Gas Market Parameter Review

Consumer Forum – 7 December 2022

Overview

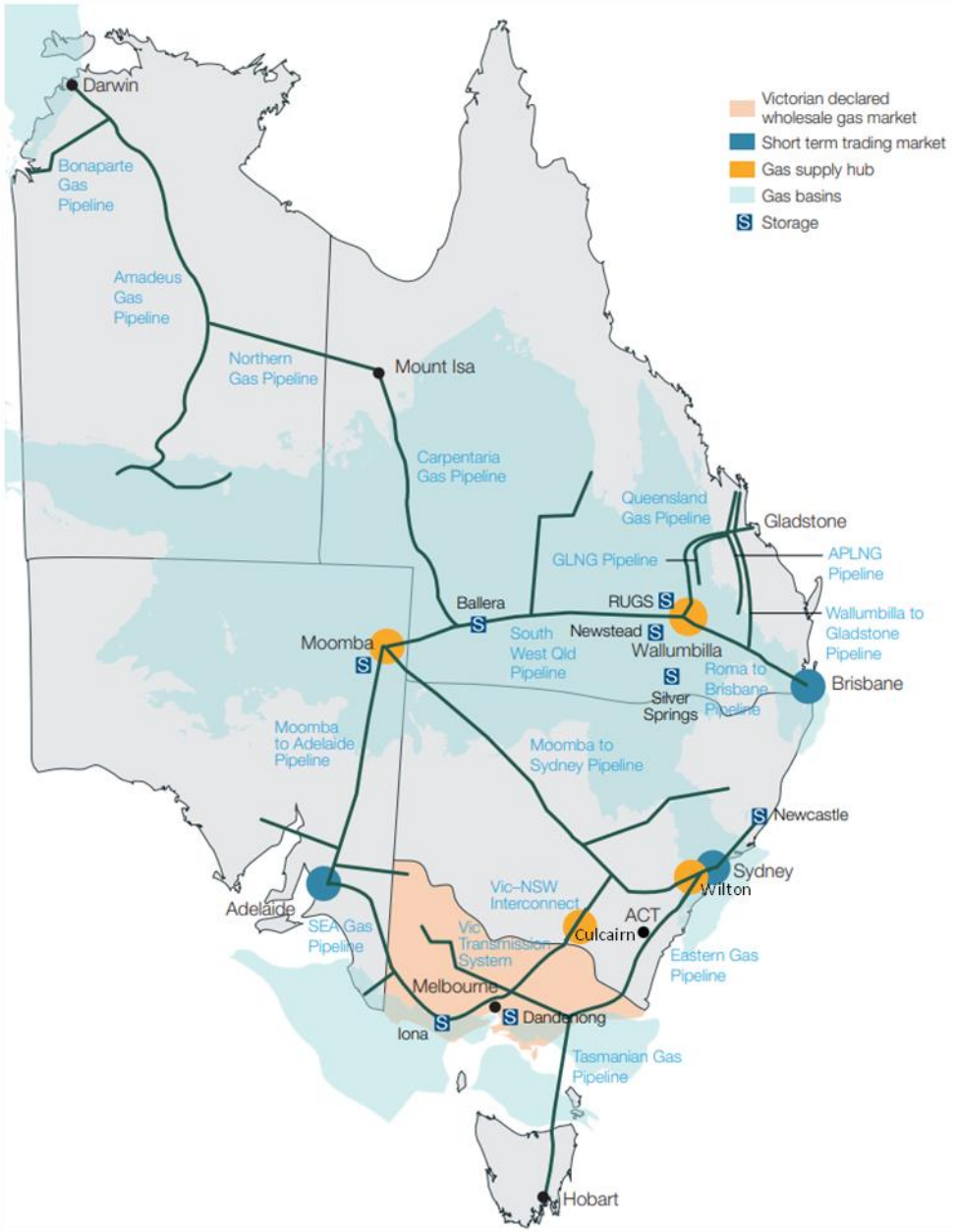
- AEMO is required to undertake a review of the STTM market parameters under NGR492. In addition AEMO is voluntarily undertaking the DWGM market parameter review in parallel.

- AEMO split this review into Parameters:

  - Modelled by Market Reform where the parameter could be more effective, or could be subject to changes in cost structure; and

  - Reviewed by AEMO where the parameter is unlikely to become more effective, or are not subject to significant changes in cost structure.

- AEMO considers that the NGO is best met by the efficient operation of the STTM and DWGM. AEMO has assessed the STTM and DWGM gas market parameters via modelling undertaken by Market Reform using relevant scenarios that can be expected to occur in the next 5 years.



Facilitated Gas Markets

This review covers the:

- The STTM hubs at Sydney, Adelaide and Brisbane (blue dots).
- The Victorian Declared Wholesale Gas Market (DWGM) (peach area)

Summary of Market Parameters

- AEMO's Draft Determination is to maintain the current market parameters.

Market Parameters	STTM	Regulatory Reference	DWGM	Regulatory Reference	Assessment Methodology
Market Price Cap (STTM) / Value of Lost Load (DWGM)	$400/GJ	NGR 364 – See MPC definition	$800/GJ	NGR 200 – see VoLL definition	Modelled Parameter
Minimum Market Price (STTM) / Minimum Bid Price (DWGM)	$0/GJ	NGR 364 – See MMP definition	$0/GJ	NGR209(5)(a) – see minimum bid price of $0/GJ.	Reviewed Parameter
Administered Price Cap (APC)	$40/GJ	NGR 364 – see APC definition	$40/GJ	Administered Pricing Procedures	Modelled Parameter
Cumulative Price Threshold (CPT)	$440/GJ	NGR 364 – see CPT definition	$1400/GJ	Administered Pricing Procedures	Modelled Parameter
CPT Horizon (STTM) / Cumulative price period (DWGM)	7 days	NGR 364 – see CPT Horizon definition	35 consecutive scheduling intervals (7 Days)	Administered Pricing Procedures	Reviewed Parameter

Gas Market Parameter Review Consultation

- AEMO will be providing a short presentation to AEMO's Consultative Forum (7 Dec) and GWCF (8 Dec) in addition to this workshop.
- AEMO's consultation page for the Gas Market Parameter Review outlines the following:

Stage 1 – Determination of Review Methodology	Date
Gas Market Parameter Workshop #1	8 September 2022
Initiation of consultation	15 September 2022
Participant submissions on review methodology	7 October 2022
Final Modelled Parameter Review Methodology	2 November 2022

Stage 2 – Determination of Market Parameters	Date
Draft Determination of Market Parameters	1 December 2022
Gas Market Parameter Workshop #2	6 December 2022
Participant submissions on Draft Determination	19 January 2022
Final Determination of Market Parameters	16 February 2023

Modelled Parameters - Introduction

AEMO onboarded Market Reform to provide the modelled parameter analysis and recommendations.

The model assessed:

- Market Efficiency – essentially ensuring the market clearing price is achievable throughout the period
- 500 days of lost profit for a range of generic participants to assess changes in parameters using the formula:

$$Days\ Lost\ Profit = \frac{Profit\ Lost}{Average\ Daily\ Profit}$$

- A range of 13 expected scenarios, developed in consultation with participants (discussed in the next slide)
- Market Reform has also indicated that the long-term gas price represented by the LGA gas price from the 2022 GSOO (forecast gas prices between $9GJ-$11/GJ) should be used to assess parameters. Current gas prices are expected to be transient, being primarily caused by the war in Ukraine.
- Alignment of Market Parameters – market design of STTM and DWGM determined to be too different to allow alignment.
- AEMO Draft Determination and Market Reforms draft recommendations are available on the Gas Market Parameter Review webpage. The presentation from Workshop on 6 December will be available later today.

Modelled Parameters - Scenarios

The scenarios are described in more detail in the Market Reform report. PC refers to Progressive Change and SC refers to the Step Change scenario from the GSOO.

DWGM Scenarios		STTM Scenarios		Linked Market Scenarios	
1	A full Longford outage during part of a high demand day in winter. 2024, 2026. *PC*	7	MSP capacity to supply SYD reduced by 50% for 3 days during winter. 2024 (without Port Kembla), 2026, 2027. *SC*	11	Extreme VIC winter demand and low storage links markets for 3 days. DWGM, SYD, ADL, 2026, SYD, ADL 2023. *PC*
2	A 2-day VNI compressor outage limiting supply from NSW, high demand days. 2026, 2027. *PC*	8	High GPG backhaul limiting supply to ADL ex ante market. 2025, 2027. *PG*	12	High NEM GPG demand for 3 days. APC in NEM. DWGM, SYD, ADL, 2026. *PC*
3	Moomba supply issue for 3 days has high exports from Victoria, NEM prices are high. 2026. *SC*	9	High GPG backhaul for BRI for 3 days. GPG demand triggers contingency gas during first gas day. 2025, 2027. *PG*	13	High world oil, gas and coal price scenario. NEM not capped. DWGM, SYD, ADL, 2026. *SC*
4	High GPG demand & coal outages during winter. Flow to SA. APC in NEM. 2023, 2025, 2026. *PC*	10	Supply interruption at SYD hub triggers contingency gas. 2024, 2026. *SC*		
5	Extreme winter demand (> 1-in-20-years) for 3 days. APC in NEM. 2023, 2025, 2026. *SC*				
6	High demand, 2-days of LNG but storage low. High NEM prices. 2026, 2027. *SC*				

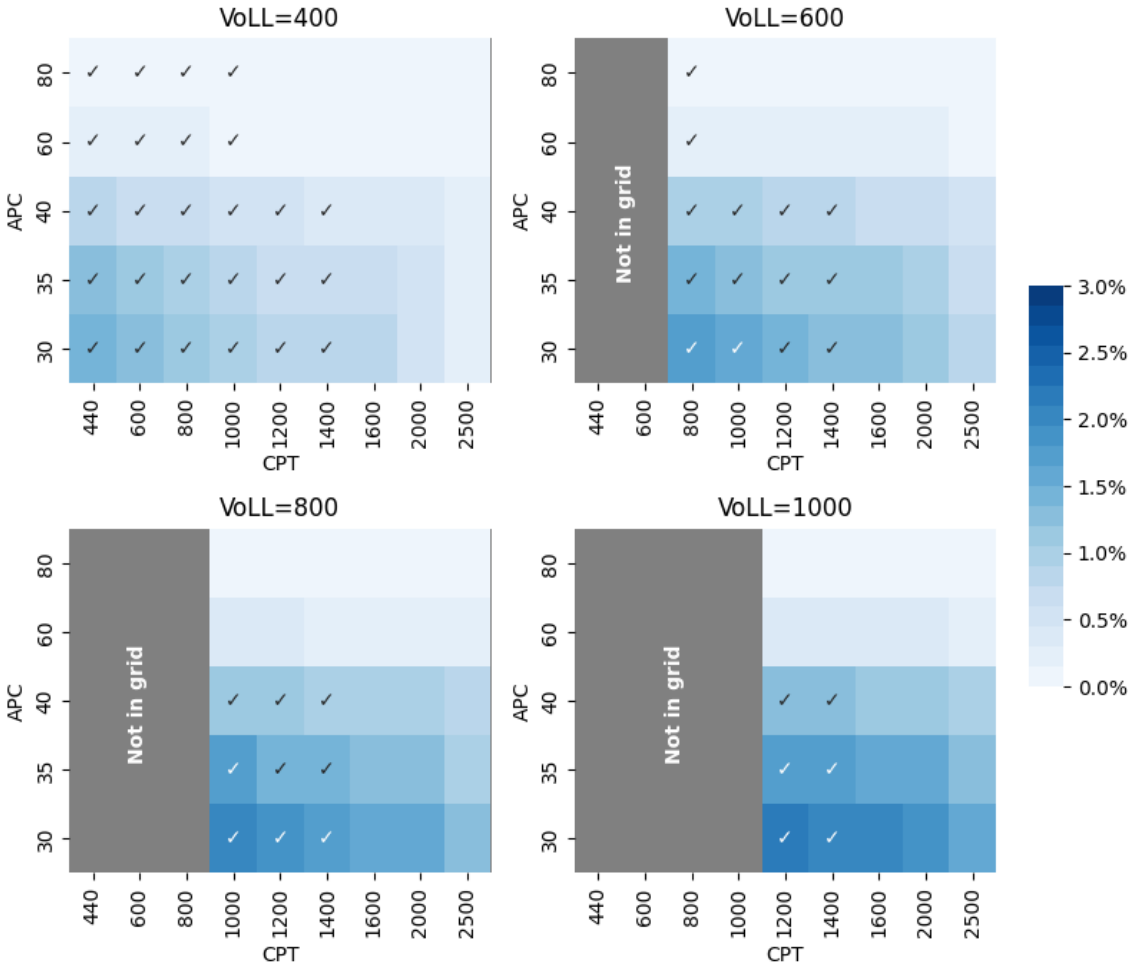
Source: Market Reform, Gas Market Parameter Review 2022, Draft Recommendations, 6 December 2022

Grid of Market Parameter Assessed

Parameter	Current Value	Grid Points Explored in Study
Market Price Cap (MPC) **Value of Lost Load (VoLL)**	STTM $400/GJ DWGM $800/GJ	Both markets: $400/GJ, $600/GJ, $800/GJ, $1000/GJ
Administered Price Cap (APC)	STTM $40/GJ DWGM $40/GJ	Both markets: $30/GJ, $35/GJ, $40/GJ, $60/GJ, $80/GJ
Cumulative Price Threshold (CPT)	STTM $440 DWGM $1400	Both markets: $440, $600, $800, $1000, $1200, $1400, $1600, $2000, $2500 Subject to CPT exceeding VoLL/MPC.

Source: Market Reform, Gas Market Parameter Review 2022, Draft Recommendations, 6 December 2022

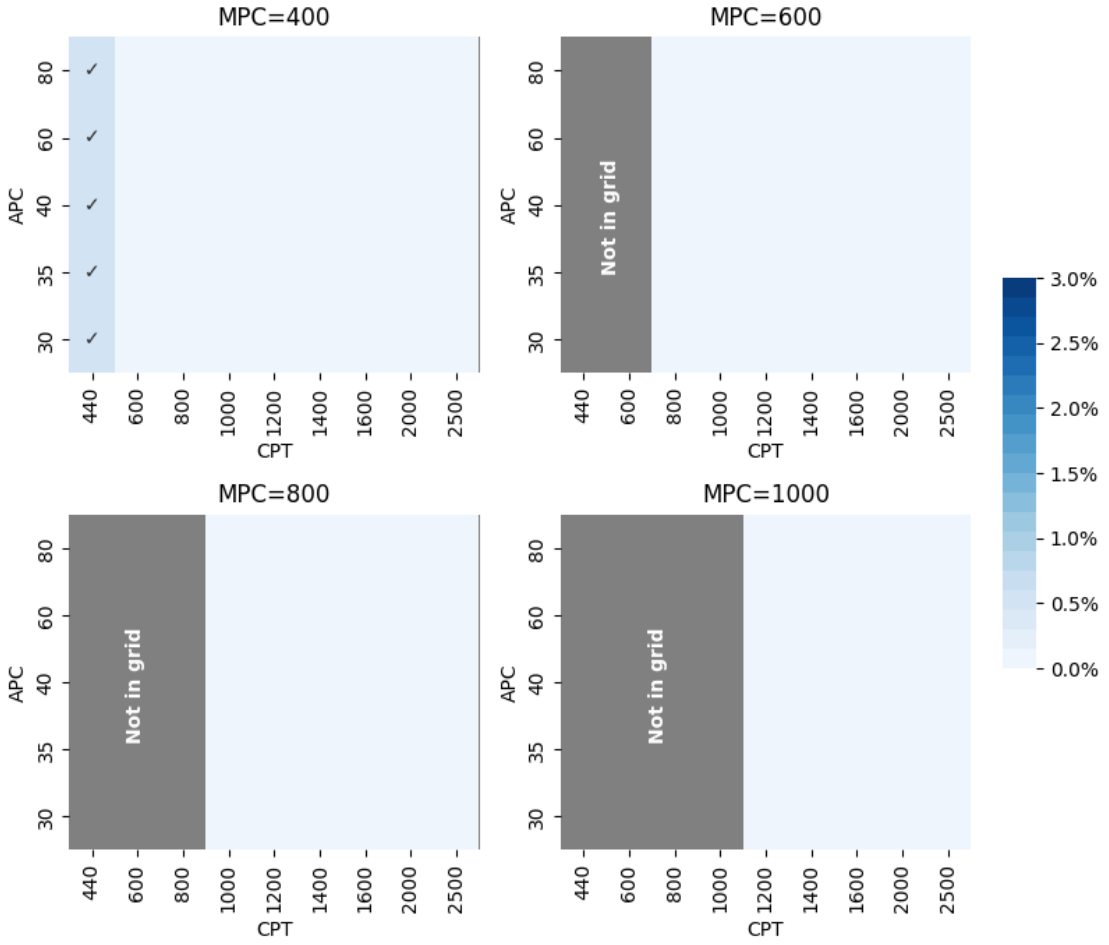
DWGM Parameters that Provide Acceptable Participant Risk Exposure



- The ticked regions represents the parameter combinations that are acceptable from the perspective of participant risk based on the parameter grid used.
- Note the actual efficiency loss recorded in each scenario varies significantly between them. .
- The areas show as “not in grid” would imply VoLL in excess of CPT which is not a viable setting.

Source: Market Reform, Gas Market Parameter Review 2022, Draft Recommendations, 6 December 2022

STTM Parameters that Provide Acceptable Participant Risk Exposure

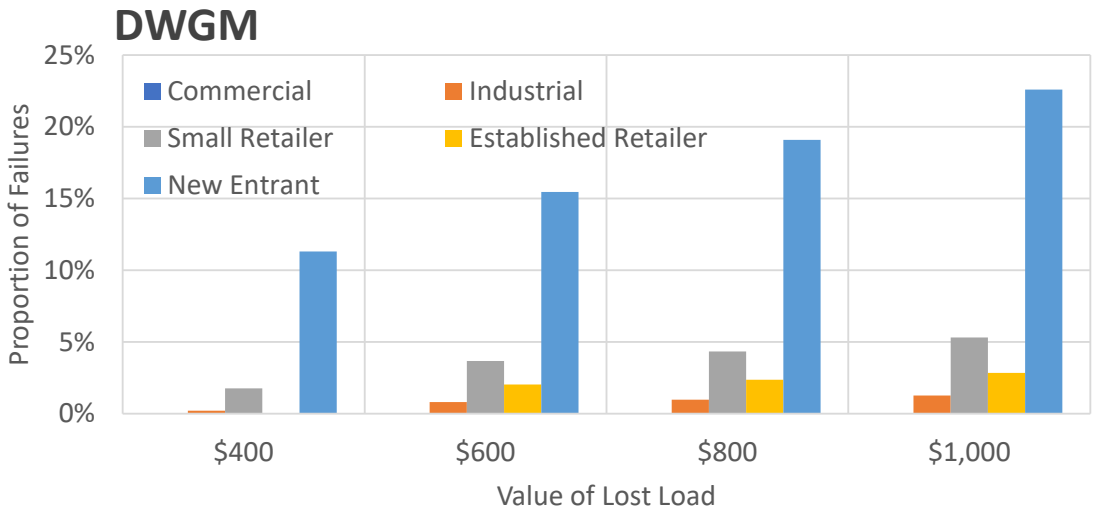


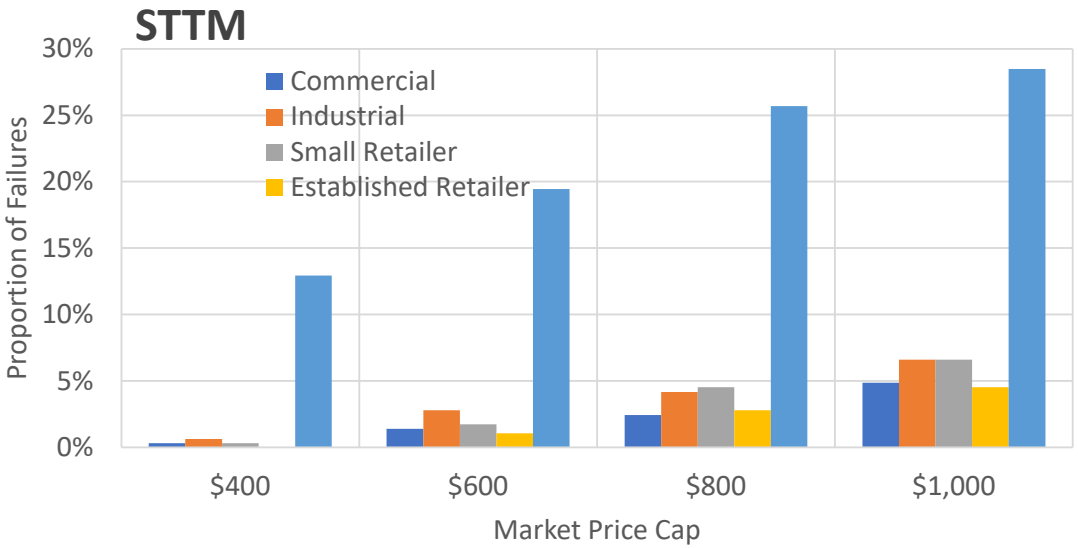
- The ticked regions represents the parameter combinations that are acceptable from the perspective of participant risk based on the parameter grid used.

- Less variation in efficiency for STTM than for the DWGM as:
  - the steps between the parameters have bigger impacts for the STTM than for the DWGM.
    - A CPT of $1400 in the DWGM is less than 2 periods at VoLL of $800/GJ
    - A CPT of $1400 in the STTM is over 3 periods of MPC at $400/GJ. Events need to last longer to cause this an administered pricing period at all.
  - The bid and offer curves have different structures
    - DWGM bids and offers are built around a participants (ideally) matched supply and demand position with greater change in price further away.
    - In the STTM there is longer tail of offers at lower prices, so relative to the DWGM there is a reduce impact on efficiency of different price caps.

Source: Market Reform, Gas Market Parameter Review 2022, Draft Recommendations, 6 December 2022

Modelled Parameters – Participant Failures





- The proportion of participants with greater than 500 days lost profit is shown for different VoLL/MPC settings.
  - These participants are assumed to fail.
- The proportion reflects performance across all possible parameter sets given the VoLL/MPC setting
- Participant risk is naturally increasing in VoLL however in individual cases, increases in VoLL do result in earlier CPT trigger
- New entrants into the current market context are especially vulnerable across all levels of VoLL
- It is not possible to derive parameter sets to protect these participant type and preserve investment incentives because their underlying profitability is insufficient.

Source: Market Reform, Gas Market Parameter Review 2022, Draft Recommendations, 6 December 2022

Options for the DWGM Gas Market Parameters

DWGM GAS MARKET PARAMETERS					
VOLL ($/GJ)	CPT ($)	APC ($/GJ)	SUPPORTS INVESTMENT?	SUPPORTS EXTERNAL MARKETS?	SUPPORTS EFFICIENCY?
400	440	ALL	No	-	-
400	600	ALL	No	-	-
400	800	ALL	No	-	-
400	1000	ALL	No	-	-
400	1200	<= $40	No	-	-
400	1400	<= $40	No	-	-
600	1000	<= $40	No	-	-
600	1200	<= $40	No	-	-
600	1400	<= $40	No	-	-
800	1000	<= $40	No	-	-
800	1200	<= $40	No	-	-
800	1400	<= $40	Yes	<= $40	>= $40
1000	1200	<= $40	No	-	-
1000	1400	<= $40	Yes	<= $40	>= $40

- The parameter sets shown keep participant risk below the 500 days lost profit standard.
- Only two parameter sets support investment. Investment support declines for two reasons:
  - The VoLL/CPT ratio prevents VoLL pricing arising before CPT is breached
  - The level of VoLL and/or APC are such that a single VoLL period in an event does not support investment.
- To support the NEM APC requires a gas APC less than or equal to $40/GJ.
- Given the feasible set the efficiency maximizing option is to choose the current parameter set
- VoLL=$1000/GJ is also an option but
  - Efficiency benefits are limited and
  - Not a large difference between CPT and VoLL, so CPT easier to trigger without prices ever reaching VoLL.

Source: Market Reform, Gas Market Parameter Review 2022, Draft Recommendations, 6 December 2022

Options for the STTM Gas Market Parameters

STTM GAS MARKET PARAMETERS					
MPC ($/GJ)	CPT ($)	APC ($/GJ)	SUPPORTS INVESTMENT?	SUPPORTS EXTERNAL MARKETS?	SUPPORTS EFFICIENCY?
400	440	ALL	Yes	<= $40	>= $40

- In the STTM the parameter sets that support the participant risk constraint all involve MPC=$400/GJ and CPT=$440
- As for the DWGM, support of the NEM APC requires a gas APC less than or equal to $40/GJ.
- Given the feasible set the efficiency maximizing option is to choose the current parameter set
- The reduced opportunities for trade in the STTM mean that the change in outcomes are more pronounced between two adjacent grid of points than in the DWGM, reducing the number of feasible options.

Source: Market Reform, Gas Market Parameter Review 2022, Draft Recommendations, 6 December 2022

Reviewed Parameters

AEMO has assessed whether the:

- Minimum Market Price (STTM) / Minimum Bid Price (DWGM);
  - Under the principles that:
    - no shipper should want to supply the spot market at a price less than MMP;
    - the MMP should be set sufficiently low as to not constrain a schedule.
  - Market prices outcomes have only shown a few (0.06%) of DWGM schedules had a $0/GJ price since 1 January 2017 until 27 November 2022.
  - No STTM market prices have had a $0/GJ market price.
  - Therefore, AEMO concluded the $0/GJ minimum market price remains appropriate.
- CPT Horizon (STTM) / Cumulative price period (DWGM)
  - Compared the operation of the CPT horizon to other markets and notes the NEM (2,016 5 minute trading intervals), DWGM (35 intraday schedules) and STTM (7 days) all use 7 day periods.
  - Therefore, AEMO concluded a 7 day CPT period remains appropriate.

Summary of Draft Determination

- AEMO's Draft Determination is to maintain the current market parameters.

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Market Price Cap (STTM) / Value of Lost Load (DWGM)	$400/GJ	NGR 364 – See MPC definition	$800/GJ	NGR 200 – see VoLL definition	Modelled Parameter
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Draft Determination Recommendation

AEMO has endorsed Market Reforms recommendation that:

- STTM and DWGM market parameters remain unchanged

In addition, has requested Participant views on:

- how to optimise future market parameter consultation processes and market parameter review methodology development processes.
- proposal for a new Administered Price Cap trigger event for the DWGM and STTM hubs that would allow simultaneous administering of two or more markets for the DWGM and STTM hubs.

Next steps in consultation

- AEMO welcomes submissions on the Draft Determination by 19 January 2023. Details can be found on the consultation page for the Gas Market Parameter Review, which outlines the following:

Stage 2 – Determination of Market Parameters	Date
Participant Submissions on Draft Determination	19 January 2022
Final Determination on Gas Market Parameters	16 February 2023

- AEMO will provide a recommendation on changes, if any, to market parameters.
- The final stage of the process is for AEMC rule change and AEMO procedure change processes to proceed with a separate consultation to implement any recommended change.

Questions

For more information visit

aemo.com.au

Consumer Risk Preferences Project

December 2022

Agenda

1. Feedback from stakeholders 2022 ISP
2. Consumer risk preferences 2024 ISP
3. Applying consumer risk preferences
4. Potential project deliverables
5. Consumer engagement
6. Projected timelines
7. Consumer forum

Feedback from stakeholders

ECA supports the next ISP spending time and resources to better identify consumer risk preferences through direct consultation with households and businesses.

PIAC - It will be necessary to undertake community engagement to understand this preference for different types of consumers for future ISP

QEUN emphasised the importance of ensuring any survey of consumer risk preferences was constructed to take account of the diversity of business and residential consumer experiences across the five regions in the NEM and the difference between urban and regional consumers

EUAA noted the importance of making any survey about consumer risk preferences robust, as the AER's Value Customer Reliability review was.

Consumer risk references 2024 ISP

2022 ISP

- The 2022 ISP broadly aligns with consumer risk preferences
- Quantification of consumer risk preferences can be improved
- 2022 ISP Consumer Panel identified consumer risk preferences as an important area for development for the 2024 ISP

2024 ISP

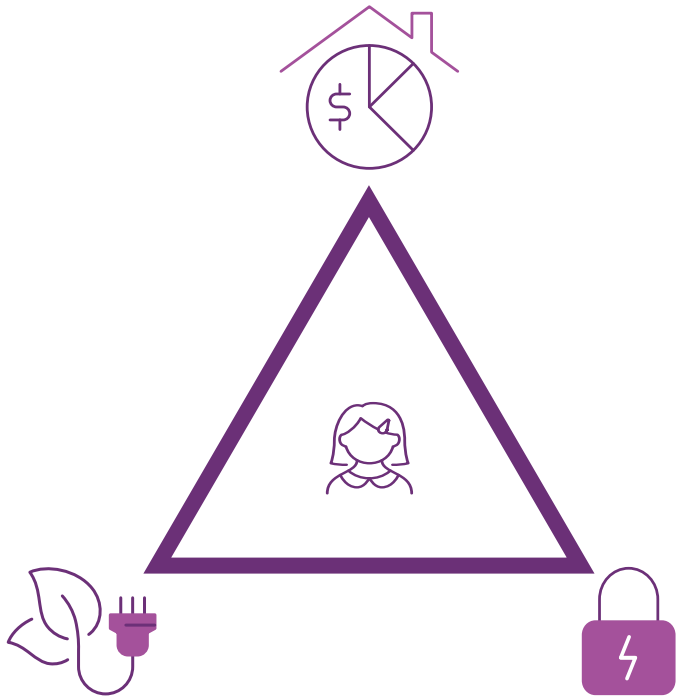
For the 2024 ISP, AEMO is looking at improving the quantification of consumer risk preferences. Some suggestions from consumer advocates included:

- Assessment of consumer behaviours
- Consumer surveys targeted to understanding consumer risk preferences

Way Forward

- AEMO engaging with consultants to develop a consumer risk threshold that can be applied as an input for the 2024 ISP.
- Kick off project in early January
- Conduct direct consumer engagement as per stakeholders feedback
- Finalise the outcomes for the draft 2024 ISP

Applying consumer risk preferences



- Risk is “the effect of uncertainty on objectives” *Australian Standard (AS/NZS ISO 31000)*
  - Uncertainty: Collection of future scenarios and/or sensitivities?
  - Objectives: Affordability / Reliability / Sustainability?
- A focus on affordability could be “the effect of uncertainty on electricity bills”

Potential project deliverables

Research analysis

- Literature review
- Explore existing research, methodologies and data
- Report of research analysis on Australian consumer risk decision in electricity

Insurance analysis

- Gather existing data of how Australians manage financial risk (e.g insurance/health)
- Data analysis
- Extract insights

Consumer engagement

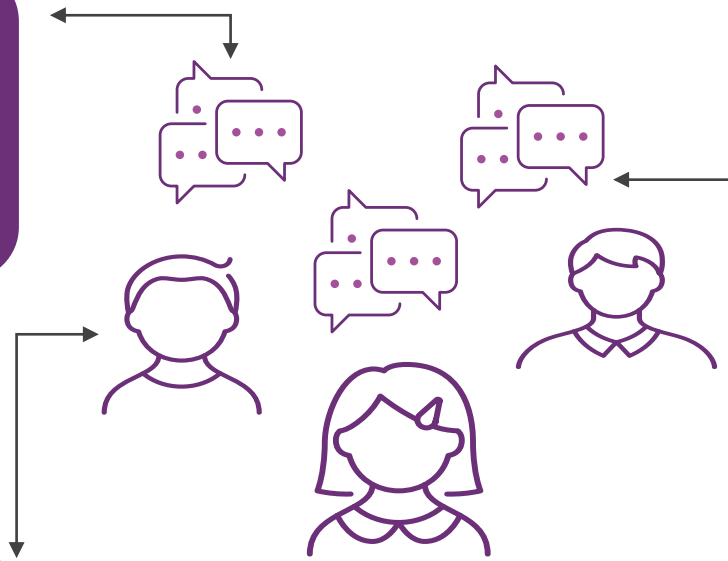
- Deliberative approach*
- Survey approach
- Data analysis
- Extract insights
- Report on the group/survey behavioral findings

*Research & Insurance analysis are discretionary

Consumer engagement

ISP Consumer Panel and AEMO have collaborated to co-design the scope of works. AEMO will continue to work closely with the ISP Consumer Panel

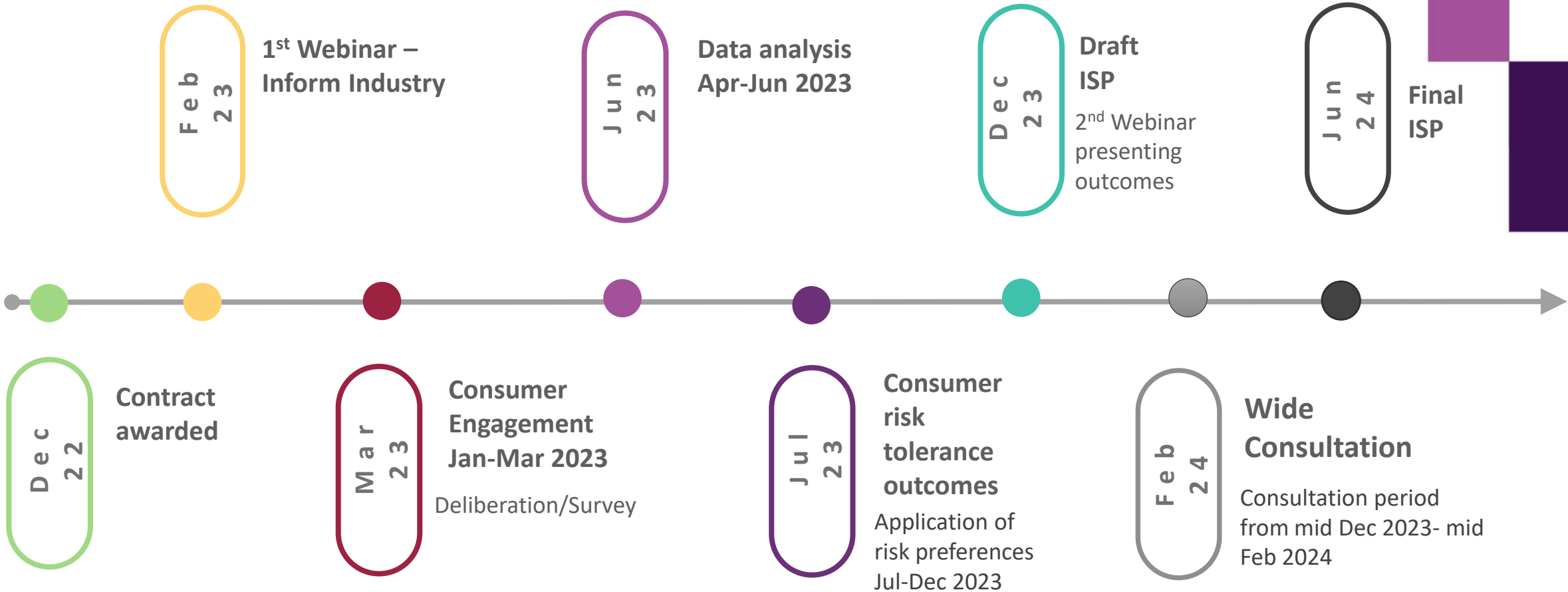
Deliberative process:
- Facilitators
- Participants
- Information



Survey process:
- Pilot Survey
- Agree on demographics/sample size
- Comprehensive engagement

Demographics for engagement- Representative of the NEM
- Business & residential groups
- Gender
- Age
- Location
- Household composition
- Housing type(renter/owner)
- Income
- Region
- Small scale renewable energy
- Energy efficiency initiatives

Projected timeline



Consumer forum

We are seeking expression of interest from industrial and commercial consumer who would like to participate.

Please reach out to:
stakeholderrelations@aemo.com.au

For more information visit

aemo.com.au

Engineering Roadmap to 100% Renewables

December 2022

Consumer Forum

7 December 2022

Background

- ISP Step Change projections indicate that by 2025 there will start to be sufficient renewable resource potential in the NEM to at times meet 100% of demand.
- AEMO has set the aspirational goal of being able to operate the power system at 100% instantaneous renewable generation by 2025.
- The FY23 AEMO Corporate Plan has set a priority to evolve and implement a roadmap to be able to operate power systems capable of 100% instantaneous renewable generation
  - This builds on the Engineering Framework Initial Roadmap (Dec '21) and the FY23 Engineering Framework Priority Actions report (June '22).
- **AEMO published the *Engineering Roadmap to 100% Renewables* on 1st Dec 2022. (report available here)**

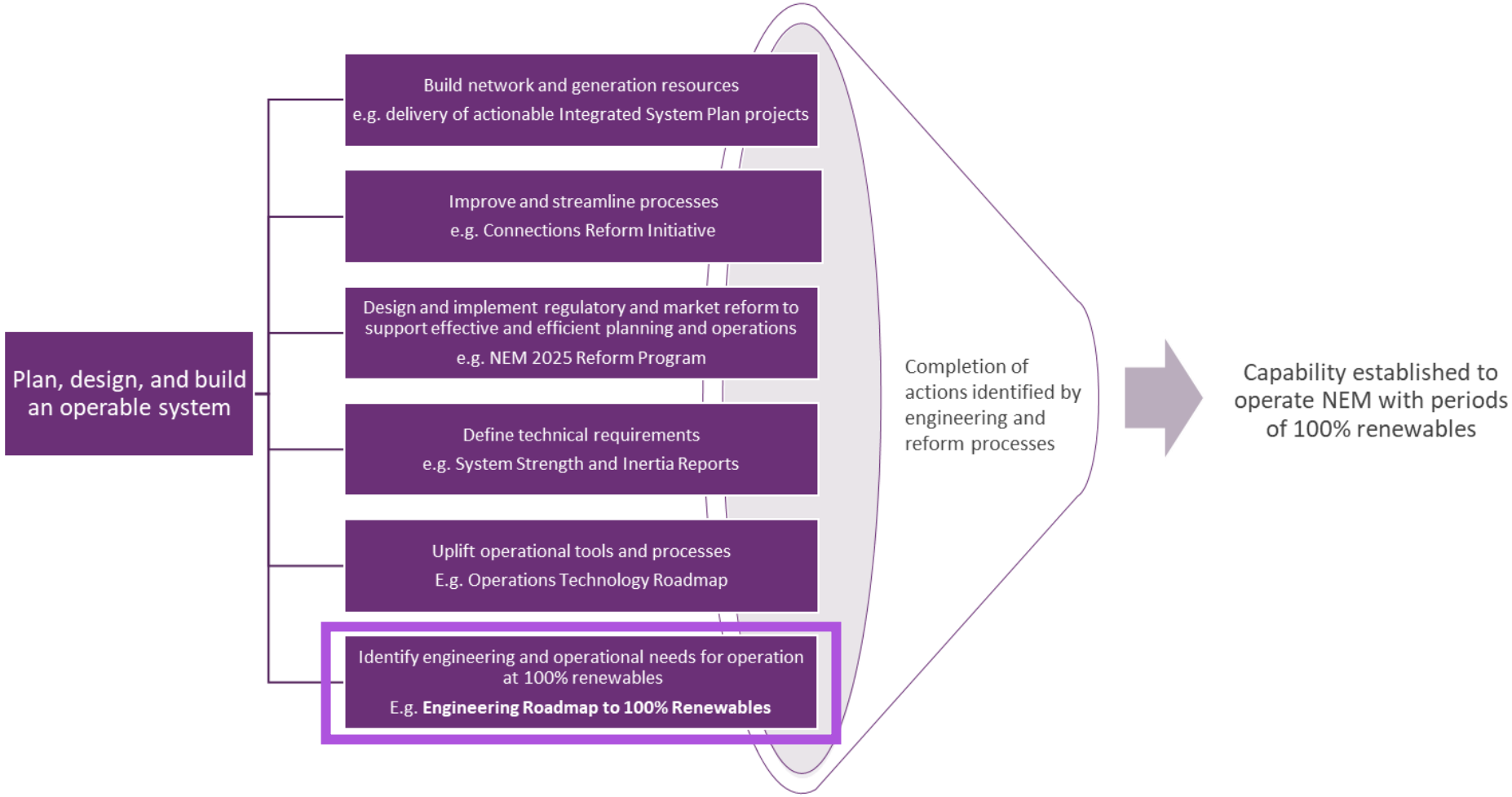
Agenda

1. Overview of roadmap scope and where it fits amongst other work
2. Roadmap structure
3. Overview of preconditions
4. Key messages and insights
5. Next steps

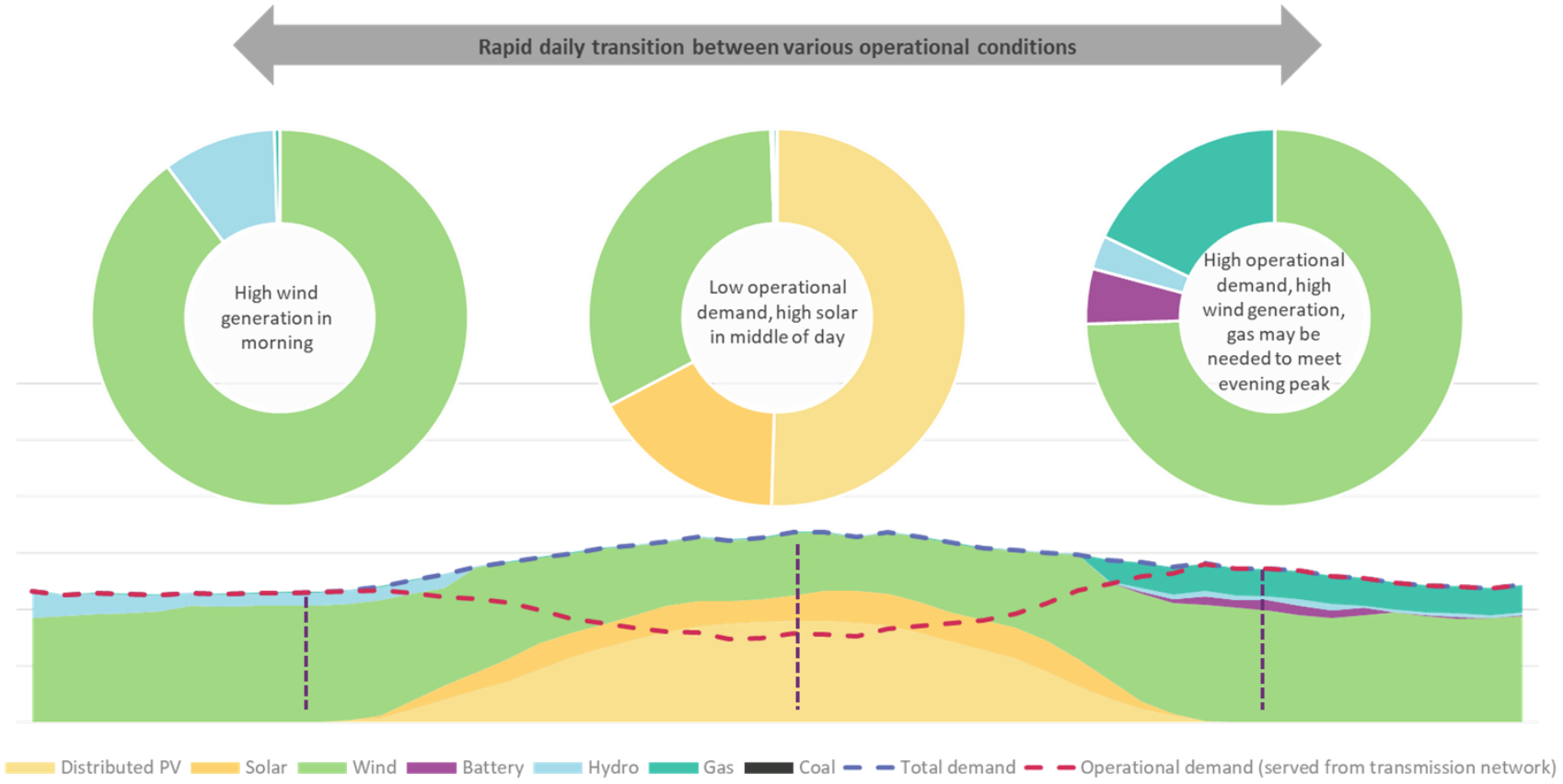
Scope

- A detailed, engineering-focussed roadmap
- AEMO's view of the technical, engineering, and operational actions required to prepare the NEM to securely and reliably operate at 100% instantaneous renewable penetration for the first time.
- Provide a technical base to inform industry prioritisation of steps necessary to securely, reliably and affordably transition through key milestones on the way to 100% renewables.
- Provide confidence around actions underway and highlight areas requiring further attention.

Preparing for 100% renewables



Rapid daily changes in generation mix



- Multiple generation mixes likely
- Rapid daily transitions
- System will be a hybrid of synchronous generation, IBR, synchronous condensers, dominated by different technologies at different times of each day.

Roadmap structure

- Roadmaps divided into 14 sections across 3 broad themes:

Power system security	System operability	Resource adequacy & capability
• Frequency & inertia • System strength • Voltage control • Transient and oscillatory stability • System restoration	• Monitoring & situational awareness • Operational processes • Power system modelling	• Utility-scale VRE • DER • Structural demand shifts • Transmission • Distribution • Firming

- For each of the 14 sections:
  - Preconditions that need to be satisfied for 100% operation
  - Actions necessary to achieve these preconditions

Power system security – pre conditions

Maintaining the secure technical operating envelope of the power system under increasing renewable penetrations.

Individual roadmaps	Draft pre-conditions for first 100% renewable periods
Frequency & inertia	• Ability to keep system frequency within defined limits following credible and non-credible events, including RoCoF containment and effective emergency frequency control arrangements. • Frequency response and frequency control ancillary services (FCAS) reserve requirements completely met by VRE, storage, demand response and other non-fossil fuel technologies. • Adequate system inertia monitoring and accurate inertia forecast capability (supply and demand side) required as an input to constraints.
Transient and oscillatory stability	• Appropriate stability limits in place for projected reductions in operation of synchronous machines. • Appropriately damped local and inter-area oscillations.
System strength and converter-driven stability	• System strength requirements met by alternatives to system configurations that require minimum loading on synchronous fossil fuel generators. • Ability to identify and manage fast and slow converter interaction driven oscillations.
Voltage control	• Sufficient steady state and dynamic reactive support to maintain reactive margins and voltage disturbances within limits, completely provided by non-fossil fuel technologies. • Coordinated voltage control at transmission-distribution interface for times of high DER. • Reactive support and voltage control arrangements for highly variable, long distance VRE power flows to load centres, and more variable daily demand profiles across transmission and distribution networks. • Sufficient reactive power absorption capability to securely supply load.
System restoration	• Effective restart arrangements, plans, procedures in place for first 100% renewables period, including adequate SRAS capable plant built in suitable locations. • Ability to manage uncontrolled DPV generation during the restart process.

System operability – preconditions

The ability to securely and reliably operate the power system and transition through increasingly complex operating conditions.

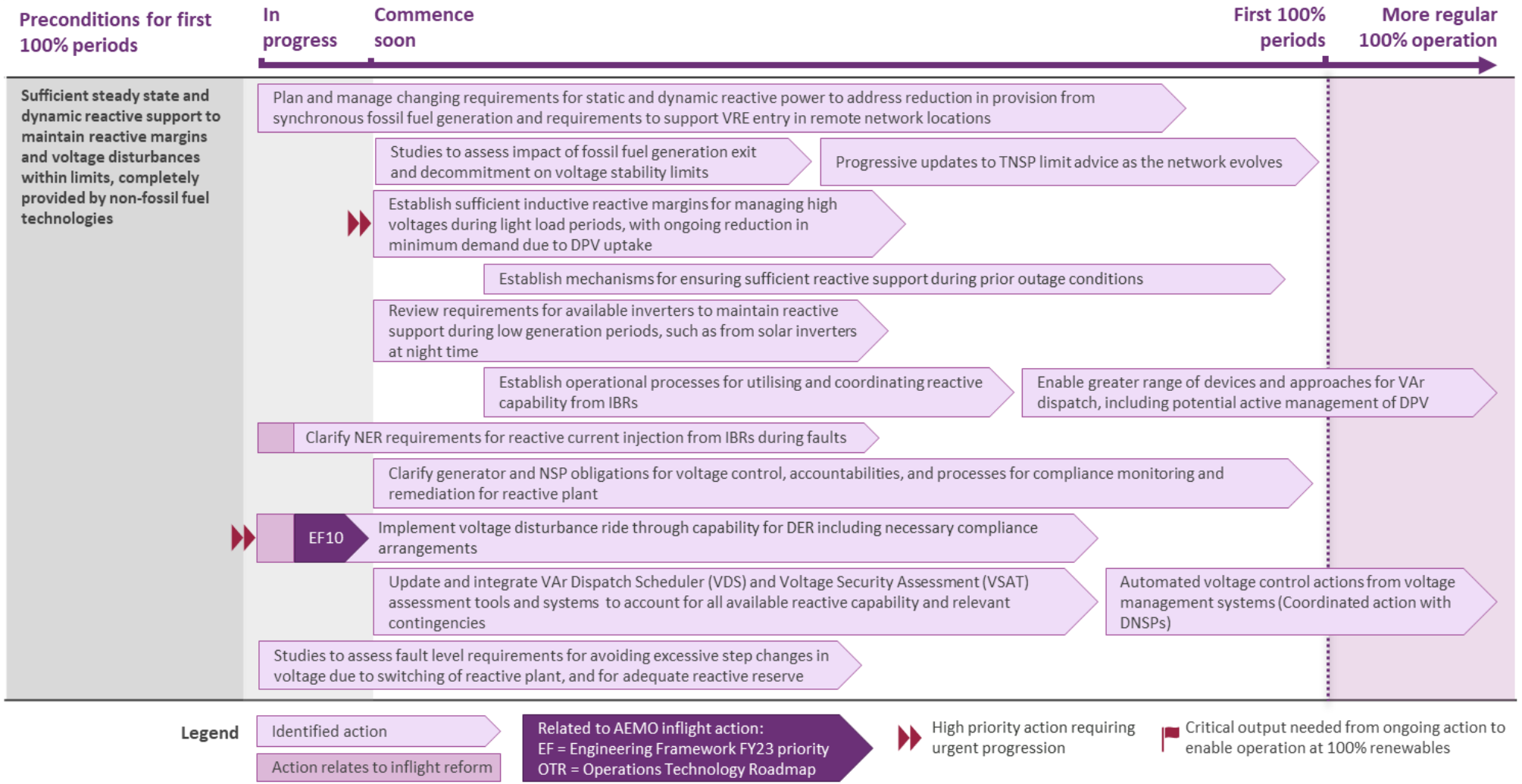
Individual roadmaps	Draft pre-conditions for first 100% renewable periods
Monitoring & situational awareness	• Sufficient weather monitoring to forecast plausible VRE generation output variability and uncertainty. • Sufficient wide area visibility of power system performance and control room tools to leverage this data for real time stability monitoring and risk assessment. • Operational communications and data exchange fit for increasing volume of generation, storage and new forms of participation in the distribution network.
Operational processes	• Ability to operationally forecast energy adequacy and quantify VRE variability and uncertainty over different timeframes. • Ability to securely and reliably manage planned outages for maintenance and the augmentation required in the transition to 100% renewables. • Dynamic security assessment and contingency analysis capability across the range of stability phenomena – real-time and look-ahead. • Reserve assessment and management processes in place to balance VRE variability and uncertainty and account for the availability of stored energy. • Significant uplift in industry training standards to ensure operator capability and sufficient training for new tools, procedures and processes.
Power system modelling	• Models and data to establish confidence in the technical operating envelope of the power system under a range of plausible operating conditions. • Ability to scale and accurately model a large number of scenarios in operational and planning timeframes. • Future system studies to assess the secure technical envelope of the power system with reducing, and eventually no, synchronous fossil fuel generation online. • Studies to develop limit advice and assess system adequacy in operational transition to first 100%.

Resource adequacy & capability – preconditions

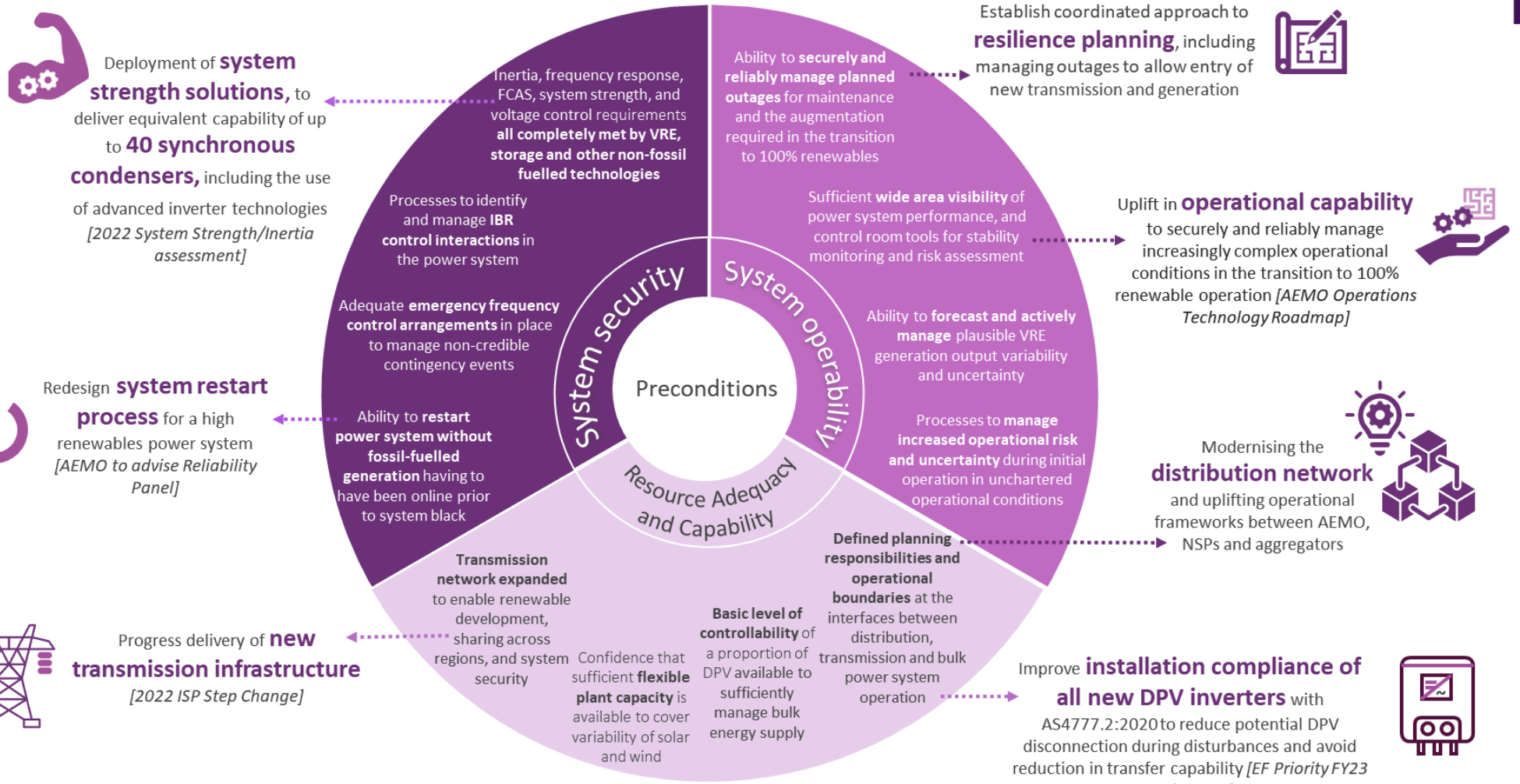
Building and integrating the energy resources and network capability to enable the renewable potential and the flexible capacity to balance variability over different time frames.

Individual roadmaps	Draft pre-conditions for first 100% renewable periods
Utility-scale VRE	• Connect and securely integrate increasing volumes of VRE. • Confidence in VRE plant performance under during different plausible disturbances and operating conditions.
DER & flexible demand	• Clearly defined operational roles and processes for managing system security and coordination across parties at times of high DER penetration. • Basic level of controllability for a sufficient proportion of the DPV fleet. • DER behaviour during disturbances quantified and managed. • Sufficient visibility and predictability of DER behaviour. • Enabling consumer participation and provision of demand-side flexibility.
Structural demand shifts	• Fit for purpose performance requirements and connection processes for new loads, confidence in their operation during all operating conditions. • Planning for energy adequacy and flexibility requirements to consider possible structural demand shifts.
Transmission	• Sufficient new transmission built to enable renewable development, sharing between regions and support system security. • TNSP planning and investment is coordinated and efficiently enables secure and reliable system operation with progressively reduced numbers of synchronous generators online. • Resilient transmission network design and system performance outcomes.
Distribution	• DNSPs able to determine and securely manage their technical operating envelope, connecting and integrating DER and VRE within their networks. • Effective planning and coordination at the transmission-distribution interface. • Clearly defined operational responsibilities at the boundary between distribution network and bulk power system operation.
Firming	• Sufficient flexible capacity available to cover VRE and DPV variability and uncertainty.

Example – voltage control



Key messages



Relevant acronyms

DPV: Distributed photovoltaics; **EF:** Engineering Framework; **FCAS:** Frequency control ancillary service; **VRE:** Variable Renewable Energy

Key insights

- Large volume of work required across industry, including significant engineering effort across AEMO and NSPs to prepare the power system
- Dependencies on industry to build a lot of infrastructure to ready us for 100% operation
- New sources of system restoration and system strength needed
- **Further work will be needed to ensure that future significant investment decisions serve the long term interests of consumers**.
  - This will include further work by market bodies to explore the most efficient regulatory and market solutions to identified engineering requirements.
- Following publication, discussion required amongst market bodies and with stakeholders regarding **how far we can efficiently get by 2025**, and what the next steps might be.

Next steps

- Stakeholder forum in early February
- Continued delivery of FY23 Priority Actions
- New priority actions for AEMO that arise from the Roadmap, if not already underway, will be assessed as part of FY24 planning and budget process.