Government of **Western Australia**
Energy Policy WA

Meeting Agenda

Meeting Title:	Reserve Capacity Mechanism Review Working Group (**RCMRWG**)
Meeting Number:	2022_06_16
Date:	Thursday 16 June 2022
Time:	9:30 AM to 11:05 AM
Location:	Online, via TEAMS.

Item	Item	Responsibility	Type	Duration
1	Welcome and Agenda	Chair	Noting	5 min
2	Meeting Apologies/Attendance	Chair	Noting	2 min
3	Minutes of Meeting 2022_06_16	Chair	Decision	3 min
4	Actions Items	Chair	Noting	5 min
5	Project Timeline	RBP	Discussion	5 min
6	Updated System Stress Modelling Outputs	RBP	Discussion	40 min
7	Planning Criterion	RBP	Discussion	20 min
8	Next Steps	Chair	Discussion	10 min
9	General Business	Chair	Discussion	5 min
	Next Meeting: 14 July 2022			

Please note this meeting will be recorded.

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Energy Policy WA

Agenda Item 4: RCMRWG Action Items

Reserve Capacity Mechanism Review Working Group (**RCMRWG**) Meeting 2022_06_16

Shaded	Shaded action items are actions that have been completed since the last MAC meeting.
Unshaded	Unshaded action items are still being progressed.
Missing	Action items missing in sequence have been completed from previous meetings and subsequently removed from log.

Item	Action	Responsibility	Meeting Arising	Status
6	RBP is to provide information to the RCMRWG on how the number of continuous LOLH matches against battery profiles	RBP	2022_05_05	**Open** To be presented under agenda item 6.
8	RCMRWG Secretariat to publish the minutes of the 5 May 2022 RCMRWG meeting on the RCMRWG web page as final.	MAC Secretariat	2022_06_012	**Closed** Minutes published on 7 June 2022

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Energy Policy WA

Reserve Capacity Mechanism Review Working Group

Meeting 2022_06_16

16 June 2022

Working together for a **brighter** energy future.

Meeting Protocols

- Please place your microphone on mute, unless you are asking a question or making a comment
- Please keep questions relevant to the agenda item being discussed
- If there is not a break in discussion and you would like to say something, you can 'raise your hand' by typing 'question' or 'comment' in the meeting chat
- Questions and comments can also be emailed to energymarkets@energy.wa.gov.au after the meeting
- The meeting will be recorded and minutes will be taken (actions and recommendations only)
- Please state your name and organisation when you ask a question
- If you are having connection/bandwidth issues, you may want to disable the incoming and/or outgoing video

Agenda

Item	Item	Responsibility	Type	Duration
1	Welcome and Agenda	Chair	Noting	5 min
2	Meeting Apologies/Attendance	Chair	Noting	2 min
3	Minutes of RCMRWG meeting 2022_06_02	Chair	Decision	3 min
4	Action Items	Chair	Discussion	5 min
5	Project Timeline	RBP	Discussion	5 min
6	Updated System Stress Modelling Outputs	RBP	Discussion	40 min
7	Planning Criterion	RBP	Discussion	20 min
8	Next Steps	Chair	Discussion	10 min
9	General business	Chair	Discussion	5 min
	Next meeting: 14 July			

5. Timeline

Project Timeline

10/06

Stage	Step	Short description	Analysis	21/01	28/01	4/02	11/02	18/02	25/02	4/03	11/03	18/03	25/03	1/04	8/04	15/04	22/04	29/04	6/05	13/05	20/05	27/05	3/06	10/06	17/06	24/06	1/07	8/07	15/07	22/07	29/07	5/08	12/08	19/08	26/08	2/09	9/09	16/09	23/09
1	Working group meetings		RCM Working Group meetings	WG				WG				WG							WG				WG		WG					WG									
1	MAC meetings		MAC meetings							MAC					MAC						MAC						MAC								MAC				
1	Step 1	Requirements analysis	(a)International Literature review																																				
1	Step 1		Gather assumptions and set up models																																				
1	Step 1		(b) Model system stress																																				
1	Step 1		(c) Analyse the required capacity services																																				
1	Step 2	Review Planning	(d) Assess the Planning Criterion																																				
1	Step 2	Criterion	(e) Assess the ICAP and UCAP Concepts																																				
1	Step 3	Review CRC allocation	(f) Assess CRC Allocation and identify options																																				
1	Step 5	Model CRC allocation	(h) Scenario Analysis - Model CRC allocation options																																				
1	Step 4	Review BRCP	(g) Analysis of the BRCP																																				
1	Consultation paper		Consultation paper																																				

Purpose of this Session

- In this session we will present updated results of the system stress modelling, including more detail on outage duration, and comparison of 50% POE and 10% POE load forecasts.
- Overall message: the additional analysis confirms the patterns and conclusions from the earlier modelling.
- We propose a refined direction for the planning criterion, including a new limb for the flexibility product.

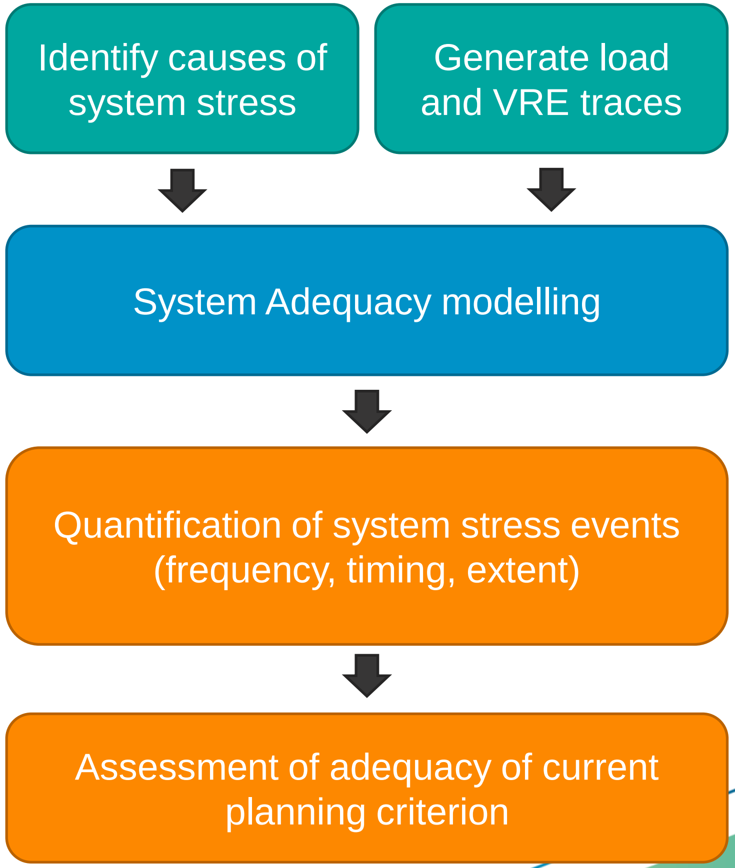
6. Updated System Stress Modelling Outputs

Modelling Methodology – Recap

System Stress Modelling Objectives:

- Identify causes of system stress – current and future.
- Quantify how the current generation mix (and other capacity sources) accommodate the identified types of system stress under credible demand scenarios (current, 2030 and 2050) and identify any deficiencies.
- Assess whether the current Planning Criterion is adequate for meeting the capacity requirements of the SWIS.

System Stress Modelling Methodology:



Modelling Methodology – Scenarios

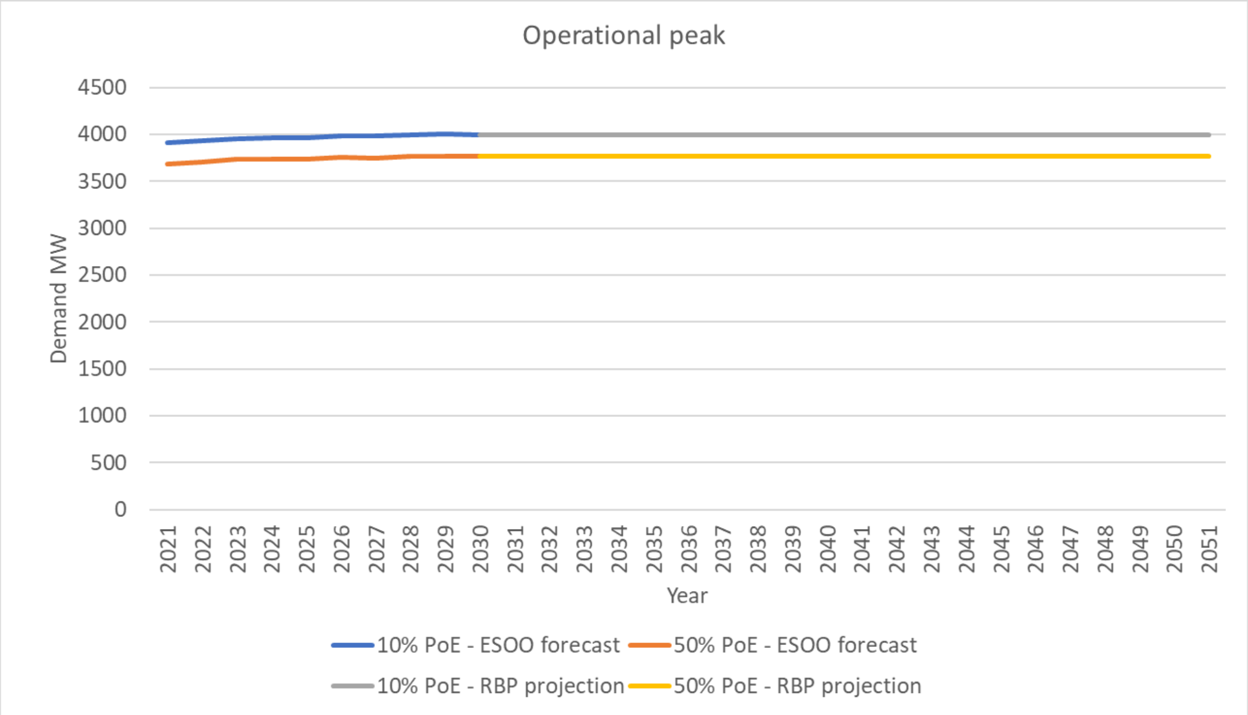
Retirement Scenarios:

	2022	2030	2050
R1	Current capacity mix	Muja retires on schedule	All thermal plant retired
R2		All thermal baseload plant retires	

New Build Scenarios:

	2022	2030	2050
S1	Current capacity mix	New capacity as required in line with respective 2050 targets	Sufficient PV + wind by 2050 to meet energy requirement. Large storage capacity **(4:30pm to 8:30pm)** Some demand flexibility
S2			PV + Wind overbuild by 2050 reducing amount of storage required Less storage capacity **(4:30pm to 8:30pm)** Large demand flexibility
S3			Sufficient PV + wind by 2050 to meet energy requirement Green H2 thermal Some storage **(4:00pm to 6:00am)** Some demand flexibility

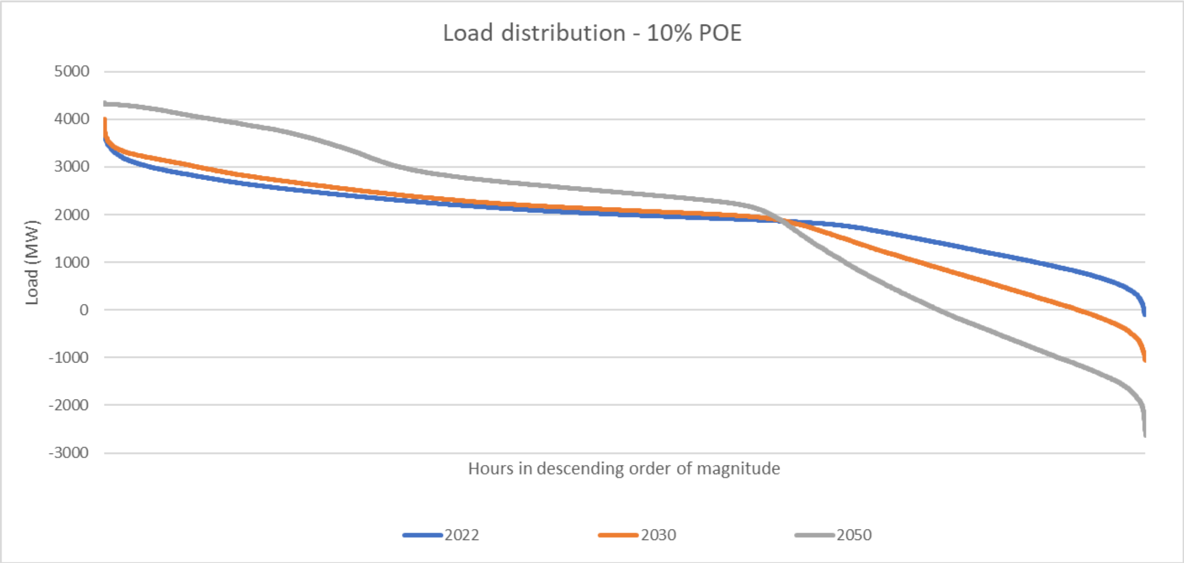
ESOO Load Forecast

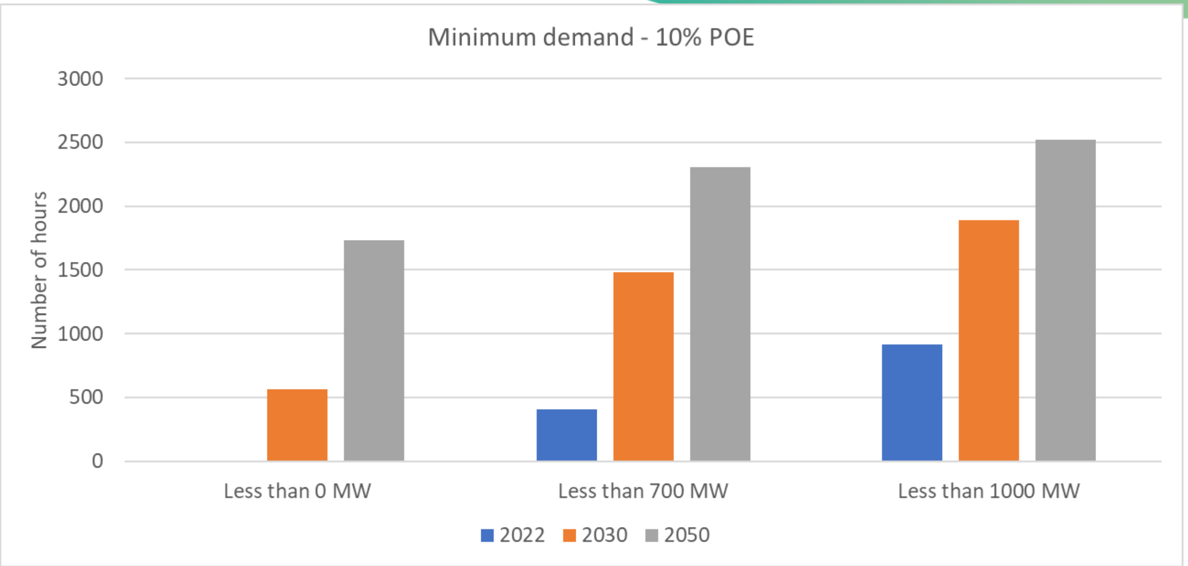


Year	10% POE (MW)	50% POE (MW)
2022	3936	3700
2030	4000	3772
2050	4000	3772

- ESOO forecasts operational demand until CY 2030 and we have extended the forecast until 2050. We have capped the operational demand to account for the accelerated increase in BTM solar uptake.
- In 2050, EV demand is significant and hence the load value is greater than the operational demand forecast.

Modelling Results – Load Analysis (10% POE)





Year	Maximum demand (MW)	Minimum demand (MW)
2022	3937	-98
2030	4002	-1021
2050	4346	-2600

AEMO have previously cited 700 MW as the minimum level of operational demand for system stability – see https://www.aemo.com.au/-/media/Files/Electricity/WEM/Security_and_Reliability/2019/Integrating-Utility-scale-Renewables-and-DER-in-the-SWIS.pdf

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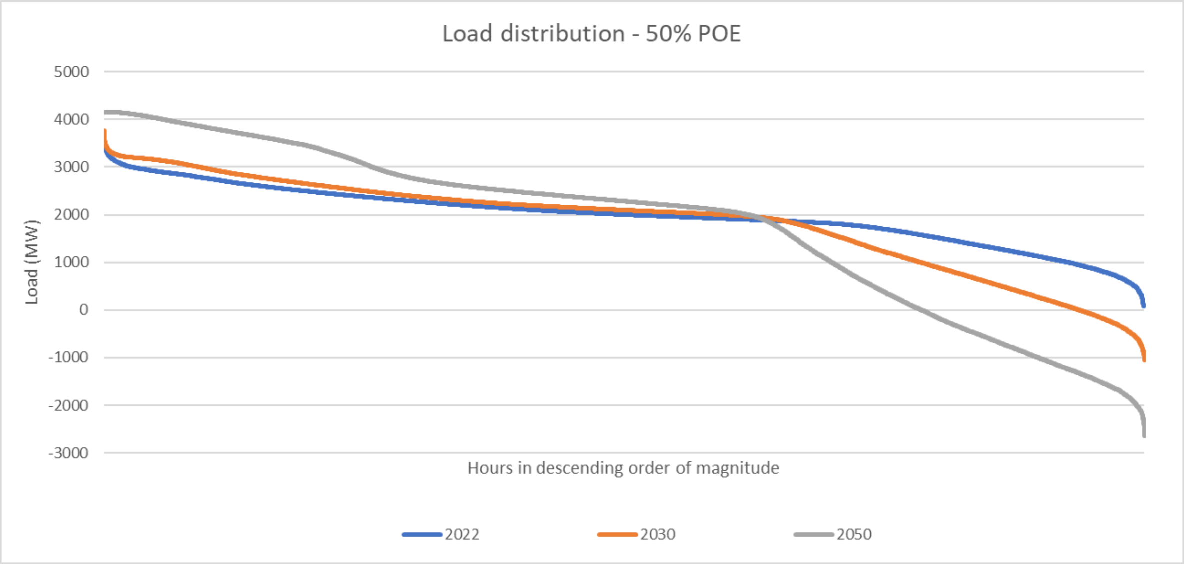
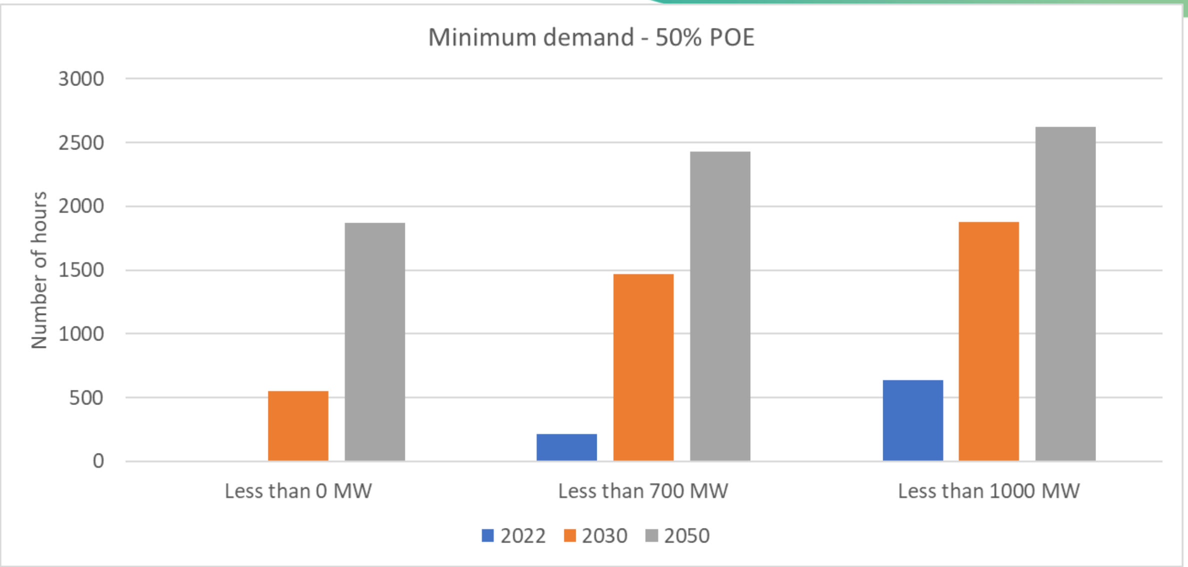
Modelling Results – Load Analysis (50% POE)



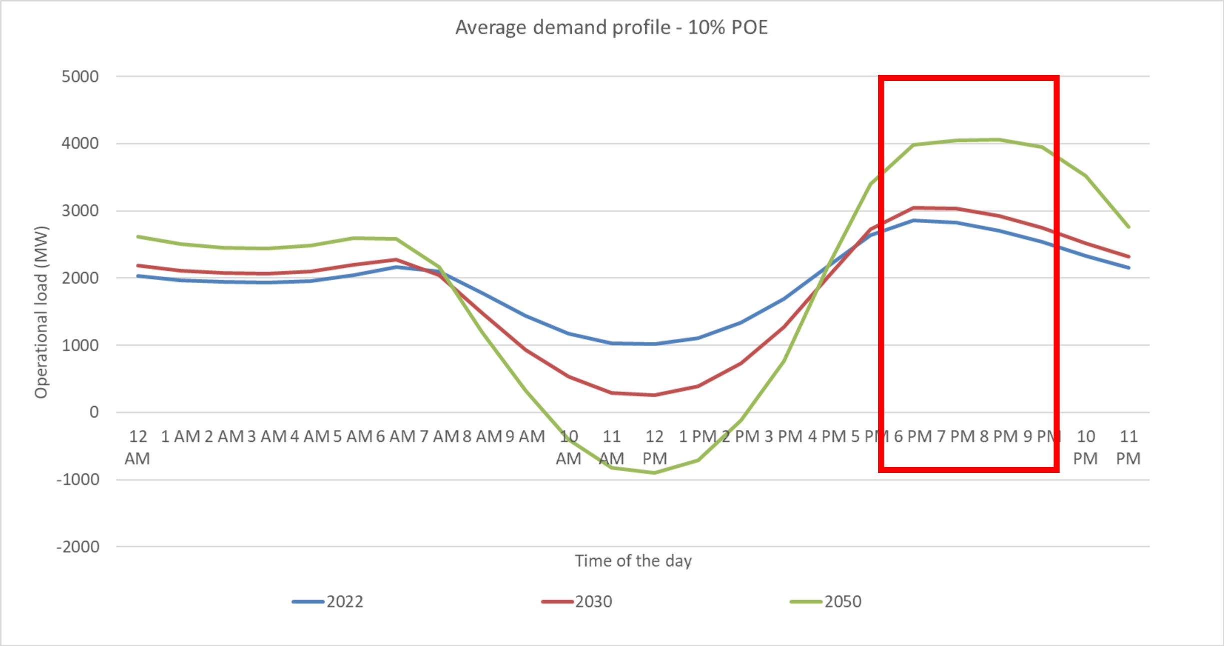


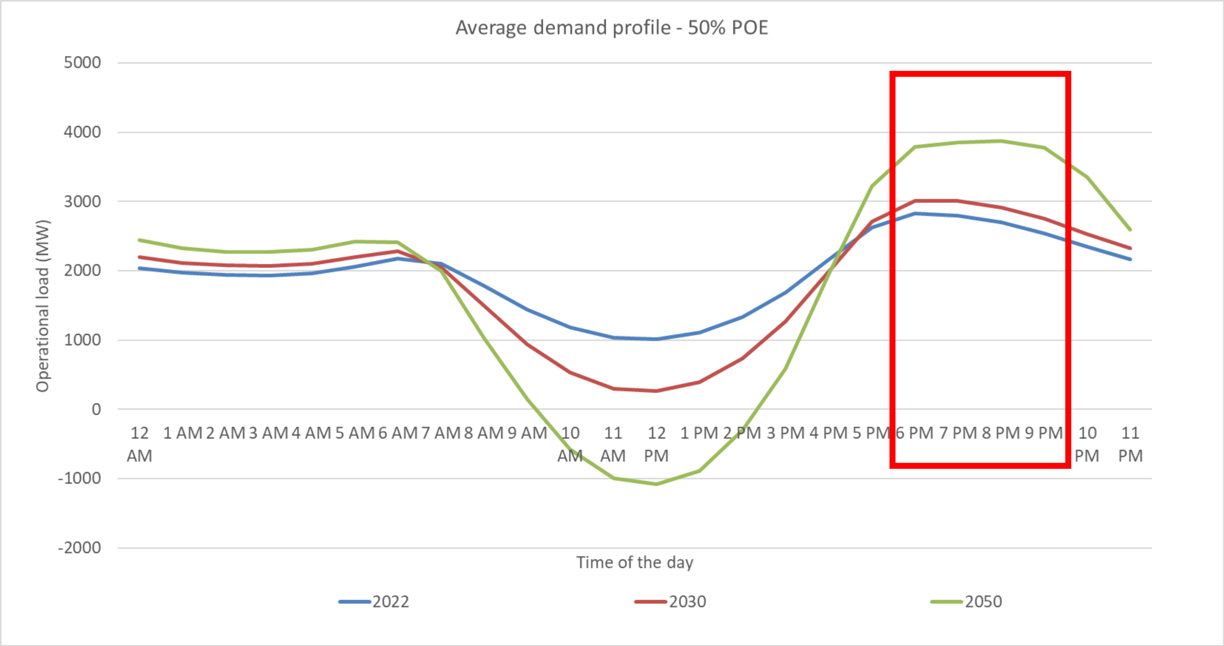
Year	Maximum demand (MW)	Minimum demand (MW)
2022	3686	-110
2030	3770	-1059
2050	4159	-2635

- Negative operational load experienced by 2030.
- Significant negative operational demand experienced in 2050.
- By 2050, demand is less than 700 MW for 2400 hours per year (27% of all periods).

Modelling Results – Evolving demand shape

System peak becomes later and flatter by 2050, occurring from 6:00pm to 9:00pm:

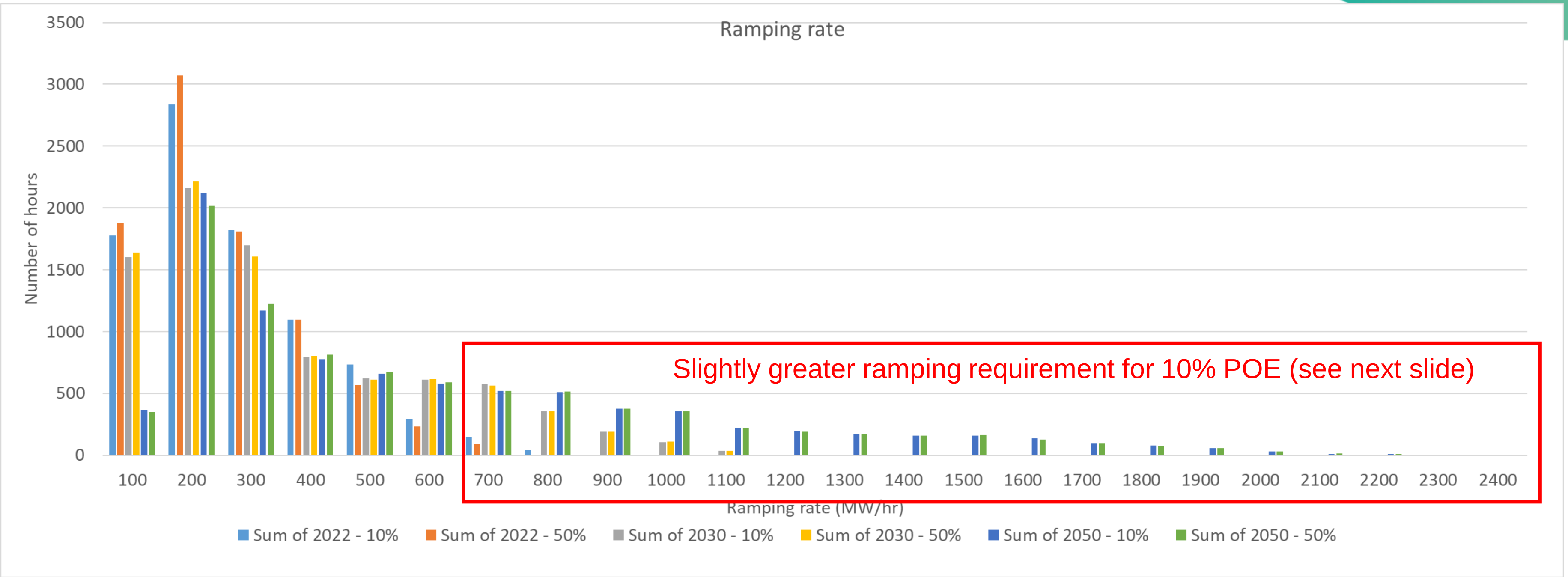




Year	Maximum demand (MW)	Minimum demand (MW)
2022	2858 – **6:00pm**	1013 – **12:00pm**
2030	3043 – **6:00pm**	262 – **12:00pm**
2050	4060 – **8:00 pm**	-903 – **12:00pm**
Periods of peak demand	**6:00pm – 9:00pm**	

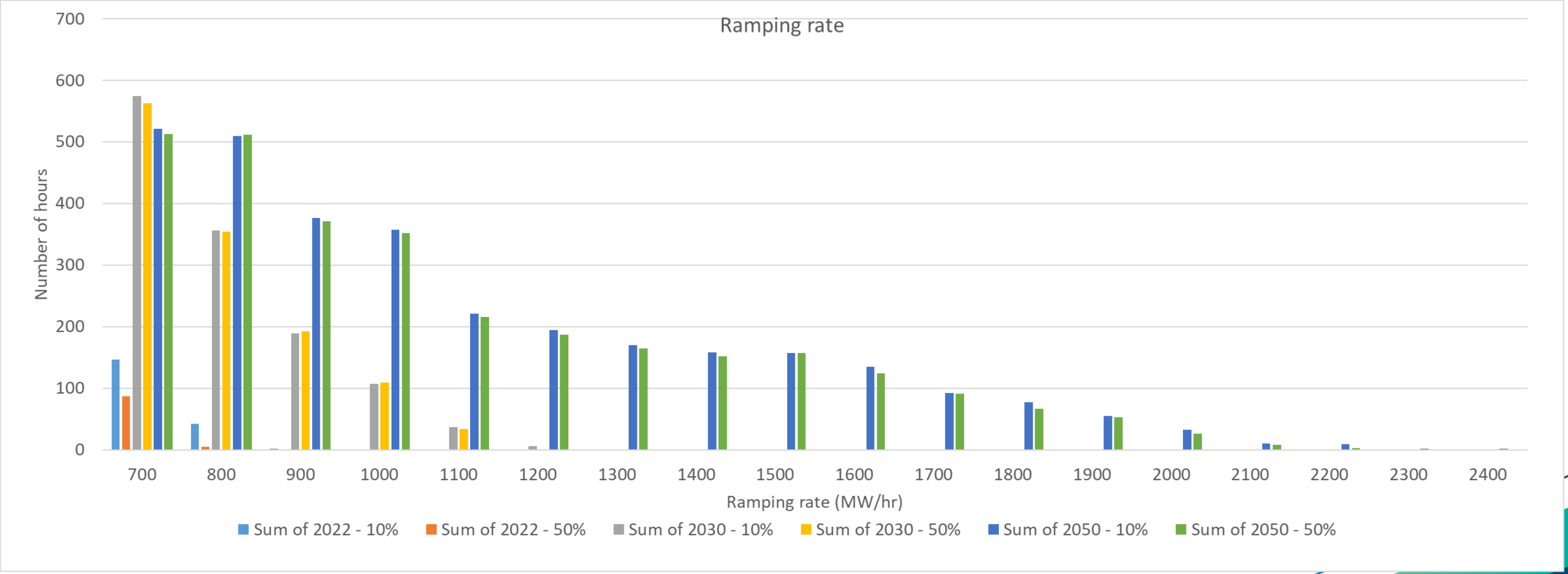
Year	Maximum demand (MW)	Minimum demand (MW)
2022	2824 – **6:00pm**	1016 – **12:00 pm**
2030	3012 – **6:00pm**	265 – **12:00pm**
2050	3876 – **8:00pm**	-1075 – **12:00pm**
Periods of peak demand	**6:00pm – 9:00pm**	

Modelling Results – Demand Ramping (1)



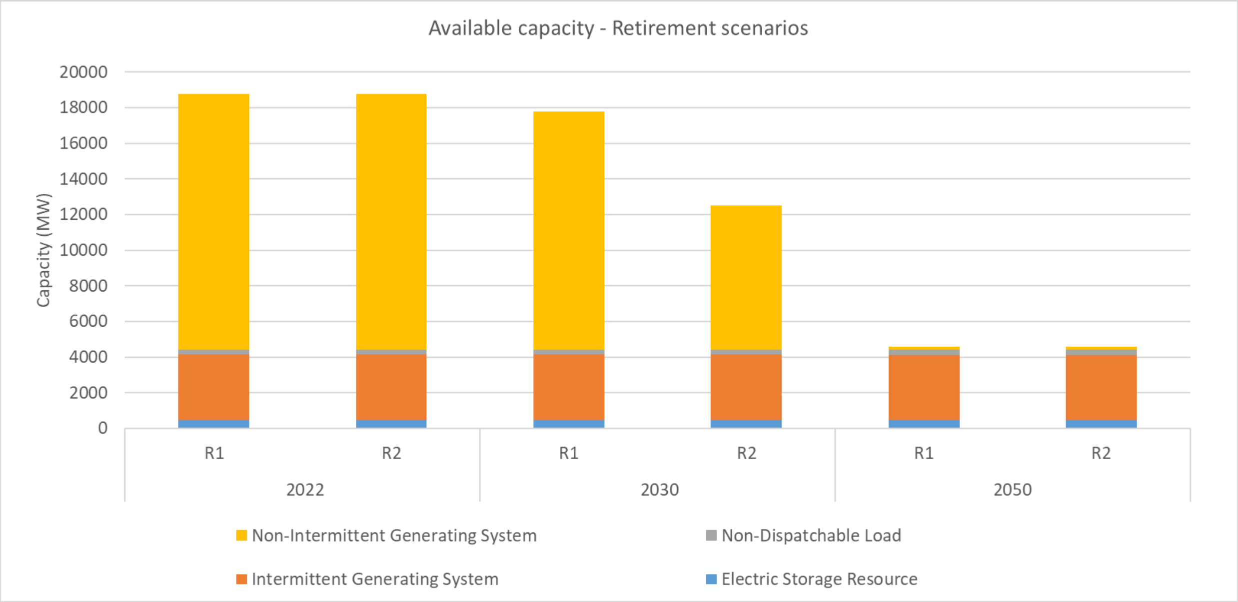
- In later years, much higher demand ramping is experienced.
- In the 50% POE load curve, the number of hours with low ramp rate is high whereas for the 10% POE case, the number of hours with higher ramp rate is higher implying higher ramping requirements for the 10% POE case.
- The highest ramp rates in 2050 are >2000 MW/hr, 3x those in 2022.
- However, these ramp rates are still well within the capabilities of current technologies (e.g. OCGT), as long as sufficient capacity is available.
- By 2050, >2GW of fast-ramping capacity (e.g. OCGT or battery) will be required.
- However, under a zero-emissions policy, options for ramping capacity are much more limited.

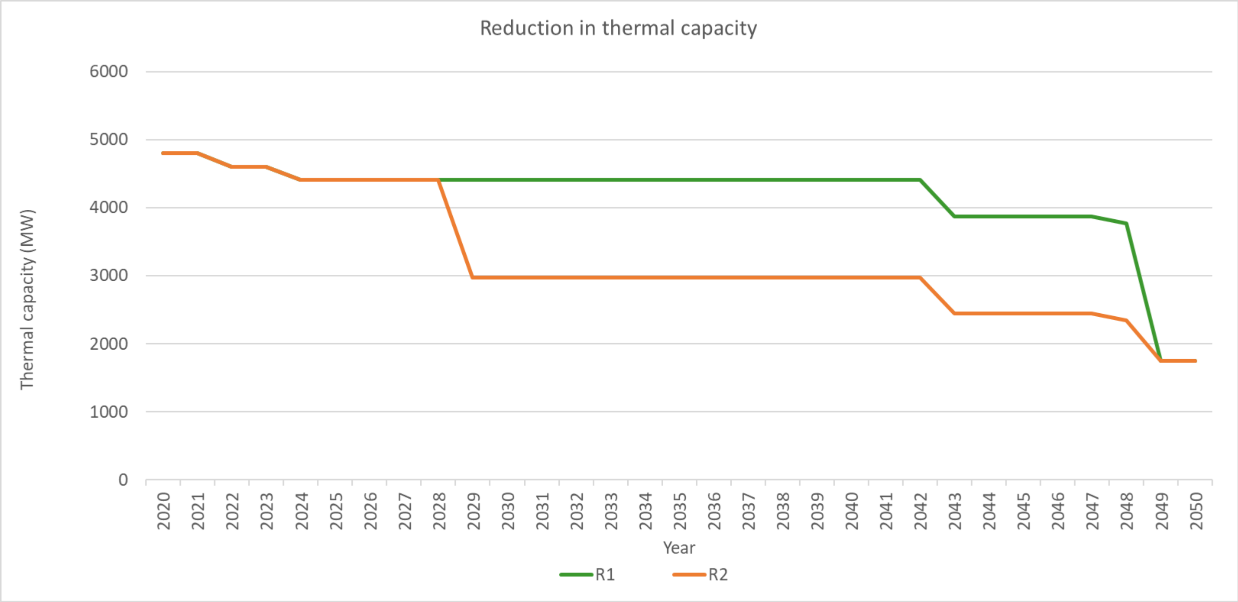
Modelling Results – Demand Ramping (2)



Modelling Results – Capacity Available

Available capacity after retirement of thermals (two scenarios):





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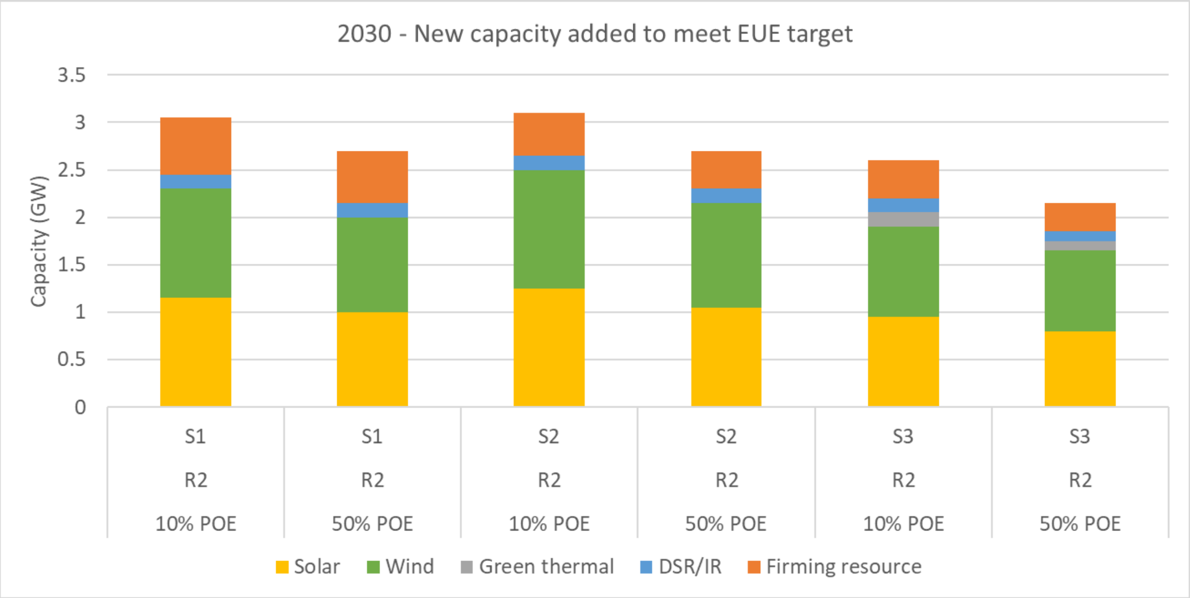
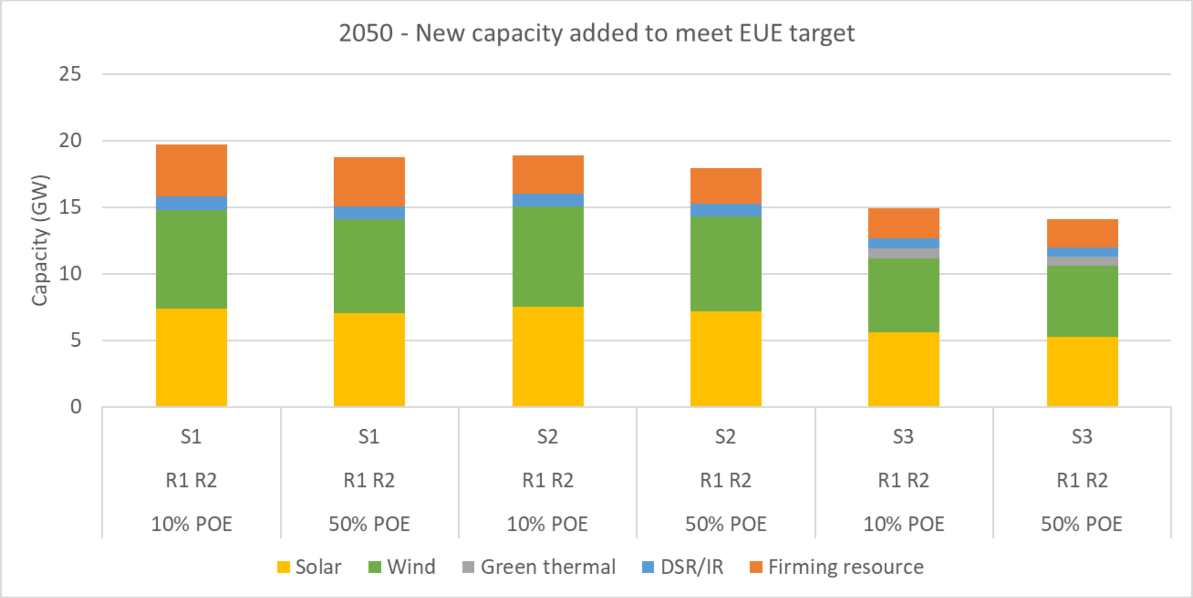
Modelling Results – Capacity Additions

Capacity additions (MW) to achieve unserved energy (EUE) close to current reliability criterion:

Proportion of new capacity added

Scenario	Solar	Wind	DSR/IR	Battery	Green thermal
S1	37.5%	37.5%	5%	20%	0%
S2	40%	40%	5%	15%	0%
S3	37.5%	37.5%	5%	15%	5%





Modelling Results – Unserved Energy – 10% POE

Unserved energy for each capacity year under each of the retirement and new build scenarios

Retirement scenario	Scenario	Year	Solar	Wind	Green thermal	DSR/IR	Firming resource	Additional capacity added	Unserved energy %
R1	S1	2022	0	0	0	0	0	0	0.000021%
		2030	0	0	0	0	0	0	0.000000%
		2050	7400	7400	0	1000	3950	19750	0.002030%
	S2	2022	0	0	0	0	0	0	0.000000%
		2030	0	0	0	0	0	0	0.000000%
		2050	7550	7550	0	950	2850	18850	0.002082%
	S3	2022	0	0	0	0	0	0	0.000000%
		2030	0	0	0	0	0	0	0.000000%
		2050	5600	5550	750	750	2250	14850	0.002016%
R2	S1	2022	0	0	0	0	0	0	0.000021%
		2030	1150	1150	0	150	600	3050	0.002086%
		2050	7400	7400	0	1000	3950	19750	0.002030%
	S2	2022	0	0	0	0	0	0	0.000000%
		2030	1250	1250	0	150	450	3100	0.002068%
		2050	7550	7550	0	950	2850	18850	0.002082%
	S3	2022	0	0	0	0	0	0	0.000000%
		2030	950	950	150	150	400	2550	0.002061%
		2050	5600	5550	750	750	2250	14850	0.002016%

Key		
New build capacity (MW)	Total capacity added (MW)	Unserved Energy (%)

Modelling Results – Unserved Energy – 50% POE

Unserved energy for each capacity year under each of the retirement and new build scenarios

Retirement scenario	Scenario	Year	Solar	Wind	Green thermal	DSR/IR	Firming resource	Additional capacity added	Unserved energy %
R1	S1	2022	0	0	0	0	0	0	0.000000%
		2030	0	0	0	0	0	0	0.000000%
		2050	7050	7050	0	950	3750	18800	0.002011%
	S2	2022	0	0	0	0	0	0	0.000000%
		2030	0	0	0	0	0	0	0.000000%
		2050	7200	7150	0	900	2700	18000	0.001993%
	S3	2022	0	0	0	0	0	0	0.000000%
		2030	0	0	0	0	0	0	0.000000%
		2050	5300	5300	700	700	2100	14150	0.002008%
R2	S1	2022	0	0	0	0	0	0	0.000000%
		2030	1000	1000	0	150	550	2700	0.002096%
		2050	7050	7050	0	950	3750	18800	0.002011%
	S2	2022	0	0	0	0	0	0	0.000000%
		2030	1050	1100	0	150	400	2650	0.002090%
		2050	7200	7150	0	900	2700	18000	0.001993%
	S3	2022	0	0	0	0	0	0	0.000000%
		2030	800	850	100	100	300	2200	0.002075%
		2050	5300	5300	700	700	2100	14150	0.002008%

Key		
New build capacity (MW)	Total capacity added (MW)	Unserved Energy (%)

Modelling Results – Capacity Additions

Key findings:

- Current excess of capacity in 2022.
- Under retirement scenario R1 (Muja retires as planned), no additional capacity is required in 2030, and zero EUE results. Under retirement scenario R2 (all thermal baseload plant retires by 2030), >800 MW renewables build is required, plus storage/DSM to balance.
- New build scenario S1 (sufficient PV + wind by 2050 to meet energy requirement) requires >0.5 GW firming resource in 2030 and >3.5 GW firming resource in 2050 to avoid excessive EUE.
- New build scenario S2 (PV + wind overbuild by 2050 reducing amount of storage required) requires 0.4 GW firming resource in 2030 and >2.5 GW firming resource in 2050 to avoid excessive EUE.
- New build scenario S3 (Sufficient PV + wind) requires much lesser storage as a firm green thermal capacity such as H_2 is available.

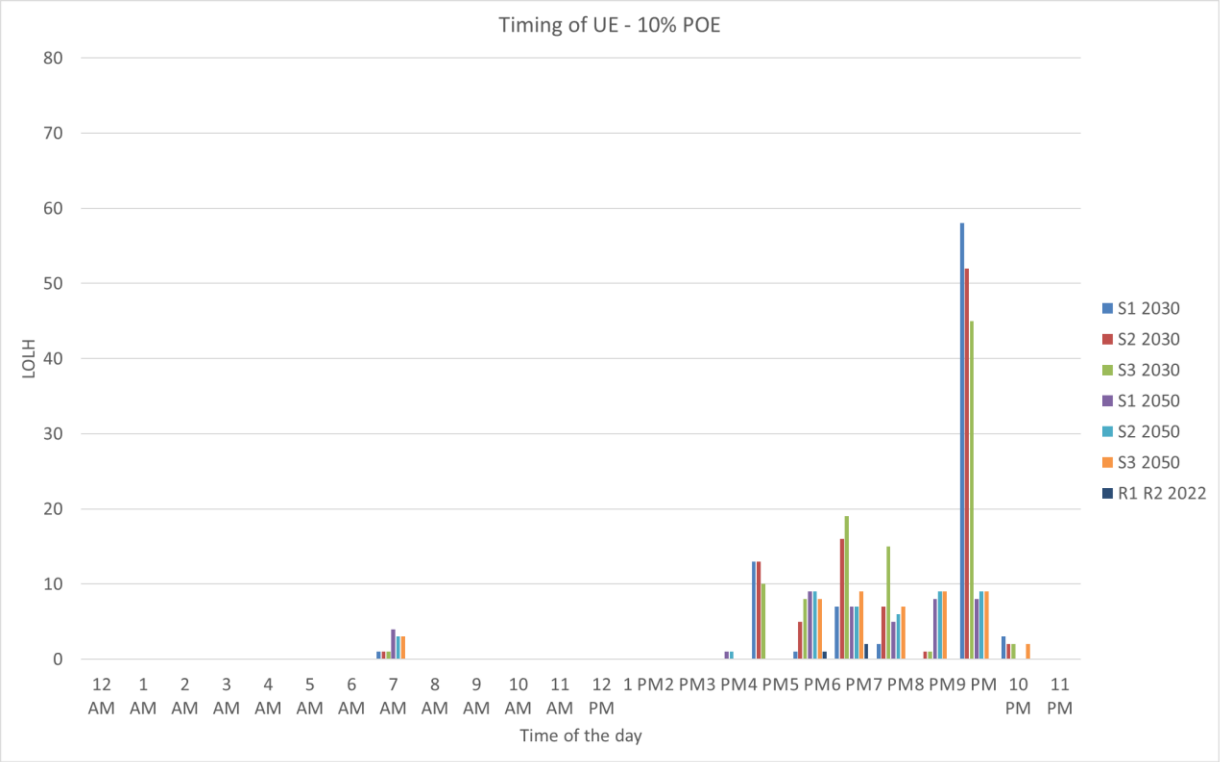
Comparing 10% POE and 50% POE:

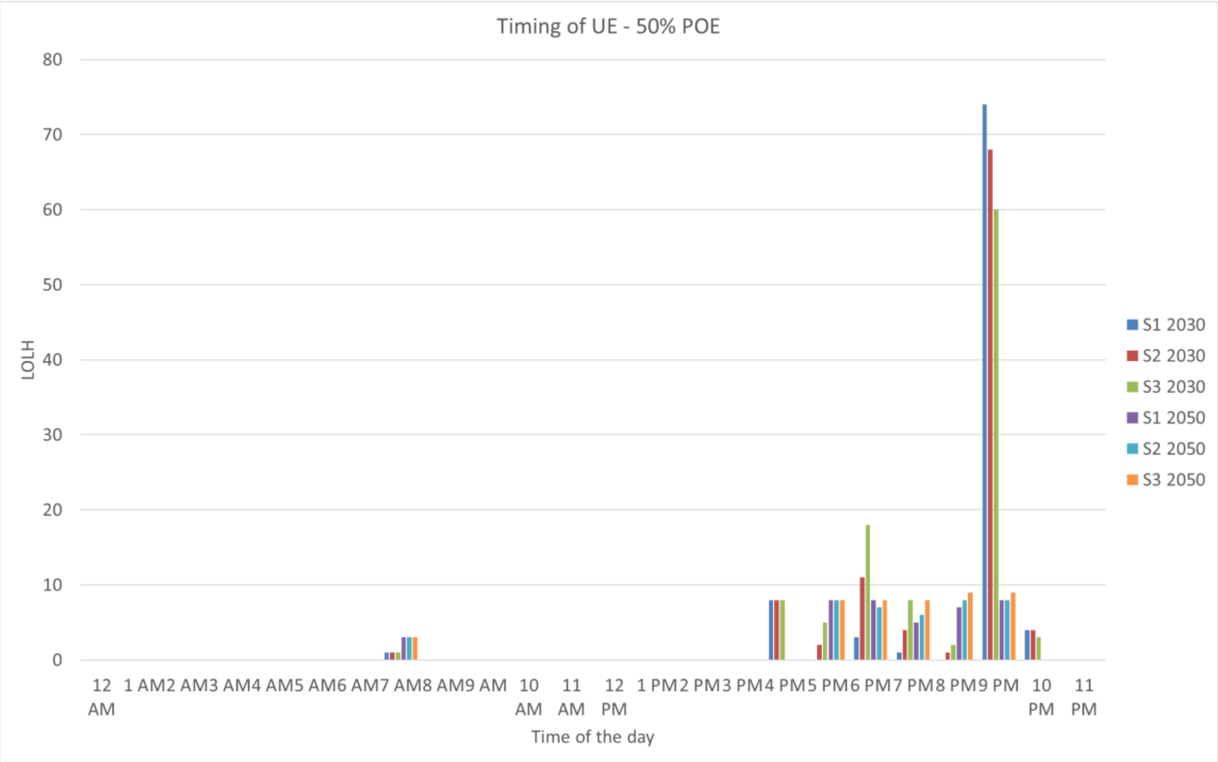
- Higher ramping and peak demand is experienced in 10% POE case (as expected).
- Capacity added to retain the UE% at 0.002% is higher for 10% POE. Around 400 MW additional capacity added in 2030 and 1000 MW in 2050 when compared to 50% POE.

	2030			2050		
10% POE	**S1**	**S2**	**S3**	**S1**	**S2**	**S3**
Intermittent (Wind + Solar) (MW)	2300	2500	1100	14800	15100	11150
Firming resource (MW)	600	450	400	3950	2850	2250

Modelling Results – Timing of Unserved Energy

Unserved energy events concentrated around evening and the morning periods

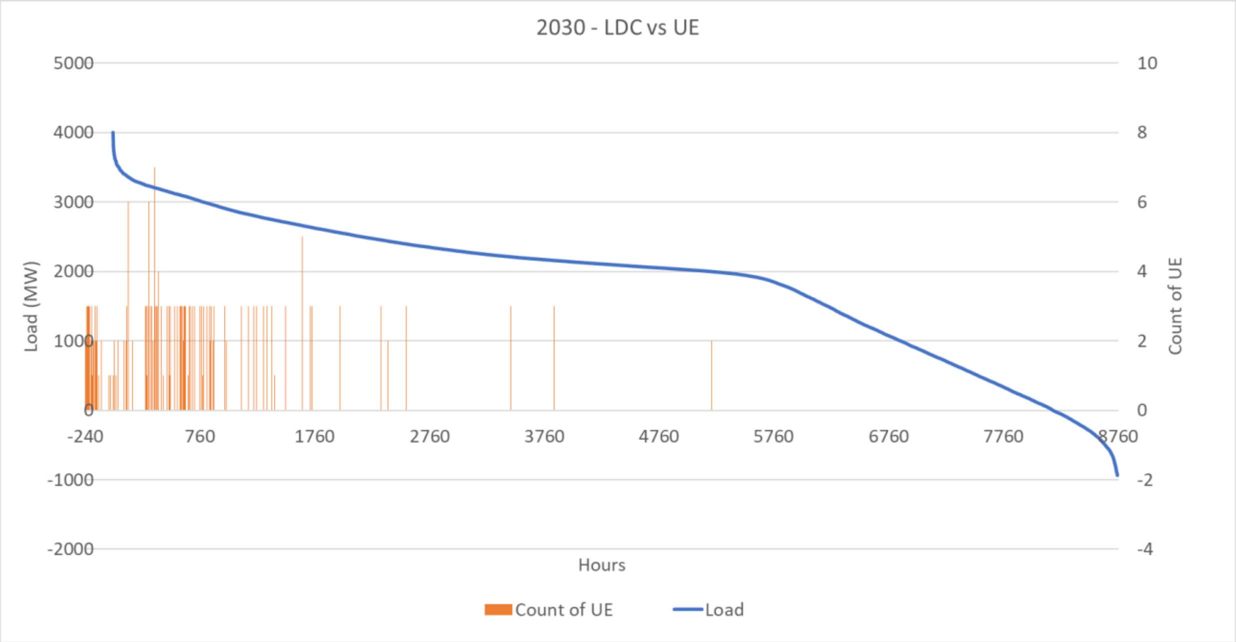


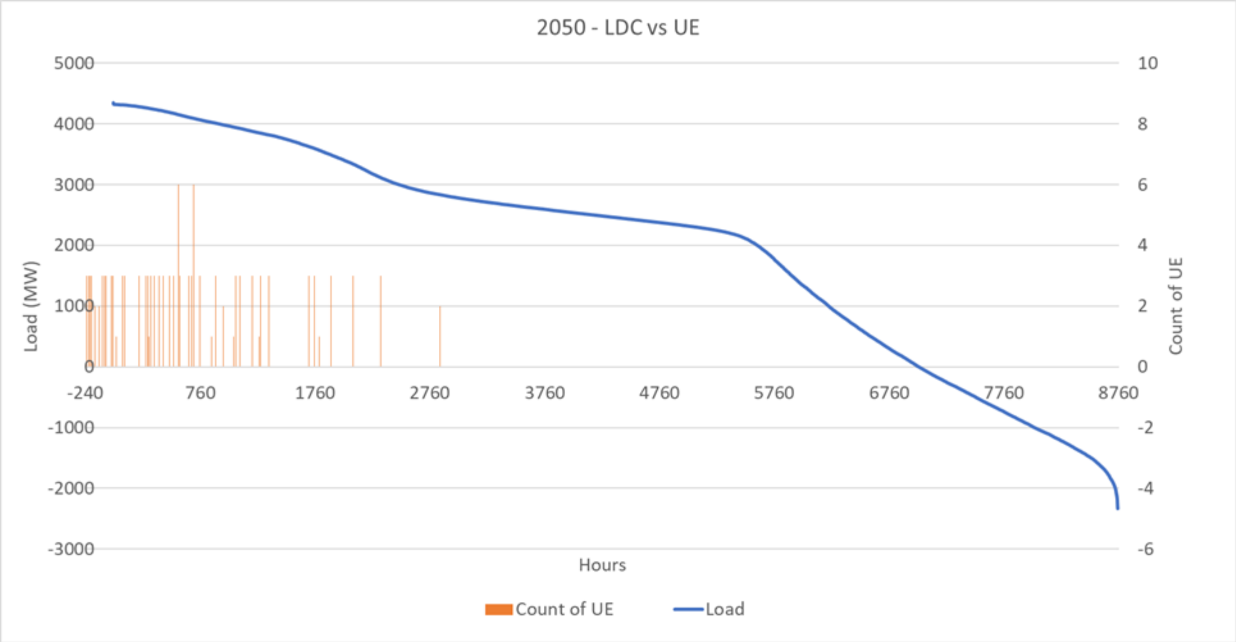


- In 2050, the EUE is distributed over several periods whereas in 2030, EUE is mostly concentrated at 9:00pm (next couple of slides).
- UE at 7:00am because of unavailability of battery and low solar output.
- The EUE at 9:00pm is greater in 50% POE case compared to 10% POE because UE is distributed over several hours and also due to the different capacity resources added in the 10% POE case.
- Around 75% of the UE is during periods of peak demand (6:00pm – 9:00pm)

Modelling results – Load vs UE – 10% POE

Most UE is experienced during periods of high load (including system peak) in 2030 and 2050

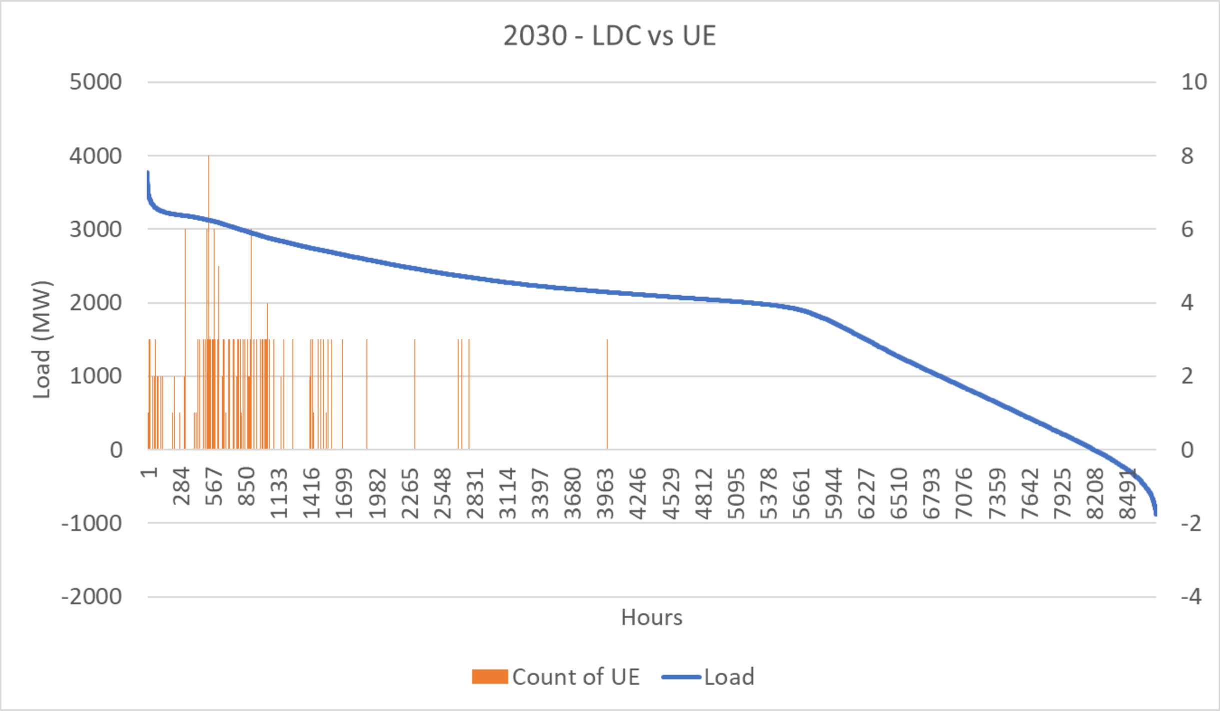


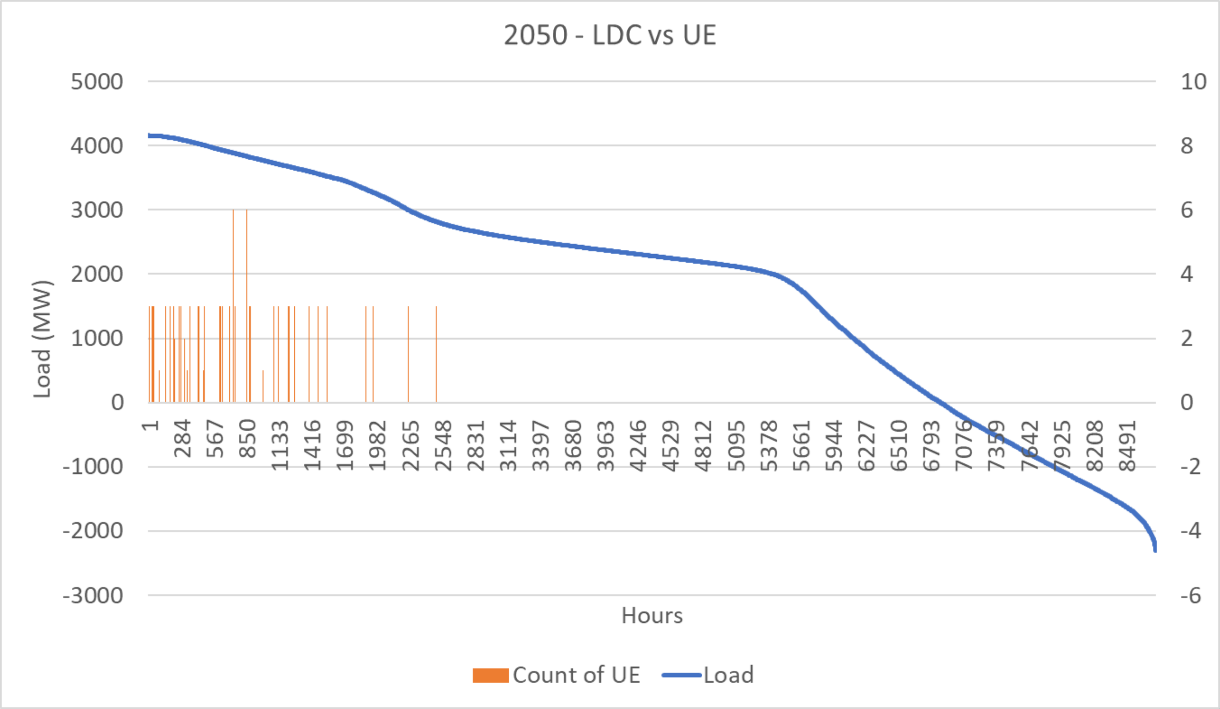


This (EUE-based) modelling shows that system peak still has relatively high likelihood of a lost load event. This confirms the need to retain a peak load limb to ensure reliability is maintained at at least the same level as today.

Modelling results – Load vs UE – 50% POE

Most UE is experienced during periods of high load (including system peak) in 2030 and 2050





Modelling Results – Measurement of Unserved Energy (1)

Amount of total unserved energy according to the hour of the day **(MWh)**

10% POE

Time	S1 2030	S2 2030	S3 2030	S1 2050	S2 2050	S3 2050	R1 R2 2022
12 AM							
1 AM							
2 AM							
3 AM							
4 AM							
5 AM							
6 AM							
7 AM	9.2	5.8	5.9	101.2	103.3	59.6	
8 AM							
9 AM							
10 AM							
11 AM							
12 PM							
1 PM							
2 PM							
3 PM				0.5	1.4		
4 PM	190.7	128.5	112.5				
5 PM	13.6	36.6	55.6	349.1	356.4	272.7	8.8
6 PM	103.7	389.9	534.8	569.6	574.7	585.3	9.2
7 PM	15.6	73.0	162.4	217.6	233.3	233.0	
8 PM		1.2	6.1	292.6	305.1	315.4	
9 PM	1331.5	1021.7	776.3	211.4	212.3	259.7	
10 PM	21.6	14.0	11.4			4.0	
11 PM							

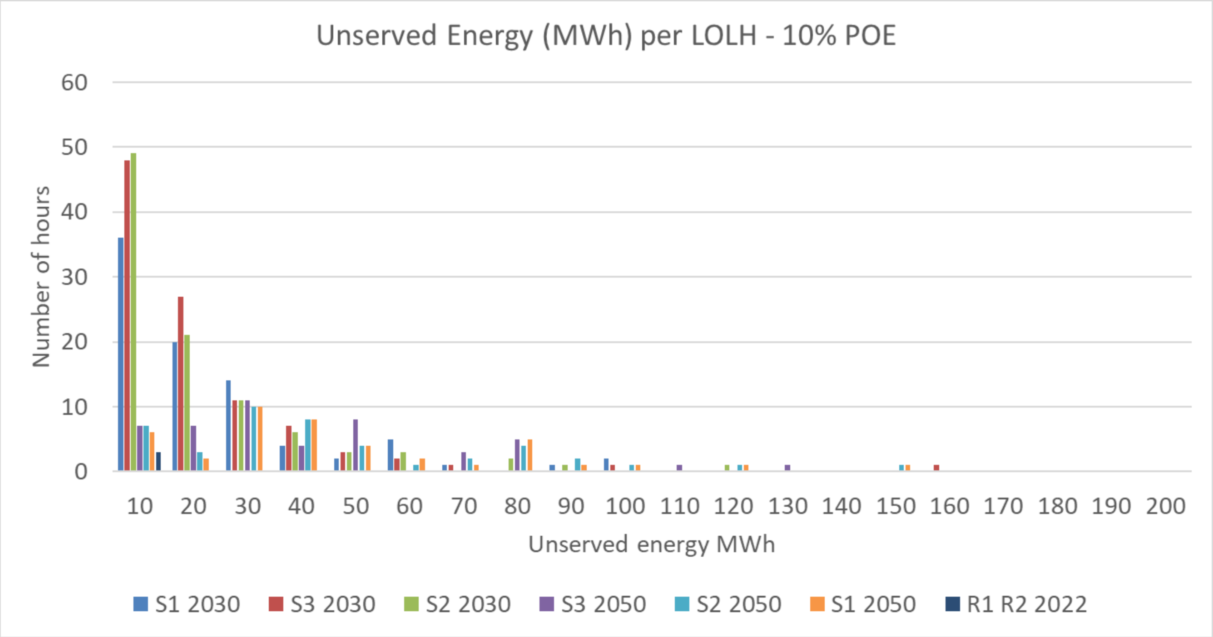
50% POE

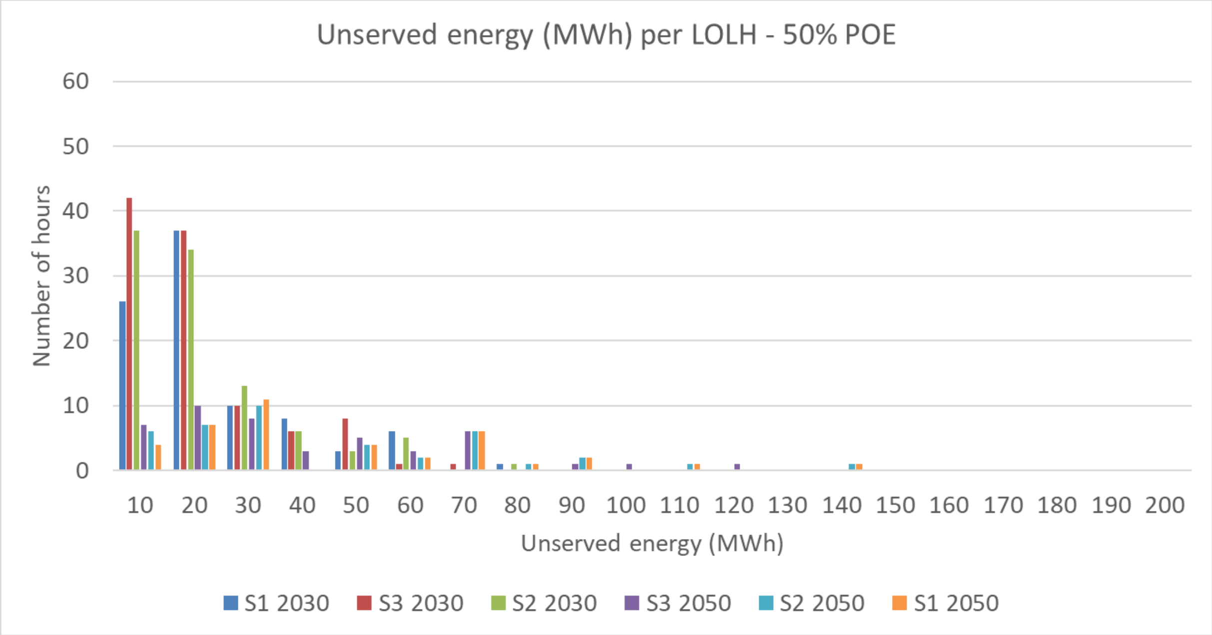
Time	S1 2030	S2 2030	S3 2030	S1 2050	S2 2050	S3 2050
12 AM						
1 AM						
2 AM						
3 AM						
4 AM						
5 AM						
6 AM						
7 AM	15.6	14.0	15.4	103.2	97.9	62.4
8 AM						
9 AM						
10 AM						
11 AM						
12 PM						
1 PM						
2 PM						
3 PM						
4 PM	121.2	105.9	109.6			
5 PM		9.9	24.4	305.3	305.8	232.8
6 PM	43.3	144.3	244.0	491.6	490.2	525.8
7 PM	3.1	38.5	78.2	166.4	170.1	178.3
8 PM		0.5	8.6	270.9	270.7	289.7
9 PM	1455.5	1324.0	1162.7	233.7	223.0	280.0
10 PM	55.0	51.5	34.0			
11 PM						

Low UE — High UE

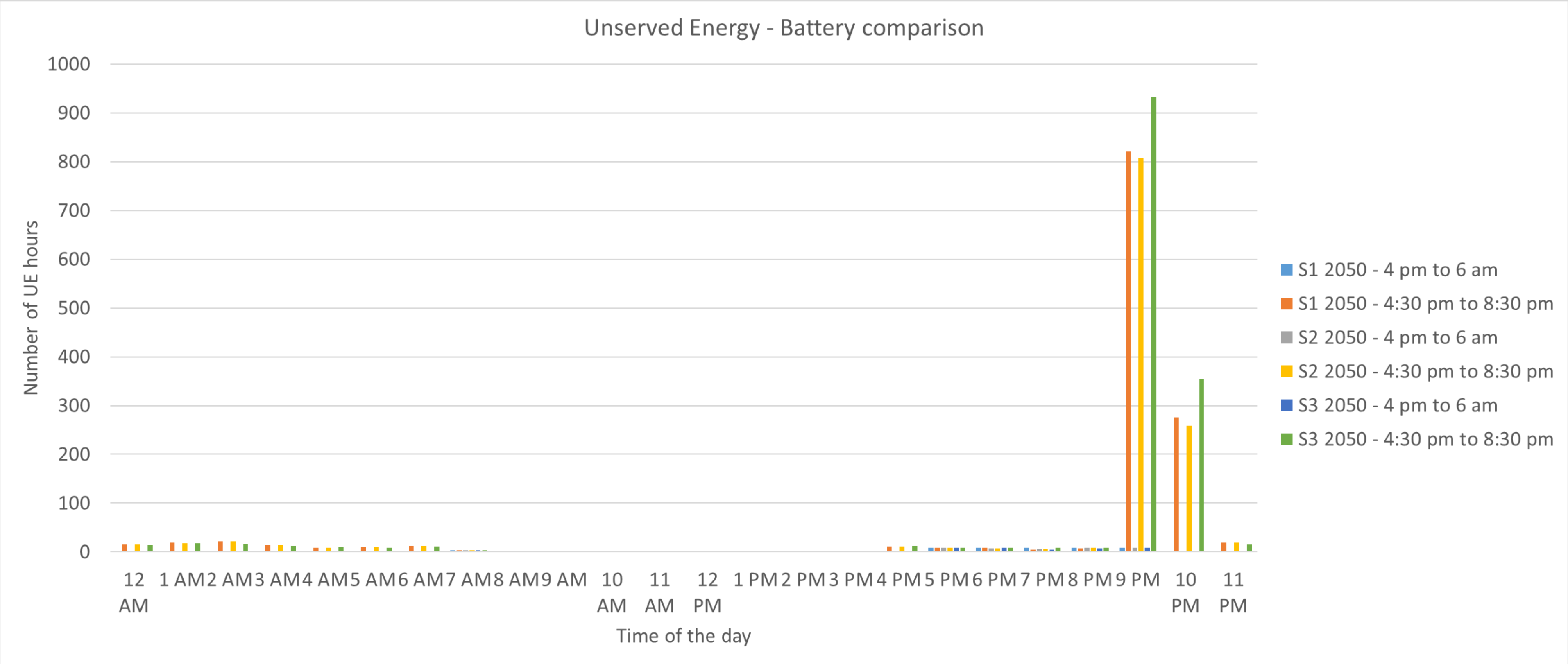
- The UE peaks at **9:00pm** in **2030**. This is because the battery reliability hours are between 4:30pm and 8:30pm and unavailability of battery leads to large UE.
- In **2050**, highest UE is experienced at **6:00pm** when the solar output is the very low and the demand is high.

Modelling Results – Measurements of Unserved Energy (2)





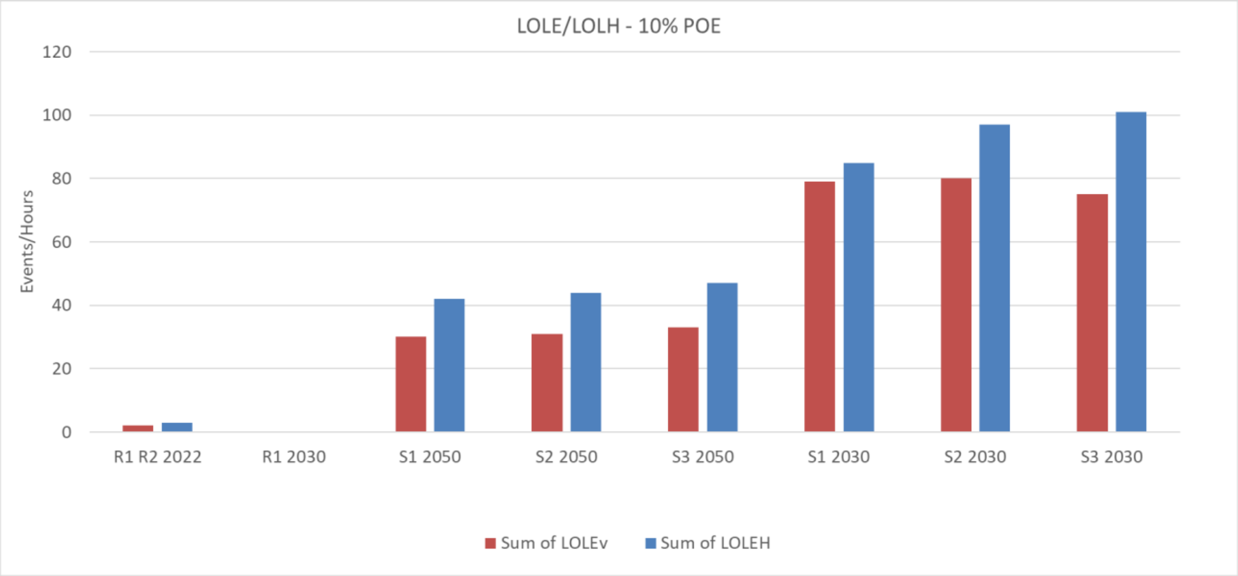
Modelling Results – Timing of Firming Resource – 50% POE

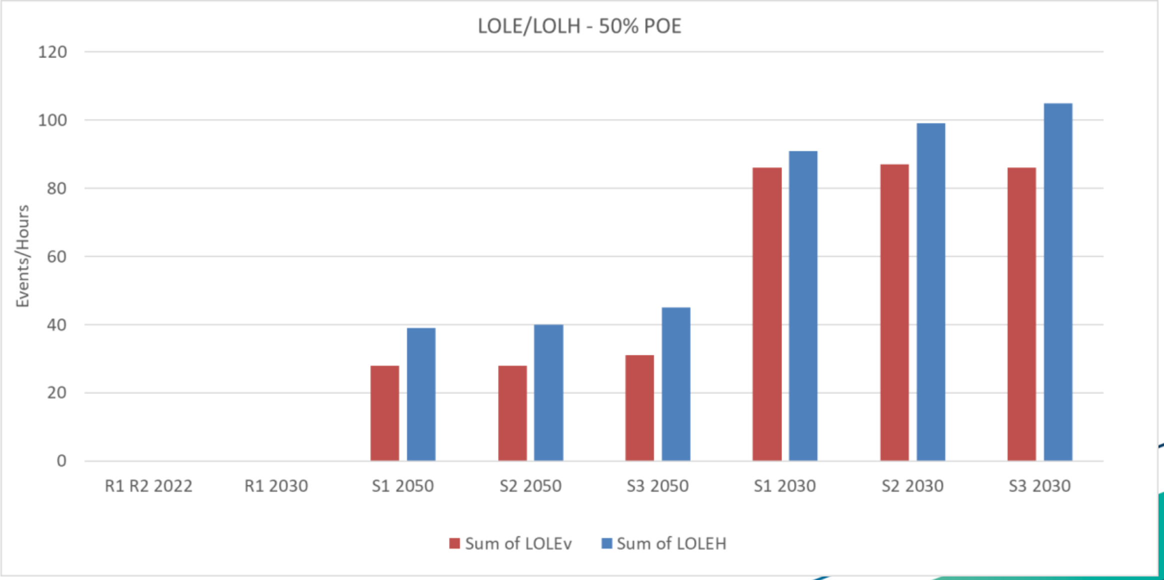


- If storage discharge periods are limited to the current RCM setting (4:30pm to 8:30pm), unserved energy occurs overnight in 2050 scenarios.
- Extending storage availability overnight prevents this.
- This indicates that capacity services are required for a broader range of hours in 2050.

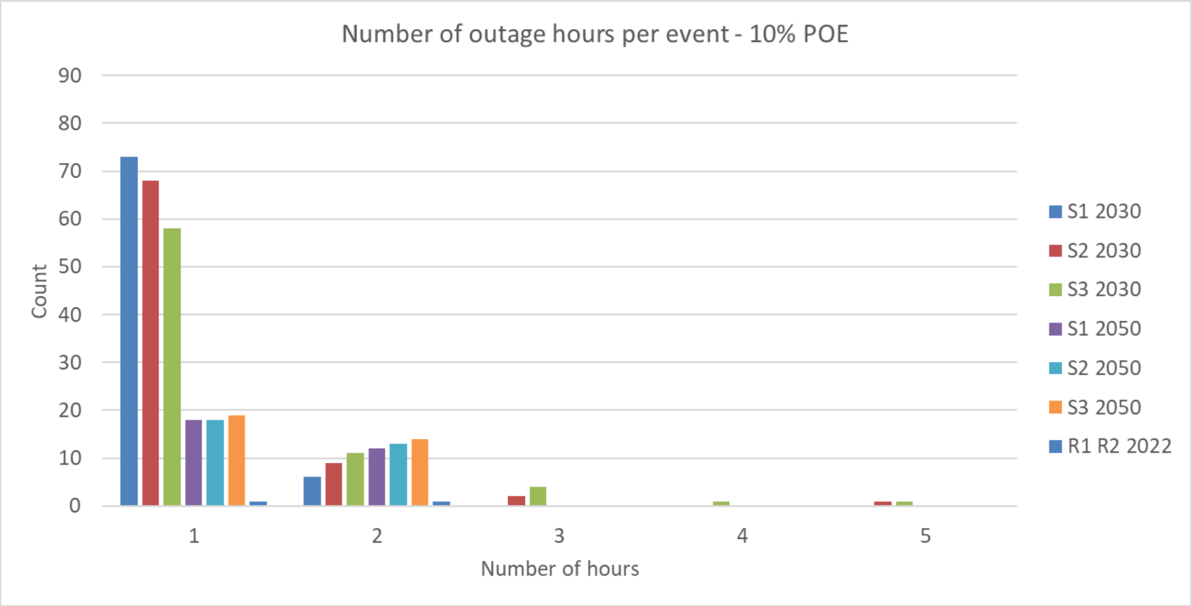
Modelling Results – Measurements of Unserved Energy

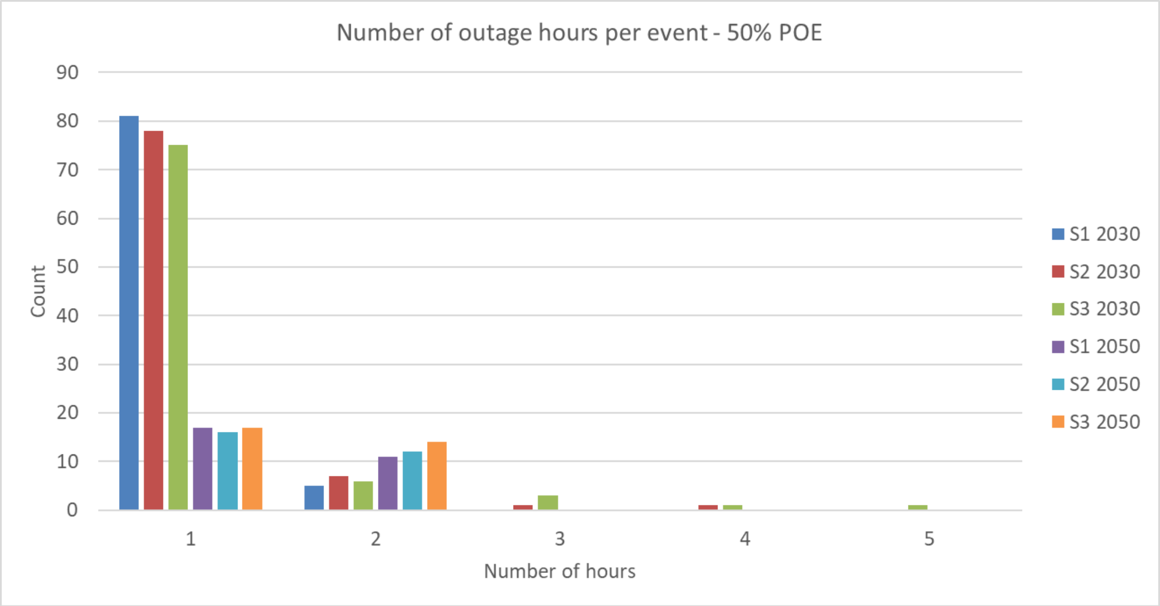
- Unserved energy at current reliability criteria levels represents a very small number of loss of load hours (LOLH) or events (LOLEv).
- Each LOLH can represent a very wide range of MWh outage quantities.
- UE remains the most nuanced measure of reliability impact.





Modelling Results – Outage Hours per Event





- Most outages are short – one or two hours – with a small number of outages up to 5 hours duration.
- The 50% POE cases have shorter, shallower events while 10% POE cases have slightly longer/deeper events.

7. Planning Criterion

Updated Planning Criterion for Peak Capacity Product

- EUE analysis shows that, with the flattening of the peak, we see loss of load events are short and shallow.
- This is consistent with retaining the first limb as a 10% POE peak exceedance measure.
- Using a loss of load event count would require that all but one event is covered per ten years, which would be more appropriate if analysis showed infrequent long and deep outages.
- No compelling reason to switch away from current peak exceedance measure.

Refined direction:

- Retain a two-limbed planning criterion for the peak capacity product
- Retain current peak load + reserve margin and EUE%.
  - Reserve margin set to at least the largest contingency.
  - If ICAP selected, reserve margin also to consider historic forced outage rate (per previous RCMRWG session).

New Planning Criterion Limb for Flexibility Capacity Product

Rules need to provide a method to determine a capacity target for the new flexible capacity product.

The system stress event that needs covering is the afternoon ramp – the “duck’s back”.

Propose that the capacity target for flexible capacity is based on:

- The maximum expected difference between the lowest expected operational load and the highest expected operational load on any day in the full year 10% POE load forecast
- Less the peak capacity product CCs assigned to intermittent facilities (capability class 3)

Operational load is key, because it excludes registered facilities – if there is a VPP of aggregated BTM PV, it can be dispatched to curtail in the middle of the day, and will not affect the operational load.

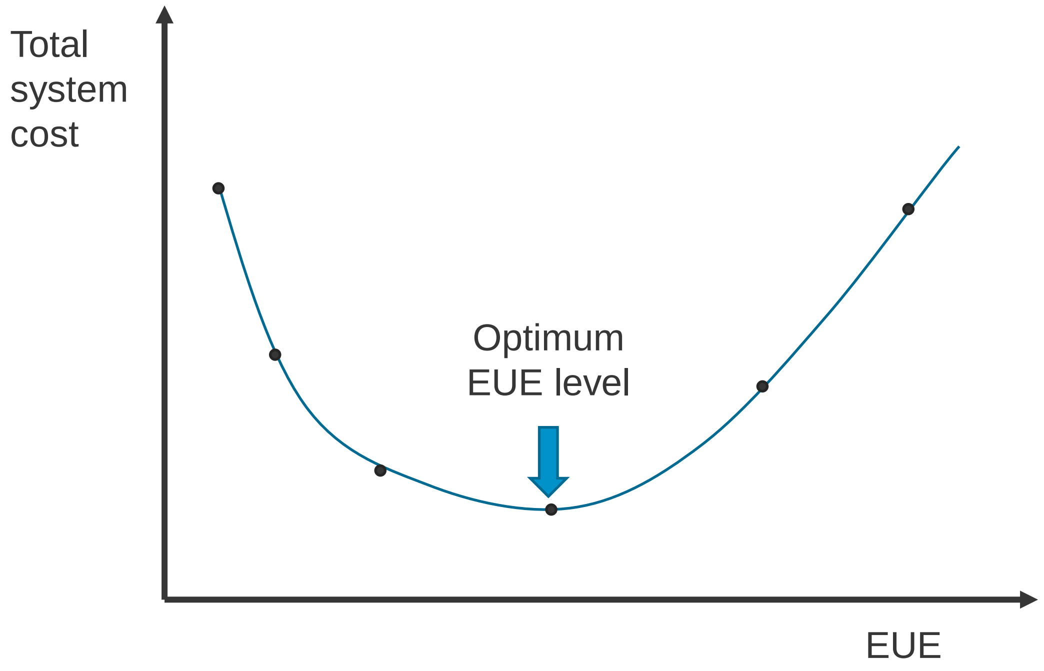
There may be sufficient flexible capacity among the fleet awarded peak capacity products. If so, this limb would be satisfied, and no additional flex service would be procured.

Recap: Approach to Revising the Planning Criterion

To determine an appropriate metric for each limb of the planning criterion, we need to explore the trade-off between higher reliability requirements and cost (noting that the outcome of the review should not erode the current reliability standard).

For the EUE limb the methodology would be as follows:

1. Determine the lowest cost new entrant technology (previous studies assumed an OCGT, could be PV + storage)
2. Determine a Value of Customer Reliability (VCR) for the SWIS (used Western Power value)
3. Perform system adequacy modelling (CAPSIM) with various levels of new capacity of the type determined in step 1 to determine the level of EUE (in MWh)
4. Determine total system cost at each level of new capacity, as EUE x VCR + cost of new capacity
5. Chart total system cost vs EUE, and determine the level of EUE at which minimum total system cost occurs.



8. Next Steps

Important Outstanding Items to be Resolved

- CRC allocation analysis (per previous WG meeting)
- Optimal EUE percentage (per slide 32).
- Pricing approach for flexibility product – ensuring correct incentives for flexible capacity.
- BRCP assessment for each capacity product (for discussion at next RCMRWG meeting).
- Economic impact modelling (per previous RCMRWG meeting).

Next steps

- **Continue analysis presented at previous working group session**
- **Next Working Group meeting mid July 2022**
  - Discuss BRCP approaches
- **Questions or feedback can be emailed to energymarkets@energy.wa.gov.au**

9. General Business

We're working for Western Australia.