Metropolitan Melbourne Voltage Management RIT-T

Project Assessment Draft Report Webinar

August 2024

We acknowledge the Traditional Custodians of the land, seas and waters across Australia. We honour the wisdom of Aboriginal and Torres Strait Islander Elders past and present and embrace future generations.

We acknowledge that, wherever we work, we do so on Aboriginal and Torres Strait Islander lands. We pay respect to the world's oldest continuing culture and First Nations peoples' deep and continuing connection to Country; and hope that our work can benefit both people and Country.

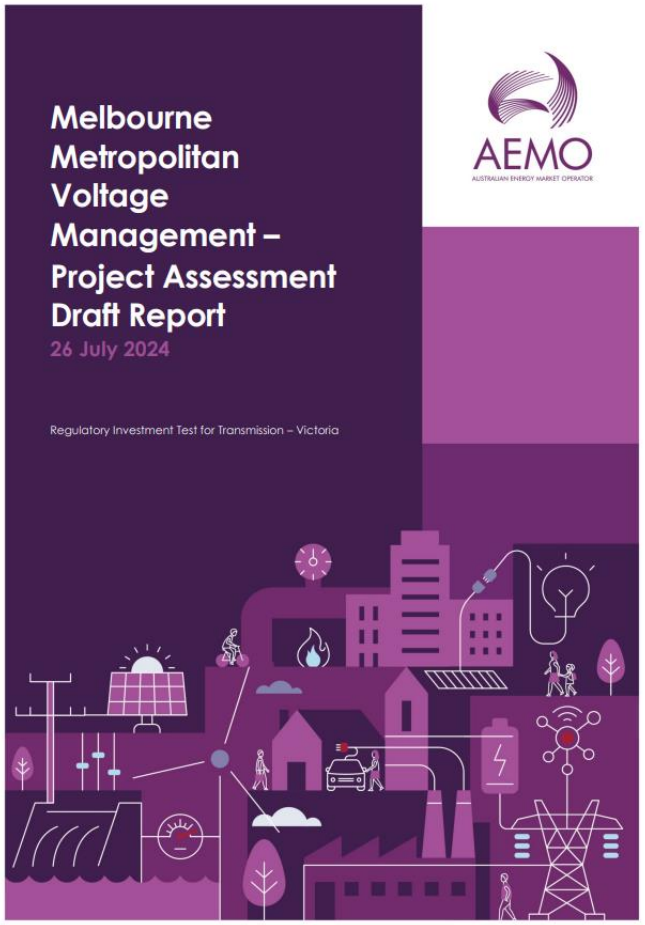
'Journey of unity: AEMO's Reconciliation Path' by Lani Balzan

AEMO Group is proud to have delivered its first Reconciliation Action Plan in May 2024. 'Journey of unity: AEMO's Reconciliation Path' was created by Wiradjuri artist Lani Balzan to visually narrate our ongoing journey towards reconciliation - a collaborative endeavour that honours First Nations cultures, fosters mutual understanding, and paves the way for a brighter, more inclusive future.

Read our RAP

Objective

The purpose of this webinar is for AEMO to summarise the Project Assessment Draft Report (PADR) and respond to questions.



The report is available here

Agenda

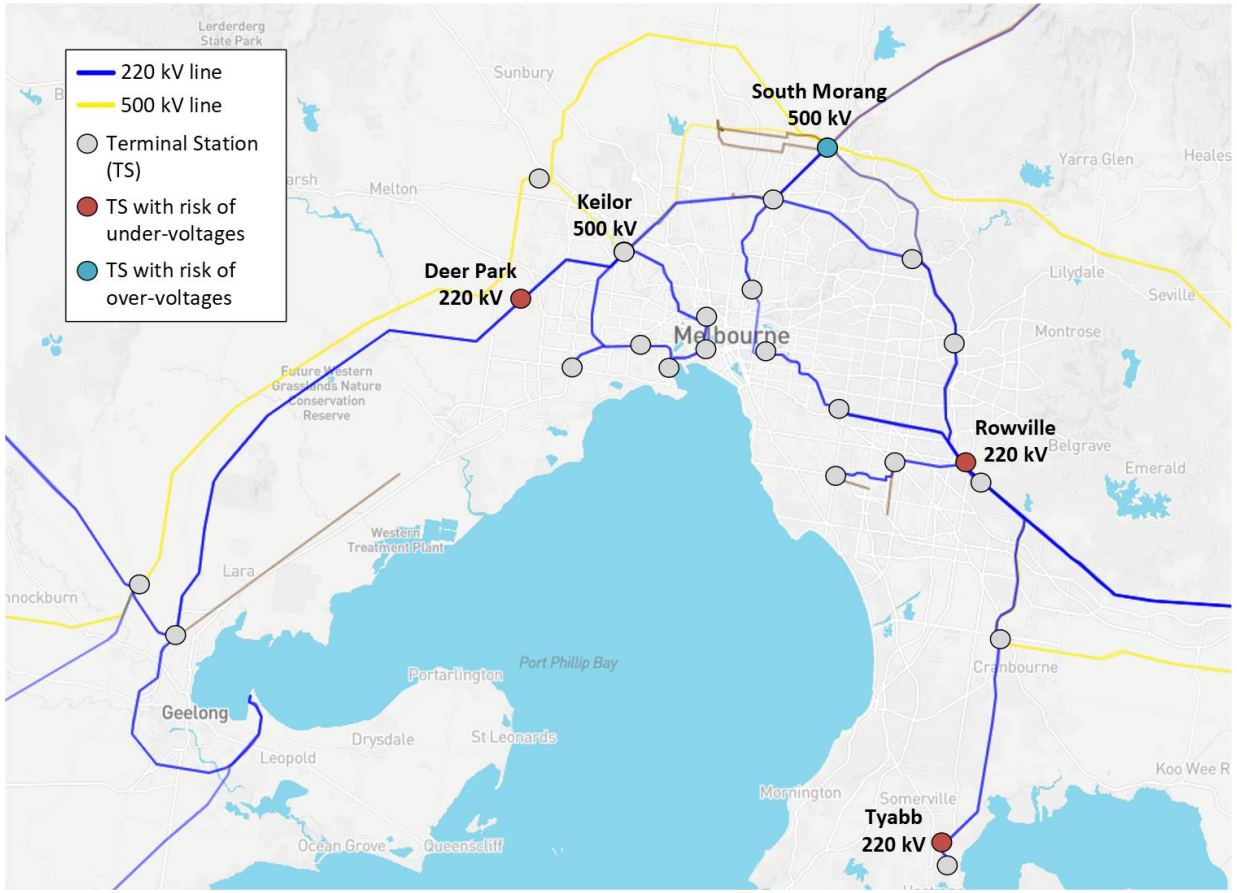
1. MMVM RIT-T Overview
2. Updates since the PSCR
3. Credible options
4. Inputs and Assumptions
5. Preferred option
6. Market benefits of preferred option
7. Indicative timeline
8. Questions and Answers
9. Next steps

Recap: Victorian Jurisdictional Planning Obligations for voltage management

- The NER requires AEMO Victorian Planning (AVP), as Jurisdictional Planner of the Victorian Declared Shared Network (DSN) to plan and design the DSN such that voltages:
  - Are maintained within +/- 10% of the normal voltage level except as a consequence of a contingency event.
  - For high voltages, following a credible contingency event, are managed within 10% of the normal voltage within 900 ms of the event
- Following a credible contingency event, low voltages are allowed to the extent of the NER to fall to zero.
- Many sites have limits tighter than the NER requirements due to site-specific limitations and the need to maintain voltage stability and quality of supply for downstream customers.

Recap: Objective of this RIT-T: to maintain voltages within limits in the metropolitan Melbourne area

- In metropolitan Melbourne, voltage limits are at risk of being breached in the next decade.
- There is both a risk of:
  - (Pillar 1) Under-voltage exceedances during high demand conditions
  - (Pillar 2) Over-voltage exceedances during low demand conditions
- AVP is undertaking this Regulatory Investment Test for Transmission (RIT-T) to identify the option/s that address these identified needs, at all sites, while maximizing net economic market benefits.
- Project Assessment Draft Report marks stage 2 of the RIT-T



New and updated assumptions since the PSCR

PSCR was published in October 2023 and was consulted on until 31 Jan 2024

Pillar 1:

- AEMO's transmission connection point forecasts of maximum operational demand have become available, strengthening the modelling for Pillar 1. In the PSCR, demand profiles from the TCPR 2022 forecasts were used then scaled to ESOO forecast.

Pillar 2:

- A control scheme minor augmentation became committed which amends the Keilor 500 kV over-voltage voltage limit for Pillar 2. (South Morang becomes the new critical site).

Common across both pillars:

- Additional committed/anticipated generator and battery connection projects have eroded some of the need identified in the PSCR.

Updated Identified Need Pillar 1: Need to manage under-voltages

Exceedances have been refined since the PSCR based on updated information in previous slide.

- Under-voltages arise when there is a shortage of capacitance in the network (i.e. reactive power demand outweighs reactive power supply).
- Low voltages may result in voltage collapse and may ultimately require load shedding if not remediated.
- Critical sites identified at:
  - Deer Park
  - Tyabb
  - Rowville

Critical Site	Low voltage limit	Possible post-contingent voltage level in next 10 years					
		2024-25	2025-26	2026-27	2027-28	2028-29	2033-34
Deer Park 220 kV	209 kV	Within limits	Within limits	Within limits	Within limits	209 kV	194 kV
Tyabb 220 kV	209 kV	Within limits	Within limits	Within limits	Within limits	Within limits	209 kV
Rowville 220 kV area	210 kV	Within limits	Within limits	Within limits	Within limits	Within limits	204 kV

Critical site	Equivalent absorbing reactive capacity to bring under-voltages within limits					
	2024-25	2025-26	2026-27	2027-28	2028-29	2033-34
Deer Park 220 kV	Nil	Nil	Nil	Nil	20 MVAr	95 MVAr
Tyabb 220 kV	Nil	Nil	Nil	Nil	Nil	30 MVAr
Rowville 220 kV area	Nil	Nil	Nil	Nil	Nil	55 MVAr

Updated Identified Need Pillar 2: Need to manage over-voltages

Exceedances have been refined since the PSCR based on updated information in previous slide.

- Over-voltages arise when there is excess capacitance in the network (i.e. reactive power supply outweighs reactive power demand).
- High voltages may result in damage to equipment, and may ultimately require distributed PV tripping, directing on of expensive generation, or transmission line de-energisation which could have adverse market consequences.

Critical site	System condition	High voltage limit	Possible over-voltage level (kV) in next 10 years					
			2024-25	2025-26	2026-27	2027-28	2028-29	2033-34
South Morang 500 kV	System normal	525 kV	525 kV	Nil	Nil	526 kV	530 kV	530 kV
Keilor 500 kV	System normal	525 kV	Nil	Nil	Nil	Nil	526 kV	526 kV
Sydenham 500 kV	System normal	525 kV	Nil	Nil	Nil	Nil	526 kV	526 kV
East metropolitan area 220 kV	Post-contingency	228 kV	Nil	Nil	Nil	Nil	229 kV	229 kV

Critical site	High voltage limit	Equivalent absorbing reactive capacity (MVAr) to bring over-voltages within limits					
		2024-25	2025-26	2026-27	2027-28	2028-29	2033-34
South Morang 500 kV	525 kV	15 MVAr	Nil	Nil	90 MVAr	215 MVAr	215 MVAr

First screening of feasible options

Option	Description
Widening operational limits	• Keilor 500 kV over-voltage limit – now being addressed through separate minor works, and therefore not forming part of the credible options tested. • Deer Park 220 kV under-voltage limit - currently requires additional Deer Park transformation or load response before limits can be uprated, making this currently not economical. Therefore, not forming part of the credible options tested. (Noting that uprating low limits doesn't apply to other Pillar 1 sites because these sites represent a broader issue across eastern metro Melbourne)
Installing additional reactive compensation capability	Including: • Capacitors • Reactors • dynamic plant such as SVCs, syncons, statcoms
Non-network options	Including: • Demand response (charging or discharging) • Additional reactive support from grid-connected generators or BESSs • Distributed PV reactive power support Two confidential submissions were received on non-network options and these were subsequently incorporated in the credible options tested.

Credible Options Tested

Option 1

- 220 kV capacitors
- 220 kV reactors

Option 2

- 220 kV capacitors
- 220 kV reactors
- committed non-network BESS voltage management service in eastern metropolitan Melbourne

Option 3

- 220 kV capacitors
- 220 kV reactors
- non-network BESS voltage management services at Deer Park 220 kV

Option 4

- 220 kV capacitors
- 220 kV reactors
- SVC (displacement of one cap and one reactors)

Inputs and Assumptions

Analysis undertaken over a 10-year period with market benefits extrapolated to end asset life

Discount rate of 7% aligned with the 2023 IASR

Generator half hour output traces from Draft 2024 ISP

Three scenarios considered and weighted in line with IASR:

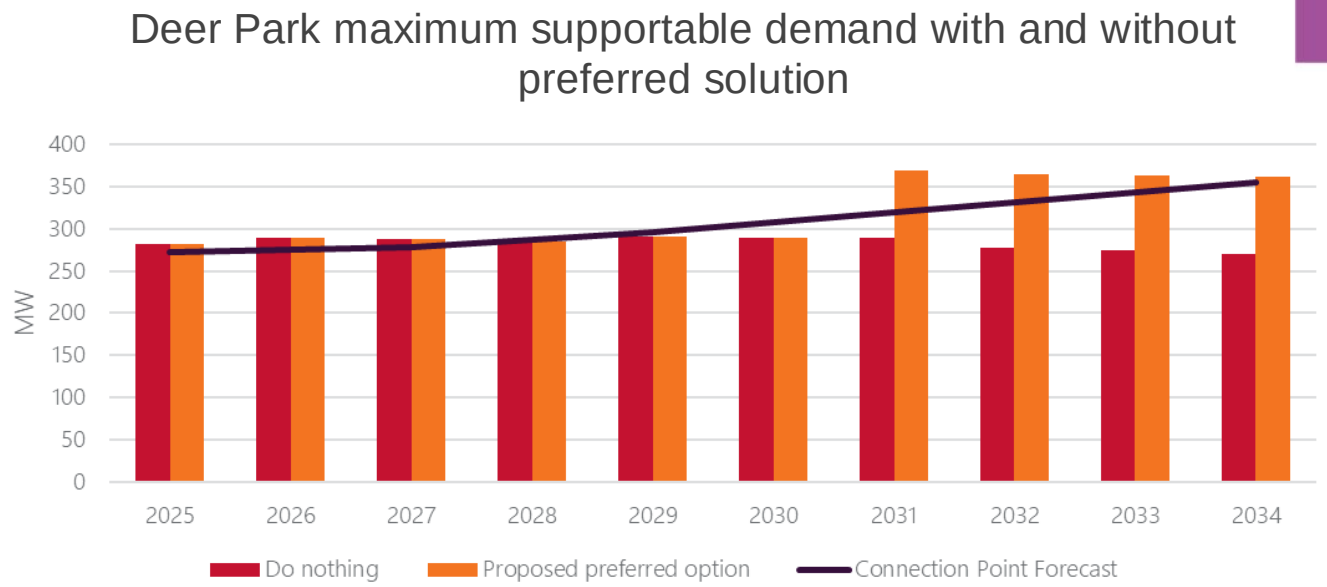
- Step change: 43%
- Progressive change: 42%
- Green Energy Exports: 15%

Demand forecasts reflect 2023 ESOO:

- POE10: 30.4%
- POE50: 39.2%
- POE90: 30.4%

Methodology for assessing credible options: Pillar 1

1. For each critical site, determine most effective load shedding block
2. Determine a maximum supportable demand in a do-nothing scenario
3. Calculate cost of unserved energy.
4. Apply credible option recalculate the cost of unserved energy and the change in value of emissions reduction
5. Compare costs/benefits of do-nothing case and each option case



Do nothing Pillar 1	Weighted outcomes									
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
USE costs ($M)	0.0	0.0	0.0	0.1	0.1	0.4	0.8	2.0	10.8	23.3
VER cost($M)	0.00	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.02	-0.04

Methodology for assessing credible options: Pillar 2

1. Calculate reactive power shortfall using operational demand, system strength minimum combinations, synchronous minimum output levels and renewable half-hourly traces.

Do nothing

2. Calculate the additional cost of starting-up and dispatching (including cost of emissions) additional generation to resolve shortfall

Credible option

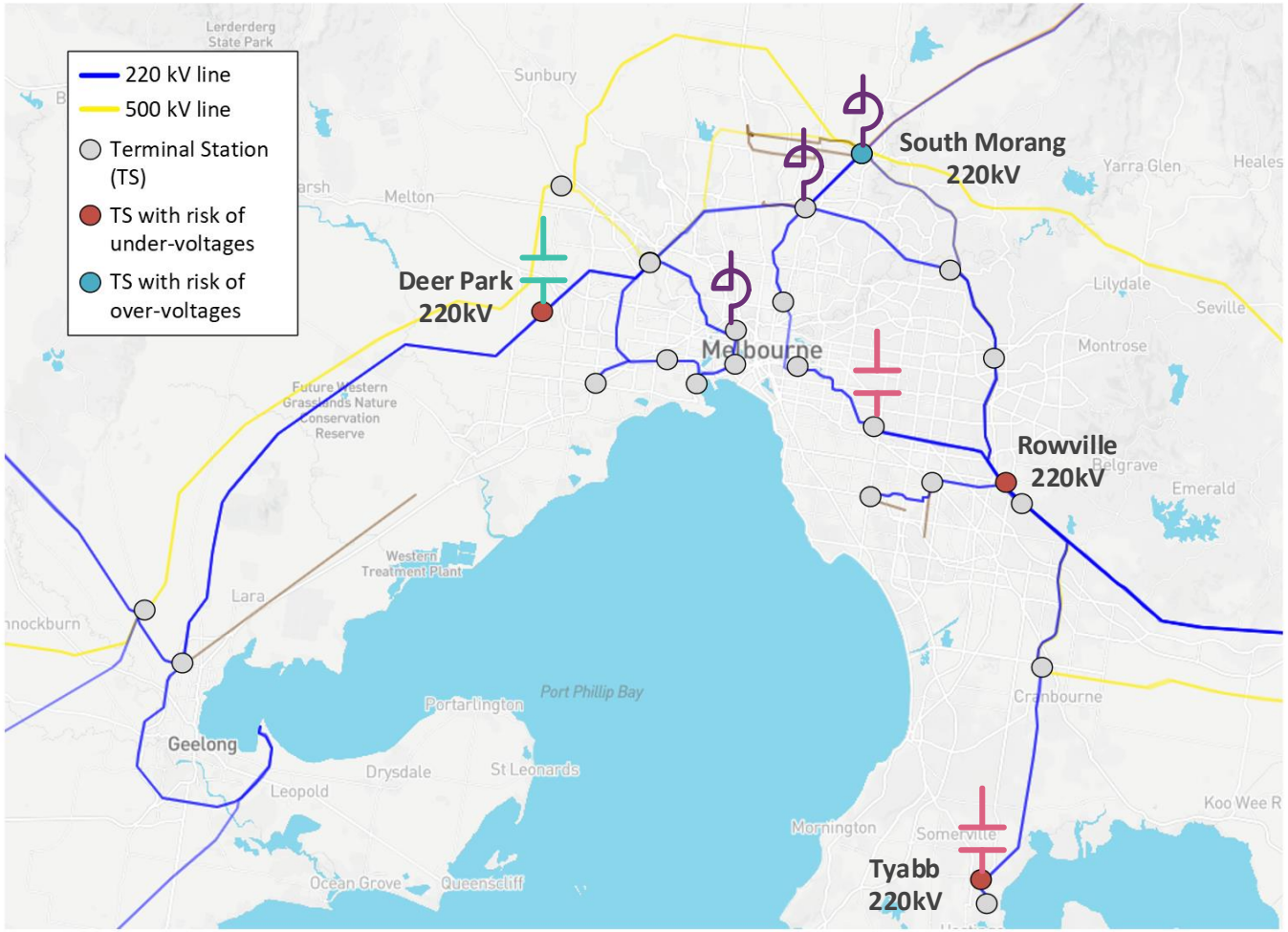
3. Calculate benefits of credible option by performing same process with the option in place and comparing with costs/benefits against the do-nothing case.

Option	Pillar 2 Weighted outcomes									
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Out of merit order start-up costs ($M)	0	0	0.00	0.04	0.13	0.26	0.41	0.40	0.52	0.57
Out of merit order dispatch costs ($M)	0	0	0.11	1.24	3.82	7.25	11.46	11.39	14.65	16.11
Displaced gen dispatch costs ($M)	0	0	0.00	0.02	0.08	0.15	0.24	0.24	0.30	0.31
Total costs associated with out of merit order dispatch of gas gen ($M)	**0**	**0**	**0.11**	**1.26**	**3.87**	**7.35**	**11.63**	**11.55**	**14.87**	**16.37**
Emissions costs associated with out of merit order dispatch of gas gen ($M)	**0.00**	**0.00**	**0.02**	**0.25**	**0.74**	**1.54**	**2.62**	**2.80**	**4.00**	**4.73**

Summary of market benefits

Option	Description	Total network MVAr invested	Capital cost ($M)	Combined Pillars weighted gross market benefit in NPV $M	Combined Pillars weighted net market benefit in NPV ($M)
Option 1 (Preferred)	Capacitors and reactors	600	45.6	285.9	256.4
Option 2	Capacitors and reactors, and non-network service in eastern metropolitan Melbourne	500 + Confidential MVAr support	39.2 + Confidential cost	284.1	Confidential (less than the net benefits in NPV for Option 1)
Option 3	Capacitors and reactors, and non-network option at Deer Park	400 + Confidential MVAr support	301.1	284.0	77.6
Option 4	Option 1 with one capacitor and one reactor displaced by one static VAR compensator (SVC) in 2029	450	57.3	286.8	246.2

Proposed preferred option



Stage 1:

- 1 x 100 MVAr shunt reactor at South Morang Terminal Station on the 220 kV level in 2029.
- 1 x 100 MVAr shunt reactor at Thomastown Terminal Station on the 220 kV level in 2029.
- 1 x 100 MVAr shunt reactor at West Melbourne Terminal Station on the 220 kV level in 2029.

Stage 2:

- 1 x 100 MVAr shunt capacitor at Deer Park Terminal Station on the 220 kV level in 2031.

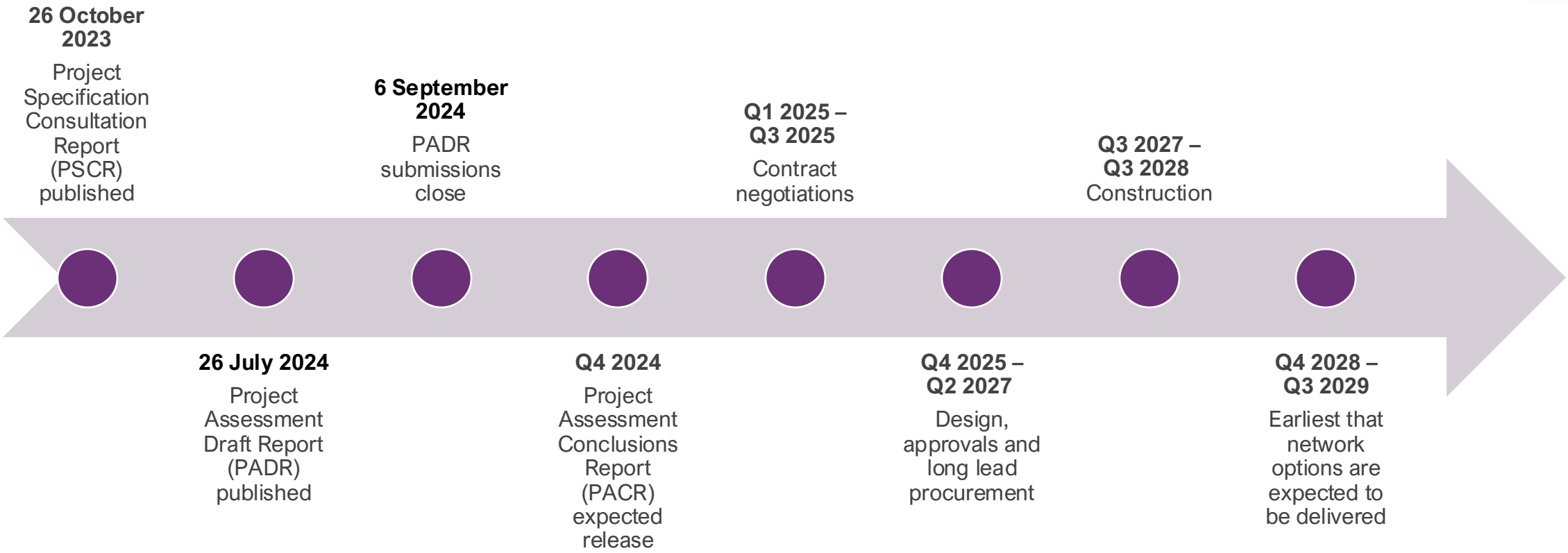
Stage 3:

- 1 x 100 MVAr shunt capacitor at Malvern Terminal Station on the 220 kV level in 2034.
- 1 x 100 MVAr shunt capacitor at Tyabb Terminal Station on the 220 kV level in 2034.

The proposed preferred option has a capital cost of approximately $45.6 million (in present value terms)

The PADR analysis identifies that investing in this option will deliver a net present economic market benefit of approximately $256.4 million

Indicative Timeline



Question & Answers

Add your questions to the MS Teams Chat.

Questions are not considered as submissions to the PSCR.

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Next Steps

- PADR consultation closes 6 September 2024.
- Make any submissions or queries to AVP_RIT-T@aemo.com.au
- Submissions will be considered in the PACR, which will confirm the preferred option and timing.

AVP continues to welcome submissions to this RIT-T in the consultation period from 26 July to 6 September, particularly on network or non-network options that may refine the proposed preferred option between now and the next and final stage of this RIT-T, the PACR.

For more information visit

aemo.com.au