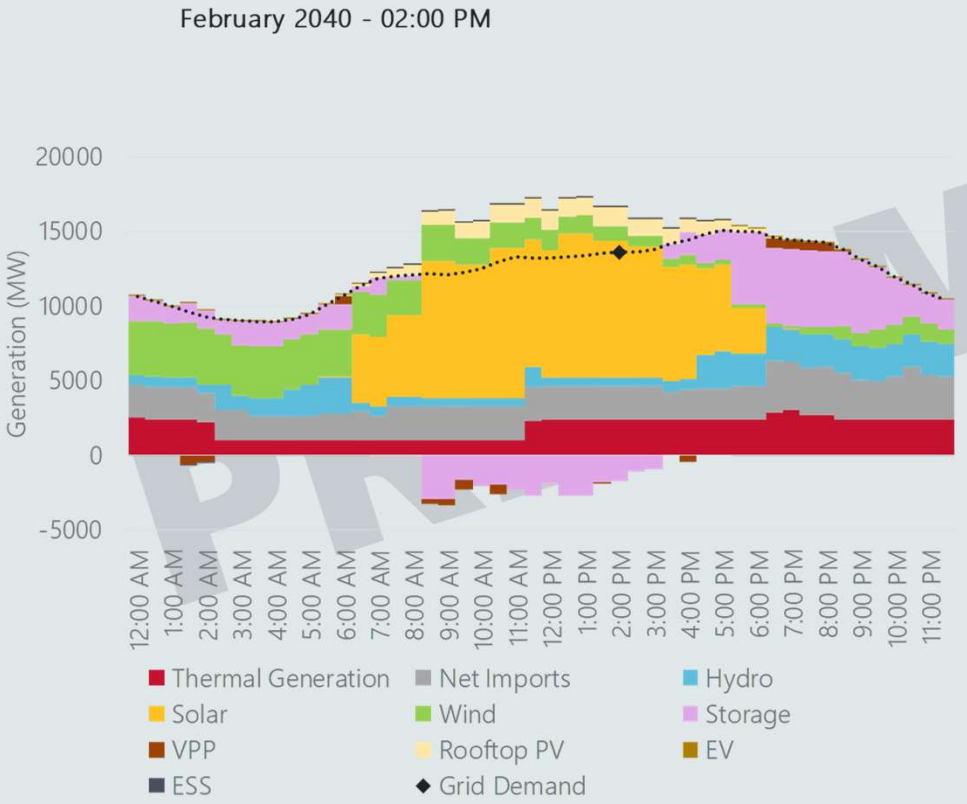

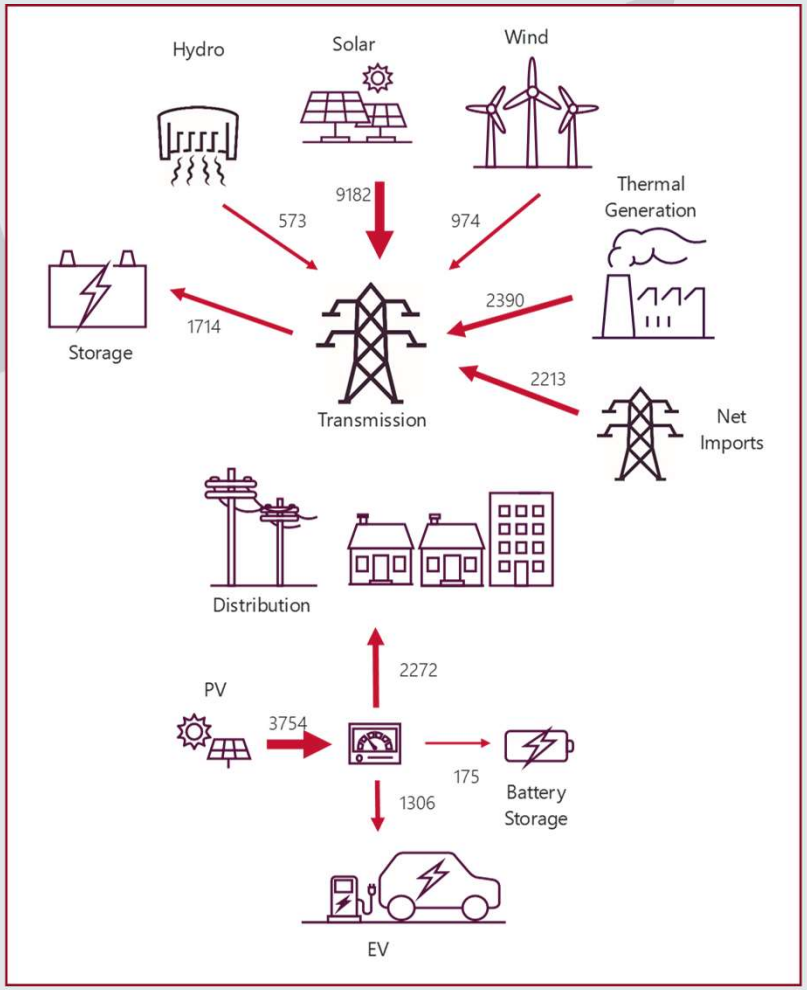

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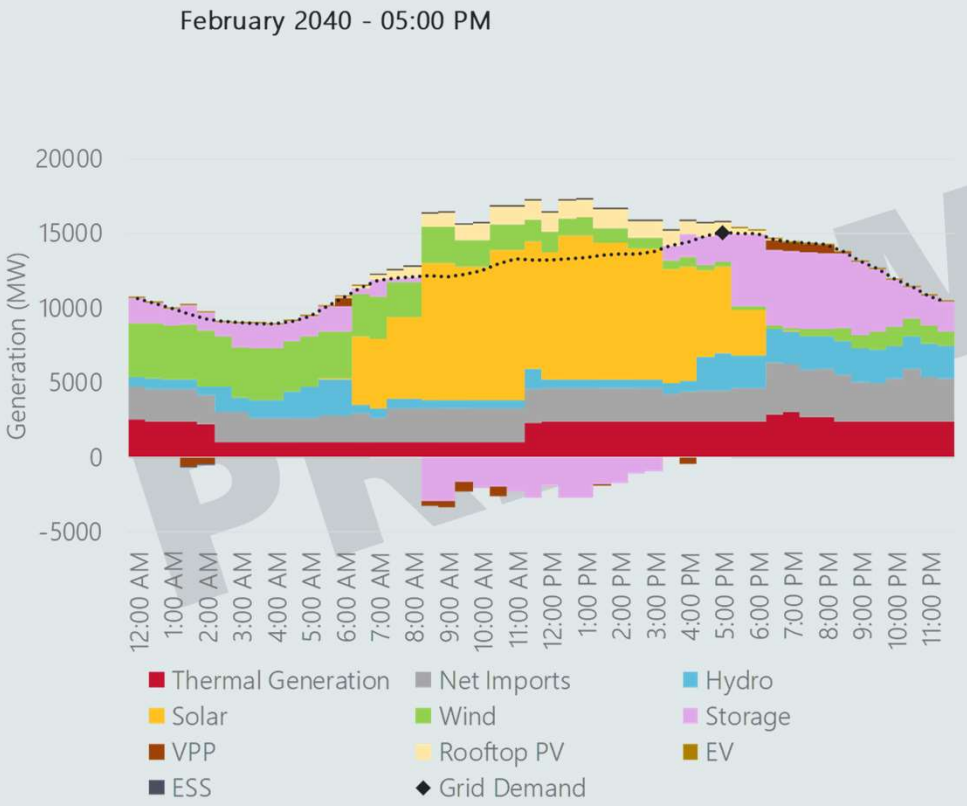

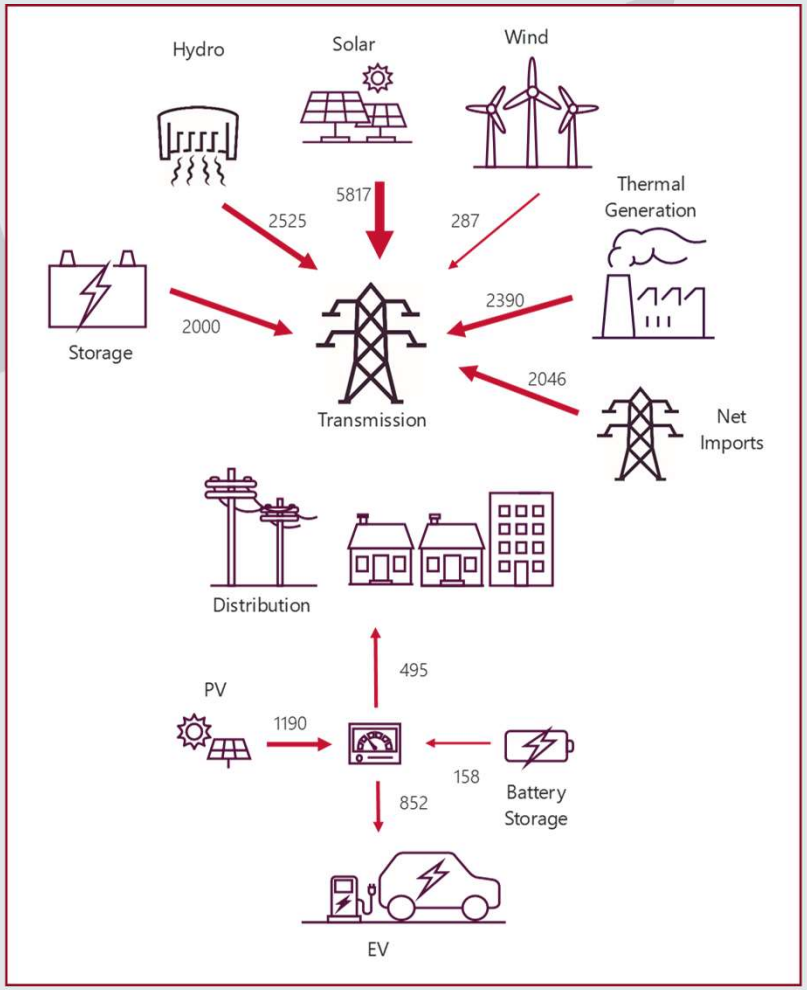

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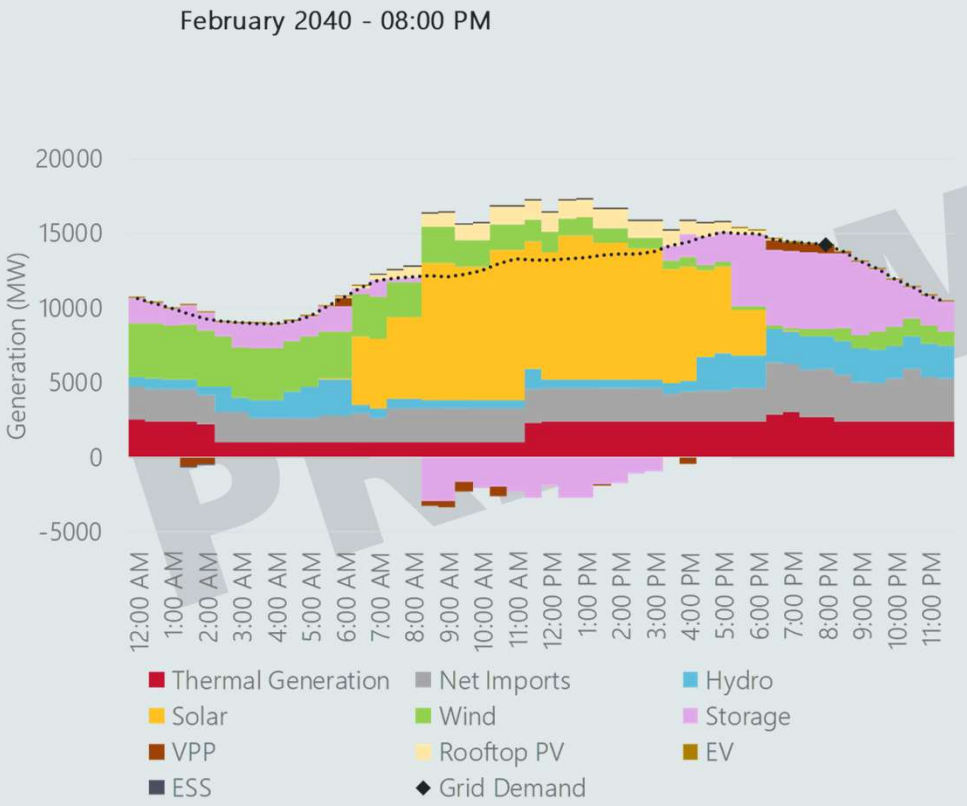
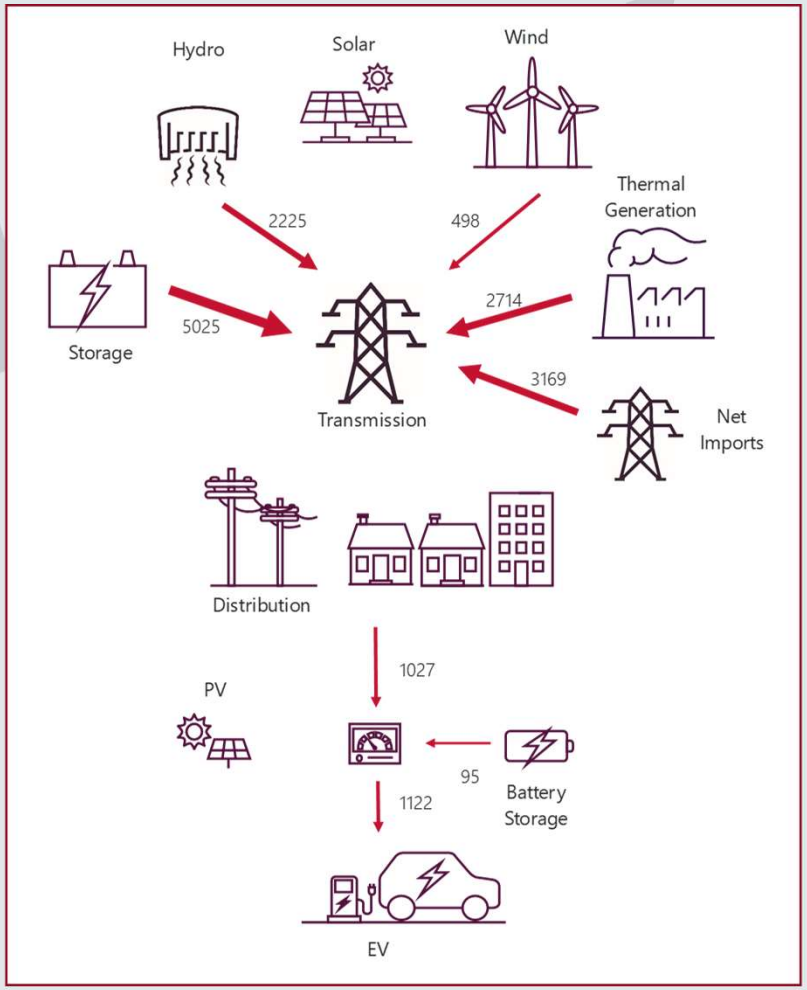
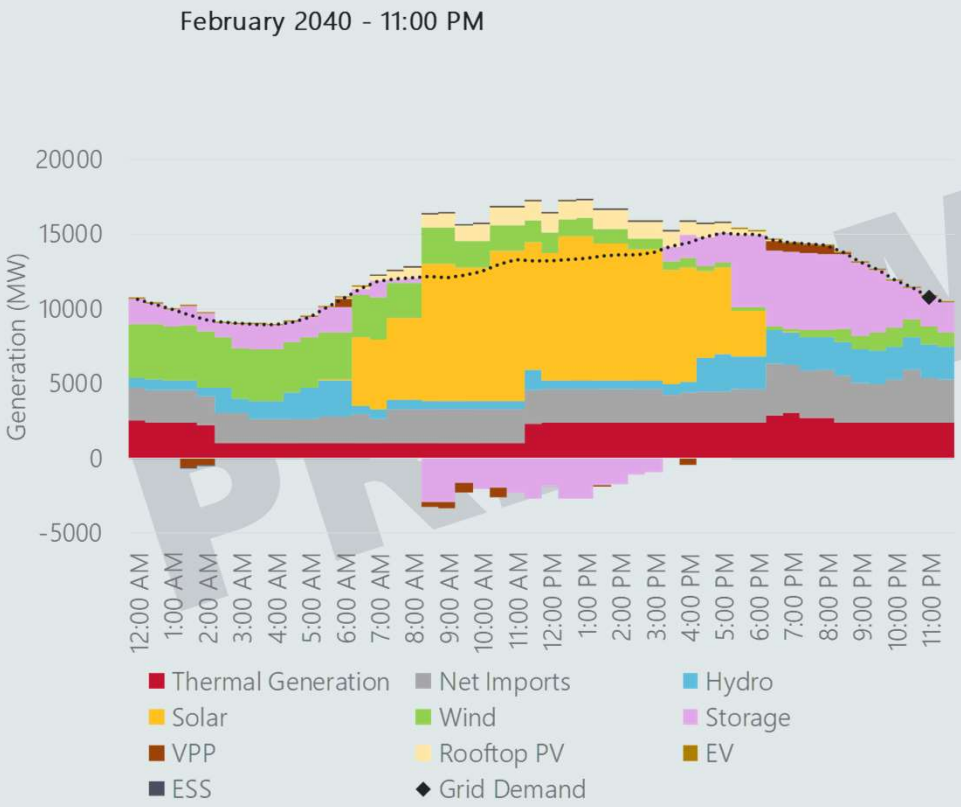
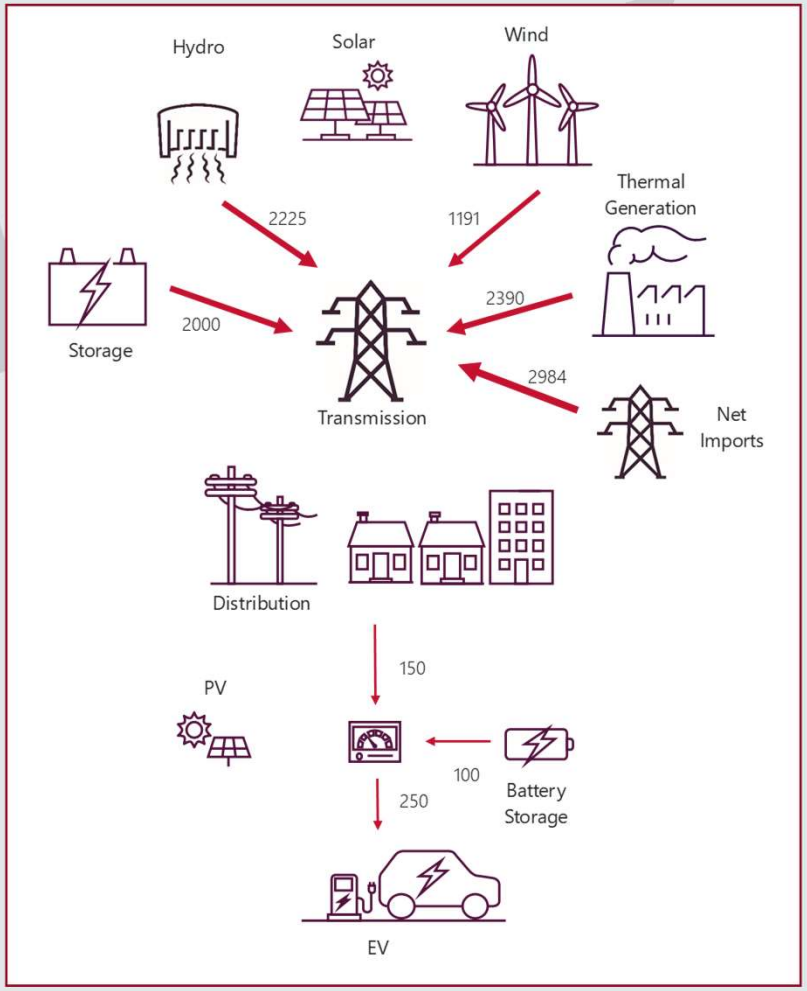


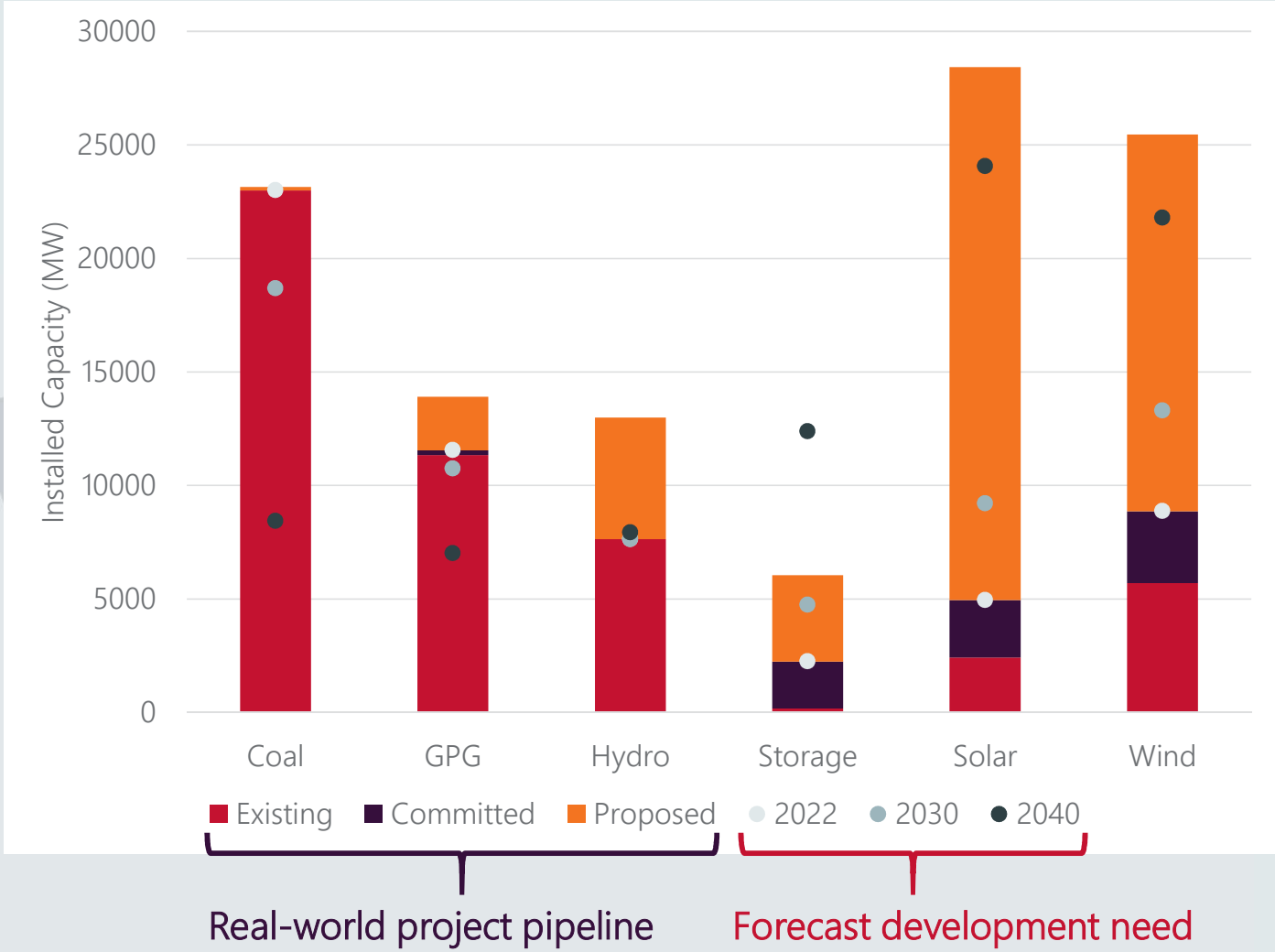


Changing load patterns will impact the need for traditional baseload, mid-merit and peaking generation





The scale of anticipated generation development by 2040 is similar to that currently proposed, except for storage



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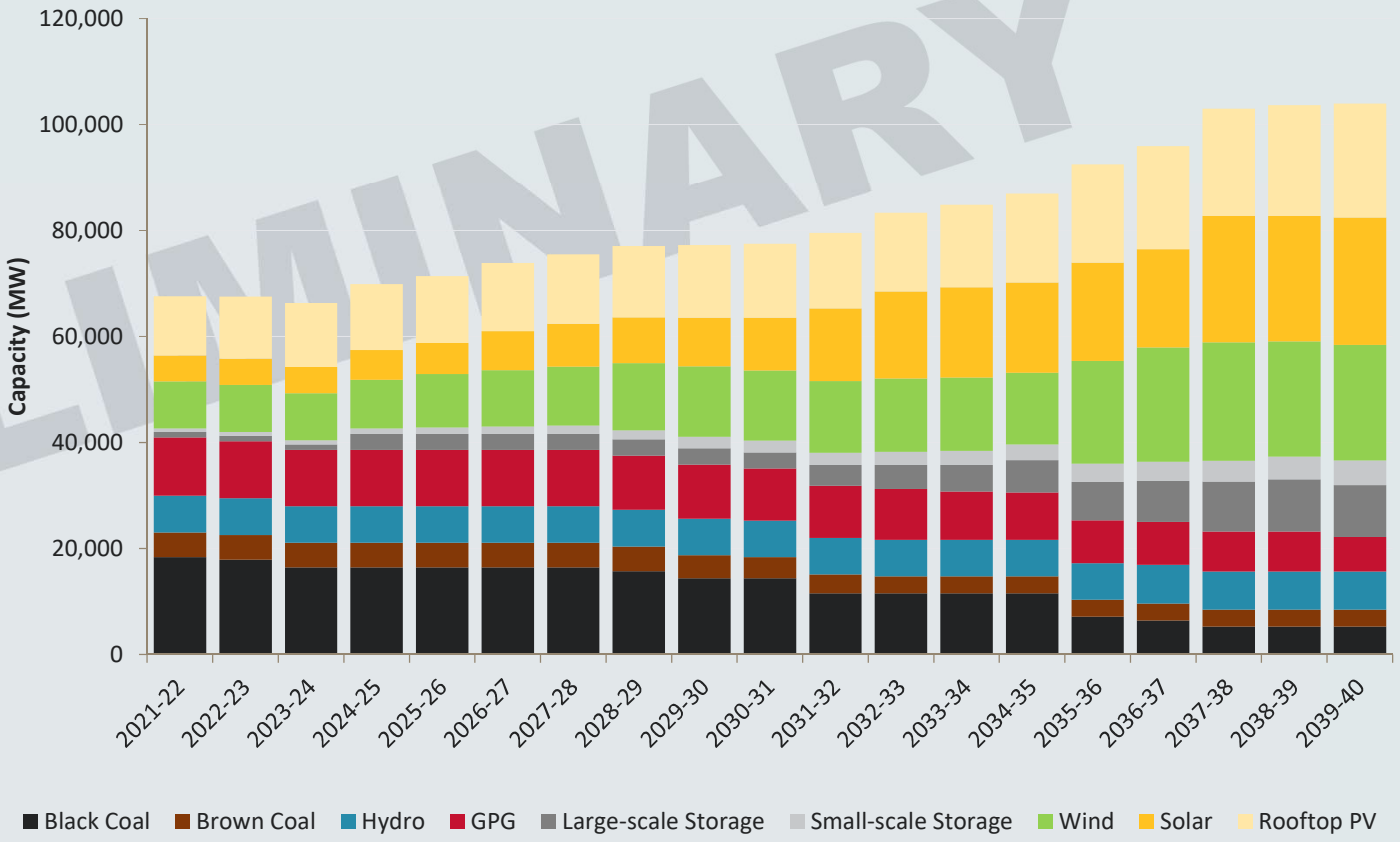
Two stages of development in the Central Scenario:

- Near term – transformation in response to clear policies
- Longer term – retirement replacements will continue to drive transformation



Policy response

Replacing capacity retirements

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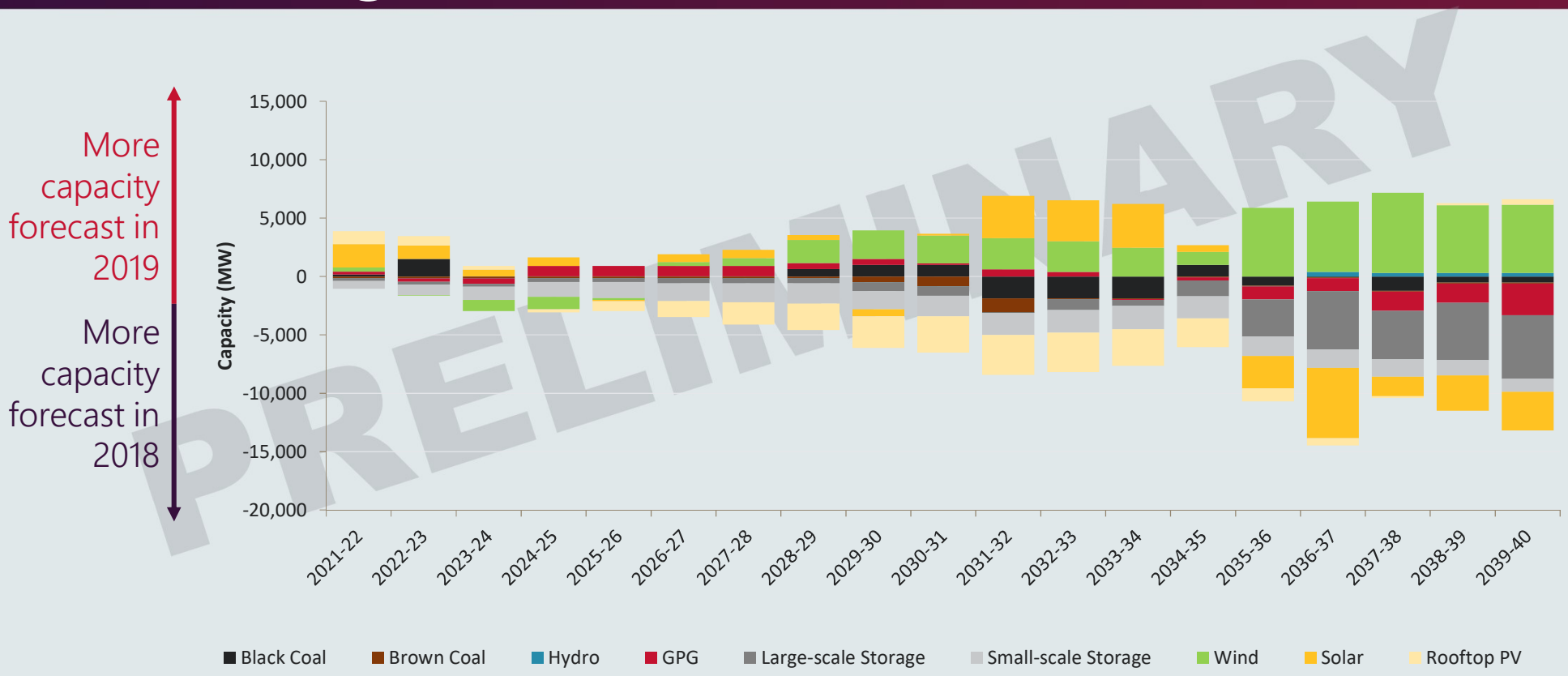
Comparison to the 2018 ISP Neutral with Storage Initiatives

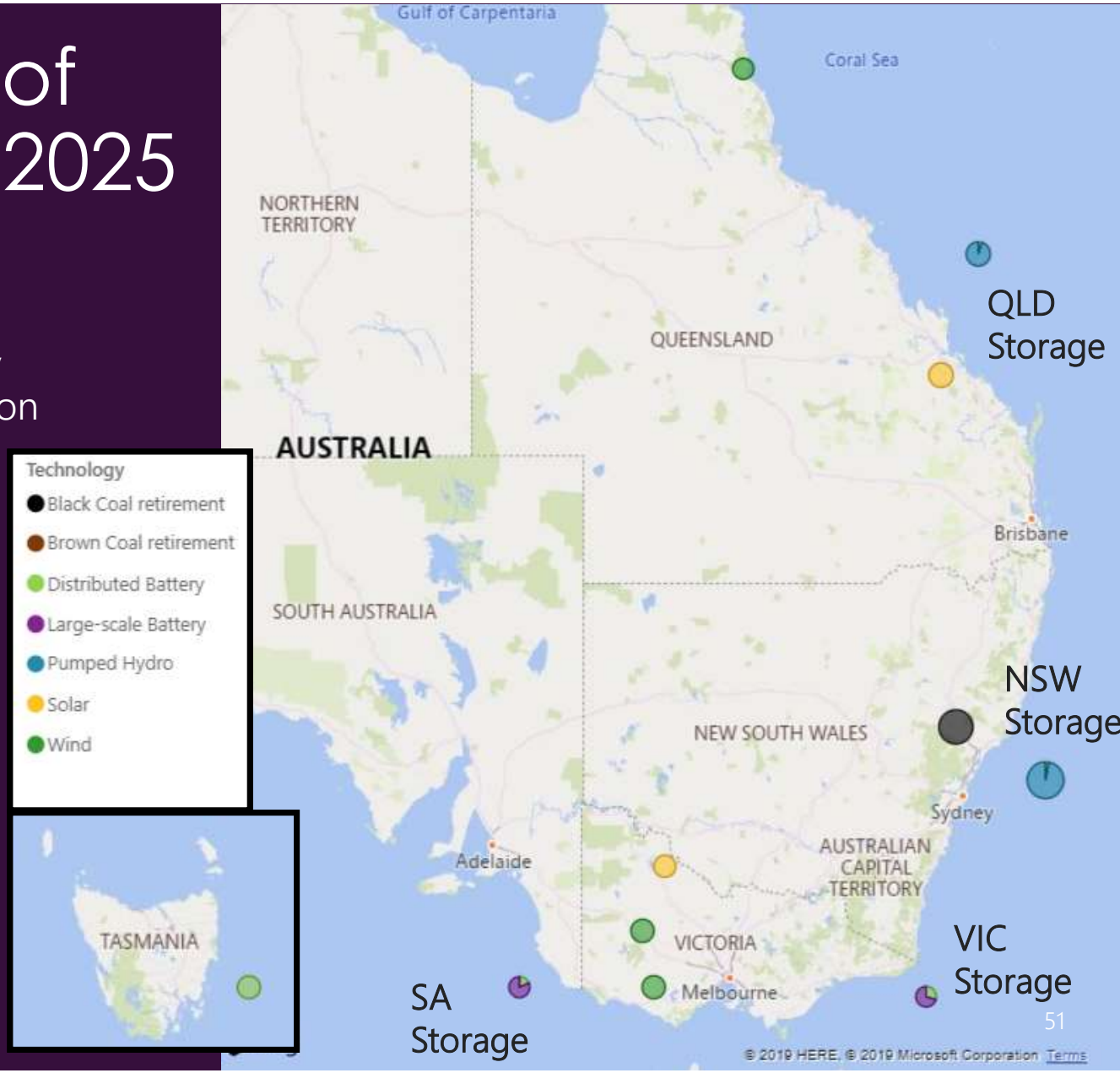


The preliminary Central scenario is broadly consistent with the 2018 ISP Neutral scenario with Storage Initiatives, showing slightly greater balance of wind and solar generation than 2018.

Projected locations of renewable energy -2025

By 2040:

- Geographically diverse renewable energy developments replacing retiring generation
- Storages provide firming support
- Role for transmission to share capacity and energy across regions



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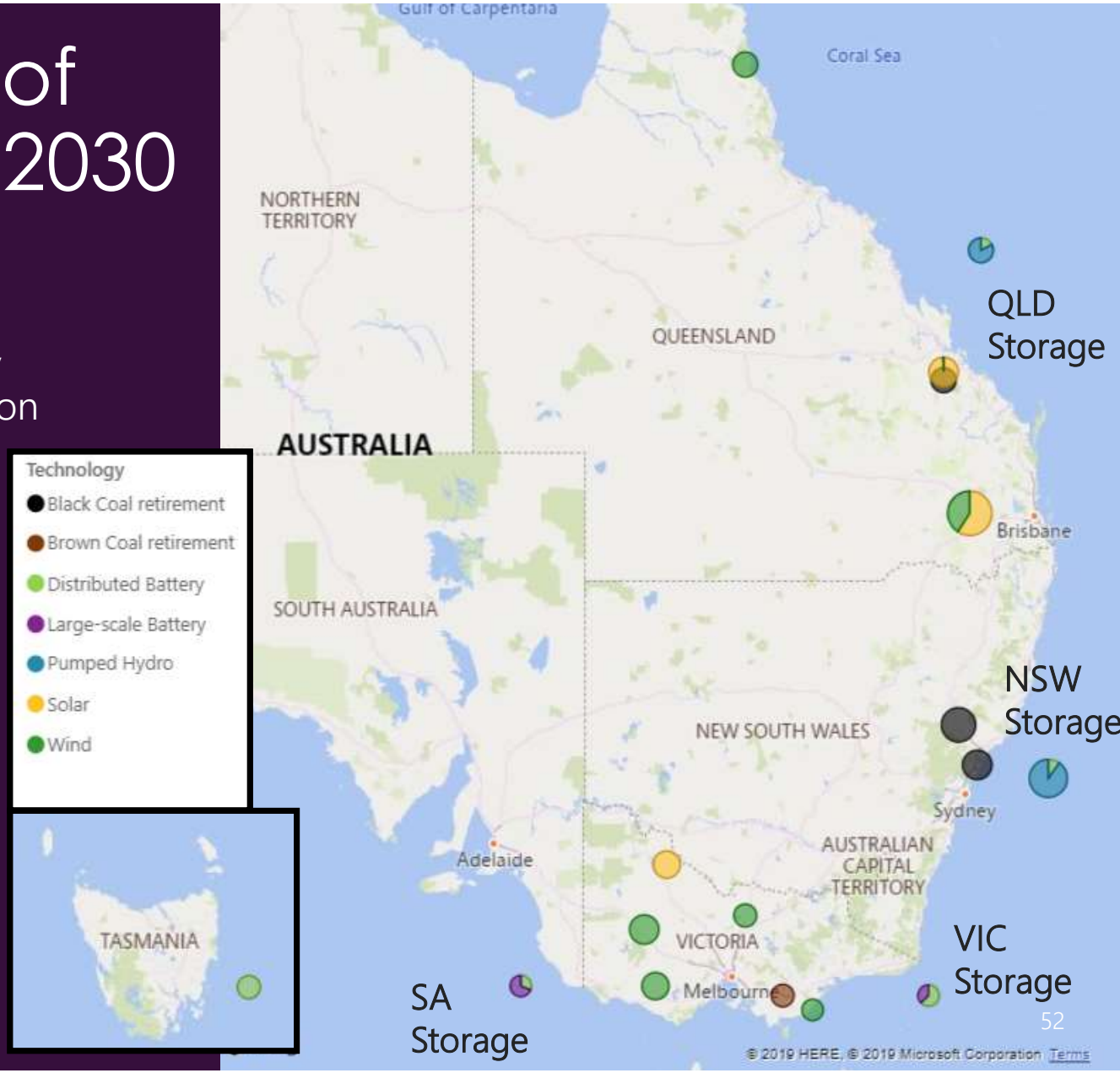
Projected locations of renewable energy -2030

By 2040:

- Geographically diverse renewable energy developments replacing retiring generation
- Storages provide firming support
- Role for transmission to share capacity and energy across regions



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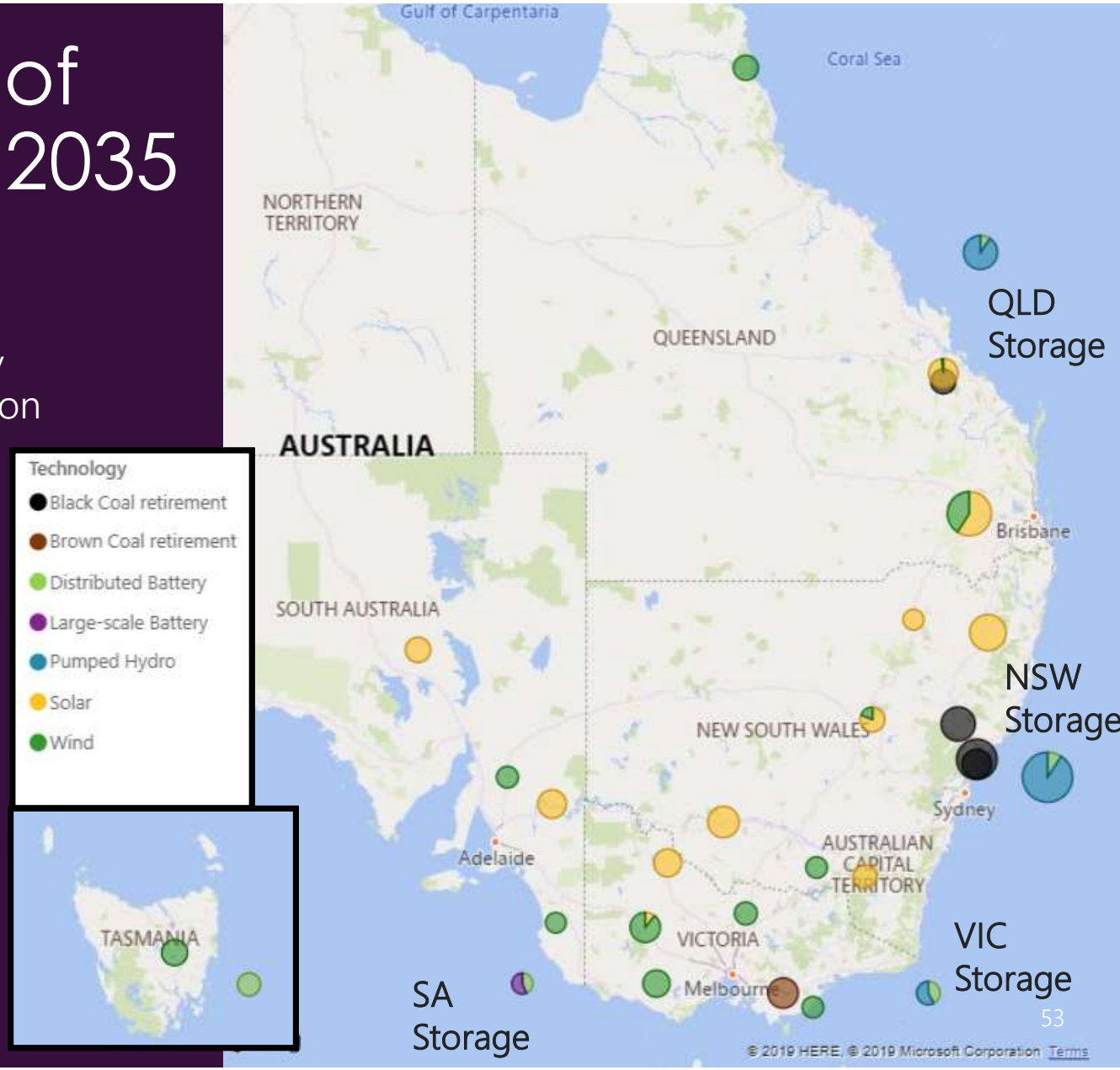
Projected locations of renewable energy -2035

By 2040:

- Geographically diverse renewable energy developments replacing retiring generation
- Storages provide firming support
- Role for transmission to share capacity and energy across regions



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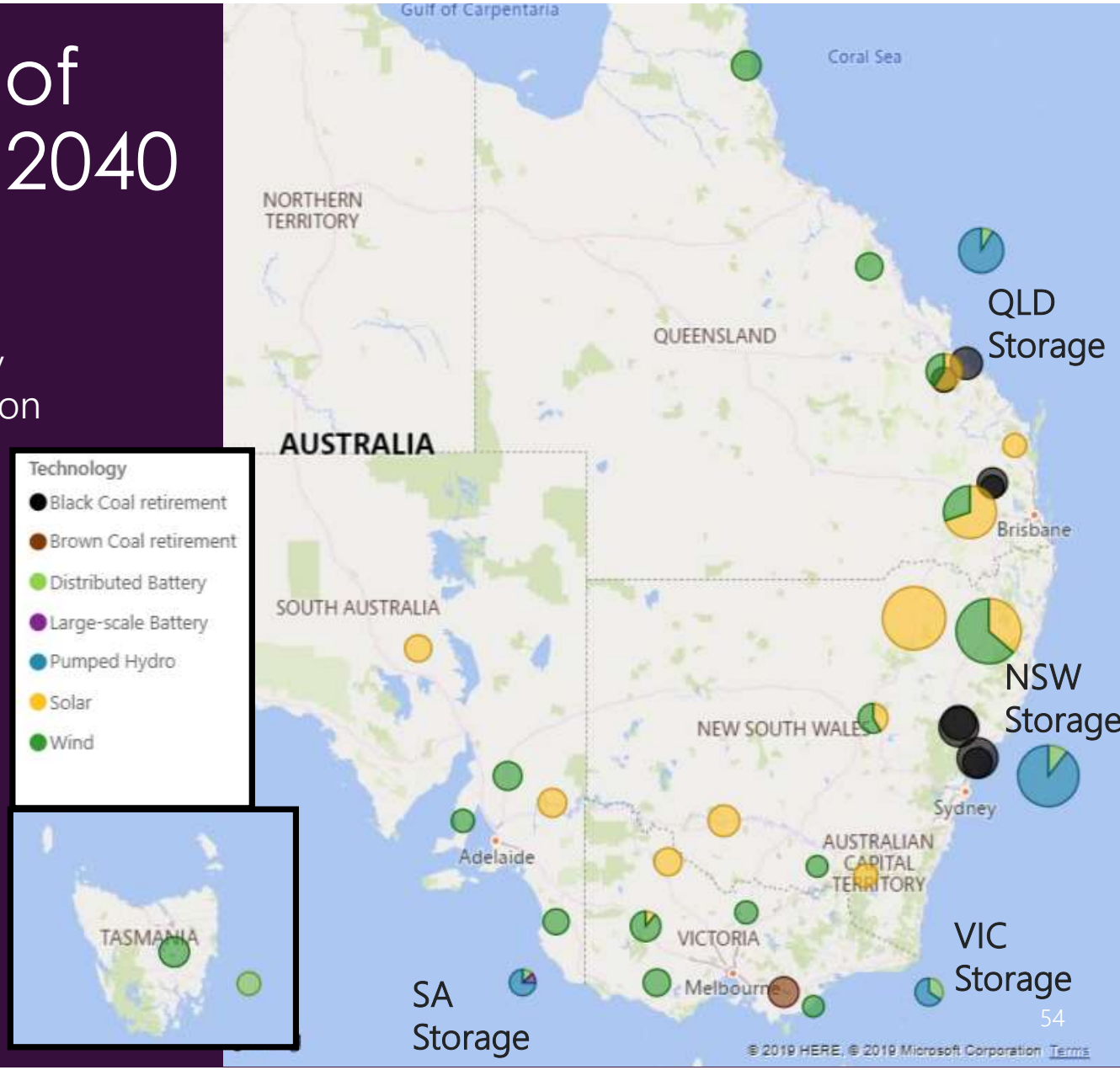
Projected locations of renewable energy -2040

By 2040:

- Geographically diverse renewable energy developments replacing retiring generation
- Storages provide firming support
- Role for transmission to share capacity and energy across regions



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Projected locations of renewable energy -2040

By 2040:

- Geographically diverse renewable energy developments replacing retiring generation
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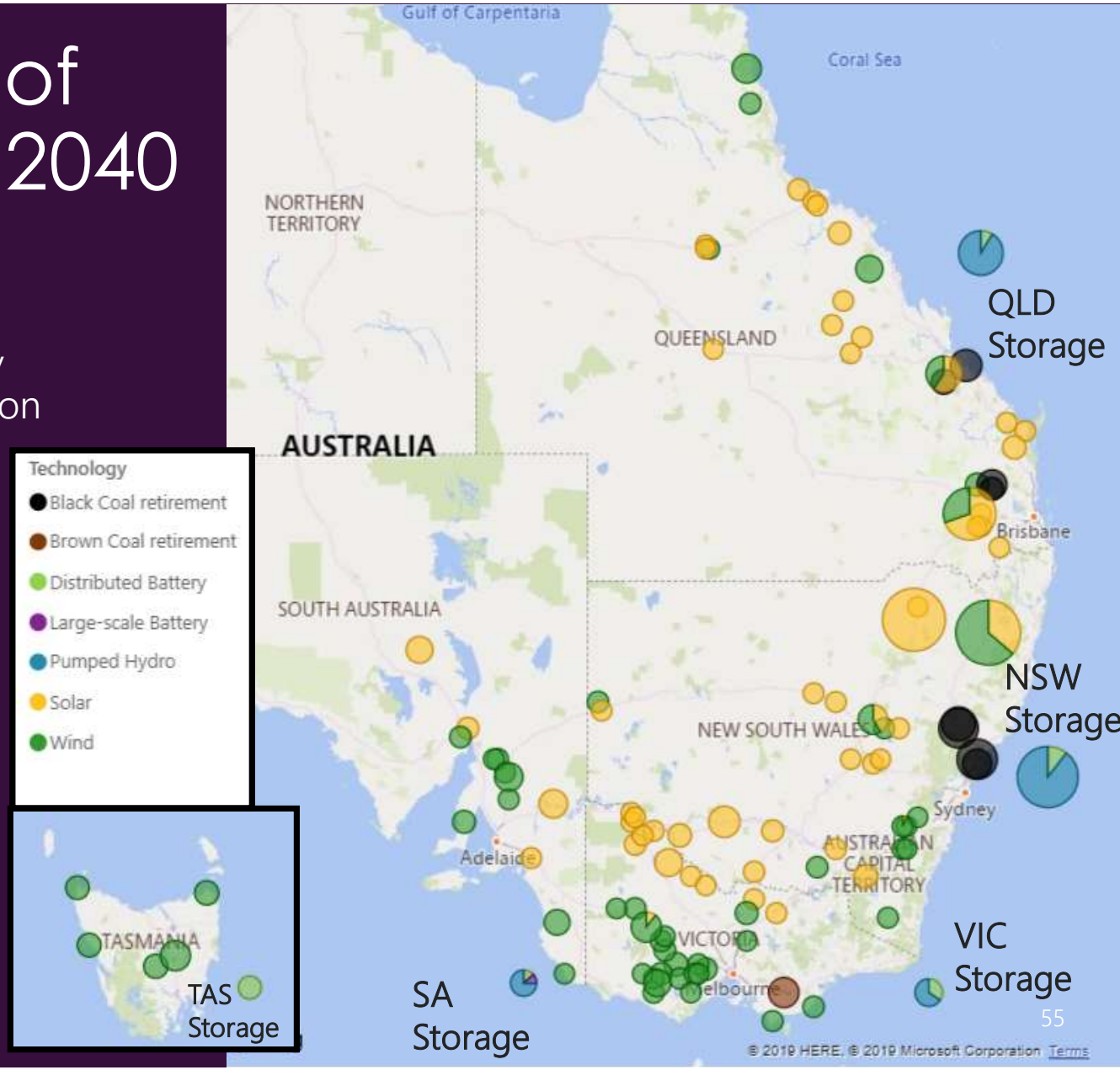
- Role for transmission to share capacity and energy across regions



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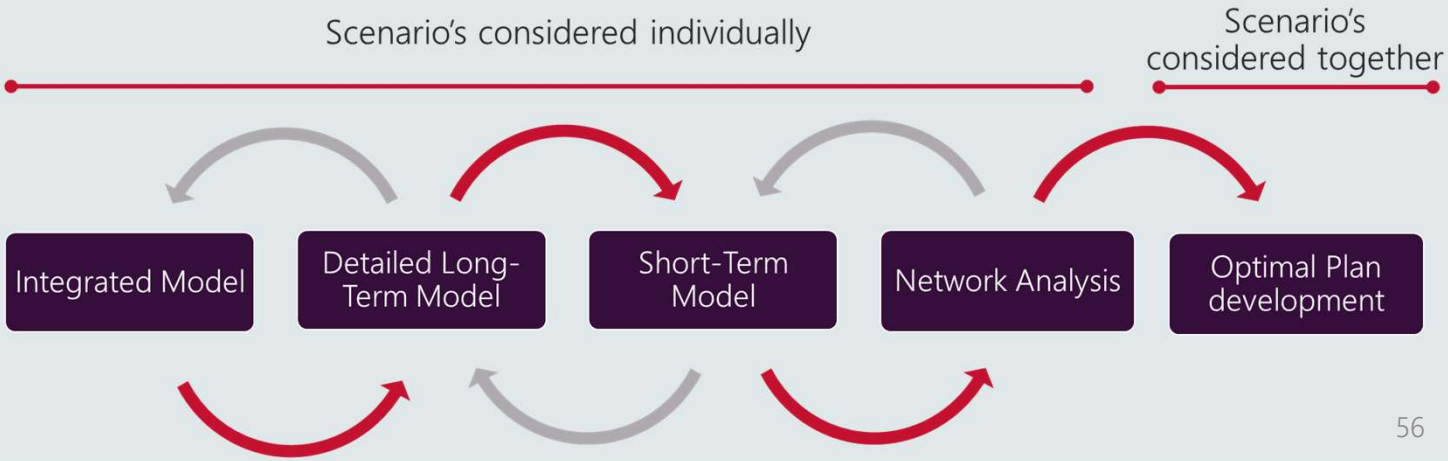
Refining the resource mix

Next steps in our modelling:

1. Iterative application of each model
2. Identification of preferred development pathways
3. Consideration of each scenario to identify the optimal development plan…
4. Consideration of risks and trade-offs. Ensuring a resilient future energy system.



Group Activity 1

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Group Activity 1 – Personal reflection

- Please take 3-minutes to:
  - Personally reflect on the outcomes presented in Session 1;
  - Feel free to review the slides; and,
  - Make additional notes on the sheets ready to share in the workshop format.

Group Activity 1 - Instructions

- We will break into workshop mode at each site, **forming groups of 8 – 12 people**:
  - Each group appoints **one 'traffic cop' / facilitator** and **one scribe**;
  - Each group will focus on **either Workshop Option A or B** (i.e. one only)
  - Over a 25-minute period, the group facilitator will seek your **key reflections on each of the four questions** in your Reflections Sheet (i.e. ~1 question / 6-minutes)
  - This will occur in **sequential 'brainstorming' mode** (i.e. seeking balanced input from all participants / avoiding critique of input or 'micro speeches')
  - The group scribe will **capture your feedback** on the butchers paper
- AEMO SME's will circulate amongst the groups and answer questions as they arise

Group Activity 1 – National report back

- National report back by each site facilitator:

  1. Summarise participants' responses / reasonableness of outcomes
  2. Share key areas of concern, burning issues and/or key questions raised
  3. Seek a response from the relevant presenter on unresolved questions

Morning Tea

Please leave your Reflections Sheets on the table if you're happy for them to be collected for input

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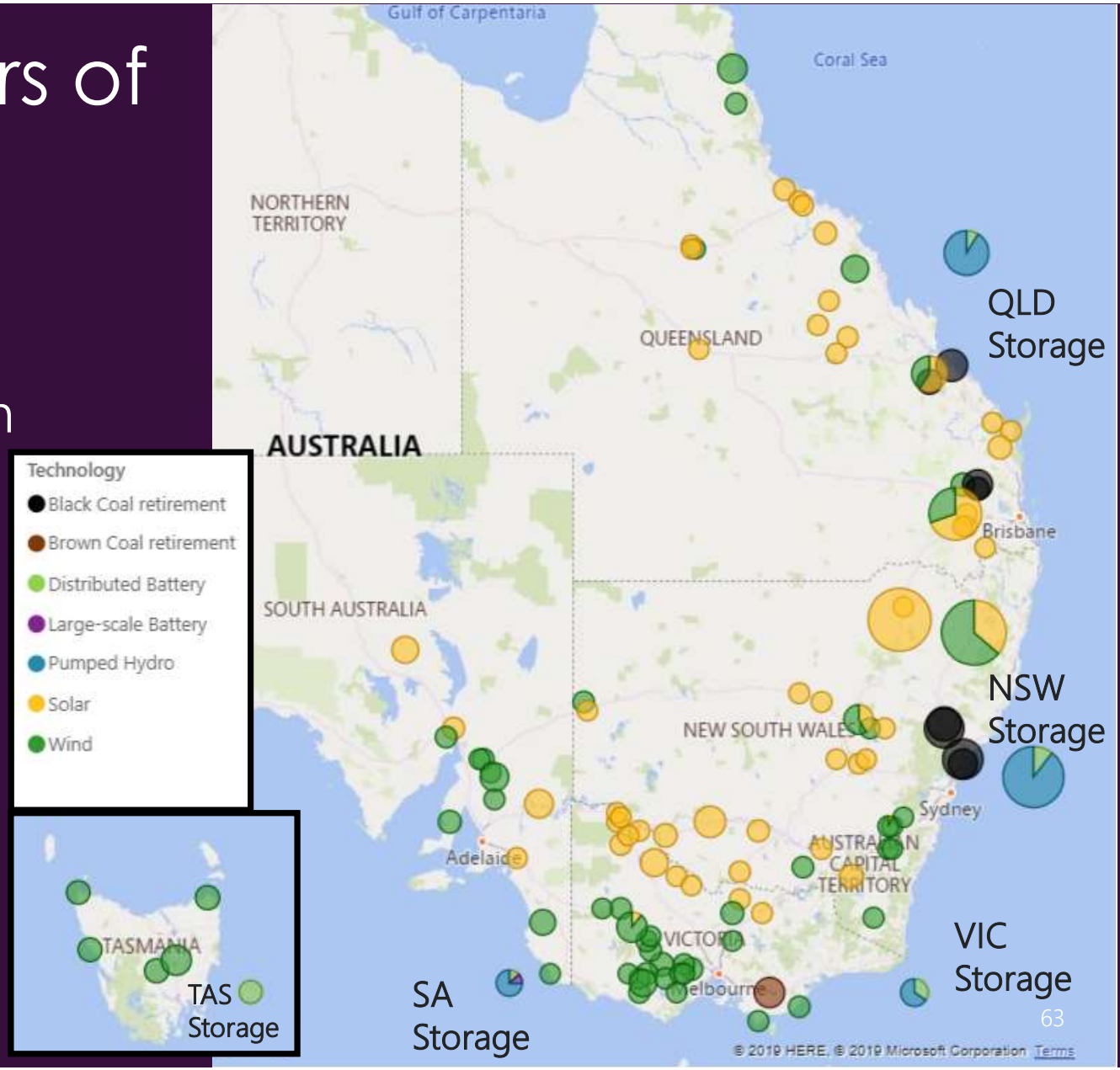
Briefing & Workshop 2:

- Preliminary grid view

Network view: Drivers of network change

1. Generator retirements
2. Locations of new generation
3. New roles for the network



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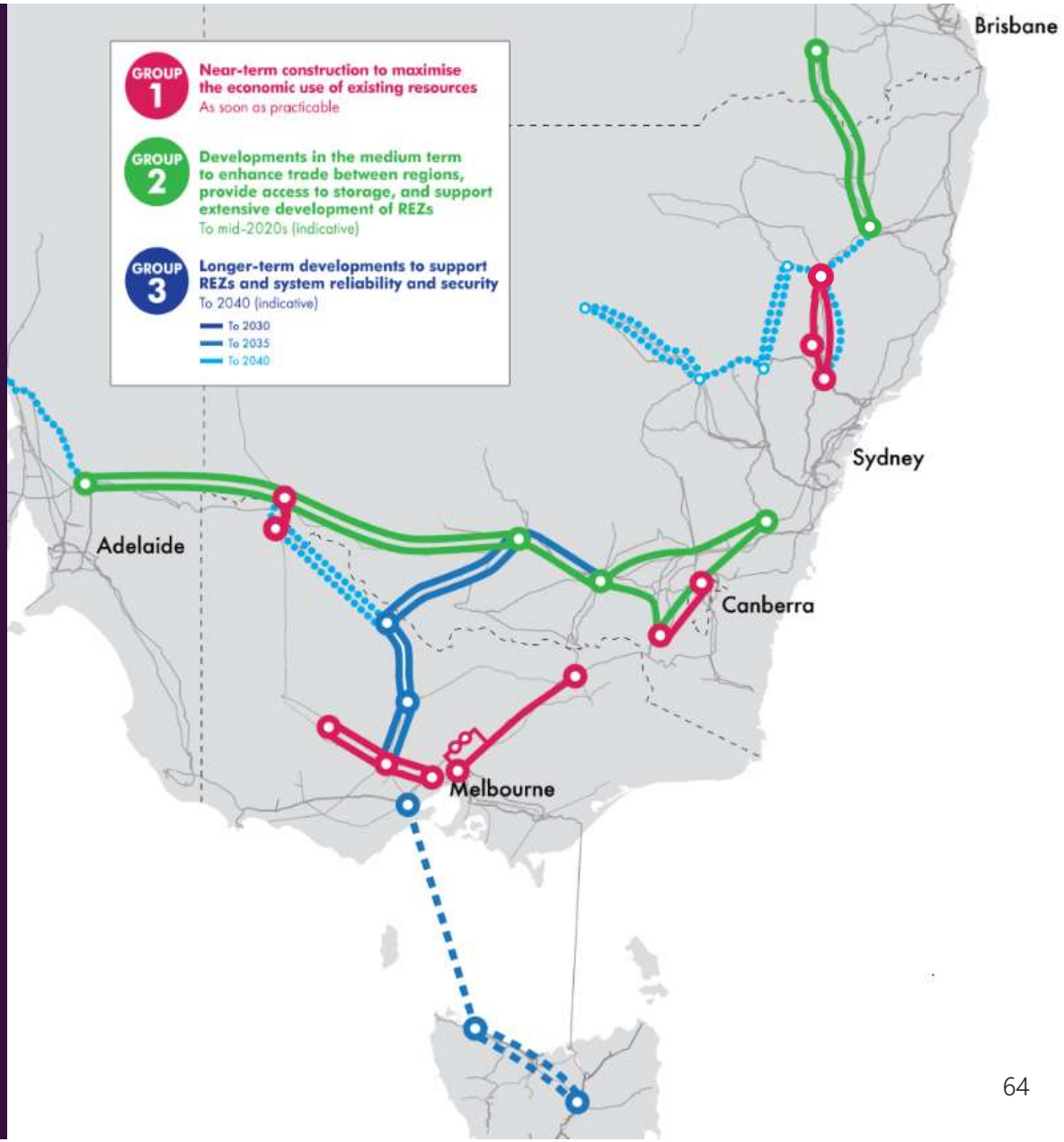
Interconnection

- Group 1 as per 2018 ISP continues to show cost reduction
- Group 2 and 3 as per 2018 ISP continue to show benefit with timing and optimal combination being tested
- Refinements of routes and configurations is ongoing



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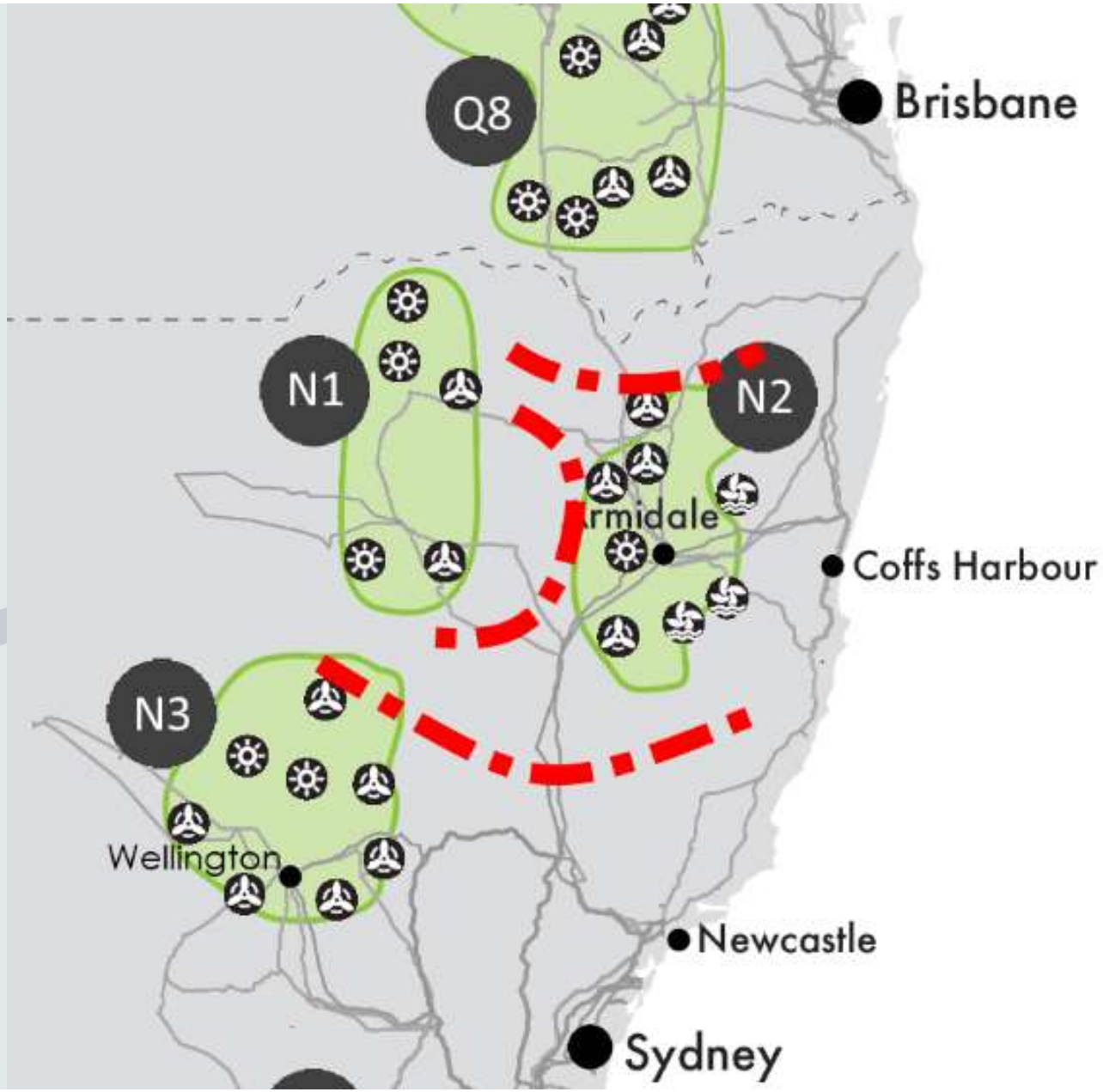
Example - Congestion in North NSW



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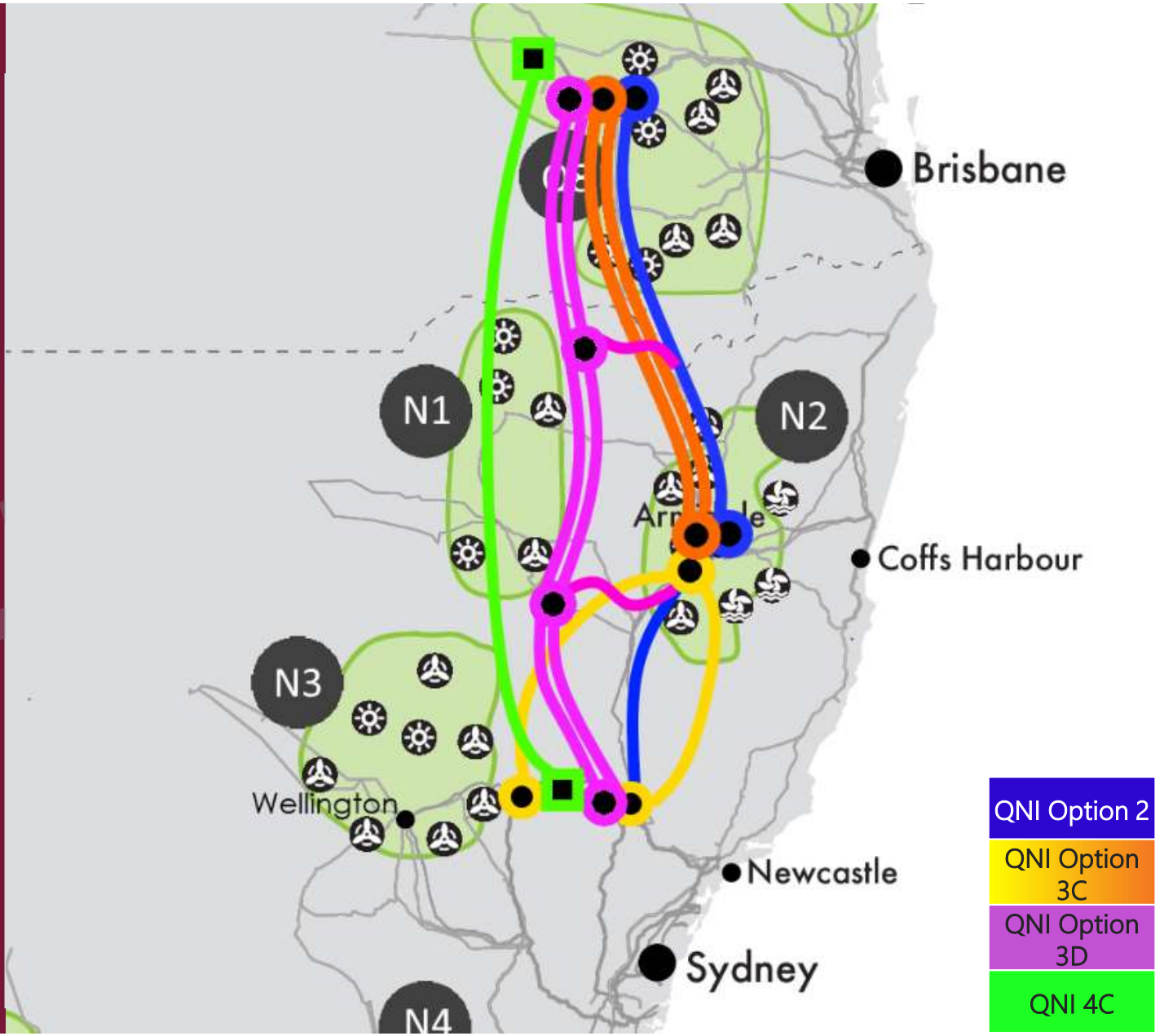
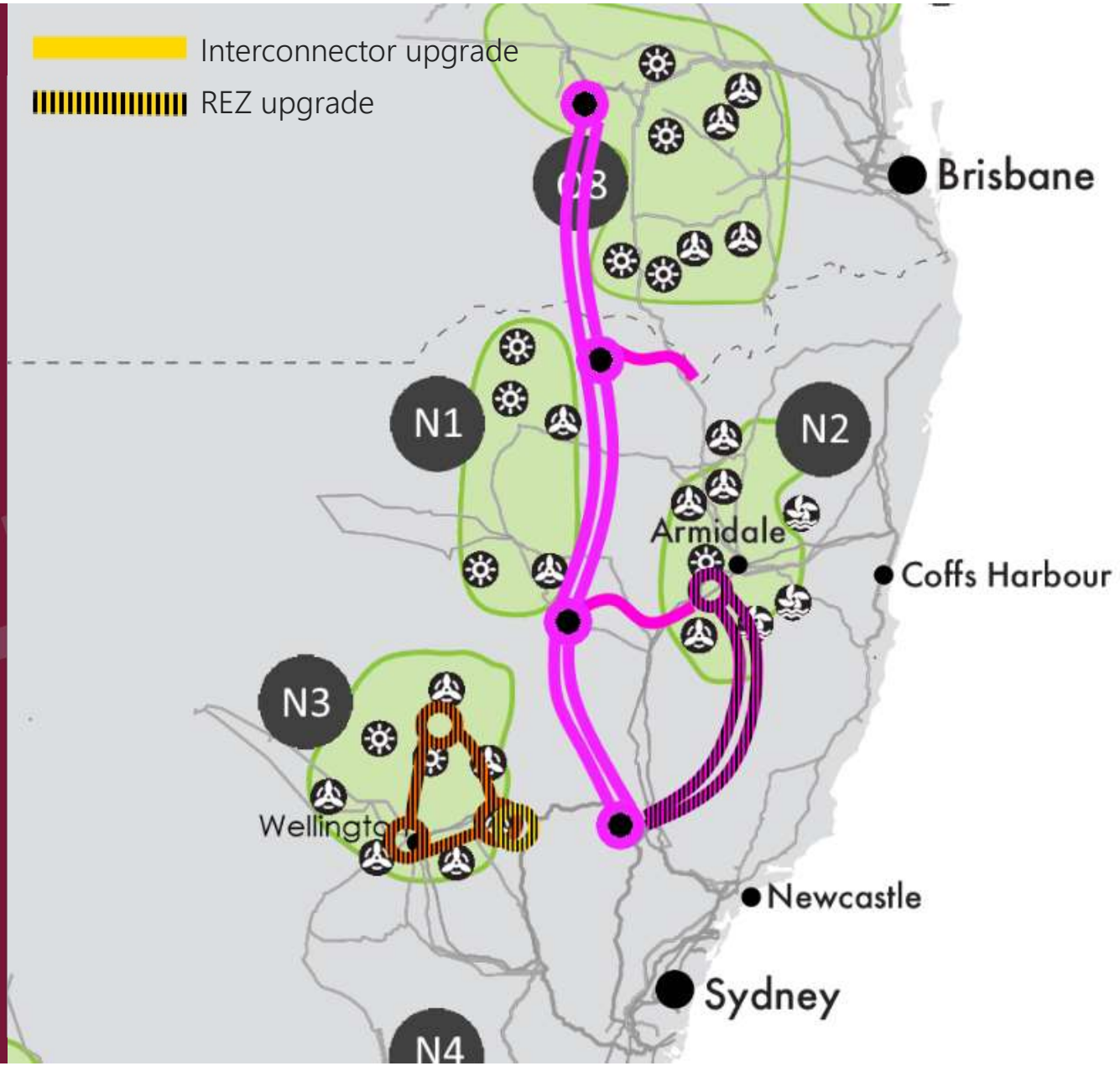
Possible solutions for augmentation

Notes: this is a subset of the options considered. See Inputs and assumptions workbook for all interconnector options

Refer to PowerLink/TransGrid RIT-T for specifics



Further possible solutions (QNI 3D)



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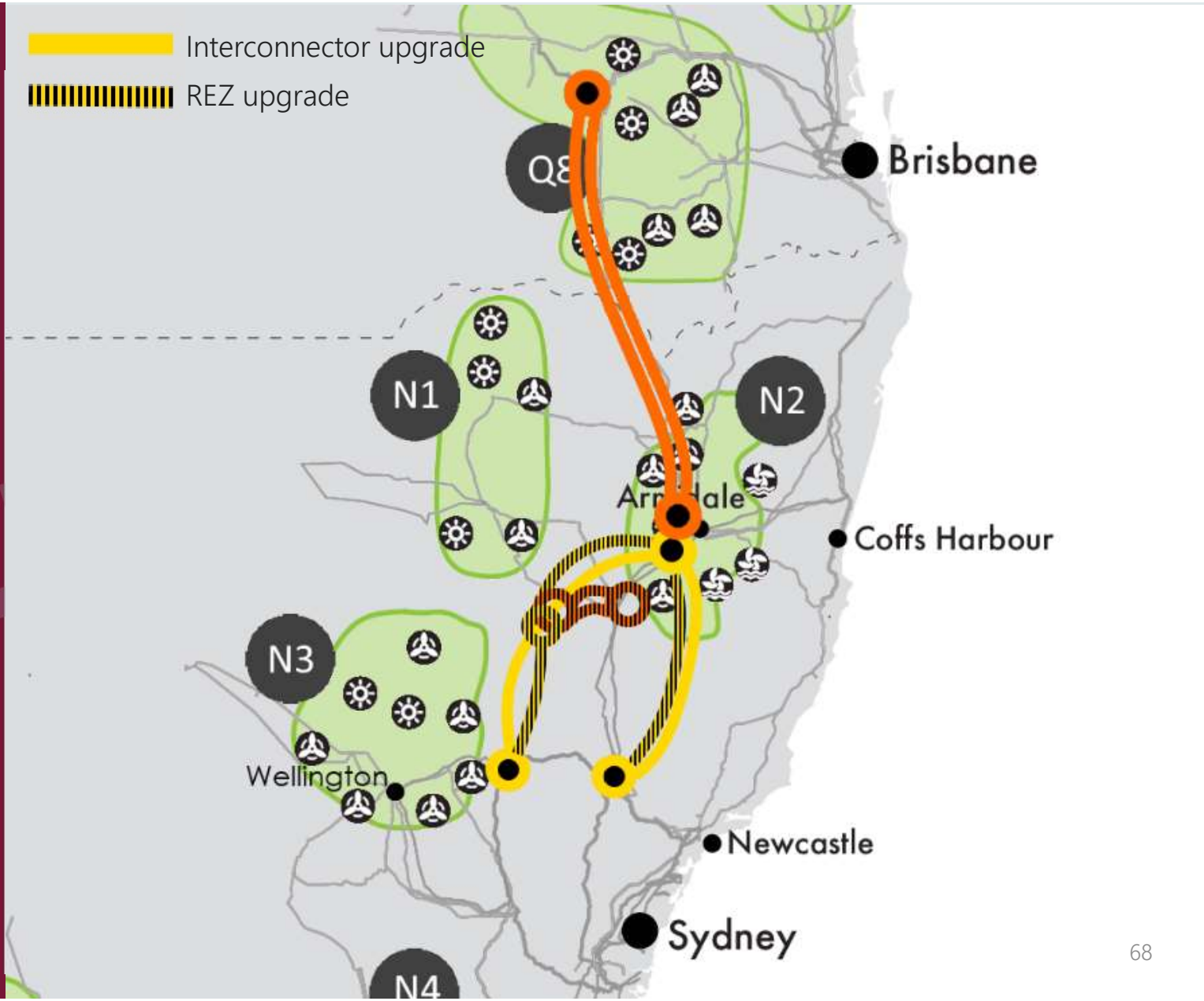
Further possible solutions (QNI 3C)



Refer to PowerLink/TransGrid RIT-T for specifics

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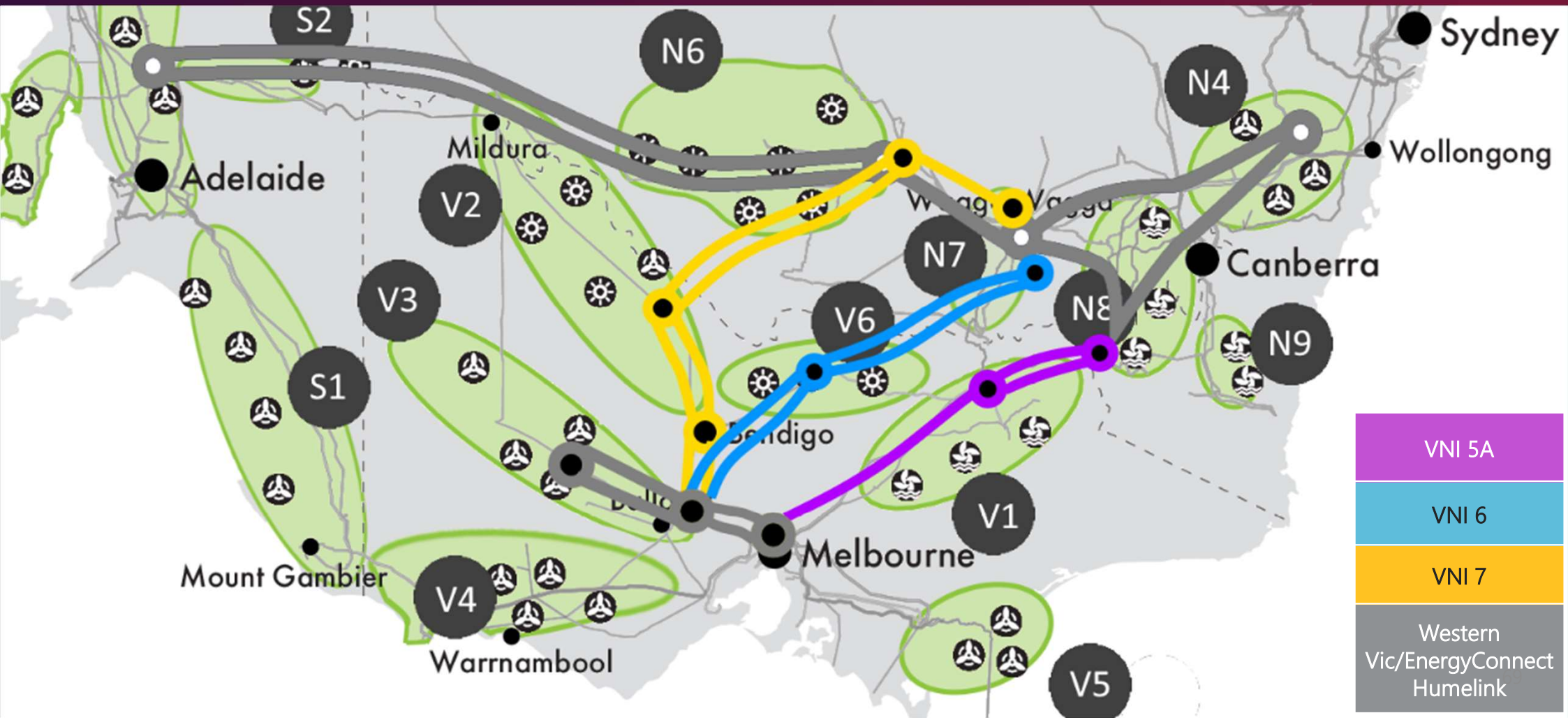
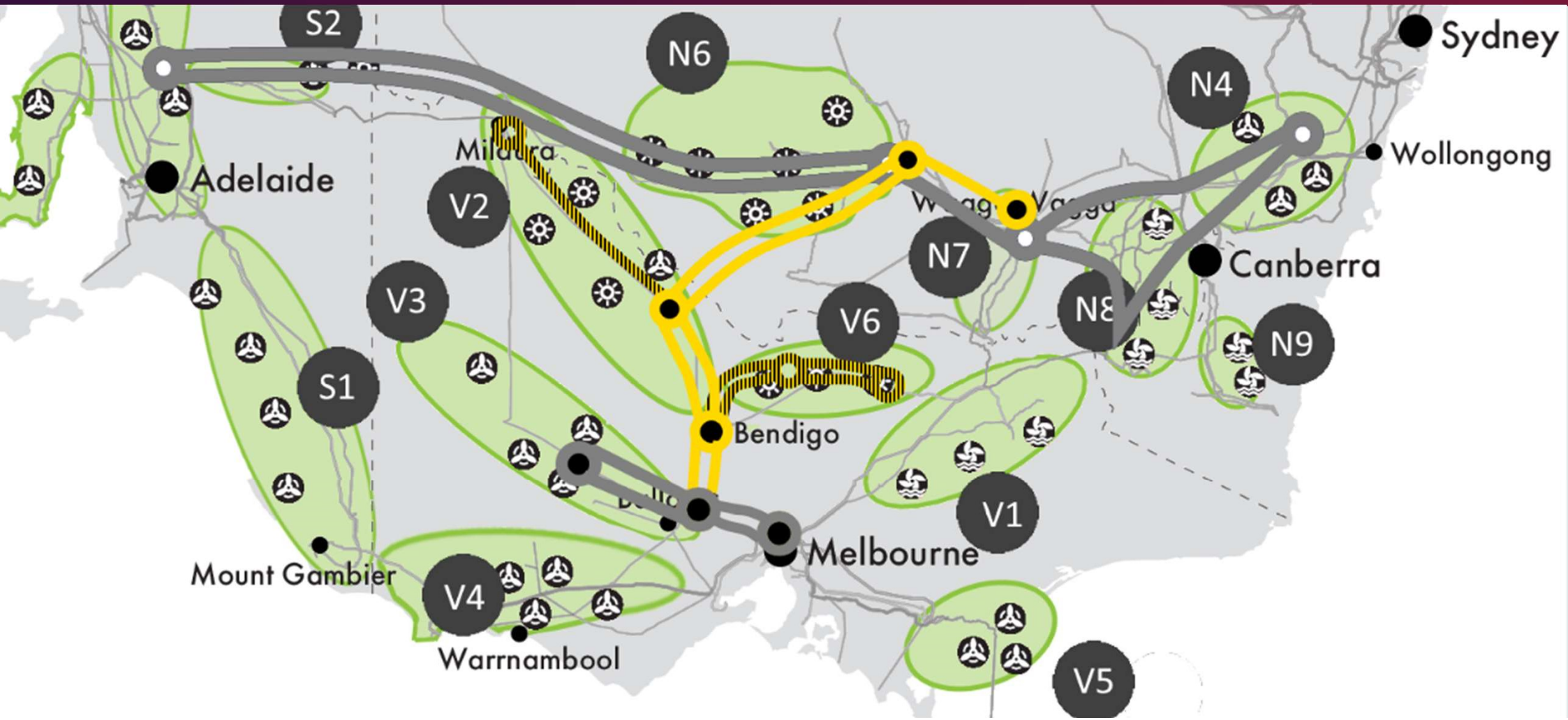
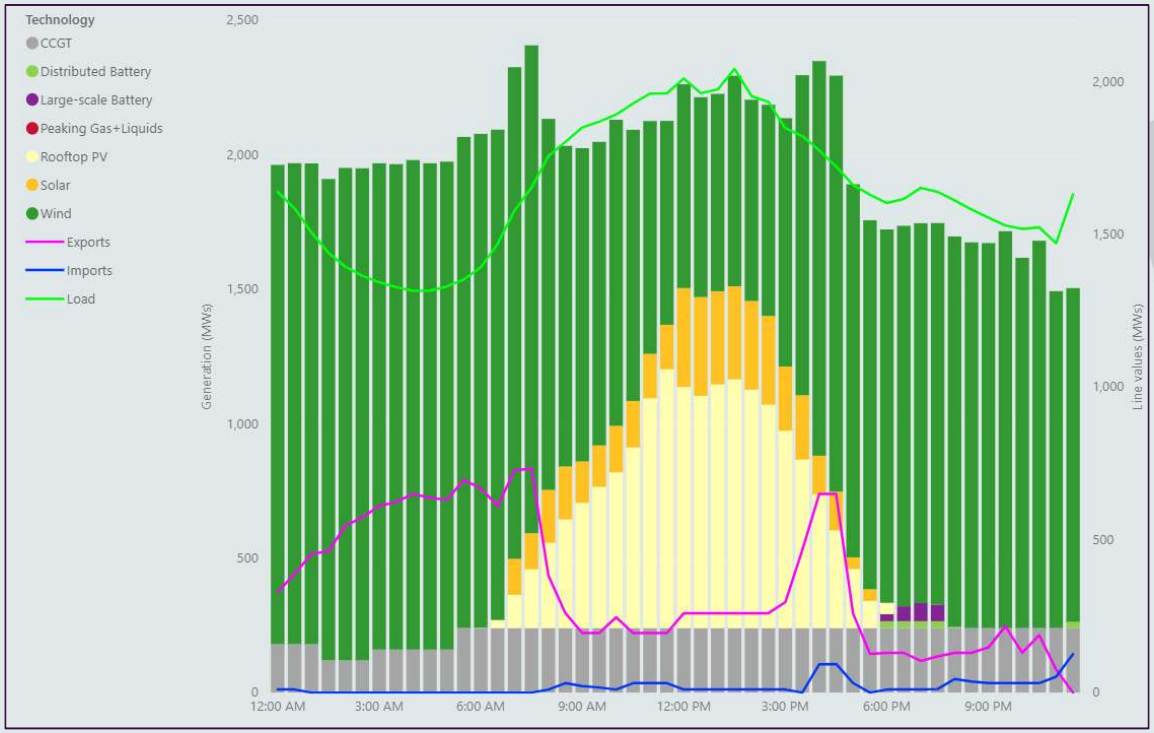
Example: Major VIC-NSW Interconnector options

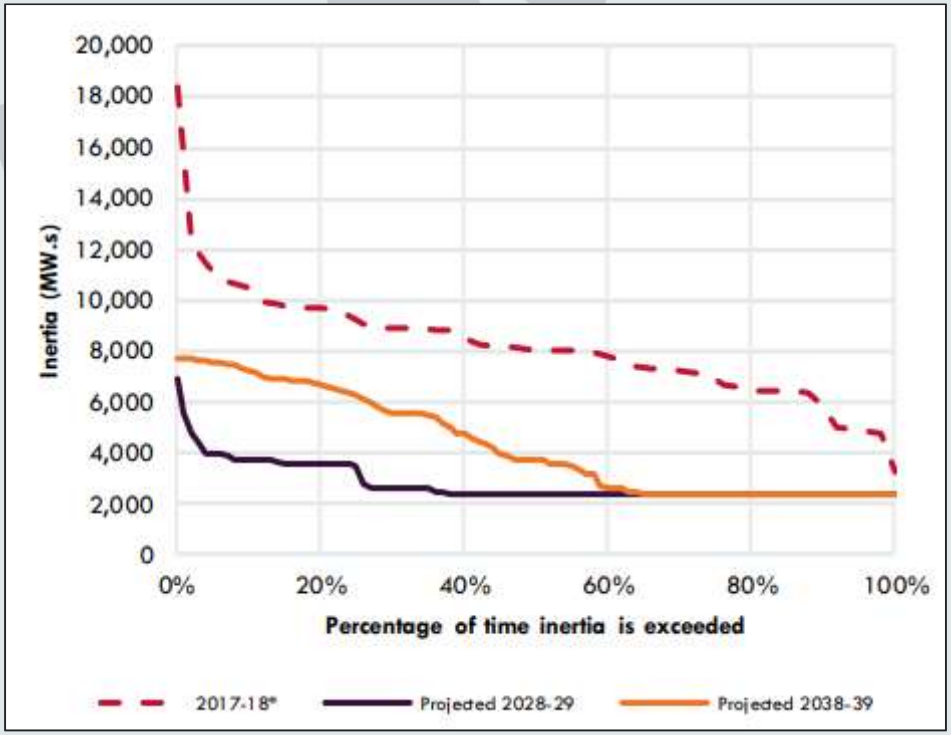


Possible solutions – KerangLink



System requirements into the future





Source: 2018 ISP

ISP approach to system services

How we intend to assess requirements when developing the ISP

- Iterative process –
  - Economic market modelling
  - Power system requirements assessment
  - Review materiality of additional costs and impact on optimal plan
  - Modify build costs/constraints & where needed iterate

- Outline services required for given resource mix, location, timing, and network state

Group Activity 2

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Group Activity 2 – Personal reflection

- Please take 3-minutes to:
  - Personally reflect on the outcomes presented;
  - Feel free to review the slides; and,
  - Make additional notes on the sheets ready to share in the workshop format.

Group Activity 2 - Instructions

- As we did earlier, we will break into groups of 8 – 12 people at each site:
  - Each group appoints one ‘traffic cop’ / facilitator and one scribe and focuses on either Workshop Option A or B
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Group Activity 2 – National report back

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  3. Seek a response from the relevant presenter on unresolved questions

Next Steps

1. Any additional post-workshop suggestions to isp@aemo.com.au by 16 Oct 2019.
2. AEMO will provide a synopsis of workshop feedback to all participants by 18 Oct 2019.
3. AEMO will be completing the modelling for the Draft 2020 ISP, including risk assessments, over the coming months.
4. The Draft 2020 ISP is scheduled for release in Dec 2019.
5. Formal stakeholder consultation on the Draft 2020 ISP will occur over Dec – Feb 2020.
6. AEMO will continue to engage and incorporate feedback into the Final 2020 ISP scheduled for delivery in mid-2020.

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Thank you for participating!

isp@aemo.com.au

Please leave your Reflections Sheets on the table if you're happy for them to be collected for input

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