AEMO Consumer Forum

Wednesday 4 August 2021

Microsoft Teams only

PLEASE NOTE THIS MEETING WILL BE RECORDED FOR THE PURPOSE OF PREPARING MINUTES

We acknowledge the Traditional Owners of country throughout Australia and recognise their continuing connection to land, waters and culture.

We pay our respects to their Elders past, present and emerging.

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Housekeeping

1. Please use the Chat function for questions or comments during presentations.
2. If you have dialled in via phone, please email your name and organisation to stakeholderrelations@aemo.com.au for our records.
3. We have emailed the slide deck around. If you didn't receive it, email stakeholderrelations@aemo.com.au and we'll forward it on.

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AGENDA

	TIME	TOPIC	PRESENTER
1	9:00am – 9:05am	Welcome and overview	Antara Mascarenhas (Chair)
2	9:05am – 9:40am	Quarterly Energy Dynamics- highlights from the July publication	Jonathan Myrtle
3	9:40am – 10:10am	AEMO's Inputs, Assumptions and Scenarios Report (IASR) 2021-22	Oliver Derum & ISP Consumer Panel
4	10:10am – 10:30am	DER integration in the NEM – key challenges and solutions	Scott Chapman
BREAK			
5	10:35am – 10:55am	Engineering Framework - update	Chris Mock & Chris Davies
6	10:55am – 11:30am	Project EDGE: Consumer insights study on DER project	Mondo Energy and Deakin University
7	11:30am – 11:35am	Other business & close	Antara Mascarenhas

Welcome and overview

Antara Mascarenhas

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Quarterly Energy Dynamics – Q2 2021

Jonathan Myrtle

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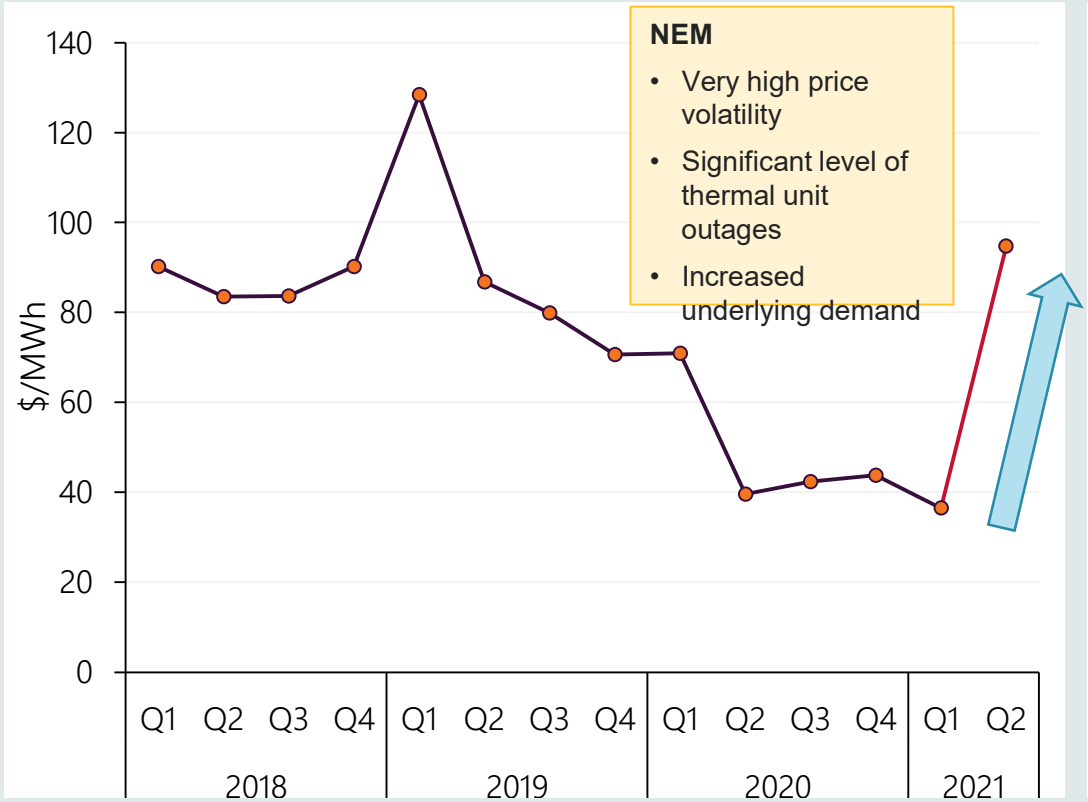
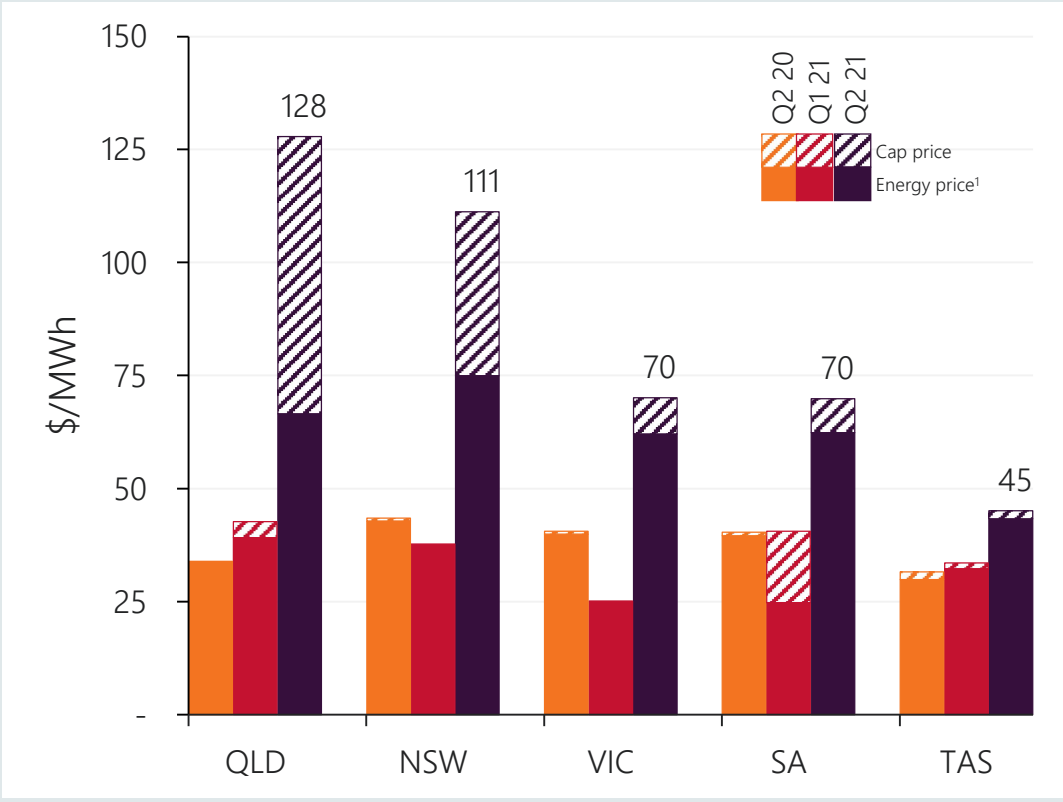
Electricity prices rebound

Sharp increase in mainland NEM prices



High price volatility in QLD & NSW



[1]*Energy price' is used in electricity pricing to remove the impact of prices volatility (that is, price above $300/MWh).*

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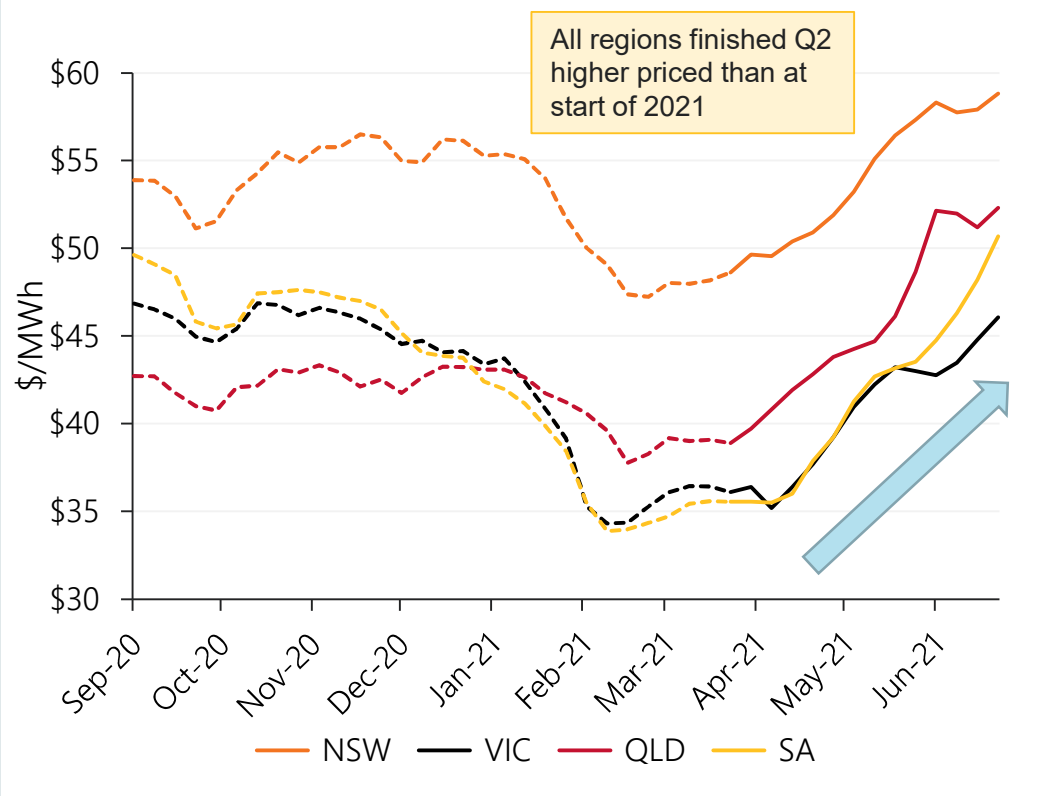
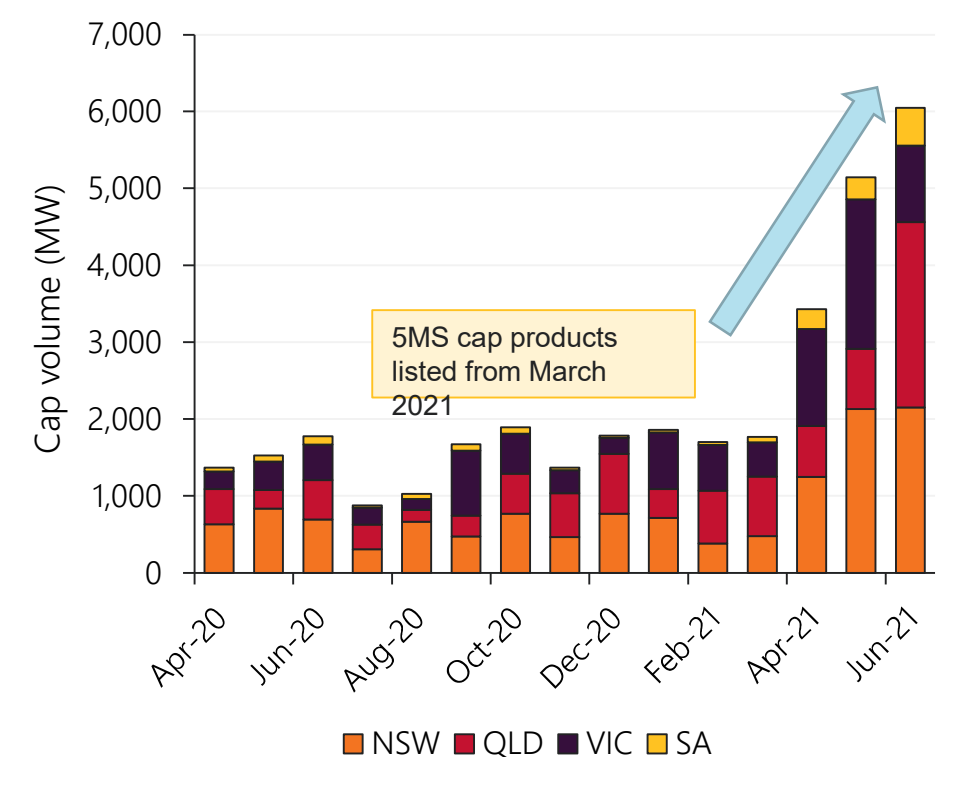
Futures prices rally

Calendar year 2022 swap prices

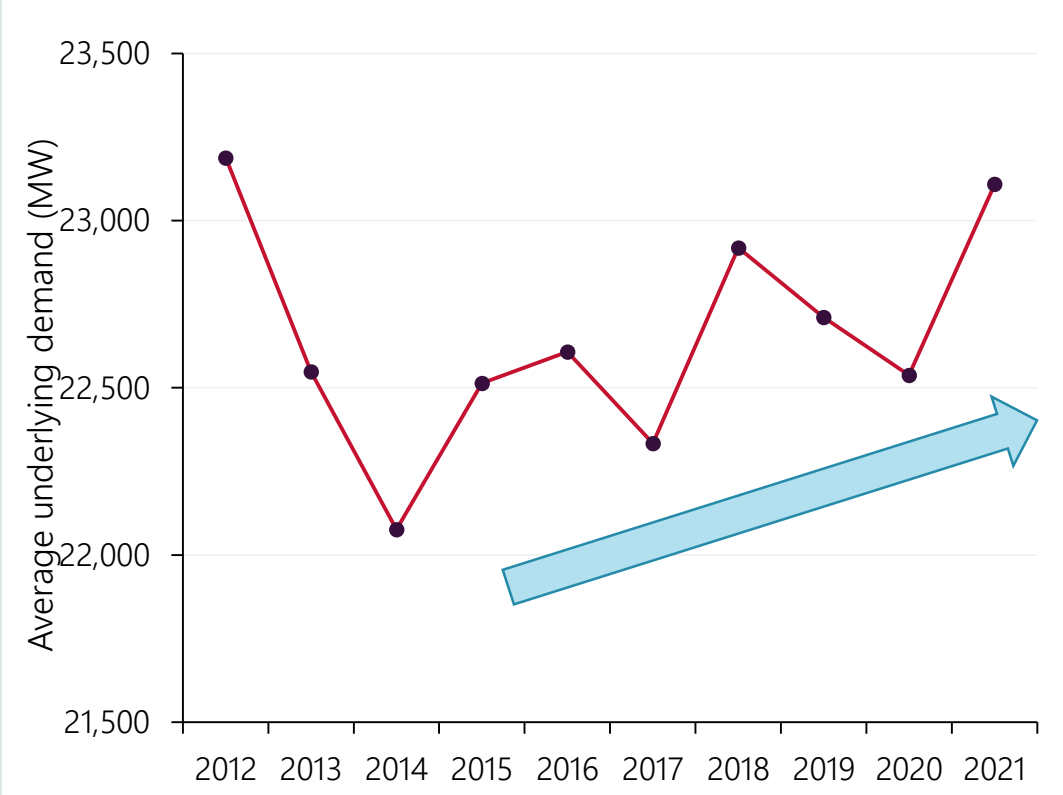


Return of price volatility sees large increase in ASX cap volume



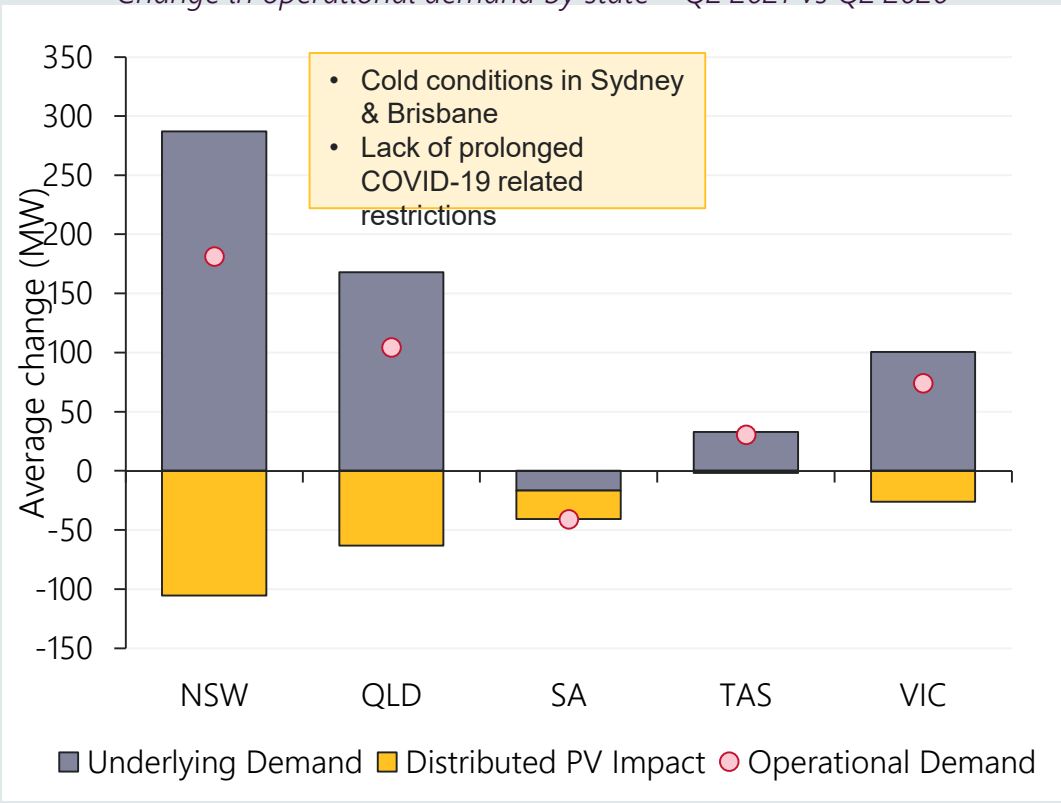
Cold Q2 weather increases demand

Highest NEM Q2 underlying demand since 2012



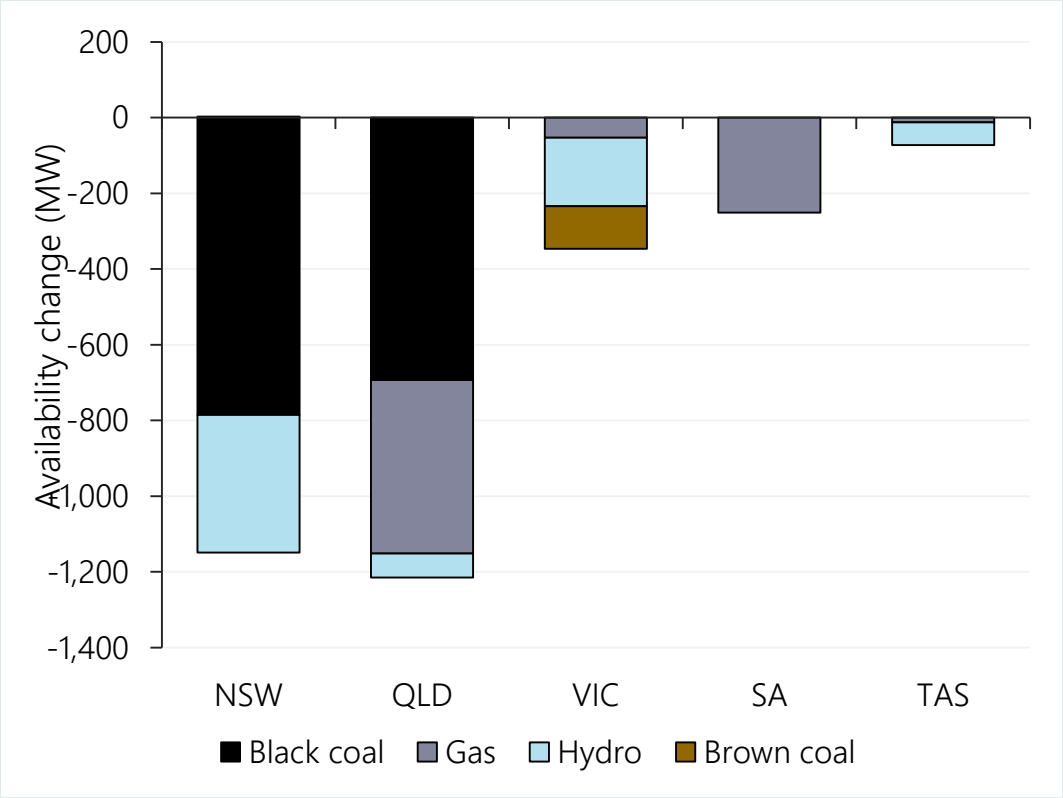
Largest demand increases in NSW & QLD

Change in operational demand by state – Q2 2021 vs Q2 2020



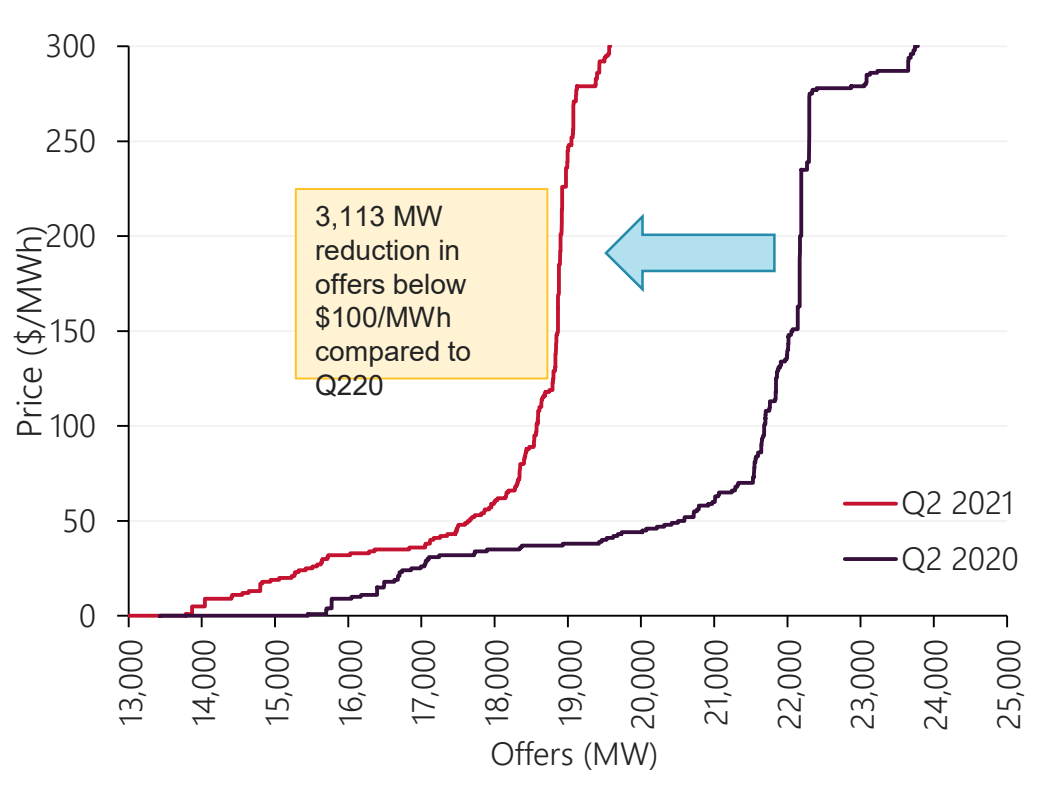
Large reduction in thermal availability

Reduced thermal availability in QLD & NSW



Higher cost supply due to outages and higher fuel costs

NEM thermal generation bid supply curve – Q221 vs Q220



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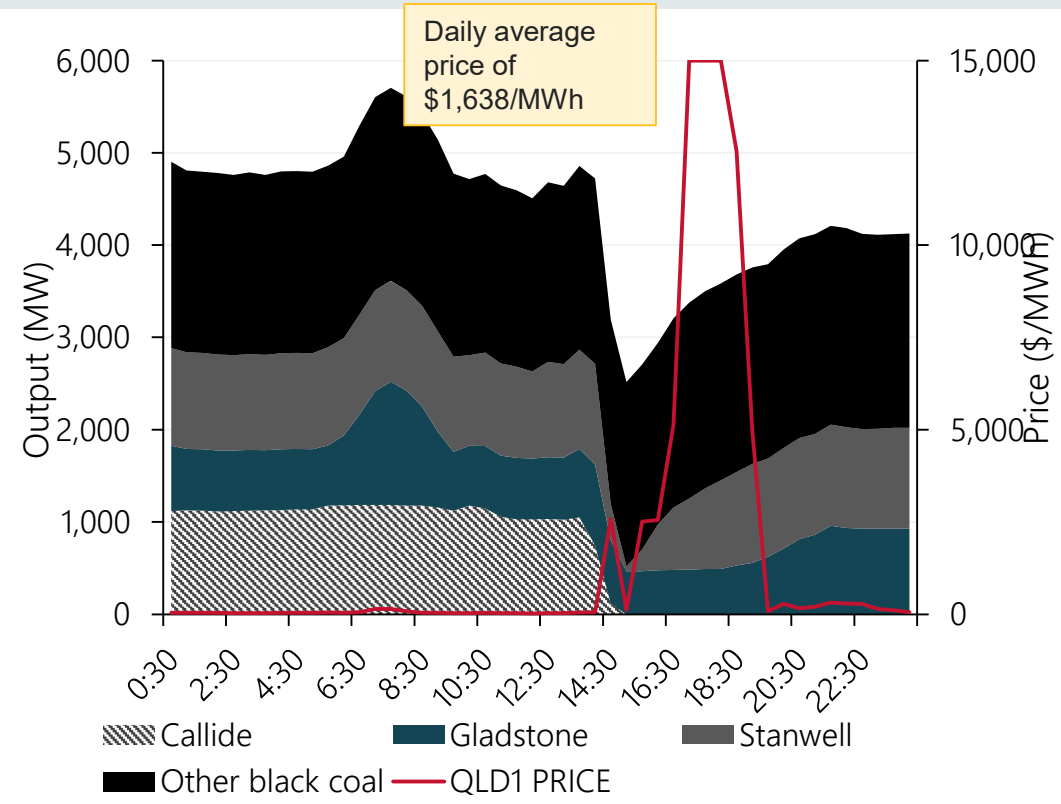
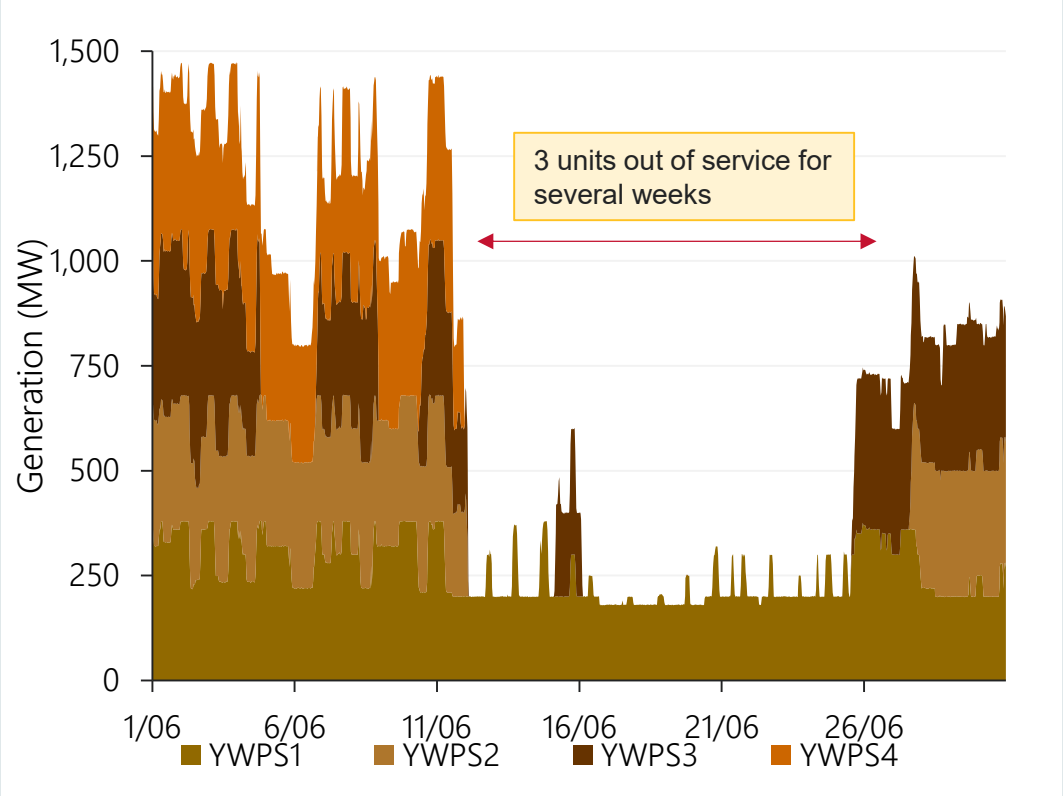
Issues at Callide and Yallourn

Major incident at Callide Power Station – 25 May

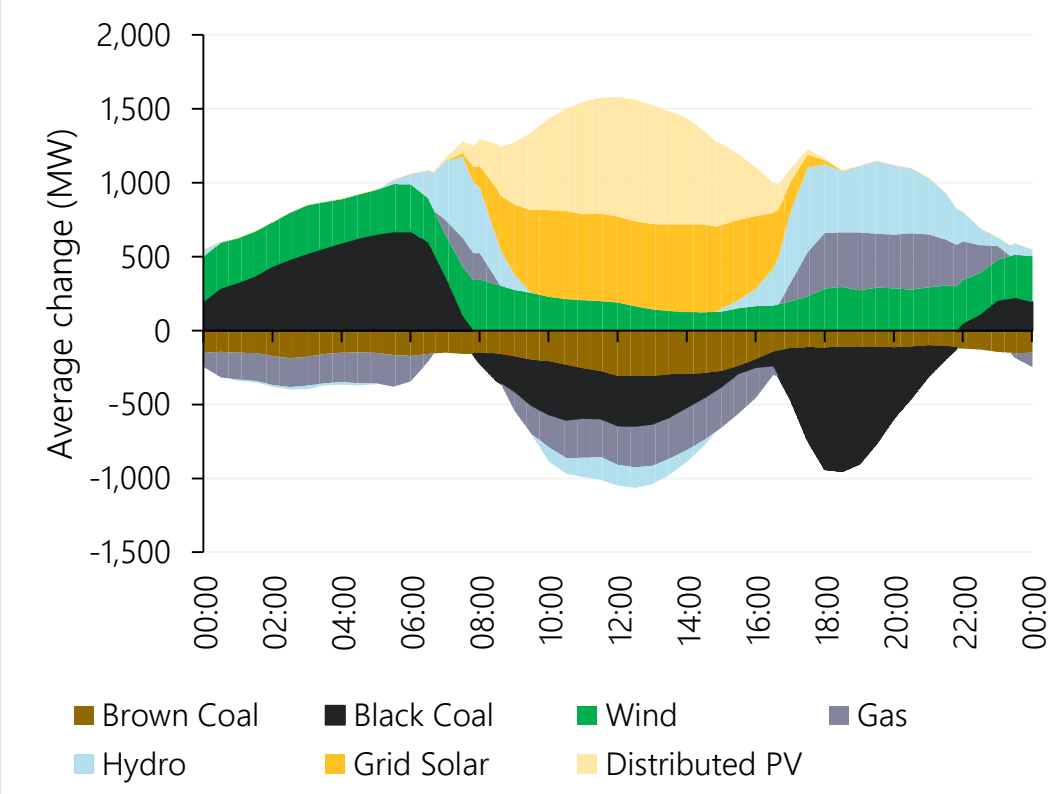


Yallourn affected by mine flood damage

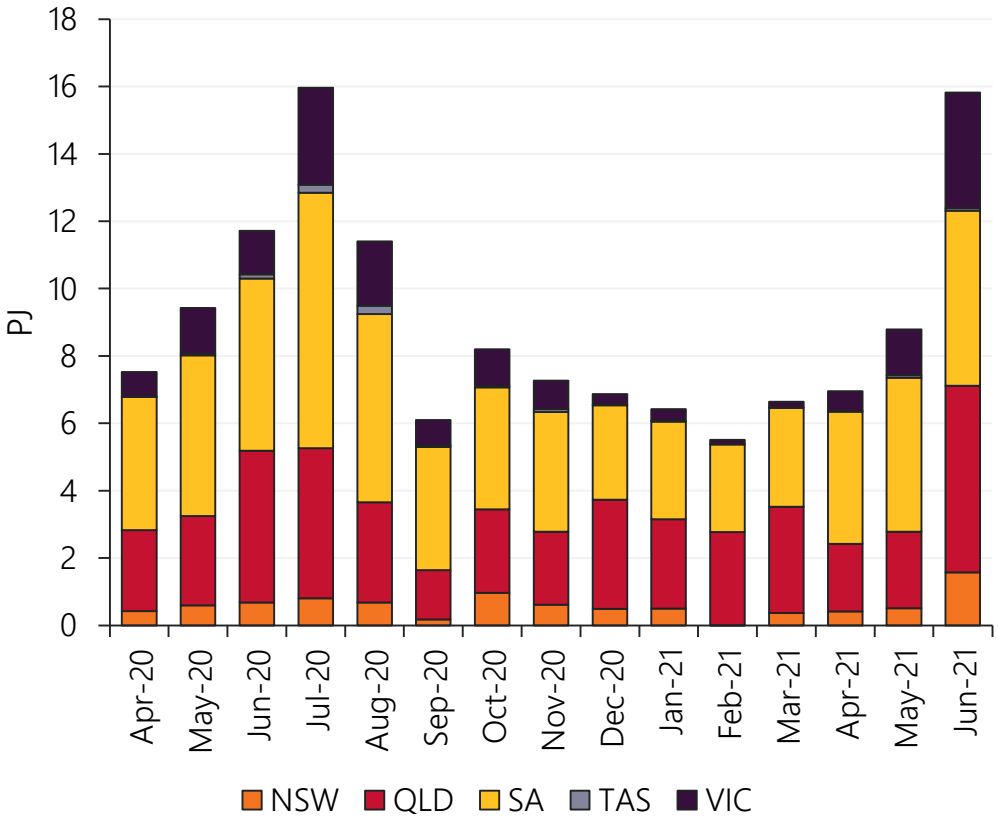


Gas and hydro cover for coal-fired generator outages

Change in output – Q2 2021 versus Q2 2020

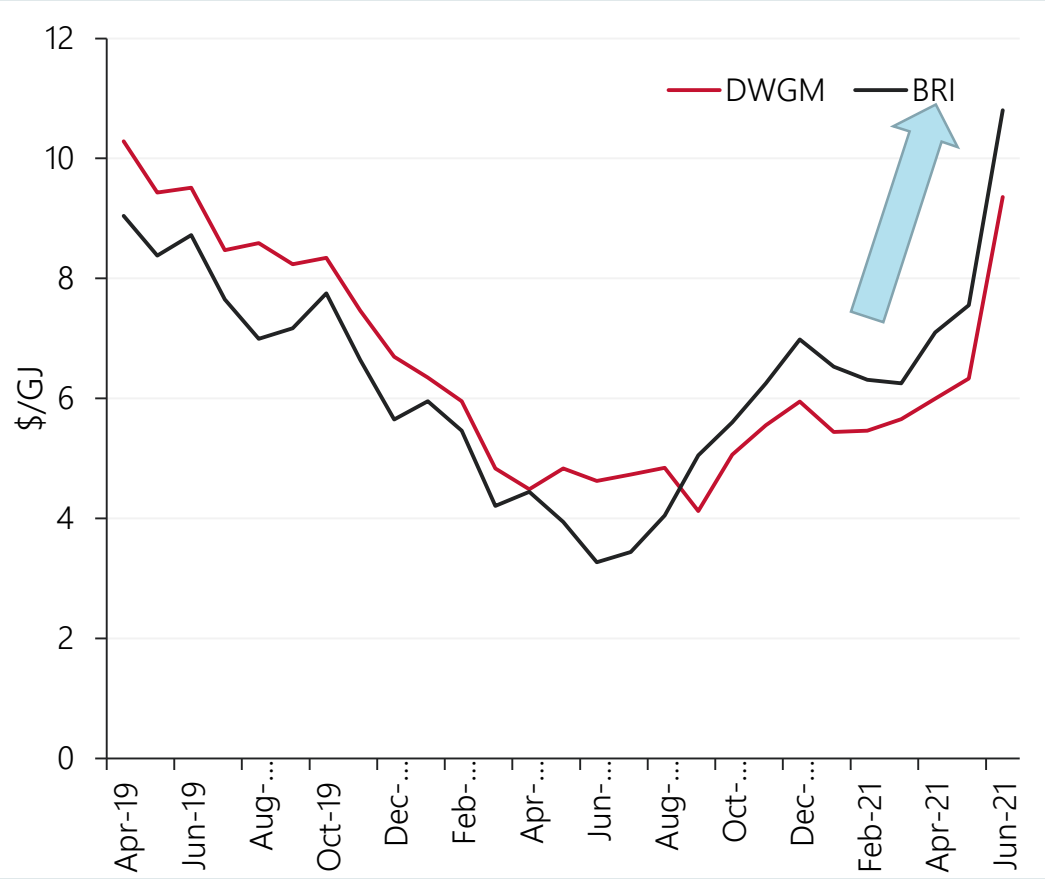


GPG rebounds from near record lows

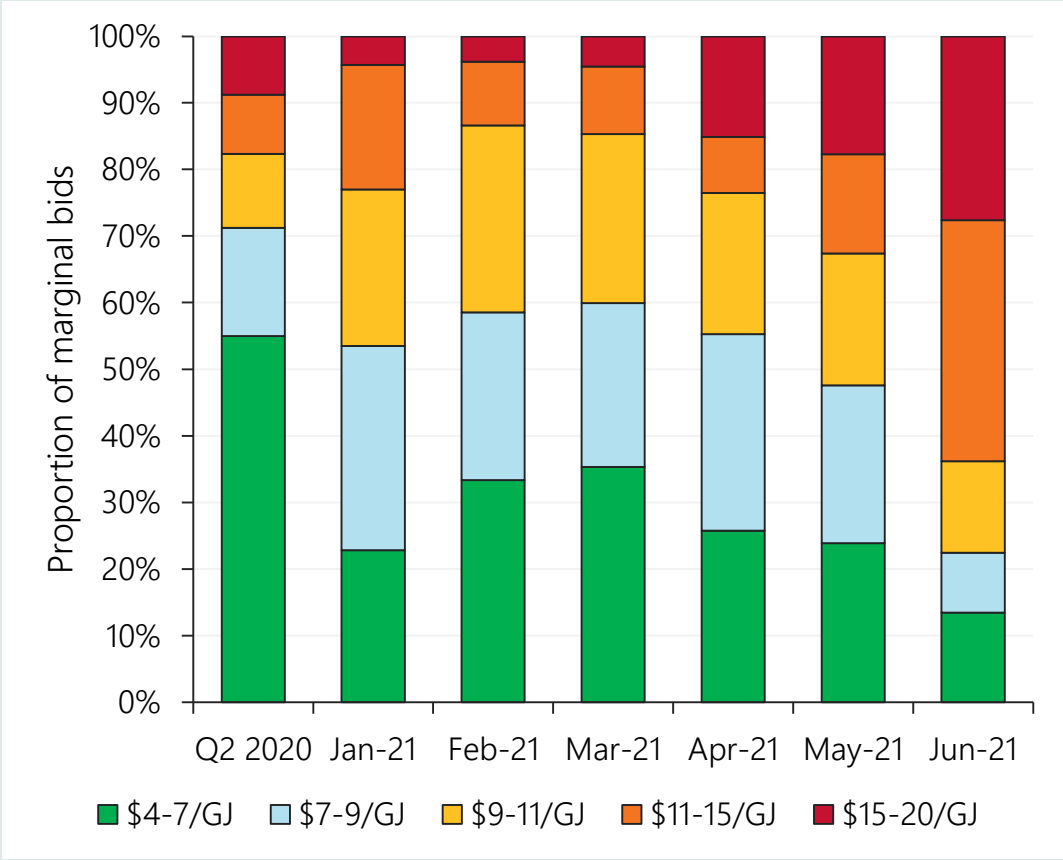


Gas prices rise sharply in May

Monthly average gas prices



Brisbane STTM bids at higher prices than Q2 2020



AEMO's Inputs, Assumptions and Scenarios Report (IASR) 2021-22

Within the context of AEMO's Integrated System Plan (ISP)

Oliver Derum & ISP Consumer Panel (Andrew Nance – Chair)

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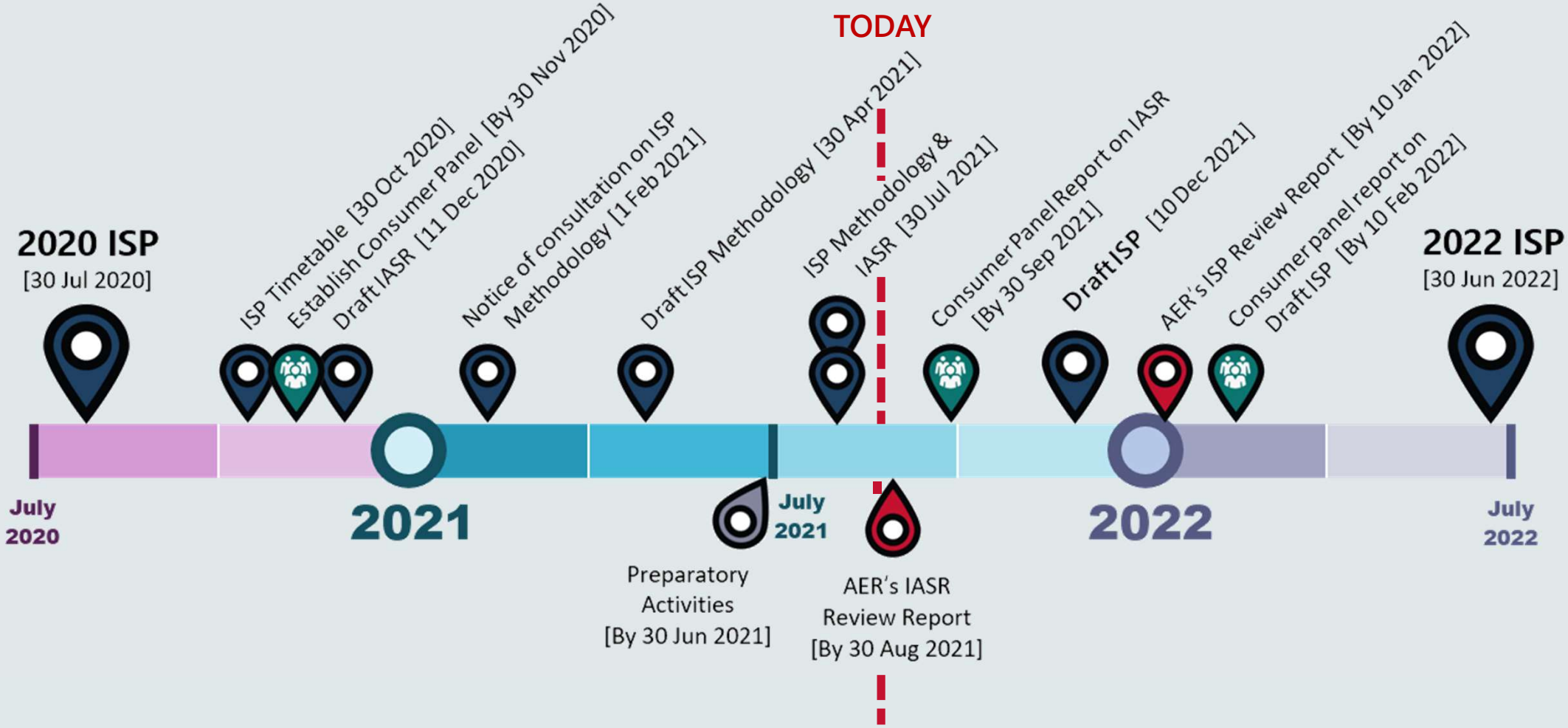
2022 ISP timeline



2020-21 ISP consultation milestones

Publication	Timing	Responsibility
ISP Timetable	30 October 2020	AEMO
Establish ISP Consumer Panel	By 30 November 2020	AEMO & ISP Consumer Panel
Draft IASR	**11 December 2020**	**AEMO**
Notice of Consultation on ISP Methodology	1 February 2021	AEMO
Revised draft scenarios	3 March 2021	AEMO
Draft ISP Methodology	21 April 2021	AEMO
ISP Methodology	30 June 2021	AEMO
Preparatory Activity Reports	By 30 June 2021	TNSPs
IASR	**30 July 2021**	**AEMO**
AER's IASR Review Report	By 30 August 2021	AER
Consumer Panel Report on IASR	By 30 September 2021	ISP Consumer Panel

Draft ISP to be published December 2021

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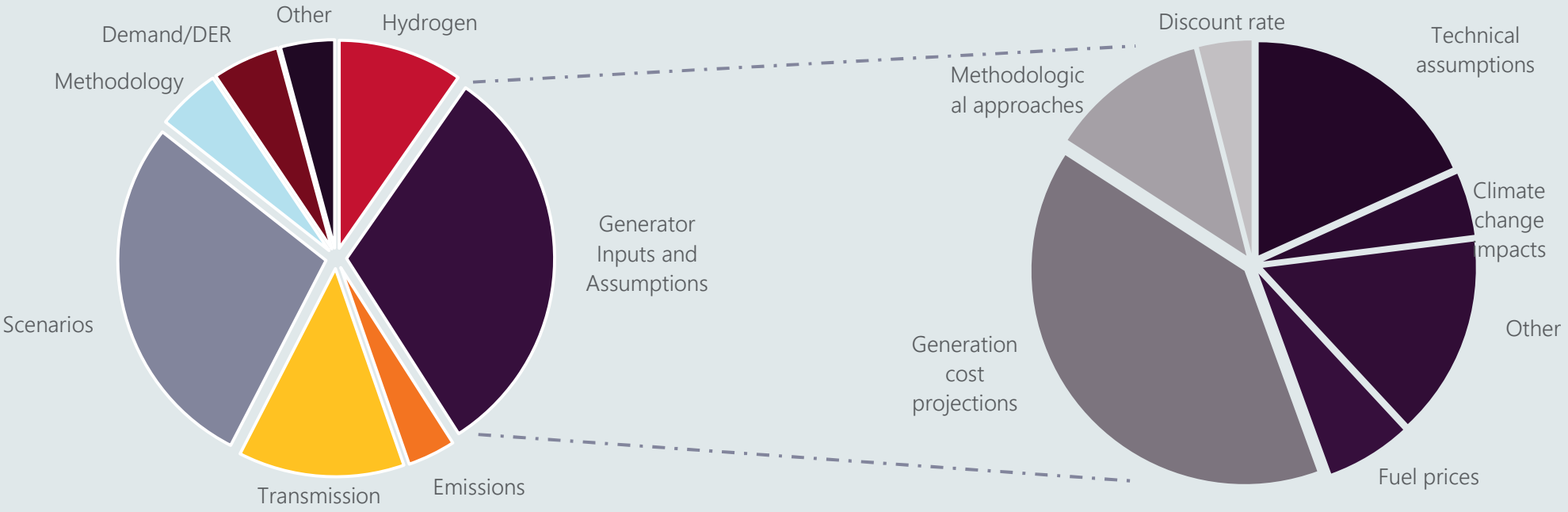
AEMO received nearly 50 submissions on Draft IASR

In addition:

- Hosted 21 webinars
- Shared 10 webinar recordings
- Published 7 reports
- Received 99 submissions across all forms of engagement

Summary of feedback

- Submissions have been categorised into high-level topics
- Several key themes raised by stakeholders
- The topic that received the most feedback was the Scenarios



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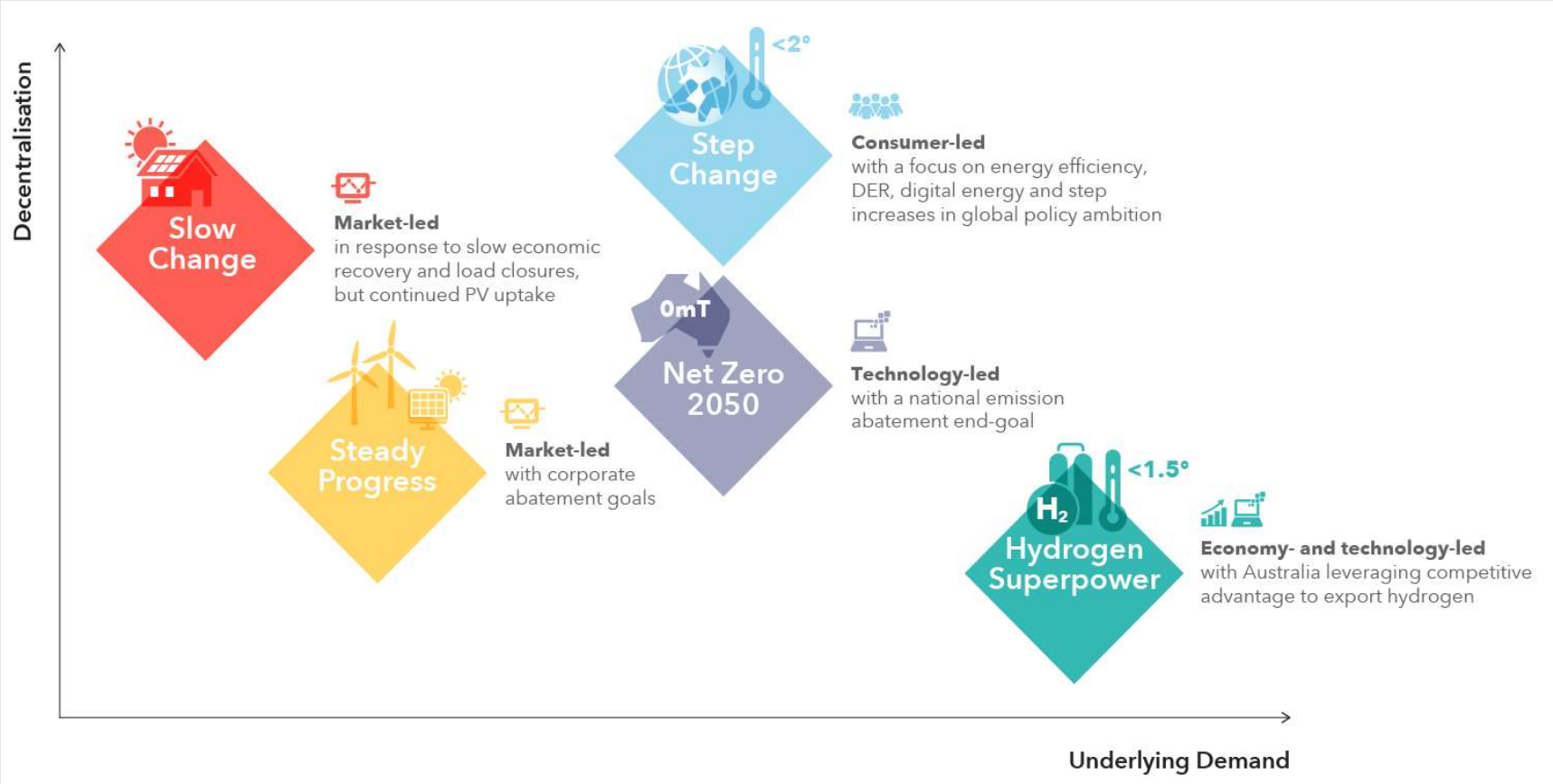
Overwhelming response to focus more on decarbonisation

Governments	Consumer Advocates	Market Participants/Developers	Networks	Climate/Industry Bodies
•Central remains limited in scope, suggesting the creation of a separate scenario representing a direction for net zero emissions by 2050 (SA government) •AEMO to consider impact of achieving net-zero emissions across the entire economy. Request for AEMO to also include a scenario that reflects NSW economy-wide net zero emissions objective (NSW government) •Where no formal response to Draft IASR provided, AEMO has discussed policy settings with governments to ensure latest information is included.	•Stronger decarbonisation ambitions in the Central scenario reflecting stated intentions by governments (Major Energy Users) •Supports incorporation of a stronger set of assumptions around the decarbonisation of the economy in the Central Scenario (Energy Consumer Australia) •It is not clear that the issue of decarbonisation is appropriately dealt with in the Central Scenario. Recommend further engagement on this issue (ISP Consumer Panel) •Central scenario should include net-zero emission target by 2050 (Havyatt Associates, ACOSS, PIAC)	•Central scenario to be more progressive, does not represent a credible baseline view of the future (RES, Infigen) •Legislated state-level interim emissions reduction targets should be integrated once announced, and we underscore the need to continue to update the modelling with legislated and defined measures as they are confirmed throughout 2021. (Energy Australia)	•Central scenario should reflect Victoria's Climate Change Act (net zero emissions by 2050) (Ausnet) •More appropriate for the Central scenario to reflect a net-zero by 2050 ambition (ENA)	•Central scenario should reflect the state-based emissions targets of net-zero by no later than 2050 adopted by every Australian state and territory (AGIG) •Central scenario should be consistent with emission trajectory of RCP2.6 (<2 degrees) (Nature Conservation Council, ACF) •Central scenario should be more similar to Sustainable Growth (TEC)

Scenarios were refined to take this feedback into account

Scenarios are informed by **pace of decarbonisation** and **level of decentralisation**, as per 2020 ISP

2020 ISP Scenarios	2022 ISP Scenarios
Slow Change	Slow Change
Central	• Steady Progress • Net Zero 2050
Fast Change	-
Step Change	Step Change
High DER	-
-	Hydrogen Superpower



This year's Integrated System Plan (ISP) extends to consider potential broad economy electrification as a method for decarbonisation.

The NEM in 2040: a snapshot

	Slow Change	Steady Progress	Net Zero 2050	Step Change	Hydrogen Superpower
DEMAND					
Electrification					
– % of road transport that is EV by 2040	22%	44%	52%	58%	76%
– % of residential EVs still relying on convenience charging by 2040	68%	61%	57%	47%	40%
– Industrial electrification by 2040	-25 TWh	8 TWh	32 TWh	45 TWh	66 TWh
– Residential electrification by 2040	0 TWh	0 TWh	6 TWh	9 TWh	10 TWh
Energy efficiency savings by 2040	16 TWh	25 TWh	30 TWh	44 TWh	44 TWh
Underlying Consumption					
– NEM underlying consumption by 2040	184 TWh	245 TWh	276 TWh	279 TWh	329 TWh
– H2 consumption (domestic), 2040	0 TWh	0 TWh	2 TWh	15 TWh	64 TWh
– H2 consumption (export), including green steel, 2040	0 TWh	0 TWh	0 TWh	0 TWh	221 TWh
– Total underlying consumption by 2040	**184 TWh**	**245 TWh**	**278 TWh**	**294 TWh**	**614 TWh**
SUPPLY					
Distributed PV Generation	47 TWh	51 TWh	61 TWh	66 TWh	83 TWh
% of household daily consumption potential stored in batteries	4%	12%	17%	32%	35%
% of underlying consumption met by DER by 2040 *	26%	21%	22%	22%	13%
Estimate of % coal in generation mix by 2040 *	50%	20-25%	15-20%	5%	0%
Estimate of NEM emissions production by 2040 (MT CO2-e)	TBD	TBD	55 (~40% of 2020 NEM emissions)	10 (~7% of 2020 NEM emissions)	1 (~1% of 2020 NEM emissions)

Level of change

* Estimates will be refined through ISP modelling

Event driven scenarios and sensitivities included to test robustness of the ISP

Event Driven Scenario:

- Where MarinusLink cost recovery issues are not resolved – will examine the impact and need for alternative investments. In this scenario, TRET is not included.

Sensitivity analyses:

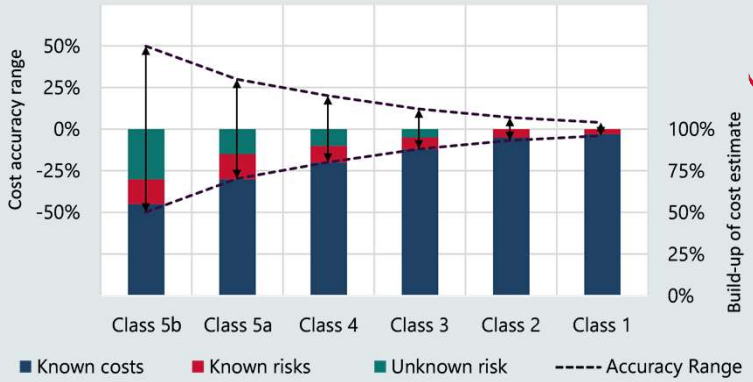
To ensure the ISP's optimal development pathway is resilient to major assumption uncertainty, AEMO will apply the following sensitivities. Additional sensitivity analysis will be informed by modelled outcomes:

Sensitivity	Description
Discount Rate	2%, 5.5% (central estimate), 7.5% and 10% to be tested
Low gas prices	Approx. $6/GJ (ex Wallumbilla, industrials) as a lower bound
Higher DER uptake	Increased uptake of decentralised generation, at the upper bound of DER forecasts
Strong electrification	Increased electrification in a future which needs to achieve strong decarbonisation, without hydrogen being ubiquitous, and with lower energy efficiency savings.

Approach for estimating transmission costs has been greatly improved

Transmission projects in the ISP

Committed and anticipated transmission projects	Project is assumed in the ISP as part of the future network, so costs are not estimated.
RIT-T projects (transmission)	AEMO adopts TNSP estimates from transmission projects undergoing RIT-Ts.
Future ISP projects with preparatory activities	AEMO requested TNSPs to estimate costs for some projects from the 2020 ISP.
AEMO estimates	AEMO estimates costs using Transmission Cost Database for projects where TNSP estimates are not available.



Public Policy settings

Policies that meet the requirements of NER5.22.3(b) are included in all scenarios

The policies that will be included in all scenarios are as follows:

- Australia's 2030 emissions reduction target
- Large-scale Renewable Energy Target (LRET)
- Victorian Renewable Energy Target (VRET)
- Victoria's 2020-21 budget initiatives affecting REZs and energy efficiency
- Queensland Renewable Energy Target and REZs (QRET) and associated Queensland Renewable Energy Zones (QREZ)
- Tasmanian Renewable Energy Target (TRET)
- New South Wales Electricity Infrastructure Roadmap
- National Electricity (Victoria) Act (NEVA)
- Various jurisdictional DER and energy efficiency policies

In some scenarios, AEMO will explore the impacts of faster rates of energy transition through the inclusion of NEM carbon budgets.

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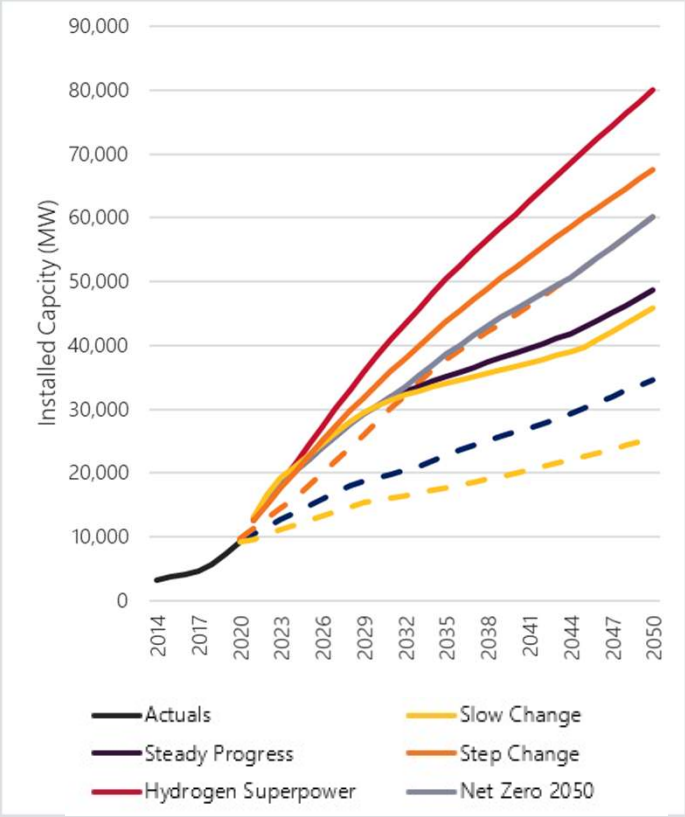
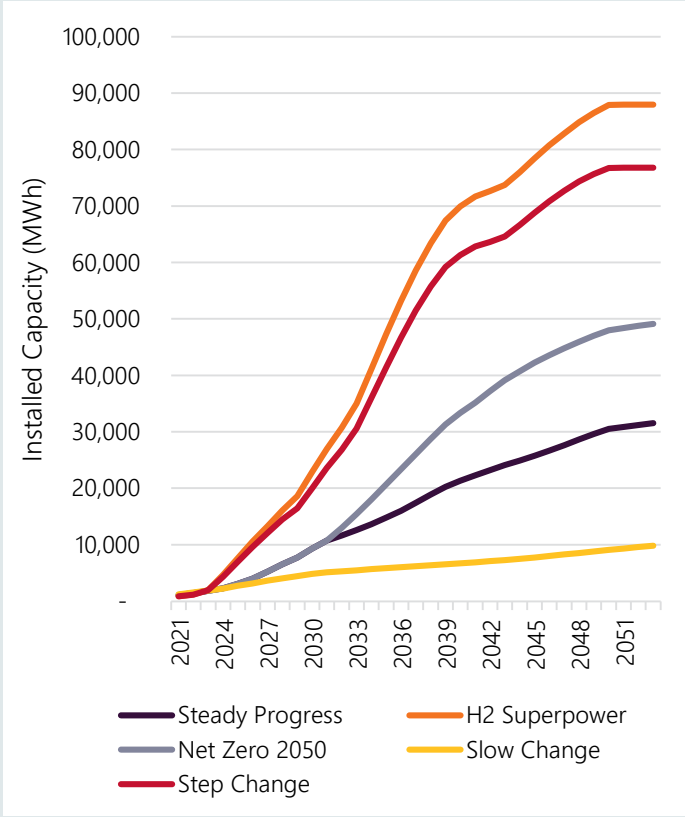
A range of distributed energy resource uptake projections are explored across scenarios

All projections updated since 2020 ISP and ESOO to reflect strong growth rates recently observed

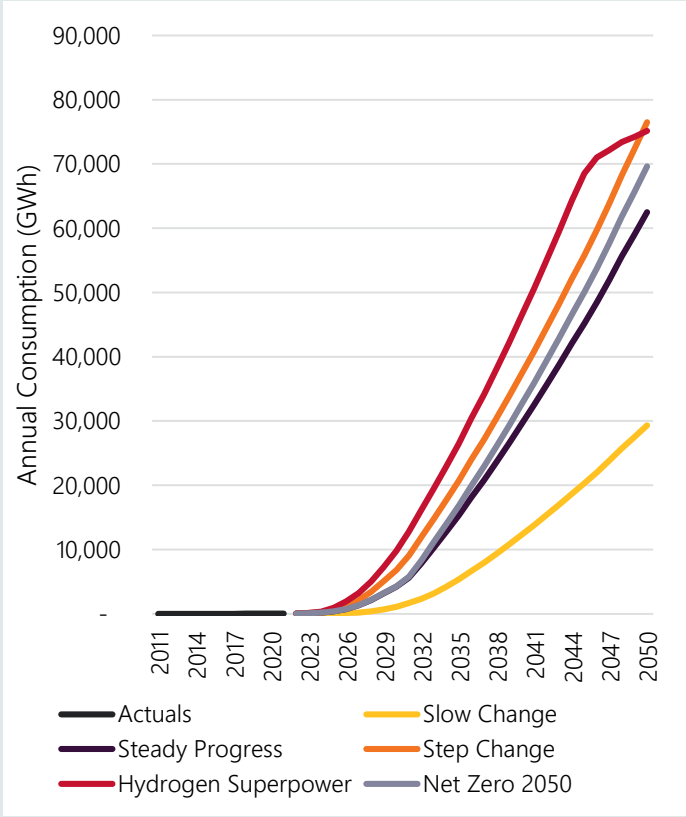
Distributed PV



Battery capacity (MWh)



Electric Vehicles



Dashed lines refer to 2020 ESOO forecasts

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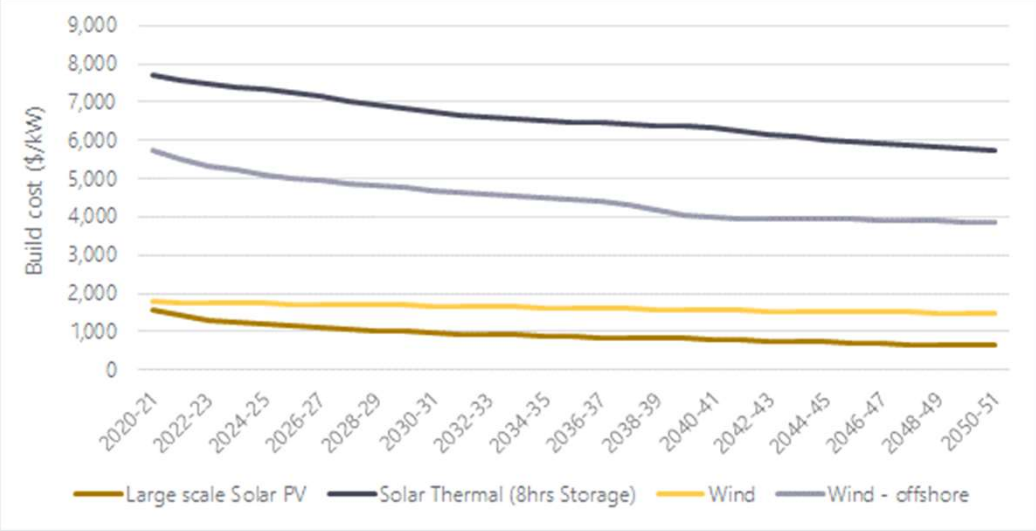
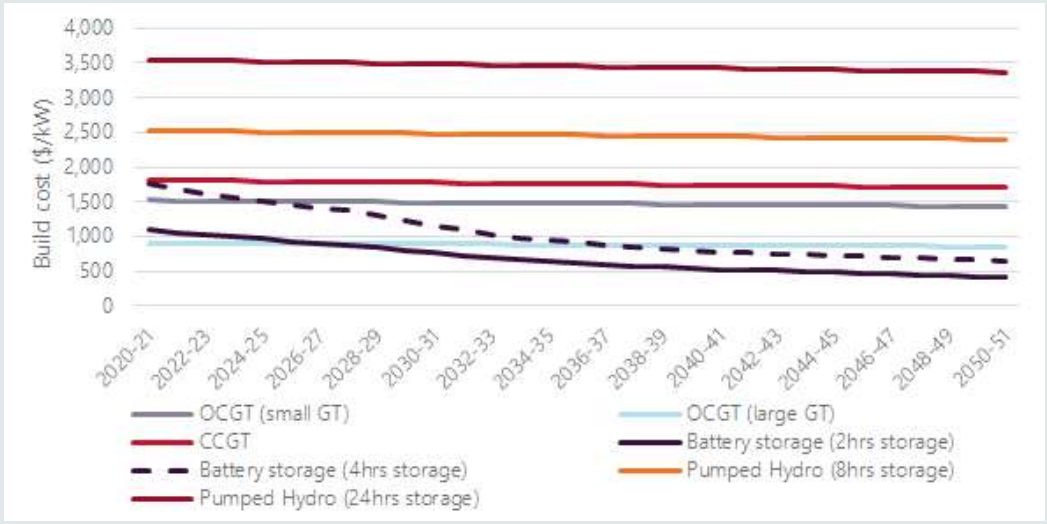
Build cost trajectories sourced from CSIRO's GenCost report

- Wind and solar



- Gas and selected storage



Downward cost trajectory for renewable generation and battery storage, whereas cost profiles are relatively flat for mature technologies such as coal, gas and hydro generation

Firming options to be considered

- Gas powered generation
  - Natural gas (CCGT, OCGT) and Hydrogen GTs
- Advanced ultra supercritical pulverised coal
- Energy storage technologies
  - Shallow storages (Depth: less than 4hrs)
  - Deeper storages (Depth: 4hr to 12hr)
  - Deep storages (Depth: greater than 12hrs)
- Solar thermal with storage (8hr depth)
- Biomass technologies
- Coordinated consumer technologies
  - Virtual Power Plants
  - Electric vehicle fleets operating with “Vehicle-to-grid” discharge

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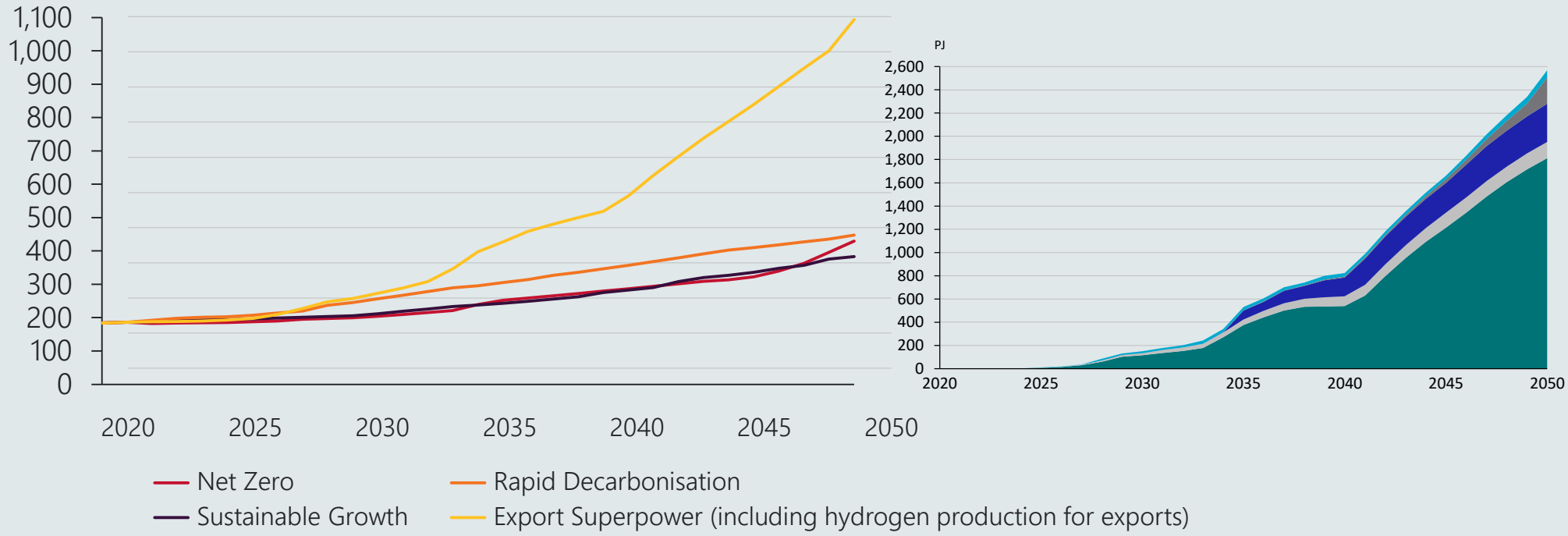
Spotlight on hydrogen

Purpose of Hydrogen Superpower

- To understand the implications and needs of the power system under conditions that enable the development of a renewable generation export economy which significantly increases grid consumption and necessitates developments in significant regional renewable energy generation.
- To assess the impact, and potential benefits, of large amounts of flexible electrolyser load.

Electricity demand (GWh)



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DER integration in the NEM – key challenges and solutions

Scott Chapman – General Manager, New Market Services

Risks in SA have materialised

- Approximately 4 in 10 consumers in SA have solar.
- The economic cost of past SA blackouts has been put at >$200m per event.
- AEMO analysis in 2019 had identified that South Australia would be challenged to maintain power system security at around 400MW of net demand.
- Probability of high solar output AND SA islanded is credible, (refer AEMO report to SA Govt in May 2020).
- Consequence very significant in terms of economic and social cost.
- AEMO, SA Govt and SAPN had to move quickly in 2020 to prepare for a likely Minimum System Load event.
- Rooftop PV Tripping Contingency Risks are also an emerging risk.
- A backstop mechanism which curtails solar in these rare circumstances is used to prevent a System Black.

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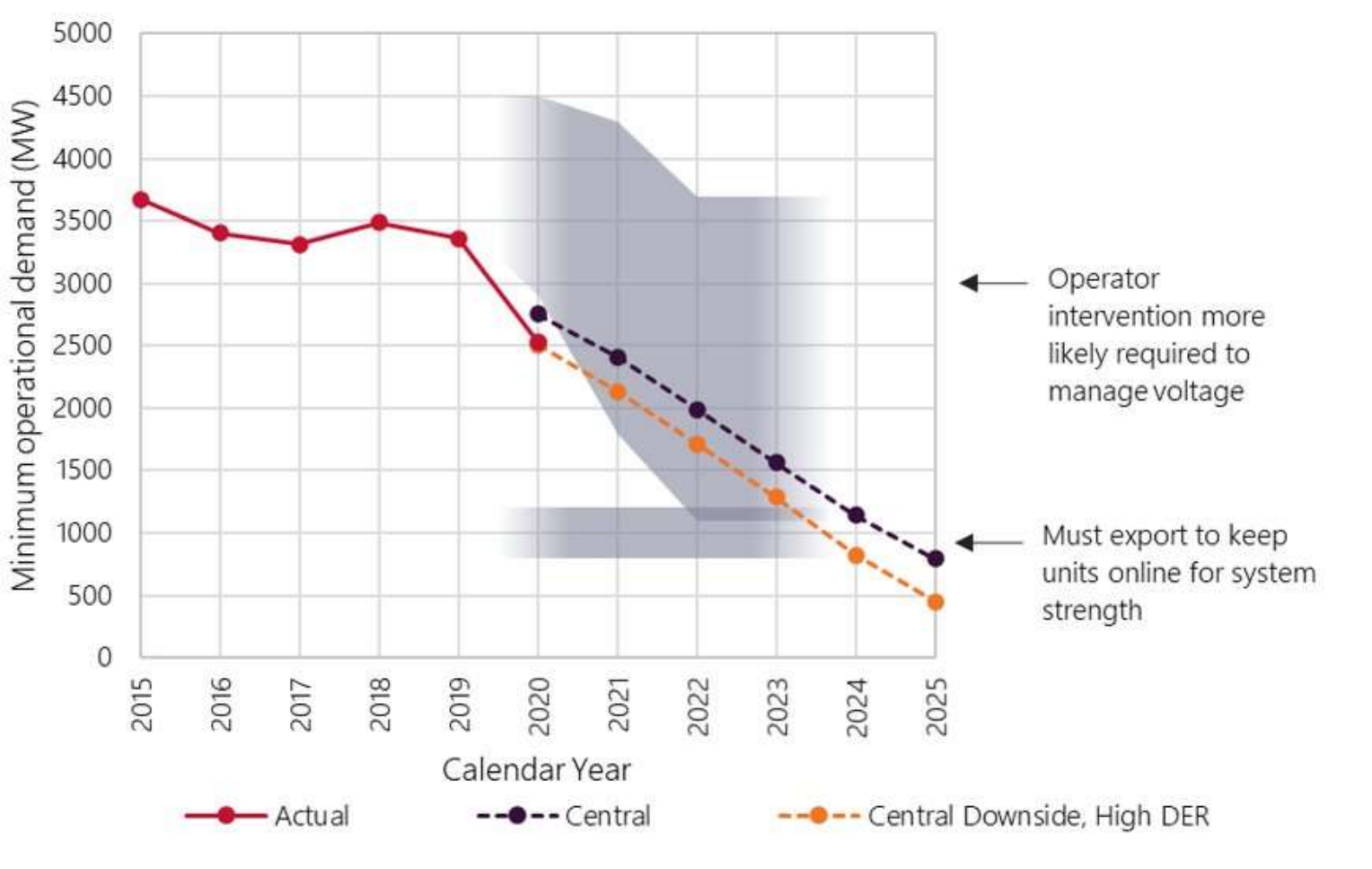
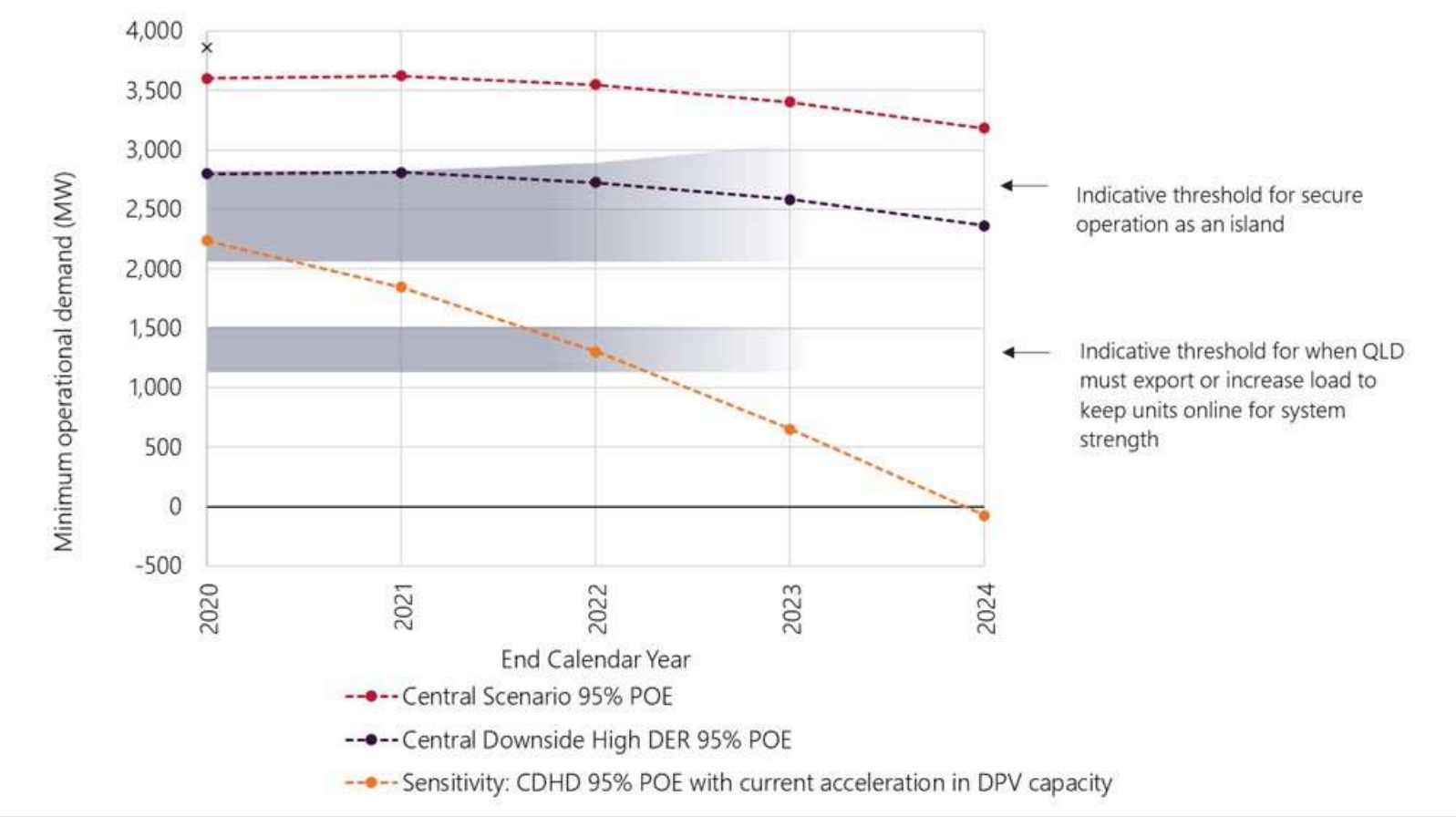
Forecast Minimum Operational Demand in Victoria & Power System Security Risks

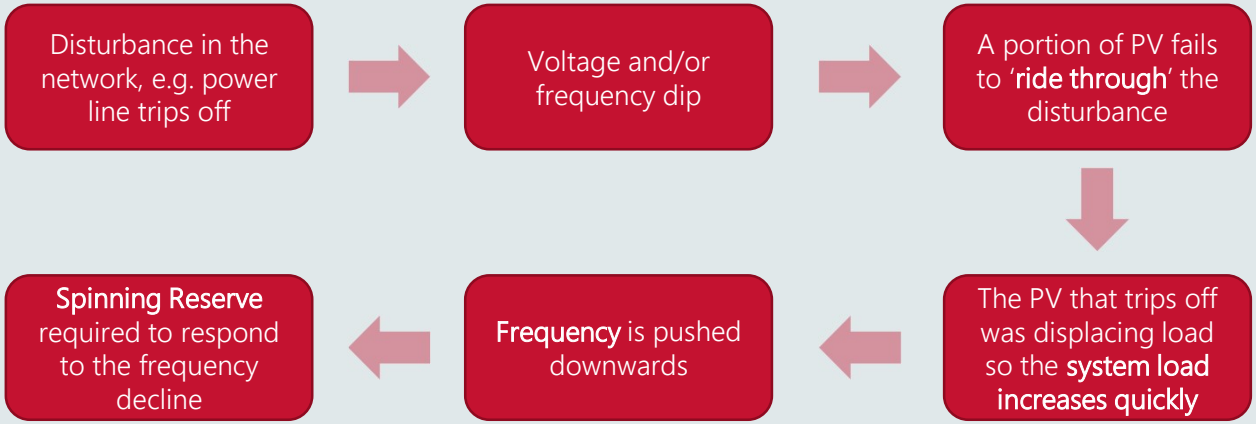


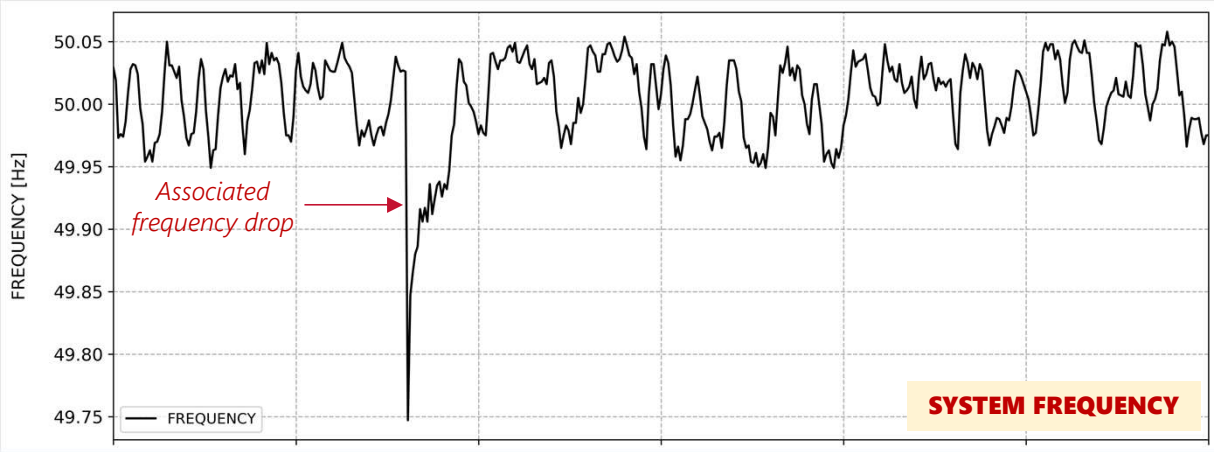
Forecast Minimum Operational Demand in Queensland & Power System Security Risks



Rooftop PV Tripping Contingency Risks

- During system disturbances (e.g. short circuit in the network), a portion of rooftop PV inverters in the system have been observed to trip unintentionally.
- This was not a significant problem in the past when there was lower penetration of DER in the system.
- AEMO continuing to build on work done to develop models to refine DER tripping estimates and scenarios.





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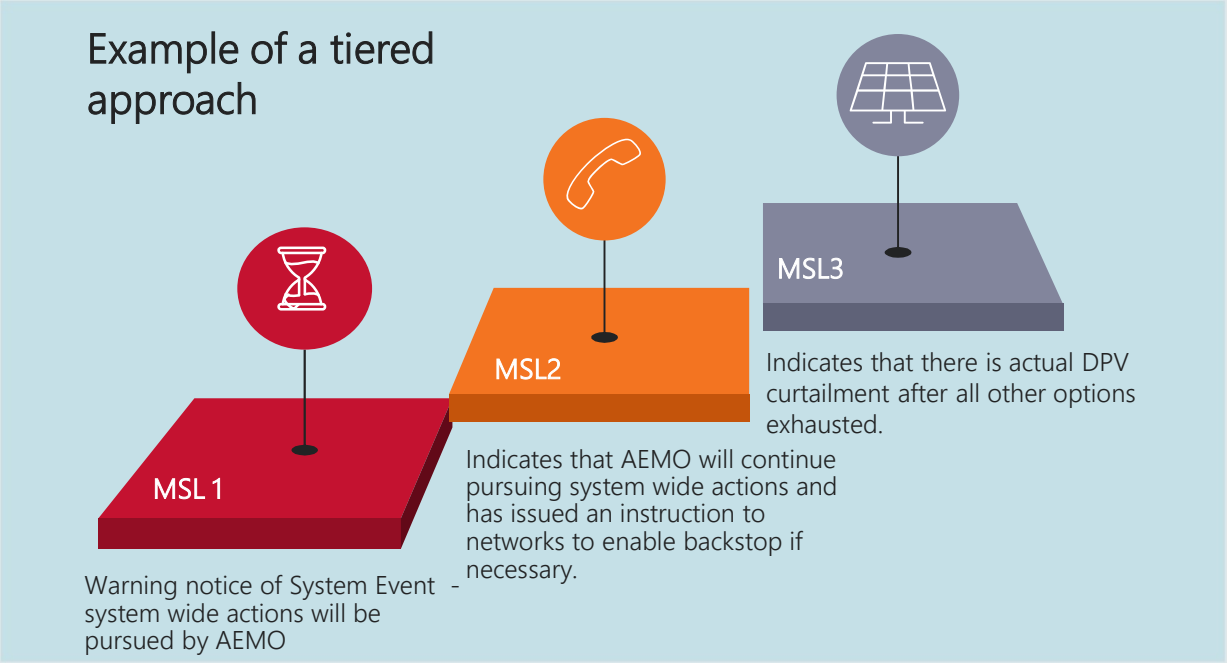
A minimum system load and DPV contingency mechanism

- Now the backstop is in place, aim to improve arrangements and methodologies.
- AEMO, its sister market bodies, and governments are contemplating a more sophisticated mechanism for minimum system load and other system events.
- A tiered approach is being considered which transparently provides signals to the market of approaching system events and interventions.
- AEMO, governments, industry and consumer groups will need to collaborate.



DER integration

Now and in the future

Efficient & effective DER Integration is about more than just backstops – need a range of incentives, responses, mechanisms and tools

Markets

Facilitating consumer choice and rewarding participation of consumer DER in electricity markets including ancillary services that support system security.

System Security Arrangements

Consumer owned DER also has an important role in arrangements to maintain system security.

Markets – P2025

- Wholesale demand response
- Virtual Power Plants
- Flexible Trading Relationships
- Tariff Reform
- Turn up services
- Underpinned by consumer protections

Technical capabilities

- Equipment and device standards
- Grid forming inverters need to be examined as a power system control mechanism – work already underway
- New ways to efficiently share data

System Operations

- Improved scenario planning & modelling required to better quantify the risk
- Development of a Distribution System Operator – System Operator model
- Rooftop solar curtailment capabilities to be used a as a last resort – prevent system black

Building Social Licence

- Diverse range of emotions, ambitions, and solutions – a human system.
- AEMO is considering ways of embedding social license in our organisation and work on DER integration.
- Building our understanding of consumers and better communicating with them.
- Active and early engagement which is tailored to the issue and stakeholders' diverse interests.
- Ongoing discussion with the ECA on how their social licence framework can be applied in the AEMO context.
- Keen to seek wider feedback from consumer groups as AEMO develops its approach to social licence.

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BREAK

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Engineering Framework - update

Chris Mock & Chris Davies

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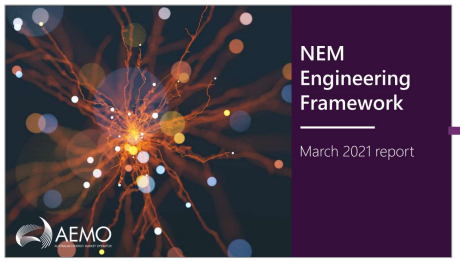
Journey so far

March 2021



March 2021 report

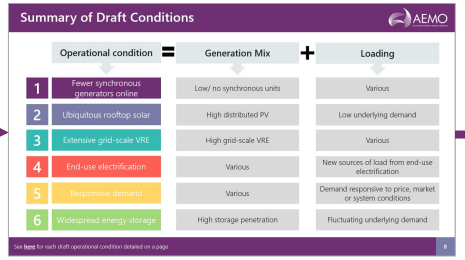
- Developed following the publication of an Engineering Framework information pack in December 2020 and strong industry support in early discussions and an industry workshop in February 2021.

April 2021

All industry workshop

- Included further context and discussion on initial operational conditions, with over 100 participants.
- A recording of the workshop and the slides presented are available on AEMO's website.

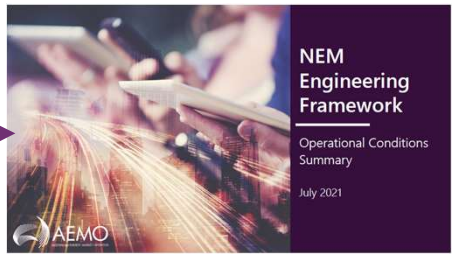
June 2021



Operational conditions workshops

- Two workshops held, including representatives from network service providers, market bodies participants, industry bodies, and research institutes.

July 2021



Operational conditions summary

- Summarises the operational conditions selected to be used in the next stages of the Engineering Framework.

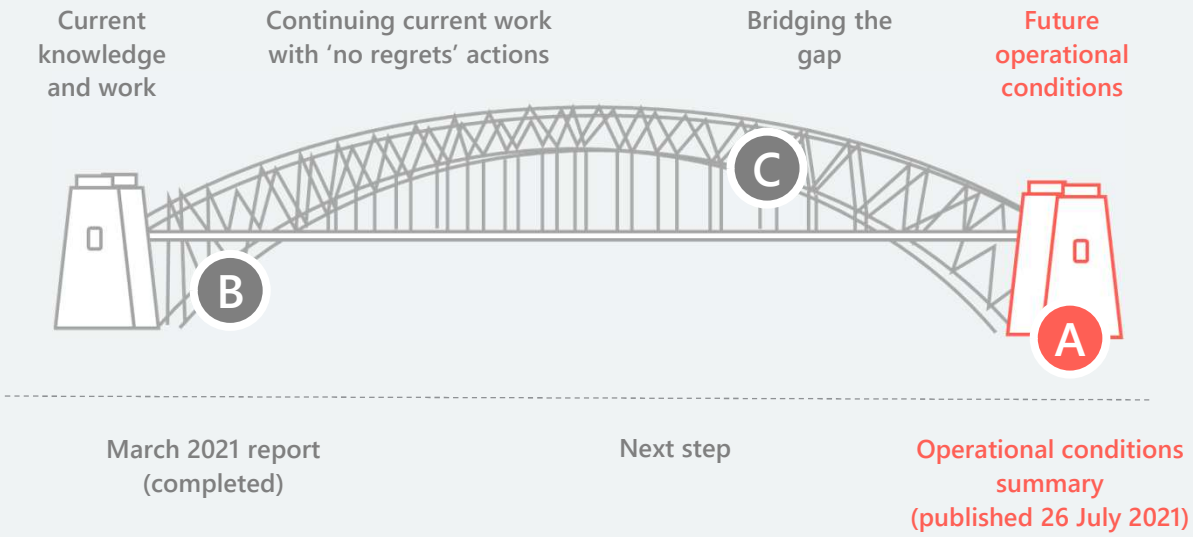
Objectives

The operational conditions summary focuses on objective A of the NEM Engineering Framework:

A Recently published – determine **future operational conditions** for the NEM power system with industry.

B Completed – consolidate a common view of the **current work underway across industry**.

C Next step – consult with industry to help **bridge the gap** between current work and future operational conditions.



Identified operational conditions

	Operational condition	= Generation mix	+ Loading
1	Fewer synchronous generators online	Low/no synchronous generators online	Low or high demand
2	Ubiquitous rooftop solar	High distributed photovoltaics (DPV)	Low underlying demand
3	Extensive grid-scale VRE	High grid-scale VRE	Low or high demand
4	Structural demand shifts	Various	End-use electrification and industrial shifts
5	Responsive demand	Various	Active demand side
6	Widespread energy storage	High on-demand storage penetration	Fluctuating underlying demand

Stakeholder insights

Fewer synchronous generators online

- Highest priority condition.
- Challenges posed addressed in the near term.
- Zero inertia grids needs defining.

Structural demand shift

- Feedback loop for other operational conditions as implementation may amplify or assist risk.
- Include sudden closures or defection off-grid.

Ubiquitous rooftop solar

- Highly relevant condition.
- Consumers are pivotal to this transition.
- Visibility, compliance, activating DER, and aligning incentives are all priorities.

Responsive demand

- Activation provides opportunities for other technologies.
- Strong collaboration with networks and new technology providers is critical.

Extensive grid-scale VRE

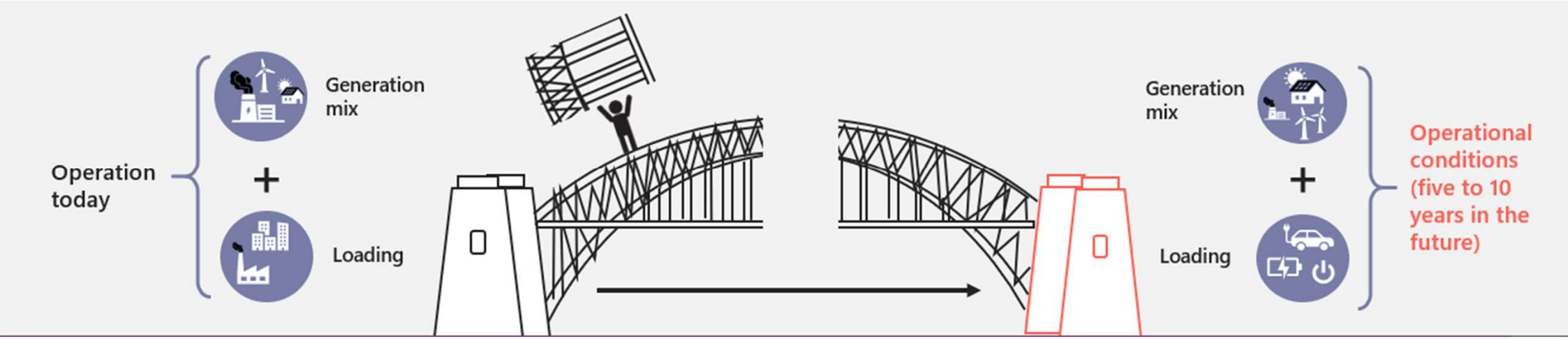
- VRE build should be aligned with declining synchronous generators online.
- Focus needed on service incentivisation and capability.
- Real-time forecasting is key.

Widespread energy storage

- Offers benefits if harnessed and valued.
- Diverse storage technologies, each with unique technical and commercial capabilities.

Next steps

- AEMO will consult with industry to start working toward the third Engineering Framework objective: bridging the gap between current and future operational conditions
- This will begin with targeted stakeholder discussions from August to October 2021
- To get involved, please get in touch with AEMO or sign up to our mailing list at FutureEnergy@aemo.com.au



Project EDGE: Consumer insights study on DER project

Mondo Energy and Deakin University

AUGUST 2021

CUSTOMER INSIGHTS RESEARCH: PRE-USE PERCEPTIONS

A/Prof Josh Newton
Deakin Business School

better consumption lab

PRE-USE PERCEPTIONS

- Deakin is conducting multiple rounds of research to examine pre-use perceptions of Virtual Power Plants among:
  - Households
  - Businesses
  - Local government

better consumption lab

DEAKIN BUSINESS SCHOOL

PRE-USE PERCEPTIONS: HOUSEHOLDS

Phase 1: Interviews

- Interviews will be conducted among households who participated in the Mondo Yackandandah trial

- Each participant will be interviewed about:
  - Their perceptions of – and experiences with – the Yackandandah trial
  - The perceived benefits of Virtual Power Plants
  - The perceived barriers to adopting a Virtual Power Plant
  - What would increase the attractiveness of adopting a Virtual Power Plant in the future

PRE-USE PERCEPTIONS: HOUSEHOLDS

Phase 2: Community survey

- Survey will be distributed to households; a small financial incentive will be provided to motivate participation

- The survey will examine:
  - Awareness of, attitude towards, and interest in adopting the Hume Virtual Power Plant
  - Perceived benefits of joining the Hume Virtual Power Plant
  - Perceived barriers to joining the Hume Virtual Power Plant
  - Desired levels of control over energy trading
  - Satisfaction with current electricity bills, retailer, distributer
  - Household and demographic information

better consumption lab

DEAKIN BUSINESS SCHOOL

PRE-USE PERCEPTIONS: BUSINESSES

- Interviews will be conducted with senior managers from local businesses

- Each manager will be interviewed about:
  - The current energy needs (and issues) facing their business
  - How their business makes energy-related investment decisions
  - Their awareness of and perceptions towards Virtual Power Plants
  - The attributes of Virtual Power Plants that would motivate their business to adopt – or reject – this technology
  - The future anticipated energy needs facing their business

better consumption lab

DEAKIN BUSINESS SCHOOL

PRE-USE PERCEPTIONS: LOCAL GOVERNMENT

- Interviews will be conducted with LGA stakeholders

- Each stakeholder will be interviewed about:
  - How their LGA makes energy-related investment decisions
  - Their perceptions of Virtual Power Plants
  - The attributes of Virtual Power Plants that would motivate their LGA to adopt – or reject – this technology
  - What LGAs are typically looking for before they endorse or subsidise energy-related products among their residents/local businesses

Other business and close

Antara Mascarenhas

Thank you for your participation!

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR