DRAFT

Scenarios for the 2023 IASR

Introduction

Please note that this webinar will be recorded and published online

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

We pay respect to their Elders past, present and emerging.

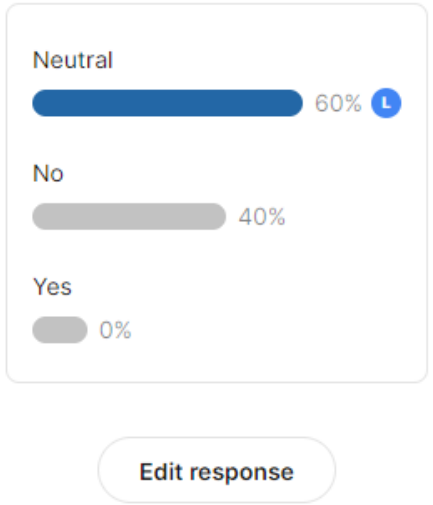
Agenda

- 2023 IASR development timeline
- The purpose of scenarios
- Recapping AEMO's 2021 scenarios
- Proposed approach to update scenarios for 2023

Interacting in today's session

To gather initial feedback during the session, we use Slido to:

- 'Vote to the top' – selected questions will be discussed.
- Poll responses – multiple choice with optional comments, displayed live.



Example response, showing distribution of stakeholder responses and option to edit response

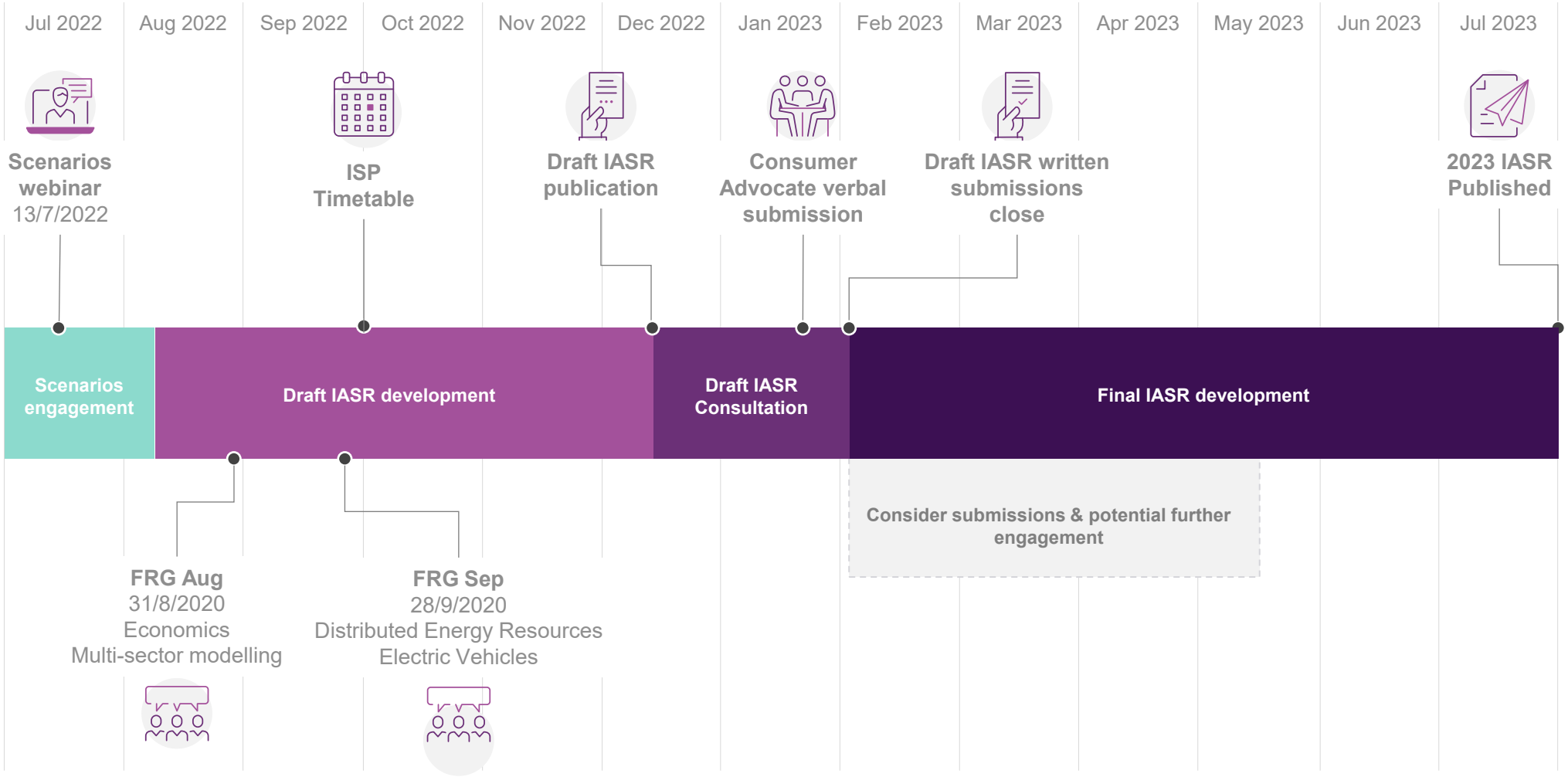
Look for this icon to indicate where poll questions will be asked

Live interactive exercise

To participate, go to www.sli.do #AEMO

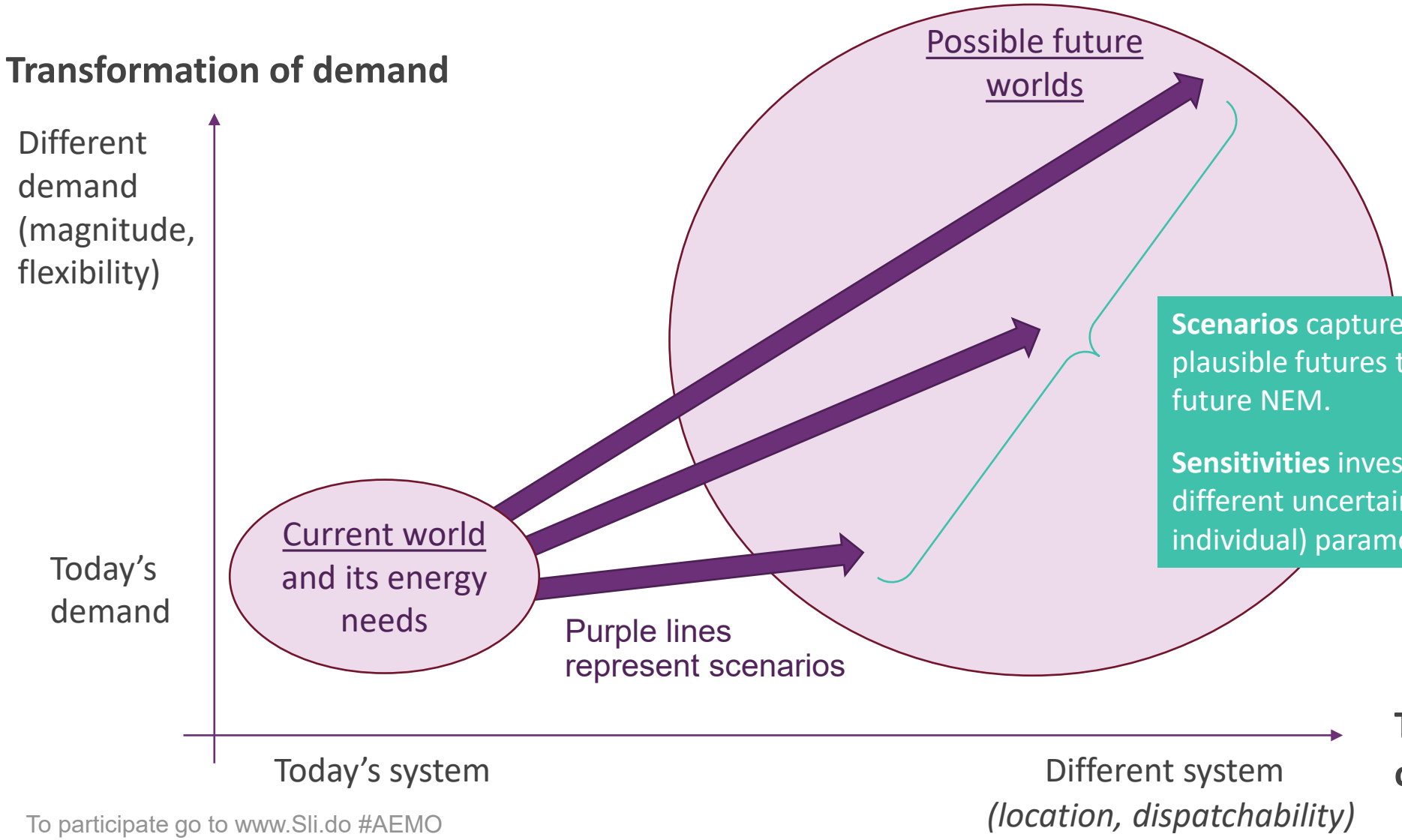
AEMO also welcomes emails to forecasting.planning@aemo.com.au.
The scenarios and their forecast key input components will be formally consulted on via the Draft IASR, December 2022.

2023 IASR development timeline



Purpose of scenario planning

Scenarios exist to define and explore potential developments of the energy system



Scenarios capture a range of possible and plausible futures to assess the needs of the future NEM.

Sensitivities investigate the materiality of different uncertainties on key (and typically individual) parameters

Scenarios recap

The 2021 IASR scenarios and feedback received

A significant effort went into the development of the 2021 scenarios…

Scenario development approach

Identify key uncertainties that materially impact the NEM

Survey stakeholders on importance of:
- Decarbonisation
- Decentralisation
- Relative cost of renewables and storage
- Electrification
- Broader economic activity and population

Combine uncertainties to create internally consistent and distinct scenarios

Workshop scenario narratives with stakeholders to test plausibility, breadth of future vision and world views

Refine scenarios based on stakeholder feedback

Attribute inputs to scenarios, aligning with scenario narratives

- Formally consult on inputs and scenarios via Draft IASR
- Engage CSIRO/ClimateWorks to inform assumptions around decarbonisation objectives

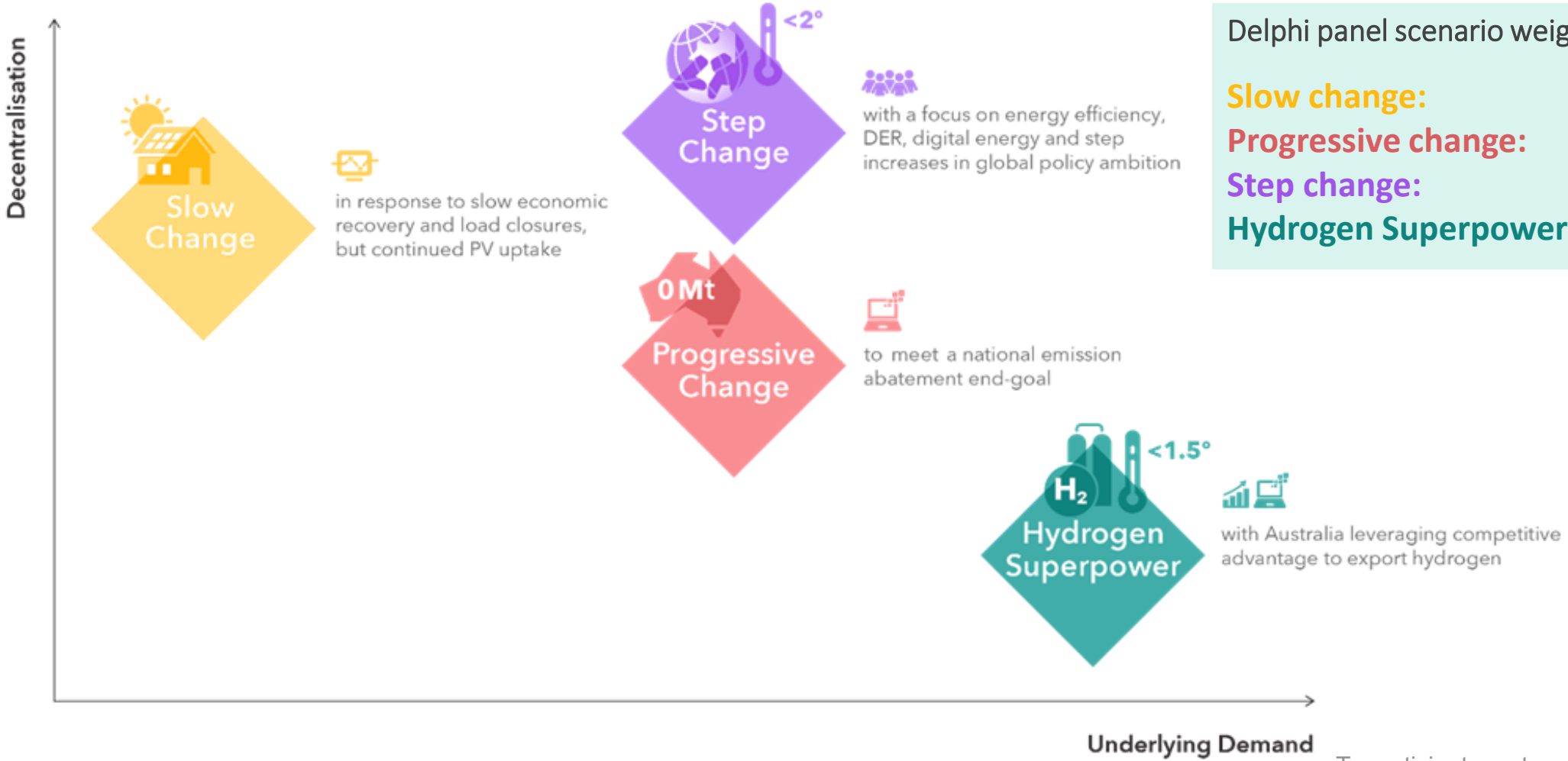
AEMO received nearly 50 submissions on 2021 Draft IASR

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

… so let's start with a recap…

Recap

2021 scenarios and their weightings



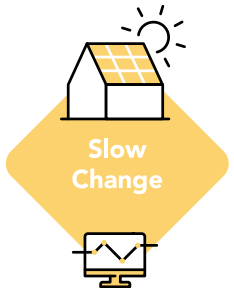
Delphi panel scenario weightings:

Slow change:	4%
Progressive change:	29%
Step change:	50%
Hydrogen Superpower:	17%

Slow Change

Challenging conditions tested the risk of over investment…

Recap



In this scenario:

- **COVID-19 recovery is slow**, supressing growth, investment, and employment. Australia's population growth is relatively lower than other scenarios
- **Consumers continue to install distributed PV at high rates**, continuing high recent uptake despite adverse economic conditions. Over time though the uptake moderates.
- In contrast, investment in **household battery storage and EVs do not grow as fast**
- Consumers' choice for **heating remains unchanged** compared to today.
- Currently legislated or materially funded **state-based renewable energy (VRE) policies are achieved**. Future investment beyond current policies, is driven by commercial decision-making.
- **Decarbonisation policy is less of a priority**. Insufficient action is taken globally to achieve the objectives of the Paris Agreement.
- **The energy transition across the economy is lower**

Is this scenario still relevant? Optional comment

Progressive Change
Technology advancements before deployment

Recap

In this scenario:

- **Uptake of DER reflect continued strong distributed investments.** Beyond 2030, energy efficiency measures gradually increase in response to progressive tightening of emission targets.
- **Moderate growth** in light of COVID-19 recovery.
- **Currently legislated or materially funded state-based VRE policies and targets are achieved.**
- **Early focus on technological R&D** leads to commercialisation of new and emerging low emissions technologies over time. **Decarbonisation accelerates after 2030**, eventually reducing emissions economy-wide to net zero by 2050.
- The **costs of new technologies continue to fall**. The electricity sector decarbonises earlier than other sectors, enabling greater progressive electrification of fossil-fuel intensive loads.
- **Electrification investments increase as 2050 approaches**. A gradual transition increases the reliance on electrification of some of the more challenging processes.
- Global emissions reductions are **insufficient to achieve the Paris Agreement's objectives**.

Is this scenario still relevant? Optional comment

Step Change

Consumer-led transformation and coordinated climate action

Recap

In this scenario:

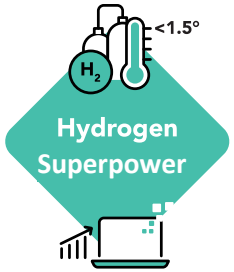
- **Moderate growth in the economy**
- Increasingly energy literate consumers contribute to lower emissions. **DER uptake is increasing** the number of active consumers who better manage energy use.
- **Strong climate action underpins rapid transformation of the energy sector. Temperature rises are approximately 2°C above pre-industrial levels**. Government policy and corporate objectives are aligned to decarbonise.
- **Currently legislated or materially funded state-based VRE policies and targets are achieved.**
- **Emissions-intensive generation sources are withdrawn earlier than presently announced.**
- **Some opportunity for domestic hydrogen** as other sectors innovate to decarbonise, but is broadly limited, either technically or economically.
- **No hydrogen export facilities are connected to the NEM.**
- **Electrification potential is high**, particularly from the transport sector. EVs soon become the dominant form of road passenger transportation.
- **Carbon sequestration supports a pathway towards net zero emissions more rapidly.**

Is this scenario still relevant? Optional comment

Hydrogen Superpower

Strong global decarbonisation with hydrogen breakthroughs

Recap



In this scenario:

- **Faster decarbonisation to tackle climate change, with net zero emissions before 2050.**
- **Australia establishes strong hydrogen export partnerships** to meet international demand for clean energy, supporting NEM-connected electrolysis powered by renewable energy.
- **The energy transition in Australia is embraced by consumers**, as they seek clean energy and energy efficient homes and vehicles

Is this scenario still relevant? Optional comment

2021 scenarios feedback and recent developments

Stakeholders submitted feedback on green gas, hydrogen and supply chain risks…

Green Gas

Support

"AEMO should construct a low emissions gas scenario. However, this needs to be a bold strategy that identifies a pathway for combining non-traditional sources of methane (biogas) with green hydrogen, with the concentration of green hydrogen increasing over time. " (NICE) [D]

"[Green gas] should be explored in terms of refinements to existing scenarios and that there would be limited value in creating an entirely new scenario" (EnergyAustralia)[D]

Opposition

"…adopting such a scenario would blunt efforts to decarbonise as rapidly and cheaply as renewable technology is increasingly allowing." (Jim Crosthwaite/ACF Geelong) [D]

"… while the prospects of low-emissions gases exist, they are still in the stages of early development and should not take focus away from thorough assessments of more plausible future energy scenarios." (Hydro Tas) [D]

Supply chain

"The threat to new generation and storage from the critical mineral supply chain and the resilience to geopolitical tensions" (QEUN)[E]
"The impact of supply chain issues on capex costs" (EUAA)[E]
"Supply chain risks related to delivering multiple projects at the same time have the potential to be a material risk to the delivery of the ISP's ODP. AEMO should consider how to better assess this risk as part of the development of the 2024 ISP." (ISP Consumer Panel)[C]

"Raw materials for supply and demand" as a factor for AEMO to consider. (Enel)[E]

Scenarios should capture price uncertainty of batteries and electric vehicles due to supply chain issues. (Shell, EUAA)[E]

Hydrogen

Urging caution

ElectraNet and the Brotherhood of St Lawrence urged caution on uncertain hydrogen costs[D]
"The cost for producing green hydrogen is highly uncertain, given the industry's infancy in Australia" (BSL)[D]

Supporting greater consideration

"While hydrogen demand is difficult to forecast in this relatively early stage of the industry's development, the Hydrogen Superpower scenario is the sole scenario in the ISP which forecasts a significant level of demand and consequently we consider that the full potential for hydrogen to play a role in the energy system has not been explored." (Hydrogen Council of Australia)[C]

A: ISP Methodology consultation B: 2021 Draft IASR consultation C: Draft 2022 ISP D: 2022 Forecasting Assumptions Update E: Forecasting Reference Group (FRG) meetings

… as well as on DER and social license…

Distributed Energy Resources (DER)

Under-forecasting concerns
"There seems to be a 'cultural bias' towards grid-scale investment. Why are we spending billions on the transmission network, but treating DER as 'a problem to be managed' when it can be a cost-effective part of the solution?" And "By 2040, distribution network service providers (DNSPs) will spend billions of dollars to support a doubling or tripling of DER on the grid. That would go a long way towards meeting the future energy needs of the system." (Total Environment Centre)[A]

"There's been an underestimation of DER in previous ISPs, DER modelling needs to consider social and business practices" (ECA)[B]

Over-forecasting concerns
"A frequent theme across several draft ISP submissions (Snowy Hydro, GE, CEC, EA, Powerlink, ENA, EA, IE&S, Hydro Tasmania, and FFI) was that the ISP's projections of DER were too high, particularly the uptake of distributed storage.

The level of co-ordination and uptake was also questioned, given the required policy reforms, social licence issues, and the issues associated with managing the interface between transmission and distribution networks, with some stakeholders considering that further investigation may be needed. Similarly, the EVC believed that the levels of Vehicle to Grid (V2G) were too optimistic, and the level of convenience charging was likely overstated given the benefits of shifting charging away from peak times." (ISP Consultation Summary)[C]

Social Licence

"Managing social licence is a key risk to the delivery of the ISP's ODP. AEMO should put more emphasis on this issue as it plans the development of the 2024 ISP" (ISP Consumer Panel)[C]
"Consumer willingness to adapt to price or other triggers" will be a key factor to consider in the 2023 IASR. (ISP Consumer Panel) [E]

Consumer advocates urged consideration of social licence too: "ISP projects can cause higher prices, so the flow on impacts to consumers needs to be investigated." (EWOSA)[c], "Some overseas projects have been deferred indefinitely due to a lack of social licence. It is important to consider the timeline and cost impacts of social licence at an early stage in the planning process." (Energetic Communities)[c] and "Modelling needs to consider social and business practices" (ECA)[B]

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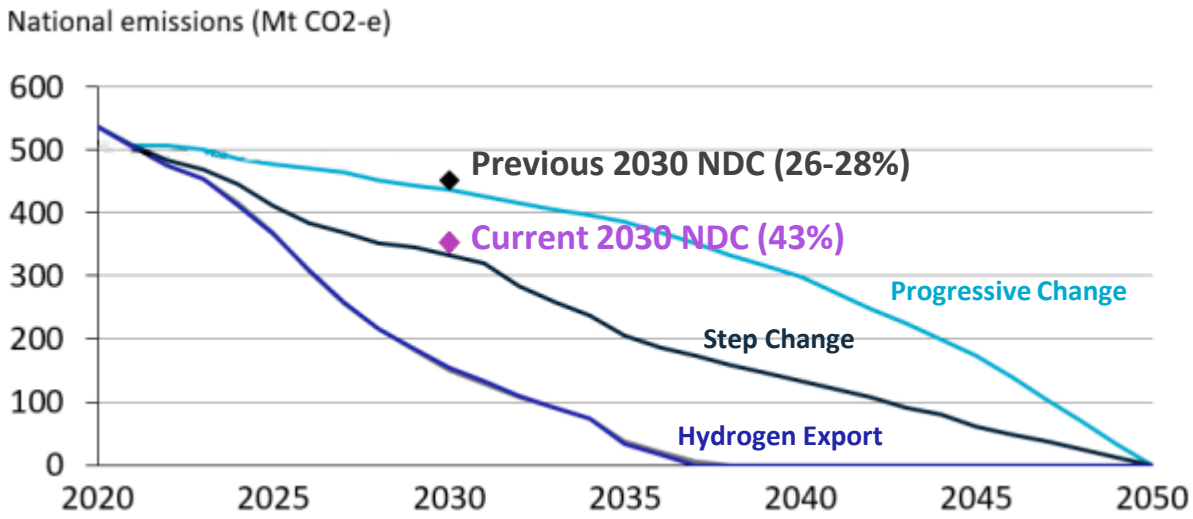
Since last consultation, there has been several changes that could affect future scenarios

- Australia's Nationally Determined Contribution (NDC) to the Paris Agreement updated to 43% emissions reduction on 2005 levels by 2030
- Other announced policies and roadmaps, e.g. removal of fringe benefit tax for EV and Victoria's Gas Substitution roadmap
- Supply chain uncertainty and greater need to consider social licence
- Alternatives to greater electrification: "green gas"
  - low emissions gas: including green/blue hydrogen, biomethane, and synthetic methane

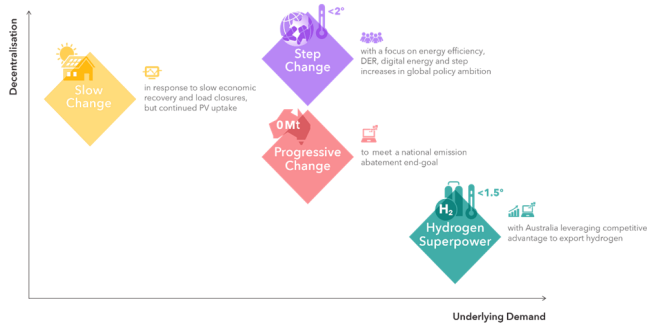


Word cloud: Any other recent changes that the 2023 scenario mix should reflect?

Proposed approach for 2023 scenarios

For the 2023 IASR, AEMO proposes to refresh the 2021 IASR scenarios

1. Start with the 2021 IASR scenarios



2. Refresh the scenario narratives to reflect recent developments

3. Develop updated scenario components and consult on these inputs and assumptions via the Draft IASR

The case for scenario consistency

"The Panel strongly encourages AEMO to consider the merits of using the same set of scenarios for two ISP iterations (at least). While some updating of assumptions and settings within the scenarios will be necessary, by maintain some consistency in the number, naming and broad narratives we would expect stakeholders will more easily engage in other aspects of the ISP methodology." (ISP Consumer Panel) 2021 Draft IASR consultation

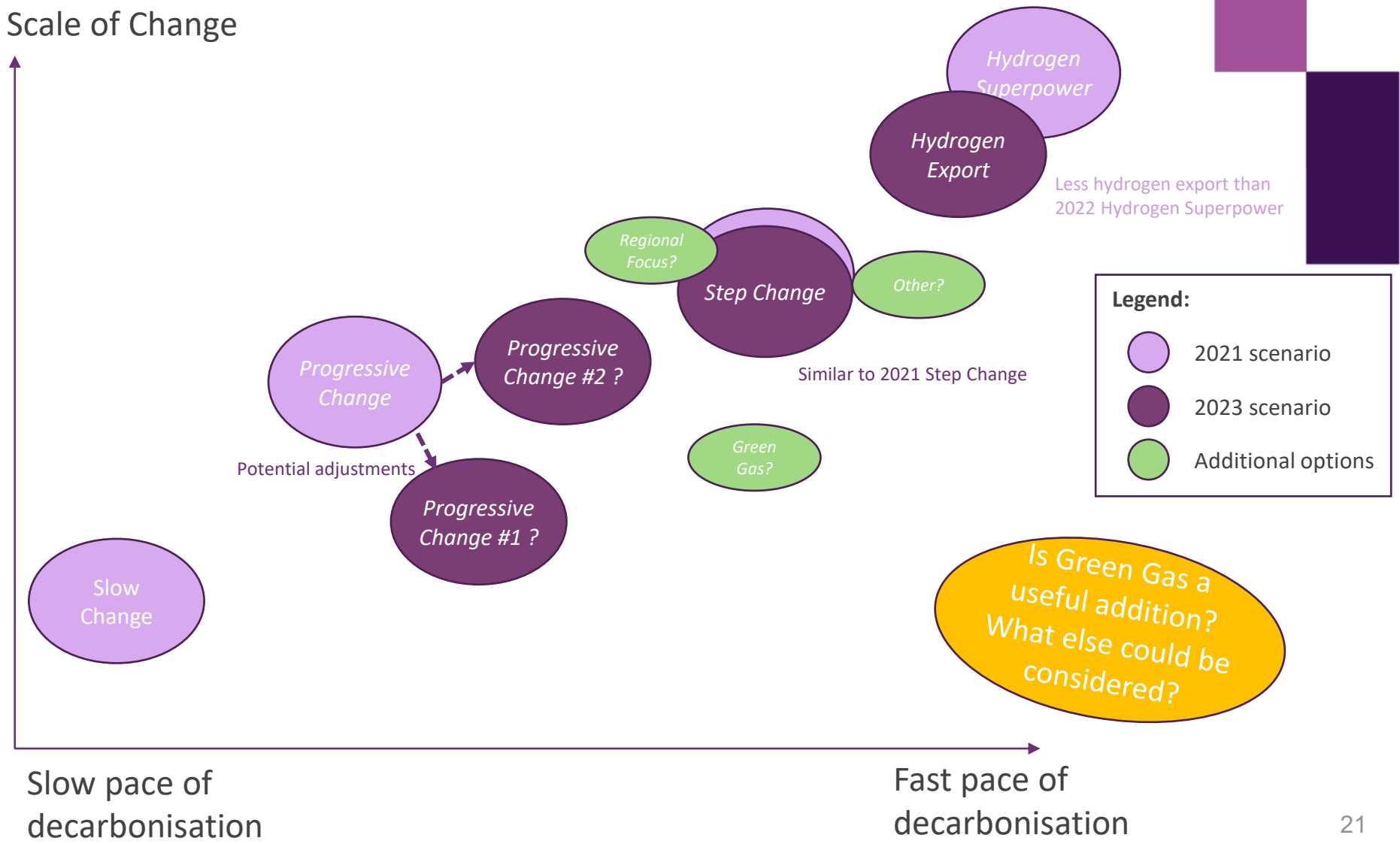
What do the proposed scenario refreshes look like in terms of the pace and scale of change?

Refinement to 2021 scenarios:

- ***Slow Change*** no longer is relevant, but possibilities for weaker economic activity remain.
- ***Progressive Change*** is aligned with Australia's new 43% emissions reduction NDC.
- ***Step Change*** is broadly consistent with 2021 settings, including a high degree of decarbonisation coordination and DER development.
- ***Hydrogen Export*** sees a rapid energy transformation and strong hydrogen export, although moderated from 2021 extremes.

New considerations:

- *Supply chain and social licence*
- *Green Gas*
- *Regional energy independence*
- Other?



Overview of proposed scenario settings

SCENARIO SETTING	Possible Progressive Change options Option #1	Option #2	Step Change	Hydrogen Export
Decarbonisation target	43% by 2030. Net zero by 2050	43% by 2030. Net zero by 2050	At least 43% by 2030. Net zero by 2050 Emissions trajectory to limit warming to <2 degrees	At least 43% by 2030. Net zero by 2050 Emissions trajectory to limit warming to <1.5 degrees
Global economic growth and policy coordination	Slower economic growth, lesser coordination	Moderate economic growth, moderate coordination	Moderate economic growth, stronger coordination	High economic growth, stronger coordination
Australian economic and demographic drivers	Lower	Moderate	Moderate	Higher (partly driven by hydrogen export)
DER uptake (i.e. rooftop PV, batteries and EVs)	Lower	Moderate	Higher	Higher
Consumer engagement e.g. in uptake of VPP and DSP	Lower	Moderate	Higher	Higher
Hydrogen use (Green Gas sensitivity exploring more)	Allowed, but small	Allowed, but small	Allowed, but small	High including significant exports
Biomethane/synthetic methane (Green Gas sensitivity exploring more)	Allowed, but small	Allowed, but small	Allowed, but small	Allowed, but small
Other electrification (Green Gas sensitivity exploring less)	Moderate (but lower with lesser economic growth)	Moderate	Higher	Moderate
Social license	Weaker	Moderate	Moderate	Stronger

Is this option valuable for planning the transition?

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Any adjustments to this scenario?

Do you support this adjusted scenario?

Questions

1. Do you consider these proposed adjustments to the 2021 scenarios appropriate for planning purposes?
2. Do these adjusted scenarios reflect a range of transformation speeds needed for testing the risks of over- and under-investment?
    - Is Australia's 43% emissions reduction NDC* now the slowest pace of transformation to consider?
3. Should DER uptake and orchestration** be a key differentiator between scenarios?
4. Other comments?

*NDC - Nationally Determined Contribution

***DER orchestration* refers to the coordination of battery storage and electric vehicle charging/discharging, such as via virtual power plants (VPP)