2021-22 Forecasting and Planning Scenarios Webinar

AEMO Planning and Forecasting

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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Objectives of this webinar

To inform stakeholders of the contributions provided by stakeholders prior to the 14 October Workshop that contributed to initial scenario dimensions

To inform stakeholders of the contributions provided by stakeholders in the 14 October Workshop that contributed to initial scenario narratives

To outline the next steps AEMO will take prior to formal consultation on scenarios later in the year

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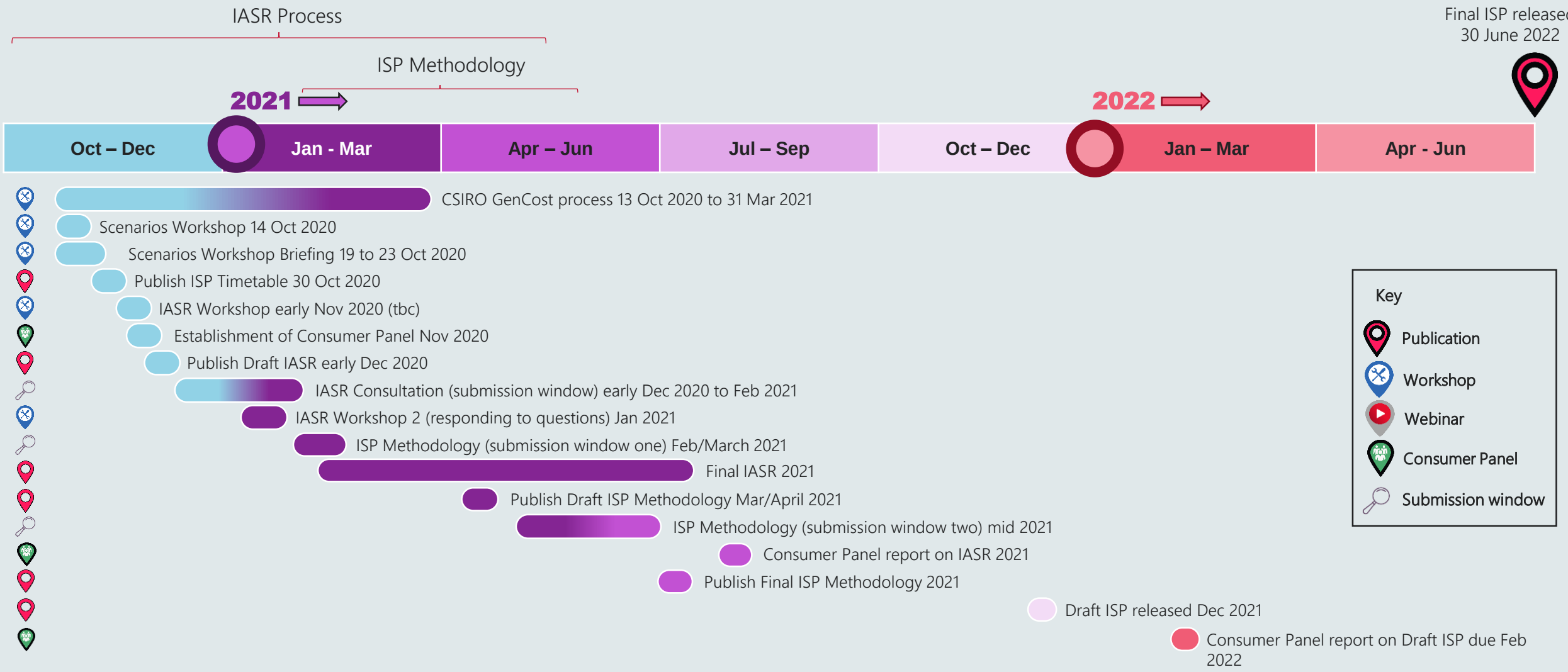
ISP 2022 indicative consultation timetable



The importance of scenario planning

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What is the value of scenario planning?

Scenarios, developed as narratives, allow us to:

- Imagine possible future worlds
- Recognise uncertainties, risks and opportunities
- Collect multiple, diverse perspectives and challenge the conventional thinking
- Consider adaptation strategies to build resilience

The set of scenarios should be:

- Plausible
- Distinctive
- Internally consistent
- Cover the breadth of possible futures

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Scenarios in the context of actionable ISP

In developing scenarios, AEMO must consider:

Key inputs and major sectoral uncertainties (which can include discrete risks) affecting the costs, benefits and need for investment in the NEM

Taking the most probable value(s) for each input that forms part of the most likely scenario

Risks associated with under- or overdue investment and over- or premature investment

Presenting information on key input variables varied across scenarios, and how that compares to the underlying range of possible values

Using internally consistent inputs

The following discretionary principles are recommended:

Consult with stakeholders in developing a purpose for each scenario

Represent a reasonable range of plausible futures, informed by stakeholder consultation – stretched, but not skewed by unrealistic events

Select inputs to construct each scenario that are NOT influenced by any development path, but should influence a development path

AEMO also provides scenarios for a RIT-T proponent to use in applying the RIT-T to an actionable ISP project, along with likelihood based weightings

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Pre-workshop engagement

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Pre-workshop scenario development process

Ask participants for input based on 5 key dimensions:

- Decentralisation
- Decarbonisation
- Relative cost competitiveness of renewables and storage
- Electrification
- Economic activity and population growth

Analyse input from participants

- Select the top scenarios based on participant feedback (~100 received)
- Summarise risks associated with the scenarios

Derive 7 new scenarios (and risks)

- The scenarios created covers a wide range of possible future worlds ranging from a world with rapid technology development and strong decarbonisation efforts to a world with stagnant growth.

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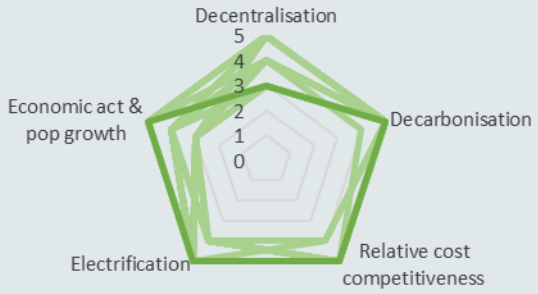
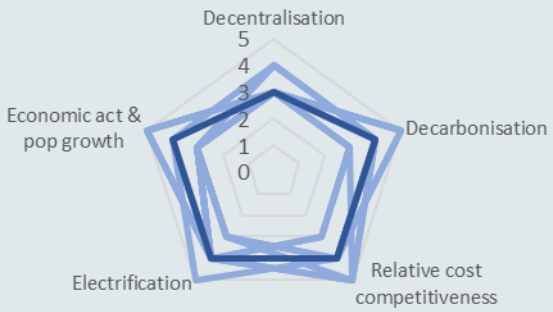
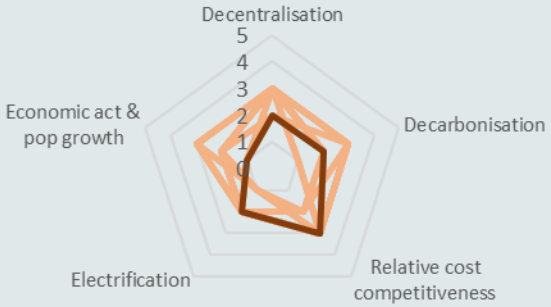
Your survey responses underpinned our scenario selections going into the workshop



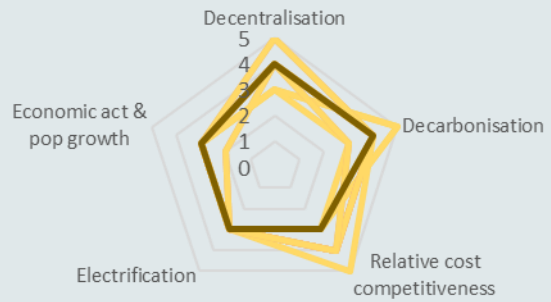
Scenario 1



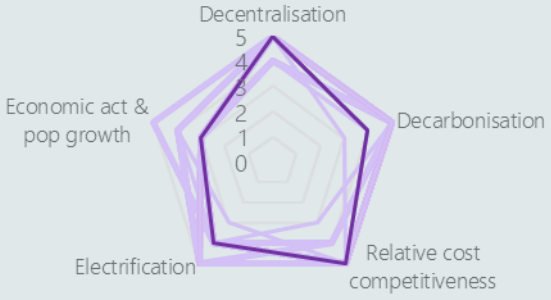
Scenario 2



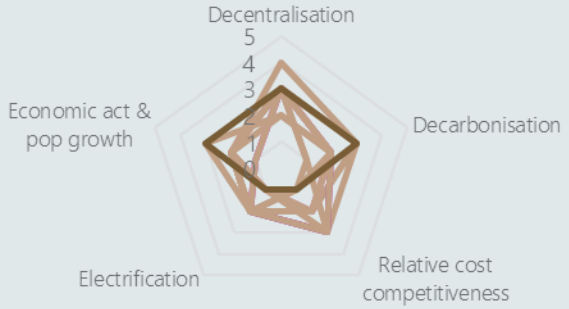
Scenario 3



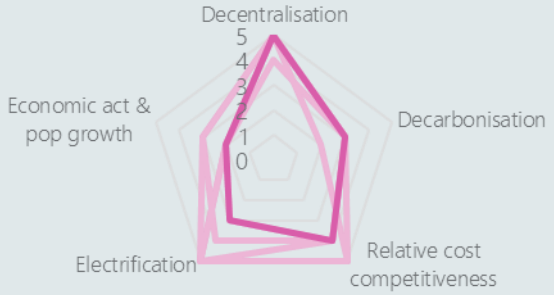
Scenario 4



Scenario 5



Scenario 6



Scenario 7

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2021-22 Forecasting and Planning Scenarios Workshop outline

80+ external attendees

65+ organisations

600+ Mural comments

Plenary Session

- Outline AEMO's consultation process
- Discuss the dimensional framework
- Introduce the future world scenarios

Spotlight Sessions

- Participants to highlight key takeaways/concerns about the existing scenarios, dimensions, future worlds…

Defining and visualising

- Defining specific scenario dimensions
- Visualising a scenario
- Naming a scenario

Developing world narratives

- What does this world look like? And,
- How did we get here?

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Spotlight session – key themes

General approach

- **Adaptiveness and integration with real world outcomes is critical** It is crucial to evolve the scenarios to align with the changing landscape so they are relevant in the future, providing a narrative that connects scenarios between ISPs, including integrating real data based on experience and sensitivities that aren't captured in scenarios, but which may emerge

Universal considerations

- **There is a need for clarity on how government policy is considered** In general, current government policy should be adequately reflected. Across the Future Worlds, the impact of major policy announcements should be considered and, for some worlds, scenarios may need to 'go beyond' current policy and not be held back by it
- **Recent economic impacts should be integrated** The impacts of the pandemic on the economy may need to be integrated into the Fast Change and Step Change-type scenarios and integrated into assumptions more broadly – e.g. population growth may slow in the short term – and the **global context** might be taken into deeper consideration, including the impact of targets, geopolitics and macroeconomics
- **Community acceptance is a critical dimension** Community acceptance is both a potential major accelerator and barrier across many scenarios. It may be necessary to integrate this in more detail within scenarios (e.g. define different degrees of acceptance)
- **Changing demand should be rigorously considered** It may be necessary to define a change in demand profile e.g. with a specific range of uncertainty. This could be affected by factors such as low population growth
- **System security and robustness** must be considered – including how to account for and adequately value system security services that have historically been provided by incumbents as they retire
- **Coal closures** may need to be considered in **greater depth**, including how coal-fired generation operates until it retires
- For some, the aggressive scenarios are **not ambitious enough** and don't clearly account for **Net Zero by 2050**

Scenario-specific considerations

- There may a need for **greater detail** on the degree and dimensions of **decentralisation** in relevant scenarios (e.g. extent, coordination, flexibility), including consideration of the impact of **two-sided marketplaces**
- It is important to understand the **firmness of energy efficiency improvements** and potential developments and investment in renewables (e.g. through triggers and pathways that identify technology developments and flag when decisions must be made)
- There may be a need to define the **degree and dimensions of electrification** in more detail for relevant scenarios (e.g. specific technologies)

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Scenario narratives

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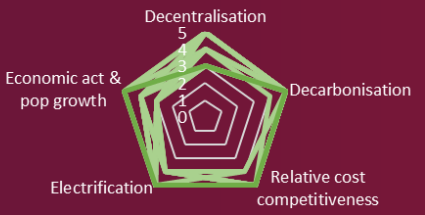
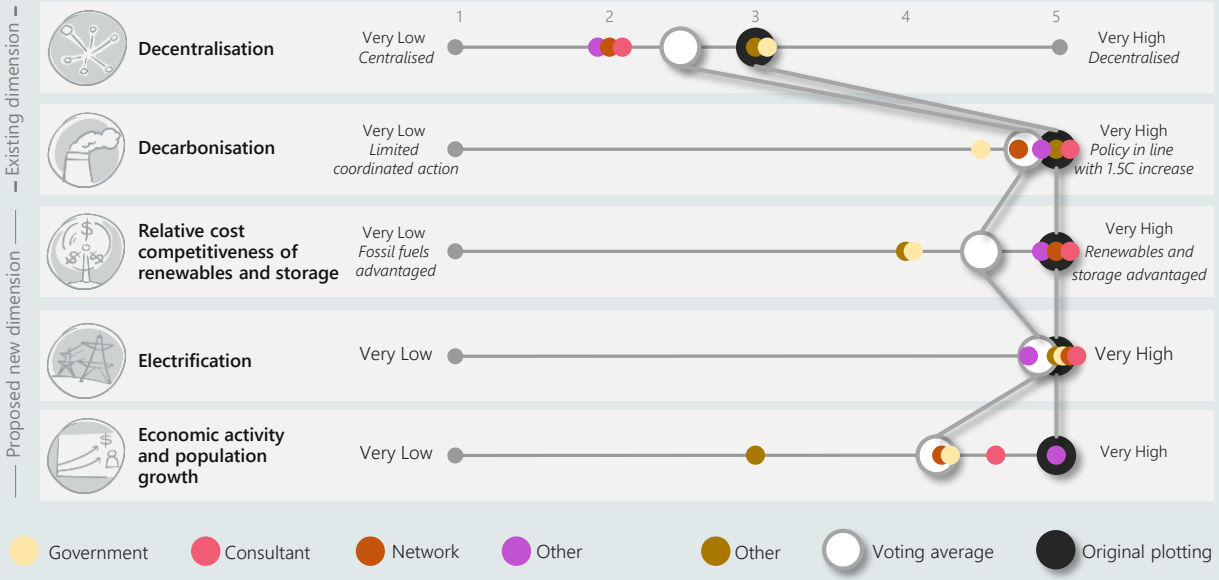
1

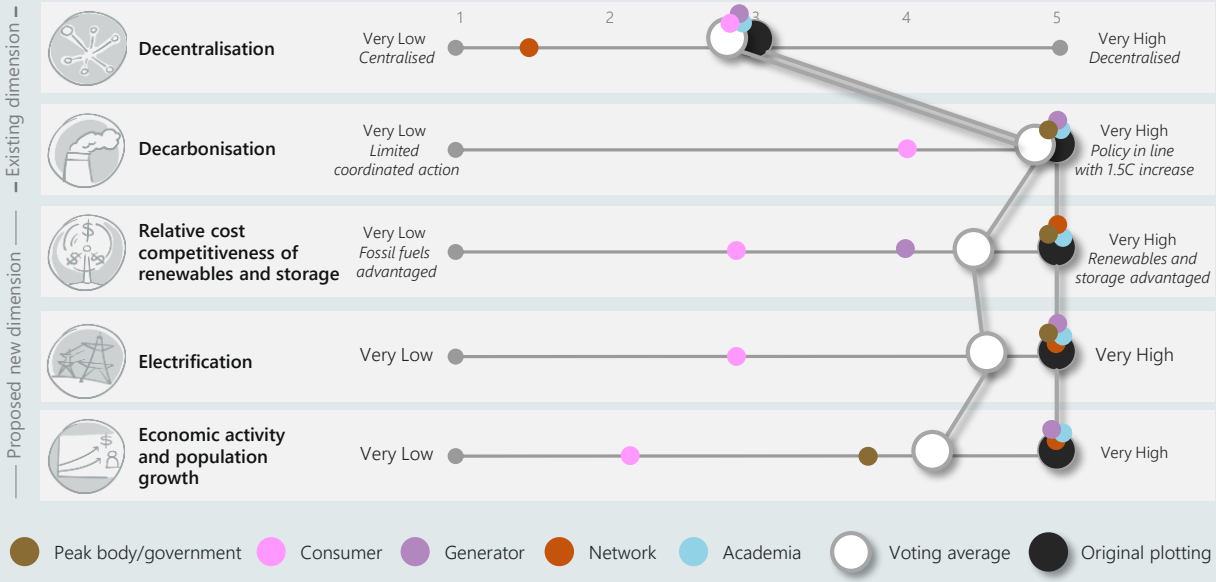
Paradigm shift, with very high levels of electrification and hydrogen export opportunities, fuelled by strong growth and strong decarbonisation ambitions.



A. Recovery to revolution



B. Energy export superpower



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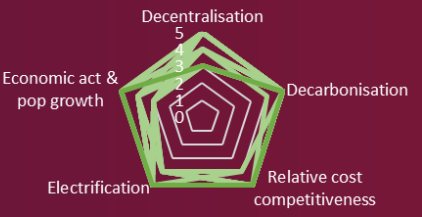
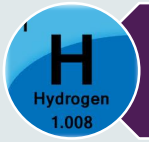


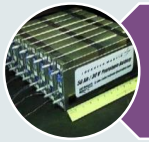
A. Recovery to revolution

Change driven by a global carbon price and early global policy directions



Australia establishes strong hydrogen export partnerships, leveraging its VRE cost and space advantage

Technological advances take place much faster than anticipated

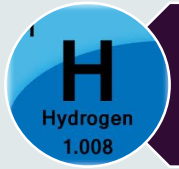


Storage becomes increasingly important managing the variability of renewable supply and demand

Consumers seek clean energy and drive wide EV uptake and the electrification of other sectors

The cost of carbon abatement drives the localisation of resources when possible via increased shipping costs

B. Energy export superpower



Hydrogen surpassing oil and gas as the most-traded form of energy

Demand for skilled resources pushes up migration, and government spending is required early on

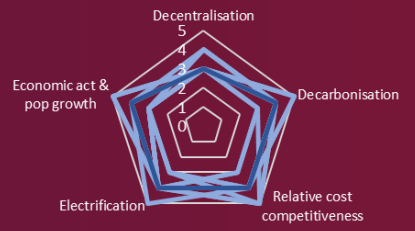
Consumers appreciate the benefits of the energy transition, adopting more energy efficient homes and vehicles. Energy prices remain a major cost.

The world goes net zero by 2050, and perhaps faster. Temperature increases by 2100 are limited to 1.5 degrees.

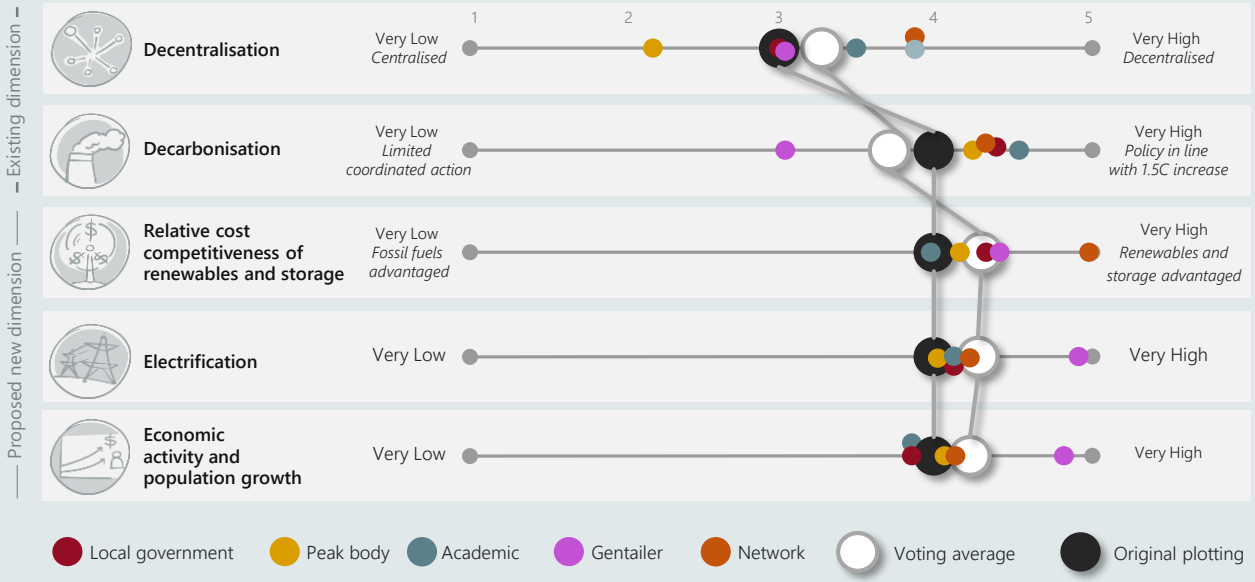
Energy exports may exceed energy demand in this scenario, and there is an increased risk of stranded assets

2

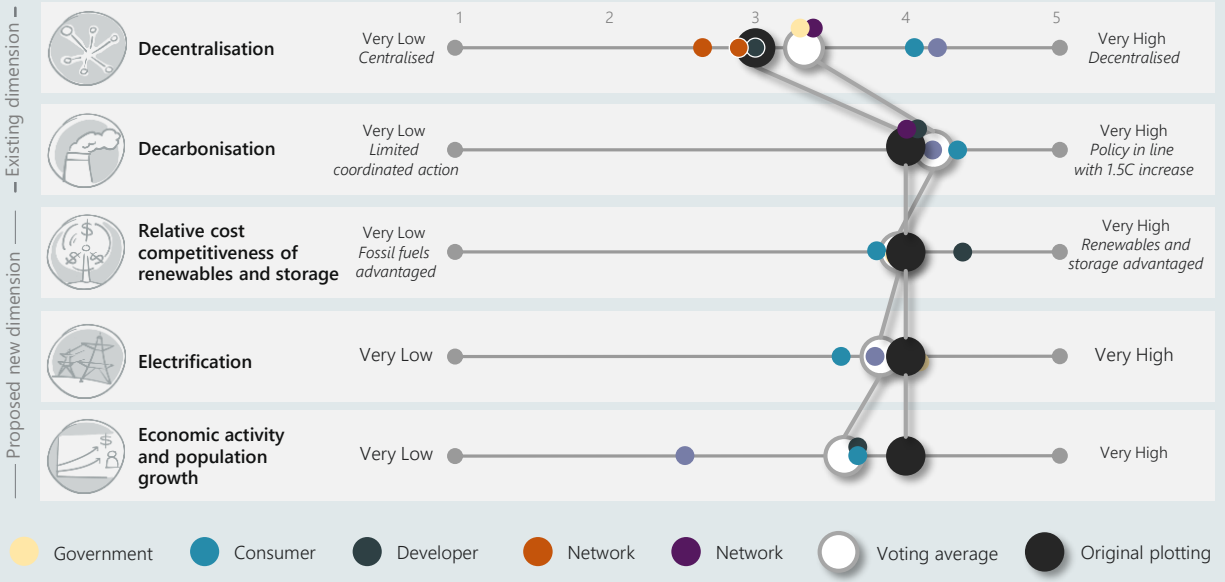
A robust economy, more ambitious decarbonisation objectives, and cost-effective renewable energy and storage support increased cross-sector electrification.



A. Sustainable growth



B. Clustered decarbonised



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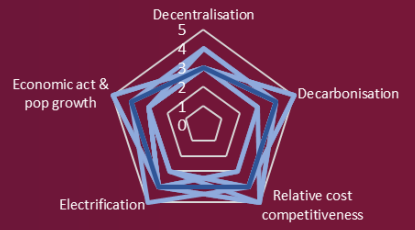
A robust economy, more ambitious decarbonisation objectives, and cost-effective renewable energy and storage support increased cross-sector electrification.



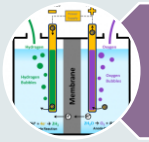
A. Sustainable growth

Local economic activity boomed after a recovery decade, supporting infrastructure and high demand

Continued population growth especially in regional areas, leading to demand decentralisation

Progressive environmental policy drives large-scale VRE, improved cost, efficiency and social acceptance of storage

Substantial electrification of transport and industry



DSP and breakthroughs in electrolysis/mineral processing led to greater optimisation with VRE generation.

This scenario requires significant additional interconnection to support storage builds

B. Clustered decarbonised

Local manufacturing improved after supply chain contractions. Low interest rates support infrastructure investment

Increased ruralisation with higher migration levels.

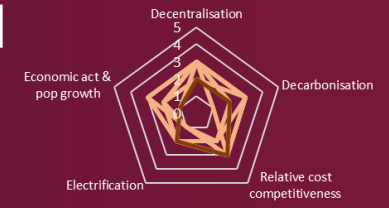
Low cost smart PV and breakthrough costs for storage, improvements in energy efficiency and DSP response at a grid level.

Technology increases consumer awareness of energy use/ costs. Higher remote working (WfH), EV uptake, carsharing.

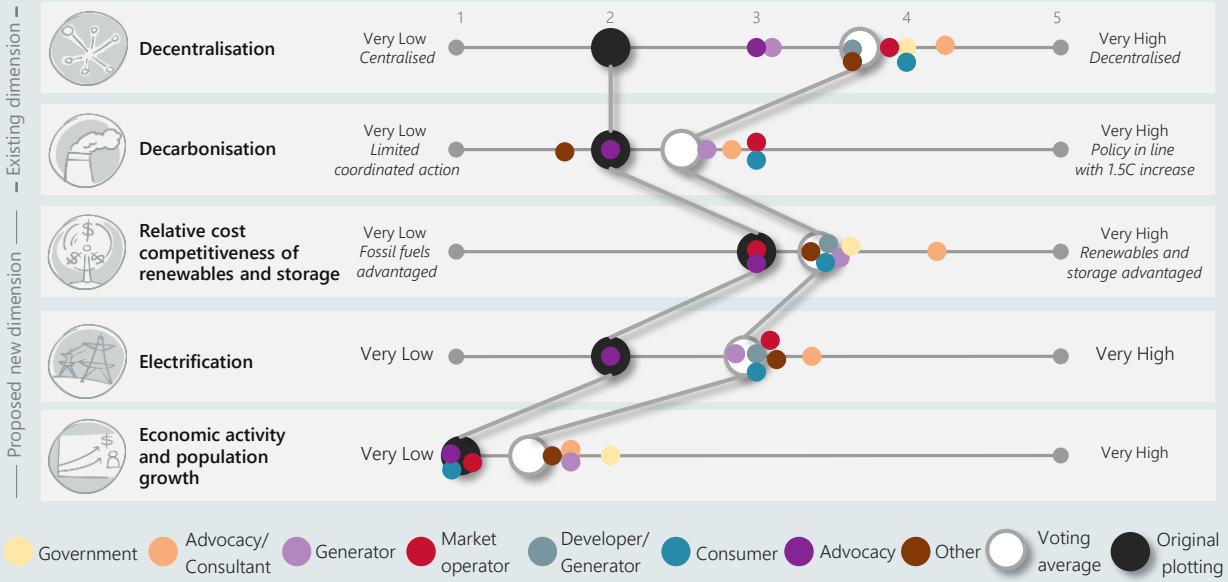
Global net zero by 2050 commitment, and some level of hydrogen generation.

Role for centralised clusters of generation in quality REZs. EV uptake and electrification drives grid growth

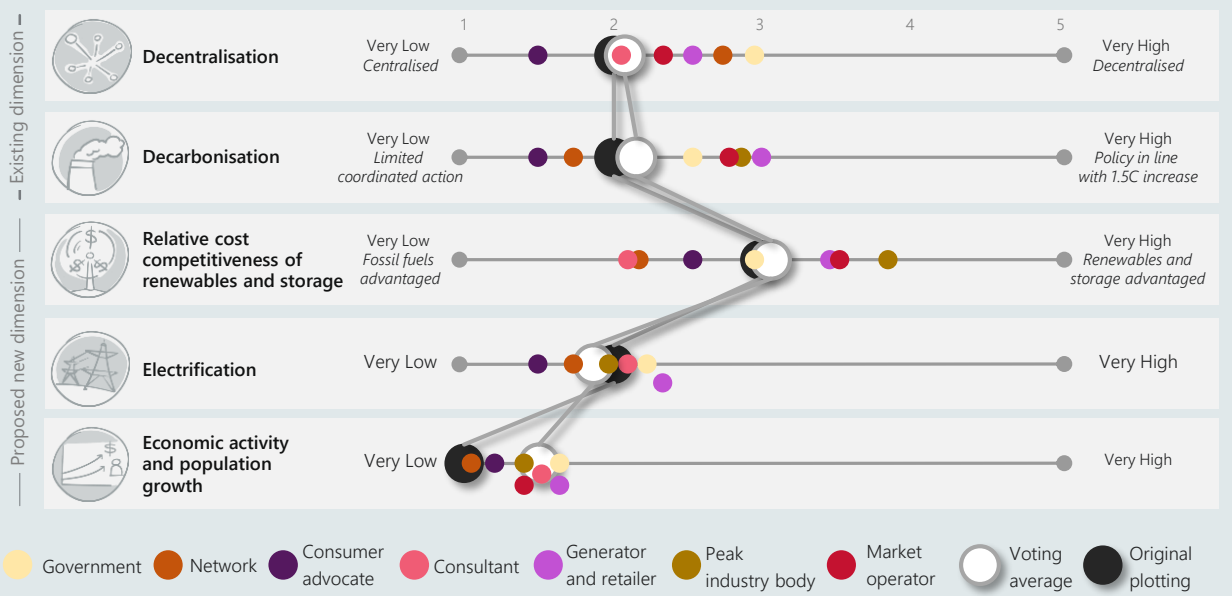
3 Sustained economic decline increases the likelihood of industrial load closures. Decarbonisation at a policy and consumer level takes a back seat.



A. Hard and slow



B. Australian flatline



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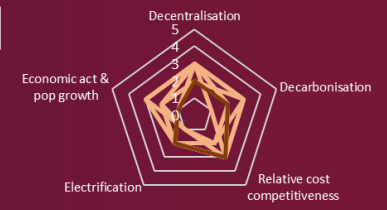
Sustained economic decline increases the likelihood of industrial load closures. Decarbonisation at a policy and consumer level takes a back seat.



A. Hard and slow

Australia's population growth declined due to a combination of domestic and international drivers

Technological developments (and lower costs) didn't eventuate

Less international travel, lower consumer spending (which also resulted in a reduction in energy use)

High rate of unemployment worldwide, industries require strong government intervention

Emission levels reduced due to the closure of local industry. Climate targets still not met due short-term policy changes

Local jurisdictions who have funds decide to go 'off-grid' resulting in a power system that relies heavily on peaking plants

B. Australian Flatline

Migration to Australia at a very low rate

Slow adoption of advanced technologies, limited to private investment (minimal government subsidies)

Significantly less focus on climate change and less international travel

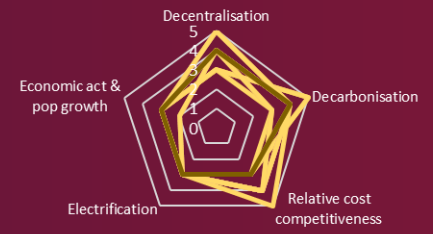
The economy never recovers from the ill effects of COVID-19

Emission reductions due to closures of large industry

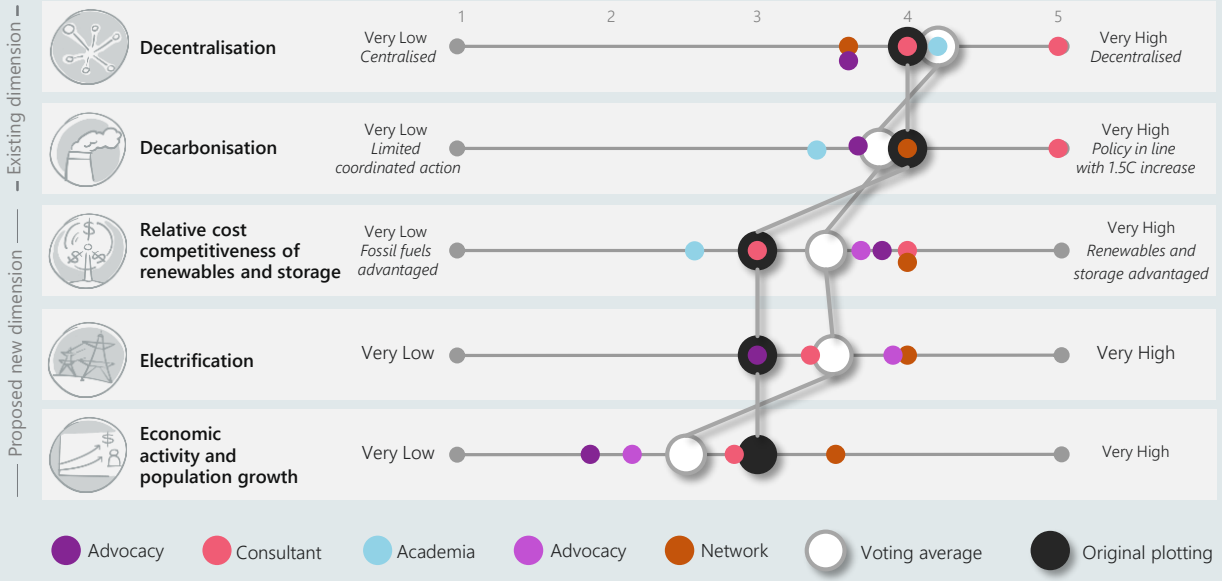
Inequality increases as the rich opt-out of the grid (and purchase EVs)

Volatility brought chaos to investment opportunities and consumers lose out

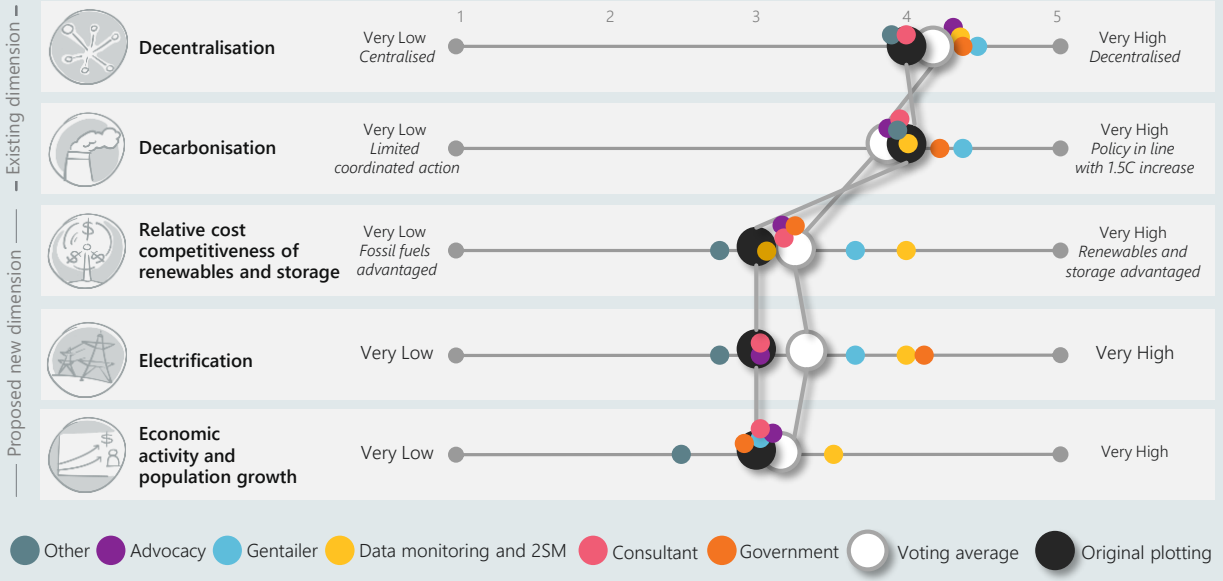
4 Higher decarbonisation ambitions are supported by consumers action including increased uptake of battery storage and rooftop PV.



A. Consumer-led decarbonisation



B. Green consumers



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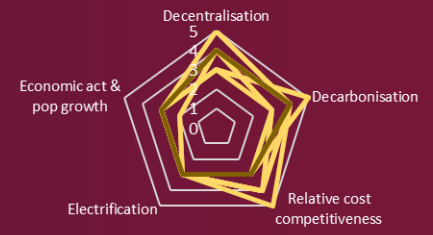
Higher decarbonisation ambitions are supported by consumers action including increased uptake of battery storage and rooftop PV.



A. Consumer-led decarbonisation

Low population growth and reduced immigration, increased ruralisation

Short term decline in the economy due to increased DER investment, followed by economic growth

Improvement in cost and performance of solar and batteries. EVs integrated with the grid, and some green hydrogen production

Great awareness and action on climate change, high levels of global decarbonisation, driving renewable investment

Consumers are active - voting for change and investing in DER

Targeted REZ development based on community acceptance – REZs drive regional population growth

B. Green consumers

Technology facilitates home office productivity - smart homes optimise energy usage, at the same time as VRE costs decline.

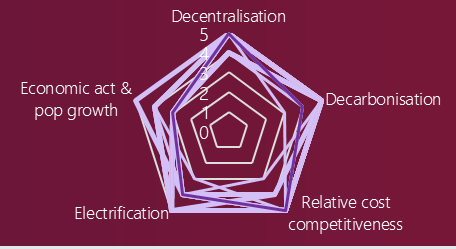
Cheap energy focuses investment on services to support the power system. Distributed storage firms rooftop PV. Increasing difficulty in entering coal PPAs.

Consumers concerns about climate may drive change, though they also respond to economic signals

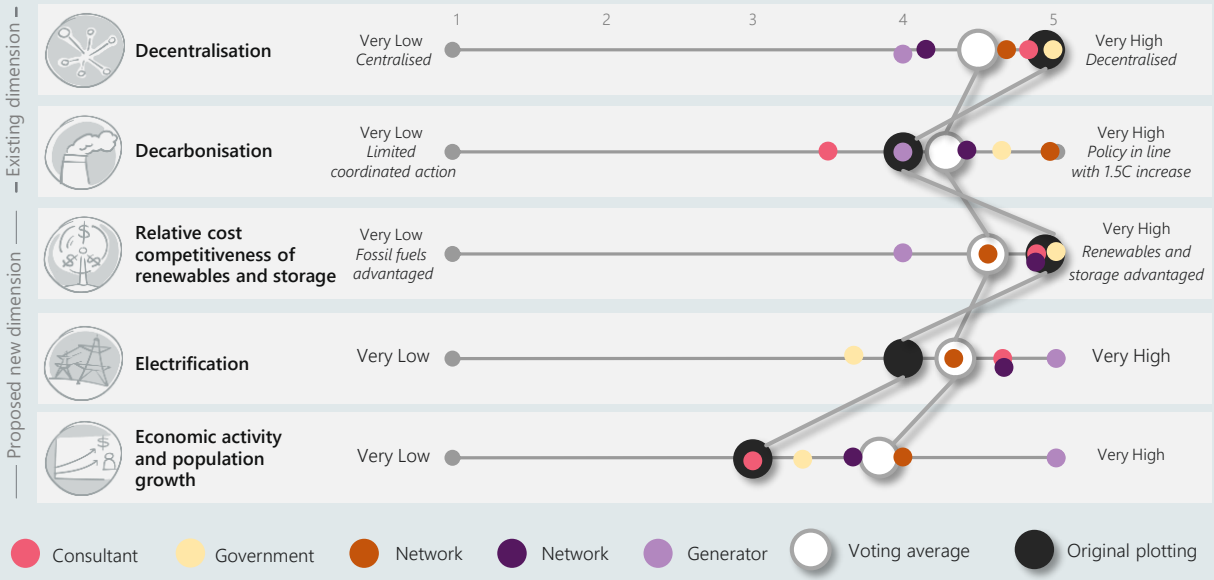
Markets and tariffs needed to evolve– more dispatchable loads and two-sided markets.

Storage and transmission play a critical role to firm renewables. Inflexible thermal power stations are shifted out and system stability representing a significant challenge.

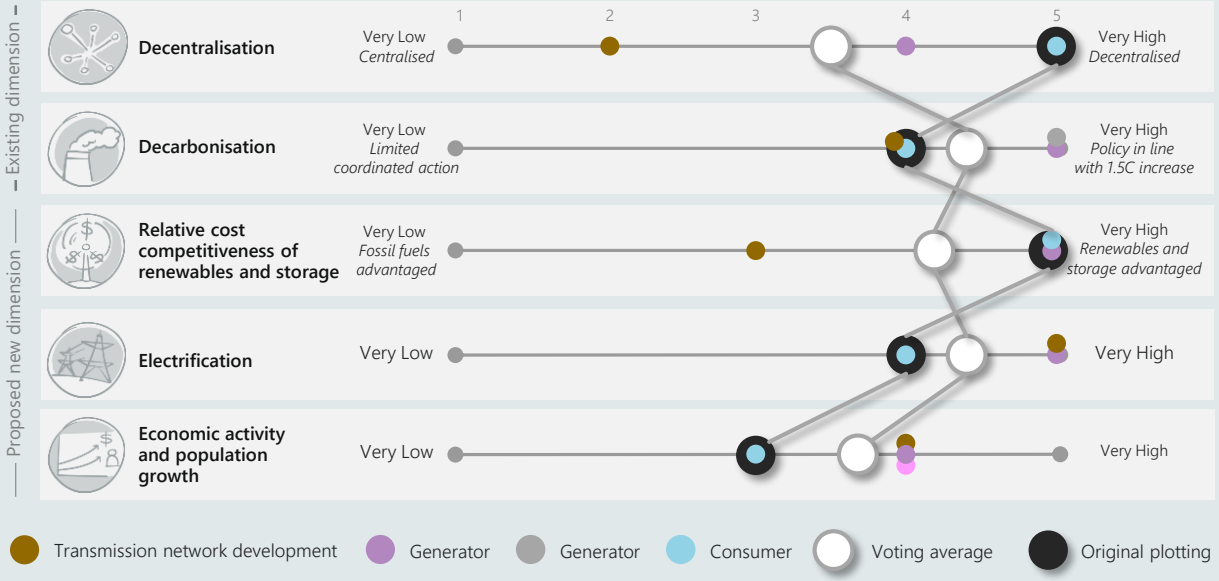
Rapidly falling costs for battery storage fuel an acceleration in the uptake of distributed energy resources. Higher decarbonisation ambitions increase the level of electrification of other sectors.



A. Consumer-driven



B. Prosumers thrive



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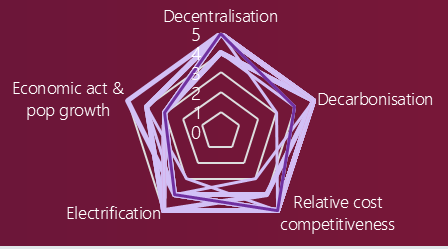


A. Consumer-driven

Population decentralised from metro areas, higher growth in rural areas

Low cost of energy in this world drives economic growth.

Consumers are more technology and energy-literate

Battery technologies become commonplace at both commercial and residential level. EVs become the dominant source of transport

Consumer action to tackle climate change and market behaviour effectively drives government policy.

This world has significant consequences for distribution utilities, more limited impacts on transmission

B. Prosumers thrive

Significant technological advances that facilitate the rapid uptake of DER

Wealth redistribution higher to provide consumers with enough liquidity to fund rapid DER uptake

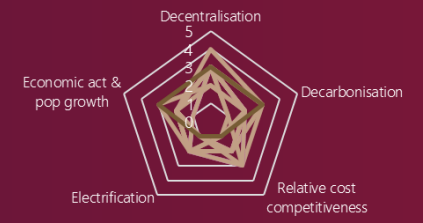
A less concentrated population, with more people moving to remote areas

Flexible working arrangements become the norm, with a different mindset to travel and transportation.

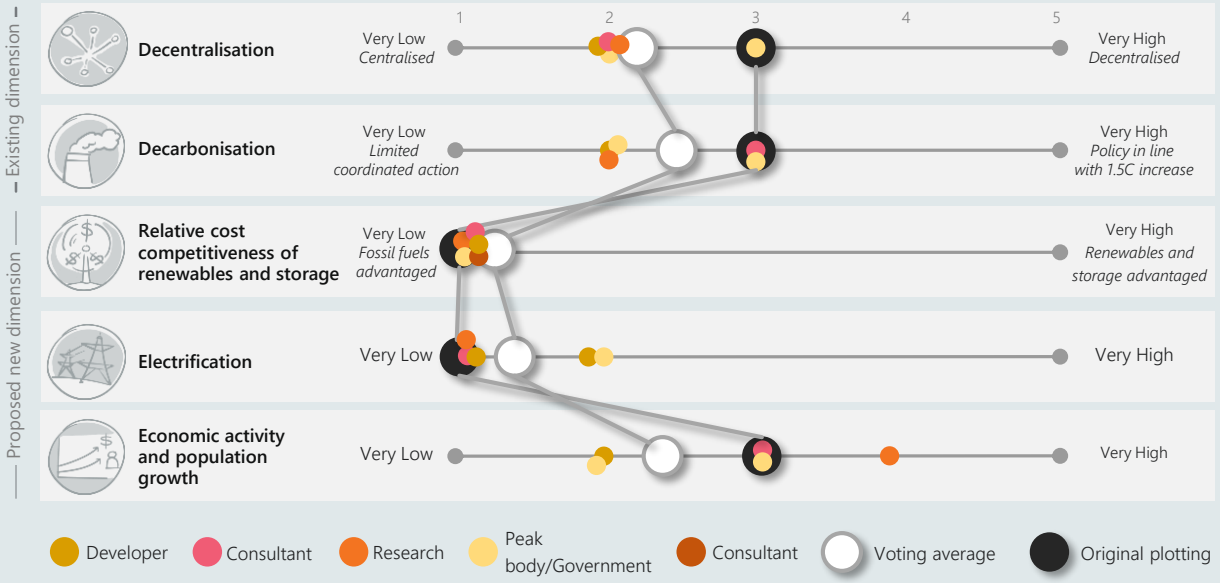
More aware of the environmental impact of grid electricity, level of decarbonisation consistent with Paris Agreement

Due to high DER uptake, transmission system need to be adapted. Dispatching electricity may also take place at a distribution level

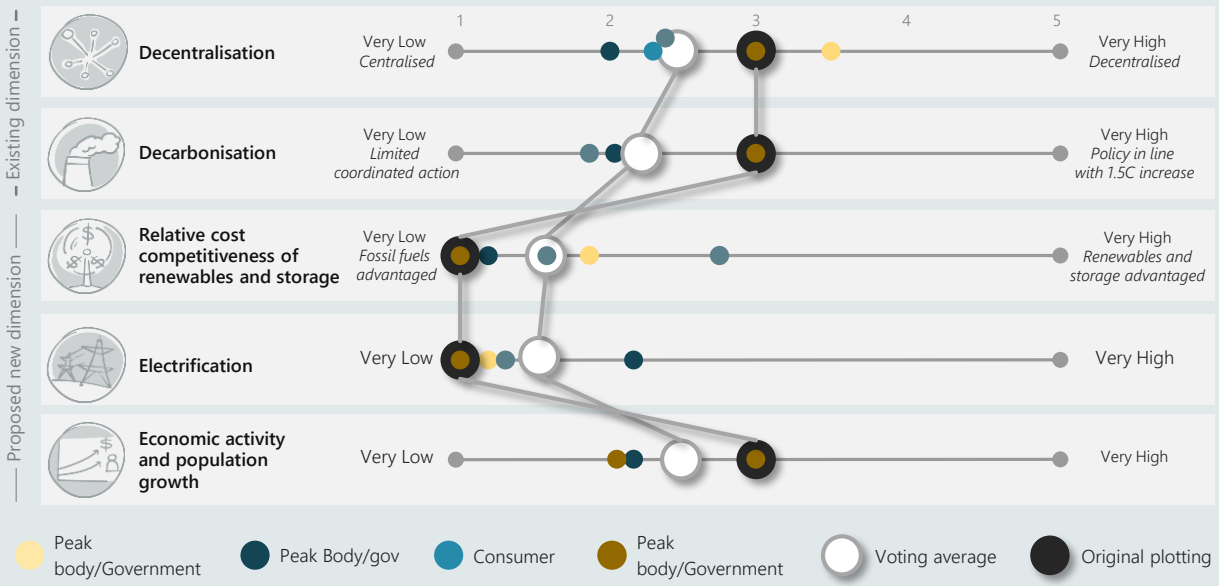
Falling gas prices and limited further cost reductions for VRE and storage increase the role for fossil-fuelled generation. Cost reductions in CCS further increase the likelihood of investment in low emission fossil-fuelled technologies.



A. Gas-driven economic recovery



B. Modernisation of fossil fuel fleet



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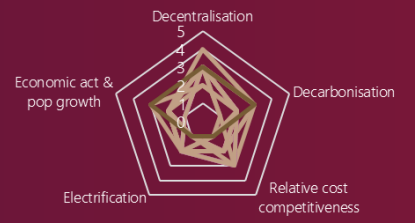


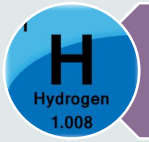
A. Gas-driven economic recovery

Manufacturing revival due to the low price of gas fuels recovery, especially over the period to 2030.

CCS is the critical technological advance. Limited cost reductions for batteries, cost reductions for solar and wind plateau

Inflection point after 2030, with an improvement in the level of relative cost competitiveness of VRE and batteries.

Possible, but less likely to meet a 2-degree target. Significant role for carbon offsets, jurisdictional policy targets are met



Limited incentives for EV adoption and potential uptake of fuel cell vehicles if blue hydrogen is produced.

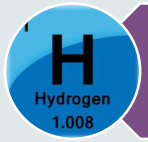
Power system sees lower levels of investment in transmission, generation and storage, with less of a need for expanded transmission.

B. Modernisation of fossil fuel fleet

Focus on maintaining as opposed to changing the nature of the grid, with somewhat lower levels of economic growth

Most significant technological advance is CCS. Scenario favours conventional technologies, slowing down the pace of innovation.

Low fossil fuel prices, limited transition away from existing vehicles. Low levels of sector coupling with sectors other than transport.

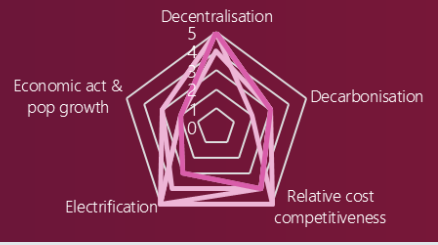


Blue hydrogen (coupling hydrogen with CCS) may play a role, with an uptake of fuel cells in transport.

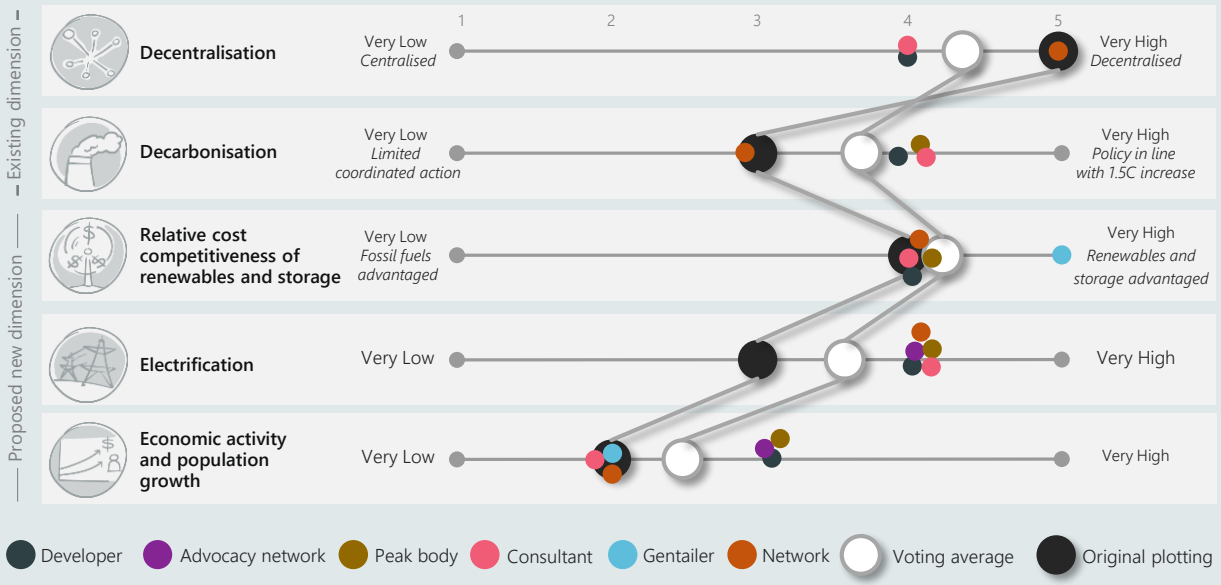
Level of decarbonisation may be inconsistent with 2 degrees, dependent on CCS. Climate risks become more important.

Lower levels of investment in the power system, with less of a need for expanded transmission and synchronous condensers.

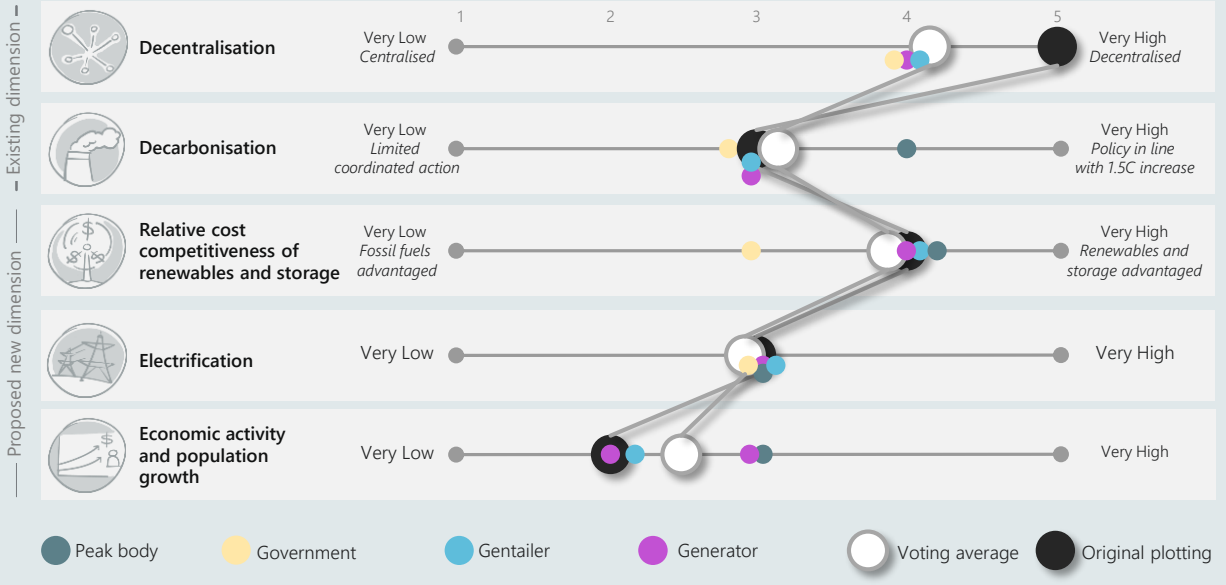
Reductions in the cost of battery storage and rooftop PV, and more muted decarbonisation ambitions drive a rapid uptake in distributed energy resources at a time of modest economic performance.



A. Consumers take charge



B. Government stimulus drives smart homes



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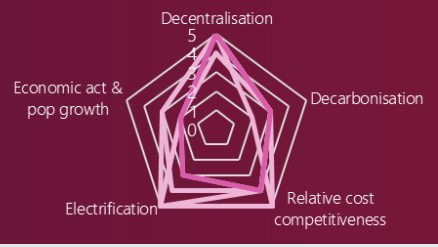
Reductions in the cost of battery storage and rooftop PV, and more muted decarbonisation ambitions drive a rapid uptake in distributed energy resources at a time of modest economic performance.



A. Consumers take charge

Moderate/low population growth - ageing population. Some ruralisation, with spatial grid implications

Very slow economic growth up to 2040, lower political appetite to pursue a strong decarbonisation agenda

Higher WfH rates and localisation of social lives - less travel and consumerism, lower levels of car usage

Consumers choose to lower their climate footprint, driving increased DER take up, incentivised by lower DER and EV costs

Consumers also decentralise to efficiently manage their consumption and rising electricity costs. Higher grid costs drive more consumers to DER.

Investment needed to increase reliability and manage control of uncoordinated DER, and reactive policies to mitigate high DER/ minimum demand risks

B. Government stimulus drives smart homes

Rising immigration and falling global economic activity. The latter leads to moderate/low growth in Australia

Low economic growth results in less investments in cheap grid production. Resulting high prices drive solar PV uptake.

Attempts to boost the economy result in increased stimulus for households - uptake in EVs, smart homes, and DER.

Technological advances and cost reductions in rooftop PV, batteries, and EVs

Government policy focuses on economic stimulus, though some policies (such as smart homes and EVs) have a positive environmental impact.

Challenge for the grid, greater focus needed for system security. Electricity prices may also be higher, due to falling demand and a slower shift away from fossil fuels towards newer technologies.

Risks and sensitivities

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What is the distinction between scenarios and sensitivities?

Scenarios:

- Explore different market conditions, different future ‘worlds’
- Important to consider risks that might impact on investment decisions, particularly in the near term
- Ensures that an investment plan is robust to significant events that can change the investment landscape

Sensitivities:

- Increases the depth of analysis and confidence in investment decisions by testing the uncertainty associated with individual input parameters
- Ensures an investment plan is robust to changes in single parameters

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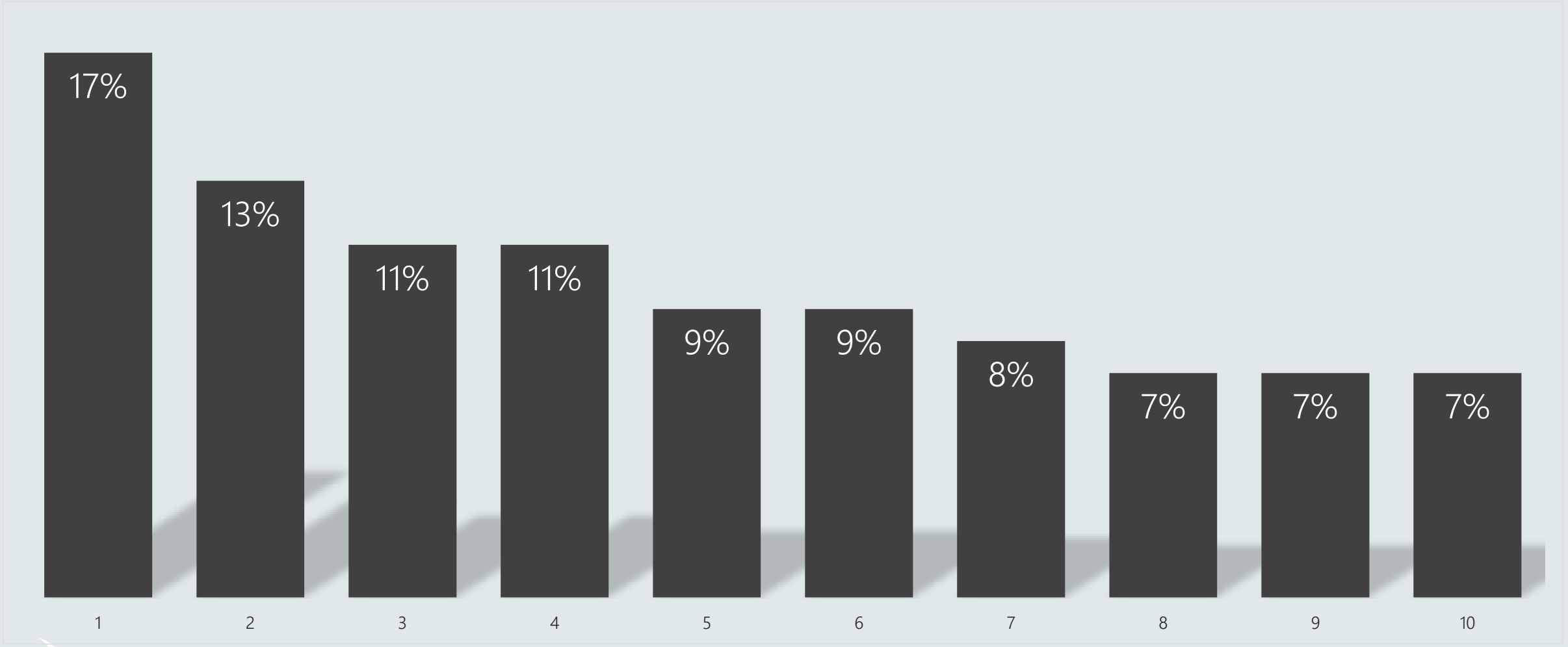
Summary of risks across all scenarios



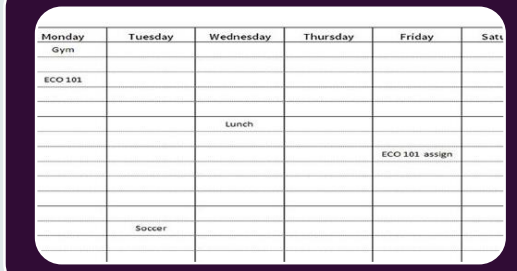
Source: Zoom polls from Groups A and B of 14 October AEMO forecasting and scenario planning workshop

Identified risks differed by scenario

Risk	Scenario	pp difference from average	Rationale
Unexpected/early coal closures	Central	+10	Coal closures is a key sensitivity, best tested on Central to ascertain the robustness of its optimal development path
Unexpected load closures	Scenario 3	+12	Scenario 3 is a low economic growth world, with greater likelihood of industrial load closures
Climate risks	Scenario 6	+11	Scenario 6 has the greatest fossil fuel reliance, both in the power sector and the energy system as a whole
Higher/lower generation/storage costs	Scenario 5	+8	Scenario 5 is the only scenario with very high levels of decentralisation and of VRE + batteries cost competitiveness

Source: Zoom polls from Groups A and B of 14 October AEMO forecasting and scenario planning workshop

Next steps



AEMO to publish ISP Timetable (by 30 Oct 2020)

IASR Workshop (Nov 2020)

Establishment of ISP Consumer Panel (by 30 Nov 2020)

Additional contributions?

- We encourage any additional contributions to the narratives discussed today to be sent to forecasting.planning@aemo.com.au

Appendix

Post-Workshop reflections

80+ external attendees

65+ organisations

600+ Mural comments