AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

2024 WEM ESOO - WA Forecasting Reference Group Meeting Welcome Slides

12 March 2024

AEMO and Ernst & Young

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

We pay respect to Elders past and present.

AEMO Competition Law - Meeting Protocol

AEMO is committed to complying with all applicable laws, including the Competition and Consumer Act 2010 (CCA). In any dealings with AEMO regarding proposed reforms or other initiatives, all participants agree to adhere to the CCA at all times and to comply with this Protocol. Participants must arrange for their representatives to be briefed on competition law risks and obligations.

Participants in AEMO discussions must:

- Ensure that discussions are limited to the matters contemplated by the agenda for the discussion.
- Make independent and unilateral decisions about their commercial positions and approach in relation to the matters under discussion with AEMO.
- Immediately and clearly raise an objection with AEMO or the Chair of the meeting if a matter is discussed that the participant is concerned may give rise to competition law risks or a breach of this Protocol.

Participants in AEMO meetings must not discuss or agree on the following topics:

- Which customers they will supply or market to.
- The price or other terms at which Participants will supply.
- Bids or tenders, including the nature of a bid that a Participant. intends to make or whether the Participant will participate in the bid
- Which suppliers Participants will acquire from (or the price or other terms on which they acquire goods or services).
- Refusing to supply a person or company access to any products, services or inputs they require.

Under no circumstances must Participants share Competitively Sensitive Information. Competitively Sensitive Information means confidential information relating to a Participant which if disclosed to a competitor could affect its current or future commercial strategies, such as pricing information, customer terms and conditions, supply terms and conditions, sales, marketing or procurement strategies, product development, margins, costs, capacity or production planning.

AEMO Forum and Meeting Expectations

This charter explains expectations regarding participation and behaviour in the AEMO's stakeholder forums.

Meeting Expectations

All participants will:

- Respect the diversity of the group.
- Speak one at a time – refrain from interrupting others.
- Share the oxygen – ensure that all attendees who wish to have an opportunity to speak are afforded a chance to do so.
- Maintain a respectful stance towards all participants.
- Listen to others' points of view and try to understand others' interests.
- Share information openly, promptly, and respectfully.
- If requested to do so, hold questions to the end of each presentation.
- Remain flexible and open-minded, and actively listen and participate in meetings.
- Abide by COVID-Safe workplace guidelines, if attending a meeting on AEMO's premises.

Roles and Responsibilities

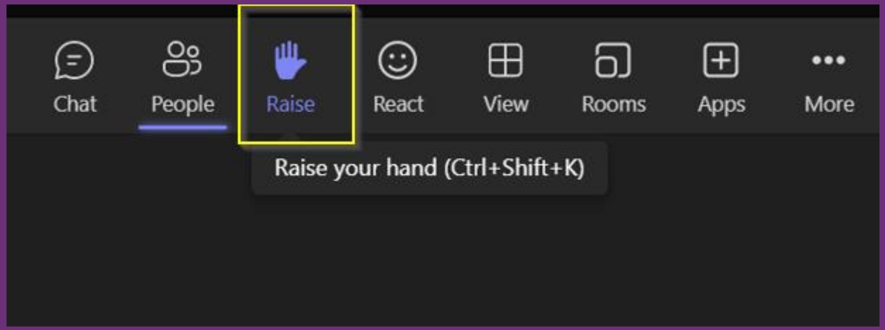
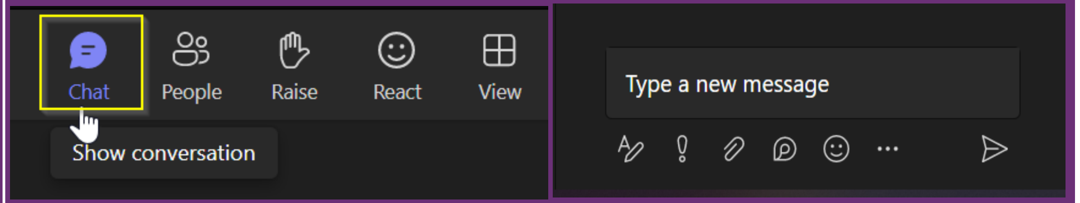
Forum stakeholders agree to:

- Be specific and fact-based in their feedback on a specific workstream or emerging issue;
- Review and provide feedback on papers and reports;
- Relay information to their colleagues or constituents after each meeting and gather information/feedback from their colleagues or constituents, as practicable, before each meeting;
- Maintain a focus on solutions or outcomes that benefit all energy consumers.

AEMO agrees to:

- Provide technical expertise in a manner that is considerate of the audience and their level of expertise;
- Assist participants in understanding issues enough to represent their views;
- Provide all participants the opportunity to voice their views.

Interacting in TEAMS

Raise hand – request to join discussion	Chat function – share comments, ask a question, or raise discussion point
	
Click the Raise hand icon to contribute to the current discussion. Please unmute when you're welcomed to join. When finished, please lower your hand by clicking the icon again and mute your microphone.	Click the Chat icon to go to the Meeting chat interface. Type your message and send. Please note that your message can be viewed by everyone attending the meeting. Please standby while AEMO either writes a response or queues for discussion.

Please state your name and organisation when you start speaking.

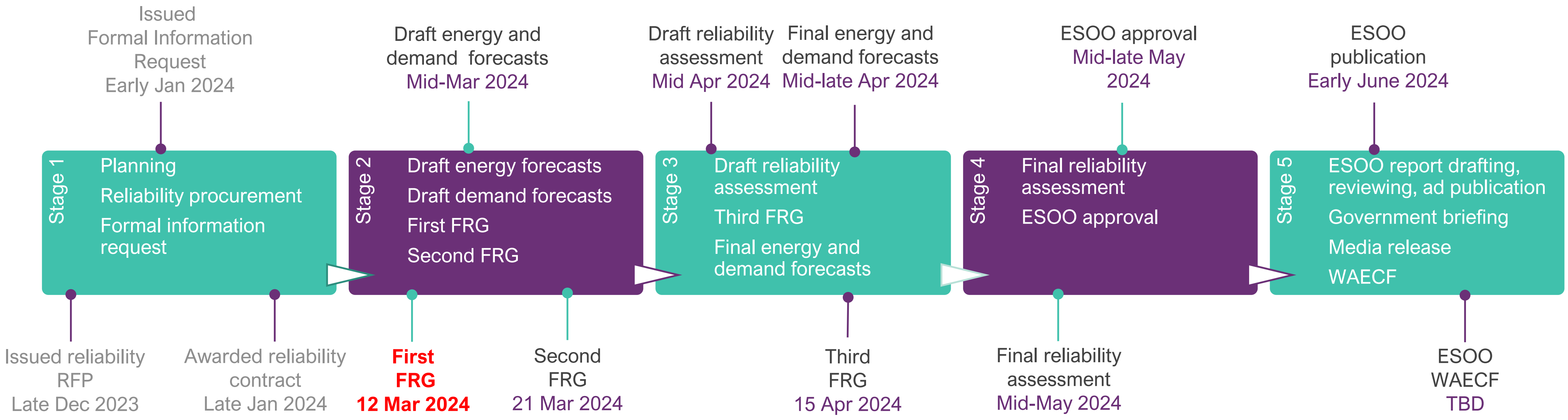
Meeting Agenda

#	TIME (AWST)	TOPIC	PAPERS	RESPONSIBLE	ACTION
1.	1:00pm – 1:05pm	Welcome and introduction	Welcome slides	WA Future System & Design (AEMO)	**Note**
2.	1:05pm – 2:25pm Presentation: 40 – 50 mins Discussion: 30 mins	Reliability assessment approach and methodology	Presentation 1	Ernst & Young	**Inform** **Consult**
4.	2:25pm – 2:30pm	Next Steps	None	WA Future System & Design (AEMO)	**Inform**
5.	2:30pm	Meeting close	None	WA Future System & Design (AEMO)	**Note**

- *Please be aware that this meeting will be recorded for the purpose of creating minutes.*
- *To make the most of our time, we'll ask the presenters to finish their presentations before taking any questions.*
- *If you have any questions after the session, you're welcome to email them to us at WA.FutureSystemDesign@aemo.com.au . Please ensure that they reach us by **COB Thursday, 14 March, 2024**.*

ESOO timeline overview

The 2024 WEM ESOO forecasts the Reserve Capacity Target (RCT) for each Capacity Year between 2024-25 and 2033-34, and, specifically, determines the Reserve Capacity Requirement (RCR) – the amount of capacity to be procured through the RCM – for the 2024 Reserve Capacity Cycle (2026-27).



Note: the timeline is updated as of 12 March 2024.

Key dates:

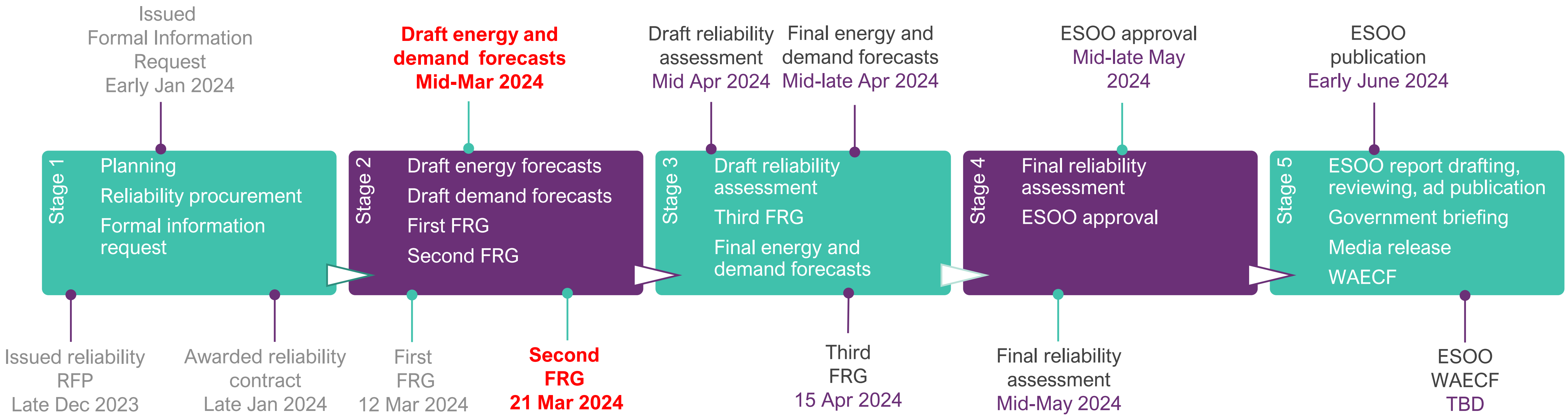
- **Tuesday, 12 March: First FRG - reliability assessment assumptions and methodology.**
- Thursday, 21 March: Second FRG - draft energy and demand forecasts.
- Monday, 15 April: Third FRG - draft reliability assessment results.
- Monday, 10 June 2024: ESOO publication deadline.

Reliability assessment approach and methodology

- AEMO has engaged Ernst and Young (EY) to undertake the 2024 Reliability Assessment that underpins the 2024 Long Term Projected Assessment of System Adequacy (Long Term PASA) for the SWIS.
- The results must be published in the annual 2024 WEM ESOO.
- EY will present its approach and methodology to deliver the reliability assessment, then open up for questions.

Next Steps

Next steps include development of draft energy and demand forecasts and presentation to the FRG.



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For more information visit

aemo.com.au

Any comments or feedback can be sent to

WAElectricityforum@aemo.com.au or *WA.FutureSystemDesign@aemo.com.au*

2024 WEM reliability assessment

Presentation of EY’s approach

Forecasting Reference Group
12 March 2024

Building a better working world

Notice

EY was engaged by AEMO to undertake the 2024 Reliability Assessment that underpins the 2024 Long Term Projected Assessment of System Adequacy (Long Term PASA) for the South West interconnected system (SWIS), in which the results must be published in the annual Electricity Statement of Opportunities (ESOO) for the Wholesale Electricity Market (WEM). EY was engaged by AEMO in accordance with Description of Supplies dated 5 March 2024 provided under the Master Services Agreement dated 10 March 2023 ("Agreement") between Ernst & Young ("we" or "EY") and the Australian Energy Market Operator Limited ("you", "Client" or "AEMO").

The enclosed presentation (Report) provides an overview of EY's approach and methodology to deliver the reliability assessment. You should read the Report in its entirety. A reference to the Report includes any part of the Report. We understand that the deliverable by EY will be used by AEMO to inform and agree the approach to be used by EY for the reliability assessment including presentation to the Forecasting Reference Group (FRG), (the "Purpose"). This Report was prepared on the specific instructions of AEMO solely for the Purpose and should not be used or relied upon for any other purpose.

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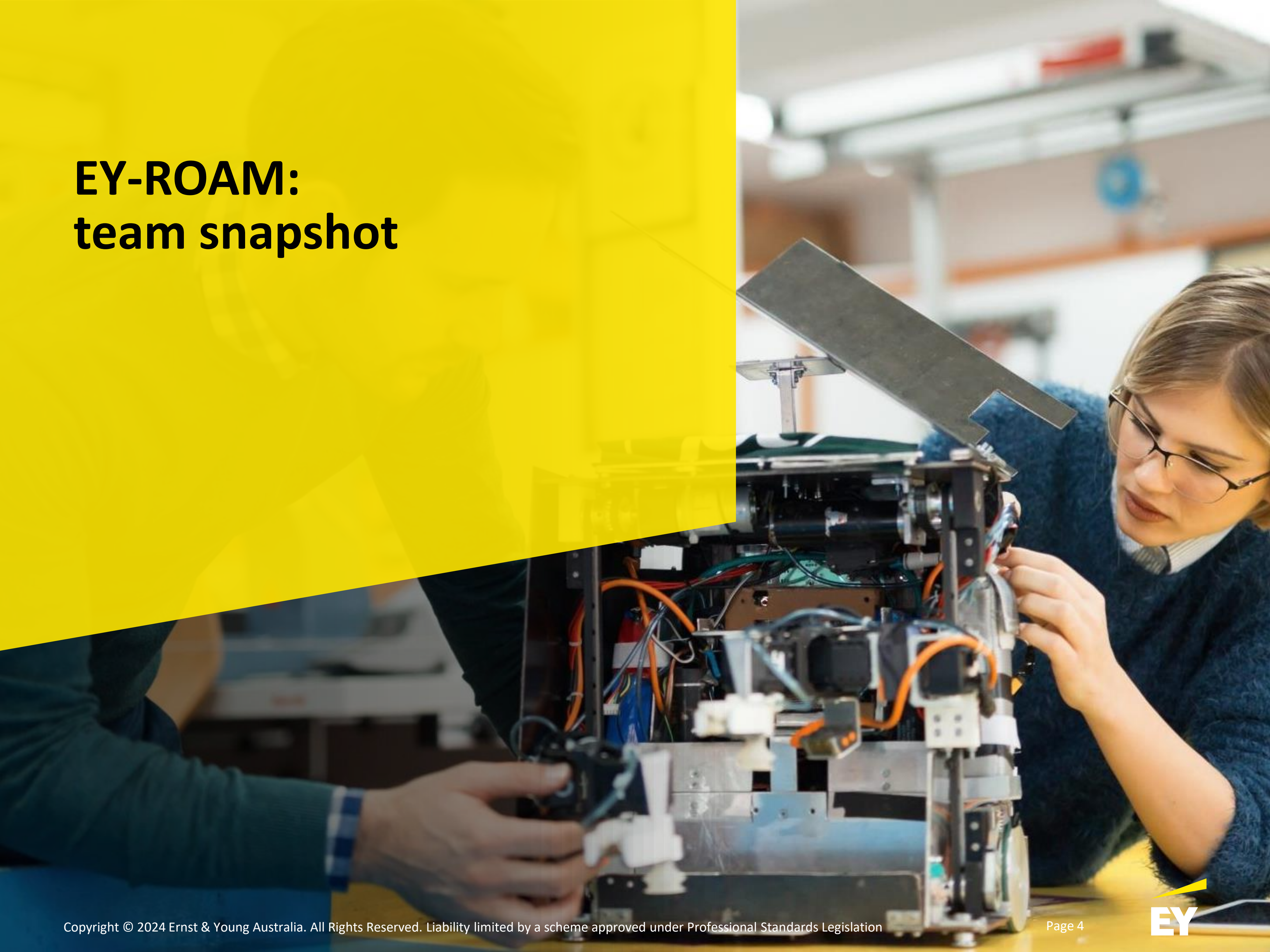
Agenda

1. EY-ROAM: team snapshot	3 mins
2. Context and scope of the reliability assessment	5 mins
3. Overview of approach	12 mins
4. Reliability assessment Scope Items	20 mins
5. Q&A	30 mins
6. Appendix	

EY-ROAM:
team snapshot



EY-ROAM's energy market modelling team

EY-ROAM specialise in analysing and modelling energy markets and the power systems that underpin them.

We use our in-house modelling software and a tailored methodology to offer a vast array of services, providing robust and fit for purpose modelling outcomes and insights to clients.

We work with renewable energy developers and energy sector investors, market and system operators, transmission and distribution network service providers, energy retailers, regulators and policymakers and governments and government agencies.

Our experience spans:

- The WEM /SWIS and regional WA
- The National Energy Market (NEM)
- The Interim Northern Territory Electricity Market (I-NTEM) and the Darwin-Katherine Interconnected System (DKIS)
- The New Zealand Electricity Market (NZEM).

Our Perth based EY-ROAM energy market modelling team has broad experience in various SWIS/WEM modelling engagements – the core team for the reliability study is below.

Reliability study team

Ben Vanderwaal

Engagement Partner

Laura Woolley

Engagement Manager / Modelling team

Kae Choo

Technical Lead

Elisha Anstiss

Modelling team

Krystian Krupa

Data analysis SME

Liz Loreck

Modelling team

Thomasina Foo

Modelling team

Context and scope of the reliability assessment

Context and scope of the 2024 reliability assessment

ESOO and LT PASA

Under the WEM Rules, AEMO is required to publish the annual Wholesale Electricity Market (WEM) Electricity Statement of Opportunities (ESOO) by early June each year.

The ESOO includes the Long Term Projected Assessment of System Adequacy (Long Term PASA) for the South West Interconnected System (SWIS).

The role of the Long Term PASA is to ensure there is sufficient capacity from:

- energy producing systems (thermal, renewable, storage capacity)
- Demand side response providers (demand side programmes, DSP)

to meet the Planning Criterion as defined in the WEM Rules.

The Planning Criterion (clause 4.5.9 of WEM Rules)

The Planning Criterion sets the SWIS reliability standard.

It stipulates that there should be sufficient available capacity in each Capacity Year to:

- Meet the forecast peak demand plus a reserve margin
  (Limb A of the Planning Criterion)
- Limit expected unserved energy (EUE) shortfalls to 0.0002% of annual energy consumption
  (Limb B of the Planning Criterion).

Reliability Assessment

Each year a reliability assessment is undertaken, which underpins the Long Term PASA, with results published in the WEM ESOO.

Last year EY carried out the reliability assessment for AEMO for the first time in the WEM, with results included in the ESOO and a detailed report of the assumptions, methodology and results published alongside the WEM ESOO.

EY is carrying out this year's 2024 Reliability Assessment for AEMO – broadly the same overall methodology and approach is applied – with some changes reflecting changes to the regulatory context, and others aimed at improving and refining the modelling approach and output analysis.

Context and scope of the 2024 reliability assessment

Key changes to the WEM Rules and impact on 2024 Reliability Assessment

- **Updates to the Planning Criterion**: Both Limbs of the Planning Criterion have updated for this year's assessment:
  - The reserve margin for Limb A now needs to consider the proportion of capacity that may be unavailable at the time of peak (due to forced outages) instead of the previous static 7.6% margin.
  - Limb B now limits EUE to 0.0002% of annual energy consumption, rather than 0.002%
- **Introduction of Capability Classes**: Three Capability Classes defining different categories of capacity have replaced the previous two Availability Classes:
  - Capability Class 1: Firm capacity that is not energy limited, such as a gas-fired Facility that meets the fuel availability requirements.
  - Capability Class 2: Firm capacity with energy or availability limitations, such as battery, pumped hydro storge or a DSP.
  - Capability Class 3: Non-firm capacity, such as a wind or solar farm with no associated firming capability.
- **Increased focus on regional capacity shortfalls**: The WEM Rules have been amended to make it explicit that AEMO must consider regional capacity shortfalls – that is EUE occurring in sub-regions of the SWIS that cannot be addressed by additional Peak Capacity outside that sub-region.

Limb requirement	Requirement at the time of 2023 study	Requirement at the time of 2024 study
Limb A: Reserve margin	Greater of: ▸ 7.6% of peak demand ▸ the largest supply contingency	Greater of: ▸ peak demand multiplied by the proportion of Capacity Credits expected to be unavailable at the time of peak demand due to Forced Outages ▸ the largest supply contingency
Limb B: EUE percentage as a proportion of annual energy consumption	Not to exceed 0.002%	Not to exceed 0.0002%

- **Scenarios for expected unserved energy outcomes**: At the time of the 2023 study, the WEM Rules required AEMO to assess the extent to which anticipated installed capacity in the WEM is capable of satisfying the Planning Criterion and identify shortfalls for low, expected and high demand scenarios.
  - The current version of the WEM Rules only requires this assessment to be made for the one in ten year peak demand assuming **expected** demand growth (WEM Rules clause 4.5.10).
- **Determining Reserve Capacity Targets**: Clause 4.5.10(b) in the WEM Rules requires AEMO to forecast the Peak Reserve Capacity Target for each Capacity Year during the Long Term PASA Study Horizon
  - The current version of the WEM Rules specifies that this determination should assume no network congestion.
  - This means running EY's dispatch model with no thermal network constraints.

Scope of the 2024 Reliability Assessment

For the 2024 assessment EY's scope includes the following:

	Scope Item 1	Scope Item 2	Scope Item 3	Scope Item 4	Scope Item 5
Scope item description / key objective	**Scope Item 1:** Develop half-hourly demand projections	**Scope Item 2:** Develop transmission network constraints	**Scope Item 3:** Identify, analyse and characterise capacity and reliability shortfalls	**Scope Item 4:** Determine if the RCT is set by Limb A or Limb B and quantify the RCT	**Scope Item 5:** Determine the balance of capacity across Capability Classes under the RCT and an appropriate mix of additional capacity in the case of shortfalls
Timescale	Capacity Years 2024-25 to 2033-34				Capacity Year 2026-27
Demand scenario	10% POE, 50% POE Low / Expected / High	10% POE Expected			

The reliability assessment will be informed by results of time-sequential dispatch modelling in our WEM dispatch model (2-4-C).

Overview of approach

High-level overview of the approach

The reliability assessment will be informed by results of time-sequential dispatch modelling.

The modelling will use our in-house electricity dispatch model (2-4-C).

EY's 2-4-C model

- Simulates key aspects of electricity market dispatch engines (such as AEMO's WEM Dispatch Engine, WEMDE).
- Includes representations of the Regulation and Contingency Essential System Services (ESS) markets.
- Captures the key characteristics of the WEM and the generation, energy storage and demand side response providers that participate in the market.
- Each Facility in the WEM is modelled explicitly and is dispatched in response to the demand forecast and ESS requirements in each half hour in each modelled scenario.

High-level approach

- Agree methodology, inputs, assumptions and settings with AEMO
- Receive AEMO's peak demand (MW) and annual energy (MWh) forecasts, as well as other inputs and assumptions
- Translate AEMO's forecasts into 30-minute demand profiles (including the impact of Consumer Energy Resources, CER).
- Receive inputs from AEMO on the transmission network and develop transmission network constraints
- Run the 2-4-C dispatch model for the WEM and each scenario (as applicable to the scope items)
- Perform the reliability assessment as required by the scope items.

Assumptions, data inputs and settings to define:

- **Demand**
- **Supply**
- **ESS**
- **Transmission network**

2-4-C dispatch model

Time-sequential dispatch in each 30-minute interval

Co-optimised dispatch of energy and ESS markets

Multiple Monte Carlo simulations of generator forced outages

Use modelling outputs to inform the reliability assessment

Dispatch modelling building blocks and outcomes

Inputs

Demand

Peak demand (MW) and annual energy (MWh) forecasts from AEMO

Large Industrial Loads capacity, hydrogen demand and electrification forecasts from AEMO

Consumer Energy Resources (CER) forecasts from AEMO

- Rooftop PV and Small Non-Scheduled PV
- Behind-the-meter batteries
- Electric vehicles

Time-sequential, 30-minute demand profiles (incl. per-interval impact of CER)*

Supply

- *Thermal and renewable capacity*
- *Storage capacity*
- *Demand-side response capacity*

Agreed list of facilities and relevant parameters

- Technical parameters (dispatchable capacity, ramp rates)
- Forced outage assumptions (multiple Monte Carlo iterations)
- Planned maintenance assumptions
- Retirement dates / entry dates
- Storage behaviour
- Wind and solar availability
- Demand Side Program (DSP) parameters

Time-sequential, 30-minute profiles of intermittent renewable resource availability (per location)*

Essential System Services (ESS)

Assumptions on:

- ESS requirements per market**
- ESS capability of supply facilities

Transmission network constraints

Constraint equations (to be applied in dispatch modelling)

Other assumptions:

- Minimum Demand Threshold
- Treatment of ESROI

Outputs

Per-interval data on expected unserved energy (EUE) and prevailing system conditions (outages, renewable resource, demand, ESS requirements etc).

**Time-sequential, 30-minute modelling bases all the inter-temporal and inter-spatial patterns in electricity demand, wind and solar energy on the weather resources and consumption behaviour in one or more historical years (reference years).*

***Modelled ESS markets will include Regulation and Contingency Reserve. The RoCoF market will not be modelled.*

Reliability assessment
Scope Items

Demand modelling: future years (based on historical reference years)

Our demand forecasting philosophy is based on splitting the operational demand sent-out (OPSO) into components modelled separately, where each has an influence on changing the shape of the demand profile.

After taking these components into account, we consider the remaining demand profile to be fixed shape consumption (FSC), which is driven by residential and business energy use behaviour patterns in response to the weather from half-hour to half-hour.

We consider these patterns to be fixed across future years, modified for future energy and peak demand trajectories.

Process

Develop historical FSC profiles…

… and scale them to target AEMO's forecast underlying peak demand (MW), operational peak (MW) and annual energy consumption (GWh) for each projection year

Include impact of half-hourly DPV generation profiles*

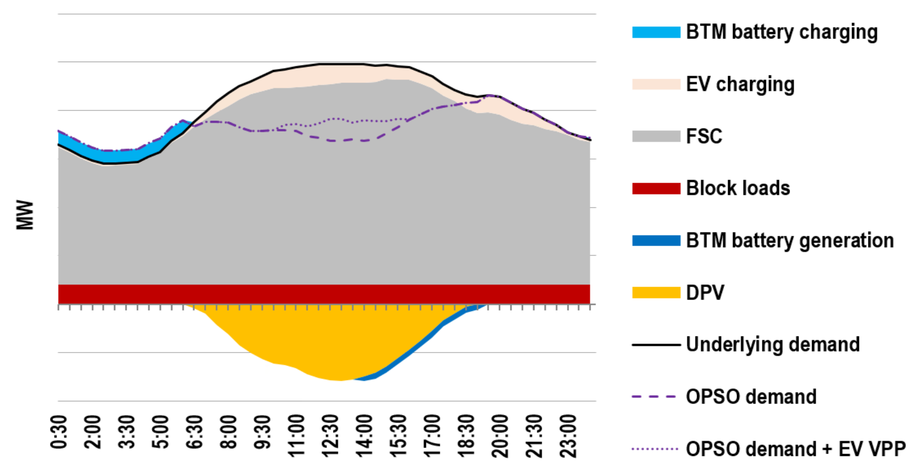
- **AEMO's DPV capacity forecasts**
- **Capacity factors assumptions agreed with AEMO**
- **EY's SEST tool.**

Include impact of EV static charging profiles

- **AEMO's EV forecasts.**
- **AEMO's EV sample charging profiles.**

Add block loads (including hydrogen loads).

Components of demand profiles for future years
(17,520 or 17,568 time-sequential 30-minute intervals in each modelled year)



Include impact of BTM battery charging and generation profiles

- **AEMO's battery capacity forecasts (MW and MWh).**
- **EY's behind-the-meter storage tool.**

- **Operate BTM storage VPPs as large-scale storage**
- **Use EY's EV VPP modelling tool to derive a demand profile for EV VPP charging.**

12 historical weather reference year profiles are created, maintaining the relationships between time-of-day consumption behaviour and weather-driven availability of renewable resources.

DPV includes rooftop PV (RPV) and small PV non-scheduled generators (PVNSG).

Key benefits of time-sequential modelling across all intervals

In the context of increasing deployment of intermittent renewable generation and the importance of security-constrained economic dispatch, half-hourly time-sequential modelling has the following benefits:

Approach to demand modelling	Maintain correlation between weather patterns and demand across the whole year (every year of each weather reference year)
Generator and storage forced outages	Fully capture the duration (and thus impact) of generator and storage outages throughout contiguous intervals in a modelled year
Modelling of storage	Time-sequential modelling also allows storage to flex between charge and discharge while maintaining the impact on its storage 'reservoir'.
Constraint development	Constraint equations in trading interval 't' are evaluated by using the generation dispatch from the previous trading interval period 't-1'
Dynamic Contingency Raise Requirement	'T-1' approach – a more dynamic approach to determining the maximum contingency size from interval to interval

Key benefits of time-sequential modelling across all intervals

In the context of increasing deployment of intermittent renewable generation and the importance of security-constrained economic dispatch, half-hourly time-sequential modelling has the following benefits:

- **Full year sequence in each modelled year:** Our modelling is done for all 17,520 (or 17,568 for leap years) half-hourly intervals in each modelled year. This allows to us capture the correlations between demand and renewable resource availability as well as the impact of outages, ramping limitations and storage availability on isolated (one half-hour) or contiguous (multiple half-hourly intervals) EUE events.
- **Approach to demand modelling:** By basing demand and renewable resource on the same weather reference year data, this means that the same weather factors that drive variability in demand from one trading interval to the next are also captured in the resource availability of wind and solar generation (large scale and behind the meter in the case of solar) in future modelled years. This helps to retain the relationships between time of day, consumption behaviour and renewable resources. We consider this an essential aspect of modelling supply reliability.
- **Generator and storage forced outages**: Using time-sequential data also allows the modelling to fully capture the duration (and thus impact) of generator and storage outages throughout contiguous intervals in a modelled year, as opposed to modelling based on data 'blocks', i.e. only selected representative days or other periods of a year.
- **Ramp rate limitations**: To the extent that they bind over a 30-minute interval, for the purpose of a reliability study it is particularly important to capture the ability of generators or DSP to ramp up or ramp down respectively to the required level from one interval to the next as we cannot assume their full output will be available in any given interval if it is still in the process of ramping up (or down).
- **Modelling of storage**: The ability of storage to provide energy in a given interval depends on its state of charge (reservoir level) and behaviour in preceding intervals. Time-sequential modelling also allows storage to flex between charge and discharge while maintaining the impact on its storage 'reservoir'.
- **Constraint development**: Constraint equations in trading interval t are evaluated by using the generation dispatch from the previous trading interval period t-1, to calculate terms in the right-hand side of the equation and to enable the left-hand side of the equation to be solved. EY's 2-4-C model is time-sequential, dispatched for every half-hour and has the required functionality.
- **Other**: This year EY's modelling of the Contingency Raise Requirement (CRR) is based on a more dynamic approach. In the 2023 study, a single MW value for CRR was applied in every interval of the modelling. This year, the dynamic approach will use a 't-1' approach which will calculate the largest contingency for each individual interval based on the dispatch outcomes in the previous interval. For the intervals we are most concerned with for the reliability study, it is likely that Facilities will be providing at or near their maximum during and around EUE events, therefore this is a reasonable proxy for the largest contingency in a given interval, and the full year time sequential modelling approach allows us to calculate this for every interval in the year (and across each of the 100 iterations and weather reference year iterations). It is noted that this approach does not capture the potential for reducing the contingency size that may result from the co-optimisation of energy and ESS services in the RTM. This is partially addressed by setting a limit on the maximum contingency size based on historical dispatch outcomes in the market.
  - The modelled requirement based on the identified contingency will be assessed based on modelling outcomes and an approach agreed with AEMO as to whether to apply a constant coefficient against the largest contingency or a varying coefficient that takes account of other system conditions during the interval (inertia etc).

Approach to developing transmission network thermal constraint equations

As part of the 2024 Reliability Assessment EY will be developing transmission network constraint equations to represent the impact that network capability has on forecast reliability in the SWIS.

- These transmission network constraint equations are linearised mathematical expressions that represent the thermal limits that the SWIS must operate within.
- They model the maximum power transfer that can flow on transmission network elements before a thermal limit is reached.
- Distribution network limitations are not modelled in this reliability assessment.

The constraint equations developed by EY will:

- Be constructed using an approach consistent with processes described in AEMO's Constraint Equation Guidelines.
- Take account of post-contingent remedial actions (which represent the impact of existing generator runback schemes and load shedding schemes installed on the SWIS) – these allow the transmission network to be operated with higher network utilisation levels.
- Take account of summer and non-summer ratings on transmission lines where available.
- Be verified for accuracy based on calculating the LHS of a constraint equation using market dispatch inputs to derive the flow on a subset of monitored branch elements and compare the flows to the same operation scenario (demand, generation, network status) in an AC power flow solution. This will be done for a subset of constraints that show the highest constraint impact. Verification of accuracy will be based on active power flow.

Constraint equations for the 2024 Reliability Assessment

- EY will receive a network model (the SWIS Base Case) from AEMO (provided by Western Power) – this represents a network 'snapshot' of the SWIS
- EY will then carry out load flow studies to derive a constraint equation consisting of a flow equation (representing the active power flow on a transmission network element) and the limit equation (representing the thermal limit that the transmission network element must be operated within).
- These constraint equations will be updated to take account of the East Region Energy Project (EREP) assumed for Capacity Year 2025-26.
- An updated network model will be provided for 2026-27 to represent a partial implementation of the North Region Energy project (NREP) with an updated full set of constraint equations.
- From 2027-28, all of the NREP transmission network augmentation project will be assumed to be implemented. At this point EY, in discussion with AEMO, will either develop a full set of constraint equations for the remaining study horizon, or move to an approach using 'nodal' constraint equations. The nodal approach aggregates supply and demand to a regional level with constraint equations used to represent import and export power transfer limits between the nodes. These transfer limits will be based on the nodal topology used in the SWIS Demand Assessment.

Determining the building blocks of Limb A

Building blocks of the Limb A requirement	Description	Note
Annual peak demand	Forecast annual operational sent-out peak demand for 10% POE scenario.	MW value for demand supplied through the SWIS (operational peak demand) for a single 30-minute interval in a Capacity Year. Provided by AEMO – for the purposes of setting the RCT, this refers to the 10% POE demand assuming expected demand growth.
Intermittent Loads (IL) allowance	Estimate of the capacity required to cover the forecast cumulative needs of Intermittent Loads, which are excluded from the 10% POE peak demand forecast.	To be provided by AEMO.
Reserve margin	Determined as the greater of: i. Forecast peak demand multiplied by the proportion of Capacity Credits expected to be unavailable at the time of peak demand due to Forced Outages ii. The size (in MW) of the largest contingency relating to loss of supply (related to any Facility, including a Network) expected at the time of forecast peak demand.	i. AEMO will provide the proportion of Capacity Credits as in input to be applied against the peak demand value as above (including transmission losses and IL, also as above). This input represents a key change in the Planning Criterion from previous years, where the first component of the margin was calculated as a static 7.6%. ii. AEMO will provide based on an assessment of the largest risk relating to loss of supply, to be determined following review of outages during peak demand events and other relevant credible risks relating to loss of supply.
Frequency regulation (FR) allowance	Capacity required to maintain SWIS frequency within the Normal Operating Frequency Band (NOFB) and the Normal Operating Frequency Excursion Band (NOFEB)	AEMO forecasts Regulation needs according to factors relating to the drivers of volatility, largely relating to quantity of intermittent generation. For the 2024 WEM ESOO, these include: • New wind farm capacity in the North Country, Mid West, and Neerabup nodes compared to the 2022-23 Capacity Year. • New wind farm capacity installed in the remaining nodes compared to the 2022-23 Capacity Year. • New large scale solar PV capacity installed compared to 2022-23 Capacity Year. • New DPV capacity installed compared to the 2022-23 Capacity Year.

Identifying, analysing and characterising capacity and reliability shortfalls

The Limb A assessment:

- **Comparison of the Capacity Credits associated with Anticipated Installed Capacity against the sum of the Limb A building blocks.**

In relation to Limb A, we will:

Quantify the Limb A requirement by determining its building blocks.

Identify anticipated installed capacity (AIC) as well as associated capacity credits (CC), advised by AEMO.

- **Identify years with CC shortfalls by comparing the annual sum of CCs against the annual requirement set by Limb A.**
- **Identify options to alleviate capacity shortfalls.**

The Limb B assessment:

- **Based on the outcomes of dispatch modelling (dispatching AIC against the per-interval demand, analysing unserved energy occurrences).**

In relation to Limb B, we will:

Run our 2-4-C model to dispatch the AIC under agreed scenarios.

Identify years with reliability shortfalls.

To do this, we will divide modelled annual EUE volumes (MWh) by annual operational energy consumption (MWh) and compare the results against the 0.0002% standard.

Identify and analyse EUE intervals to:

- **Investigate EUE drivers, including capacity shortfalls isolated to a sub-region of the SWIS**
- **Identify options to alleviate reliability shortfalls (EUE >0.0002%).**

AIC (Anticipated Installed Capacity) =
Existing Capacity – Retirements + New Entrants

For AIC in the expected scenario it is assumed that AIC will include:

- Facilities in the WEM awarded Capacity Credits for 2022 or 2023
- Facilities with contracts under the 2024-26 Peak Demand NCESS will be included:
  - Registered Facilities for the entire outlook period
  - Others only for the 2024-26 NCESS period
- Facilities under contract negotiation under the 2025-27 NCESS will be included:
  - Registered Facilities and upgrade of the Registered Facilities for the entire outlook period
  - Others only for the 2025-27 NCESS period
- Projects with publicly announced final investment decisions
- State-owned coal retirements progressing as announced (Collie by late 2027 and Muja D by 2029)
- Bluewaters Power Station assumed to retire by late 2026

Forecasting the RCT (as set by Limb A or Limb B)

Informed by the analysis described in the previous step, we will forecast the RCT as per below.

<table>
<tr><th></th><th colspan="2">Limb A / Limb B assessment</th><th colspan="3">RCT assessment</th></tr>
<tr><th rowspan="2">Case</th><th>Limb A assessment (MW)</th><th>Limb B modelling and assessment</th><th>Limb B re-modelling</th><th>Item 2 AIC,
Item 2 Reserve Capacity (MW)</th><th>Forecast RCT (MW)</th></tr>
<tr><th>CC minus Limb A requirement</th><th><u>2-4-C modelling</u> (dispatch AIC, assess EUE)</th><th><u>2-4-C modelling</u>
(dispatch AIC with Capacity delta, observe EUE)*</th><th>AIC from Scope Item 1 plus capacity delta</th><th>Outcome of Scope item 2</th></tr>
<tr><td>Case A</td><td rowspan="2">Capacity credits surplus</td><td>Reliability surplus
(EUE <0.0002%)</td><td>• Based on modelling results, decrease AIC by removing existing capacity**
• Run model, observe EUE %, re-iterate (if needed)</td><td rowspan="4"><u>Item 2 AIC:</u>
• AIC less existing capacity removed
or
• AIC plus generic capacity added
<u>Item 2 Reserve Capacity</u>
• Reserve Capacity associated with AIC minus Reserve Capacity associated with removed capacity
or
• Reserve Capacity associated with AIC plus Reserve Capacity associated with new generic capacity added</td><td rowspan="4">Greater of:
• Limb A requirement
or
• Item 2 Reserve Capacity</td></tr>
<tr><td>Case B</td><td>Reliability shortfall
(EUE >0.0002%)</td><td>• Based on modelling results, increase AIC by adding new generic generating units
• Run model, observe EUE %, re-iterate (if needed)</td></tr>
<tr><td>Case C</td><td rowspan="2">Capacity credits shortfall</td><td>Reliability surplus
(EUE <0.0002%)</td><td>Same as per Case A</td></tr>
<tr><td>Case D</td><td>Reliability shortfall
(EUE >0.0002%)</td><td>Same as per Case B</td></tr>
</table>

***AIC (Anticipated Installed Capacity) = Existing Capacity – Retirements + New Entrants**

****Capacity to be removed based on expected retirement dates.**

EY

Determining the balance of capacity across Capability Classes under the RCT for 2026-27

Our analysis in the previous step will inform the forecast RCT for each Capacity Year.

The RCT is an estimate of the total amount of capacity required in SWIS to meet the Planning Criterion for each Capacity Year. The RCT forecast for 2026-27 sets the requirement for Capacity Credits that need to be procured by AEMO (Australian Energy Market Operator) in the 2024 Reserve Capacity Cycle.

This scope item requires EY to determine the minimum capacity required to be provided by Capability Class 1 and Capability Class 3 capacity and an appropriate mix of additional CC1 and CC3 capacity required *if* any shortfall is identified for 2026-27 in the 10% POE expected demand scenario.

This represents another key change from last year's WEM Rules and reliability study approach.

Availability Class 1

- Thermal generators
- Renewable generators (Solar PV, Wind)
- Hybrid facilities (generator + electric storage resource, ESR)

Availability Class 2

- Demand-side response capacity
- Standalone (i.e. not hybrid) ESR

Additionally, the current version of the WEM Rules also introduces the concept of the 'Availability Duration Gap Load Scenario' and the 'Availability Duration Gap'.

These must be taken into consideration in determining the minimum Capability Class requirements.

Capability Class 1

- Firm capacity that is not energy limited, such as a gas-fired Facility that meets the fuel availability requirements

Capability Class 2

- Firm capacity with energy or availability limitations, such as battery, pump storge hydro or a DSP

Capability Class 3

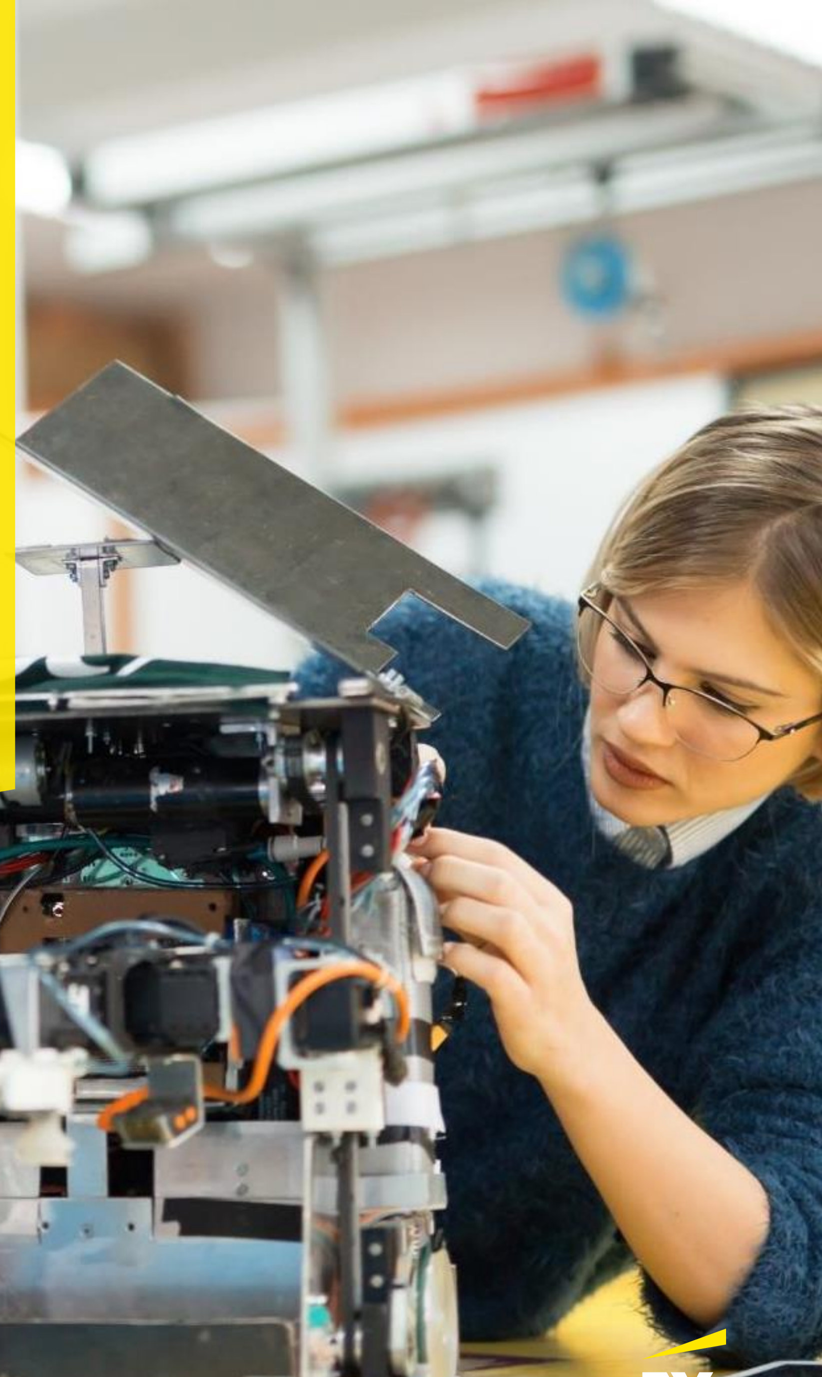
- Non-firm capacity, such as a wind or solar farm with no associated firming capability.

Notwithstanding the changes to the WEM Rules, our approach in principle will be similar to the 2023 study:

- Align modelled capacity with the RCT determined in previous scope items
- Run model and observe EUE as compared to the 0.0002% standard.
- Increase capacity of storage and DSP separately to determine the maximum capacity of each of these before the standard is breached.

Thank you for your attention.

Let’s move on to the Q&A session.



Appendix

Demand modelling:
EY's philosophy

Our demand forecasting philosophy is based on splitting the operational demand sent-out (OPSO) into components modelled separately, where each has an influence on changing the shape of the demand profile.

These components include:

- **Behind-the-meter rooftop PV and small non-scheduled PV (PVNSG)**
- **Electric vehicles (EVs)**
- **Behind-the-meter batteries (which has a positive and negative demand at different times)**
- **Block loads (big industrial loads)**

After taking these components into account, we consider the remaining demand profile to be fixed shape consumption (FSC), which is driven by residential and business energy use behaviour patterns in response to the weather from half-hour to half-hour.

We consider these patterns to be fixed across future years, modified for future energy and peak demand trajectories.

Weather-driven patterns and time-sequential modelling

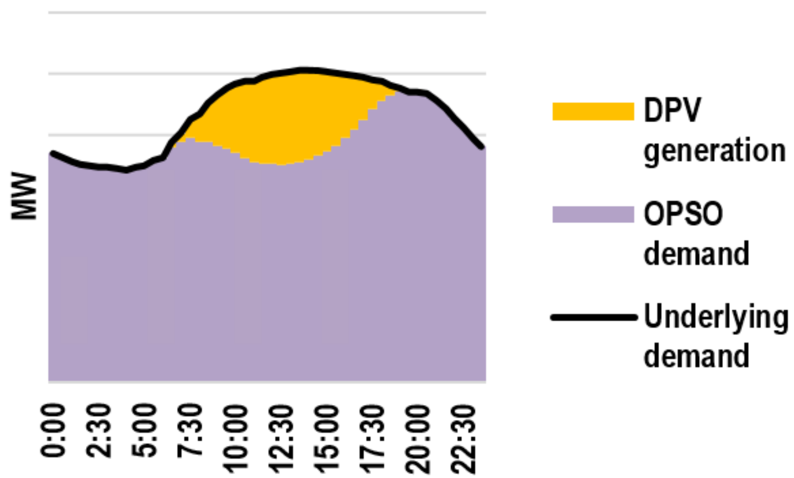
- EY's approach to conducting forward-looking half-hourly demand modelling is to base all the inter-temporal and inter-spatial patterns in electricity demand, wind and solar energy on the weather resources and consumption behaviour in one or more historical years.
- This helps to retain the relationships between time of day consumption behaviour and weather-driven availability of renewable resources. We consider this an essential aspect of modelling supply reliability.
- We believe that retaining correlation (or temporal synchronisation) between demand and renewable resource data is fundamental to assessing the reliability / operability of power systems, particularly with increasing penetration of wind and solar generation. All the correlated interactions between weather-dependent demand, wind and solar availability at different sites are projected forward consistently, maintaining the impact of actual weather patterns.
- **We will apply up to 12 years to draw analysis from** – the more reference years included, the more different types of weather patterns can be captured.

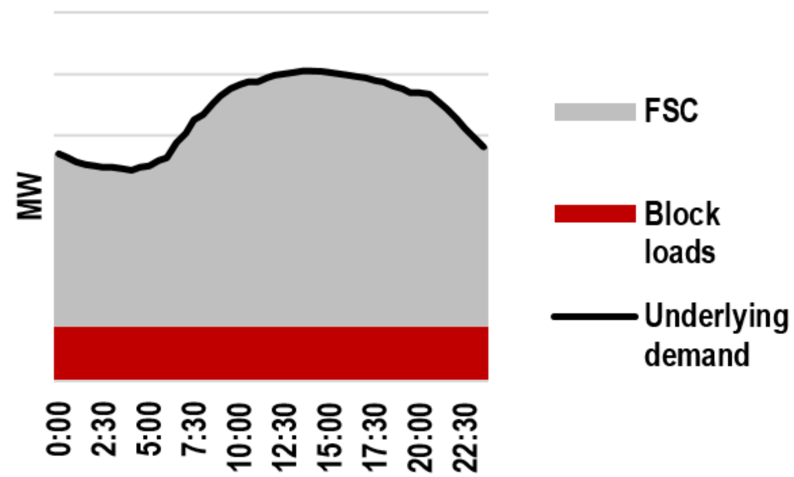
Demand modelling: historical reference years

Use historical OPSO^ demand… …add historical DPV* generation …to obtain an underlying demand profile.

Next

Subtract block loads… …to obtain half-hourly FSC** profiles.





The FSC (fixed shape consumption) component is driven by residential and business energy use behaviour patterns in response to the weather from half-hour to half-hour. We consider these patterns to be fixed across future years, modified for future energy and peak demand trajectories.

This process is performed for:

- **A range of historical reference years (between 2010-11 to 2021-22)**
- **Each time-sequential 30-minute interval in each year (i.e. across 17,520 or 17,568 intervals).**

^OPSO stand for operational sent-out.

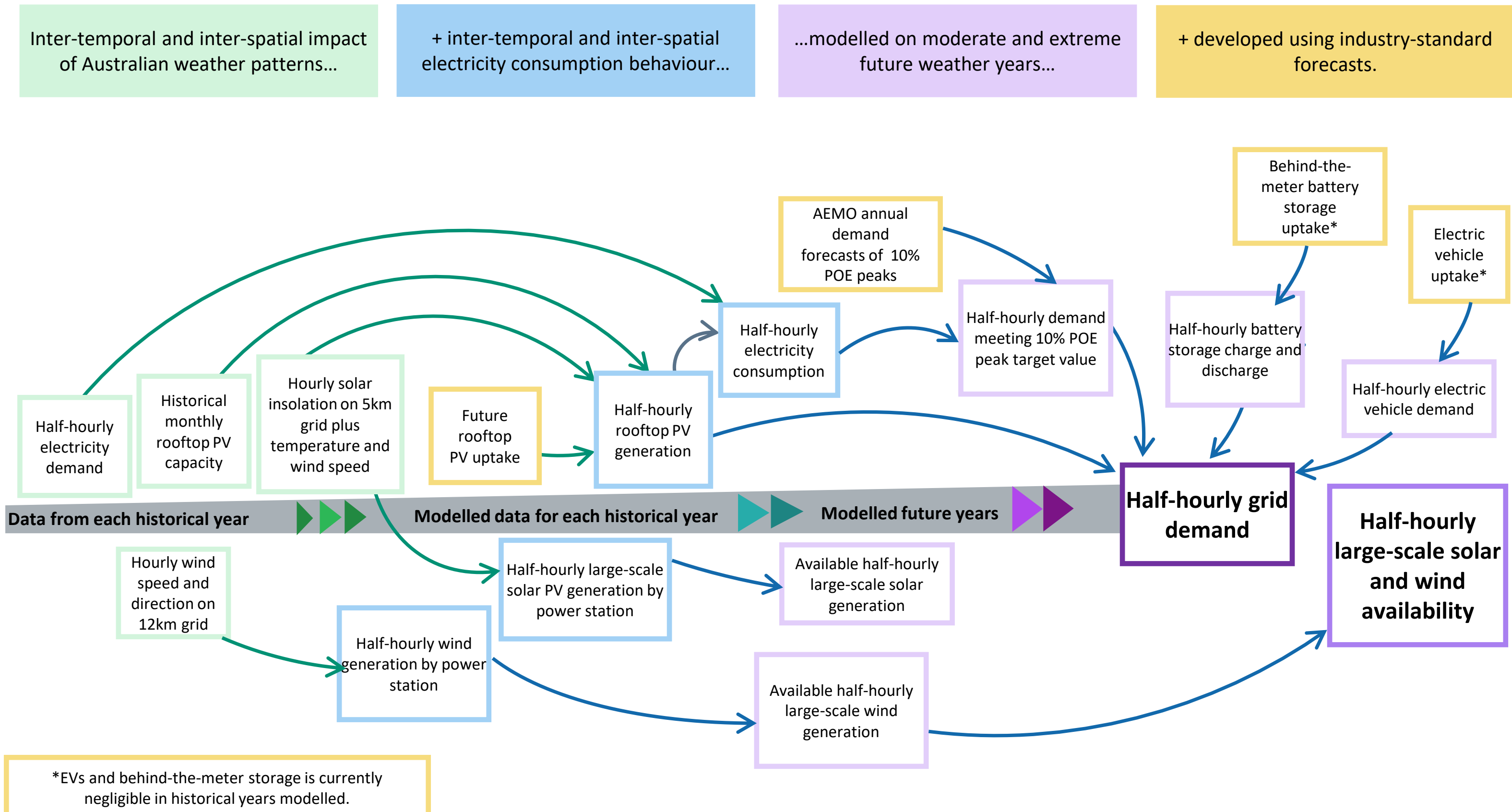
***DPV includes rooftop PV (RPV) and small PV non-scheduled generators (PVNSG). Subject to data availability, this may also capture the impact of EVs and BTM batteries, as well as load shedding.**

*****FSC stands for fixed shape consumption.***

Development of time-sequential data inputs

EY's approach to conducting forward-looking half-hourly demand modelling is to base all the inter-temporal and inter-spatial patterns in electricity demand, wind and solar energy on the weather resources and consumption behaviour in one or more historical years.

This helps to retain the relationships between time of day, consumption behaviour and renewable resources. We consider this an essential aspect of modelling supply reliability.



We believe that retaining correlation (or temporal synchronisation) between demand and renewable resource data is fundamental to assessing the reliability / operability of power systems, particularly with increasing penetration of wind and solar generation.

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