Port Kembla Pumped Hydro benefits;

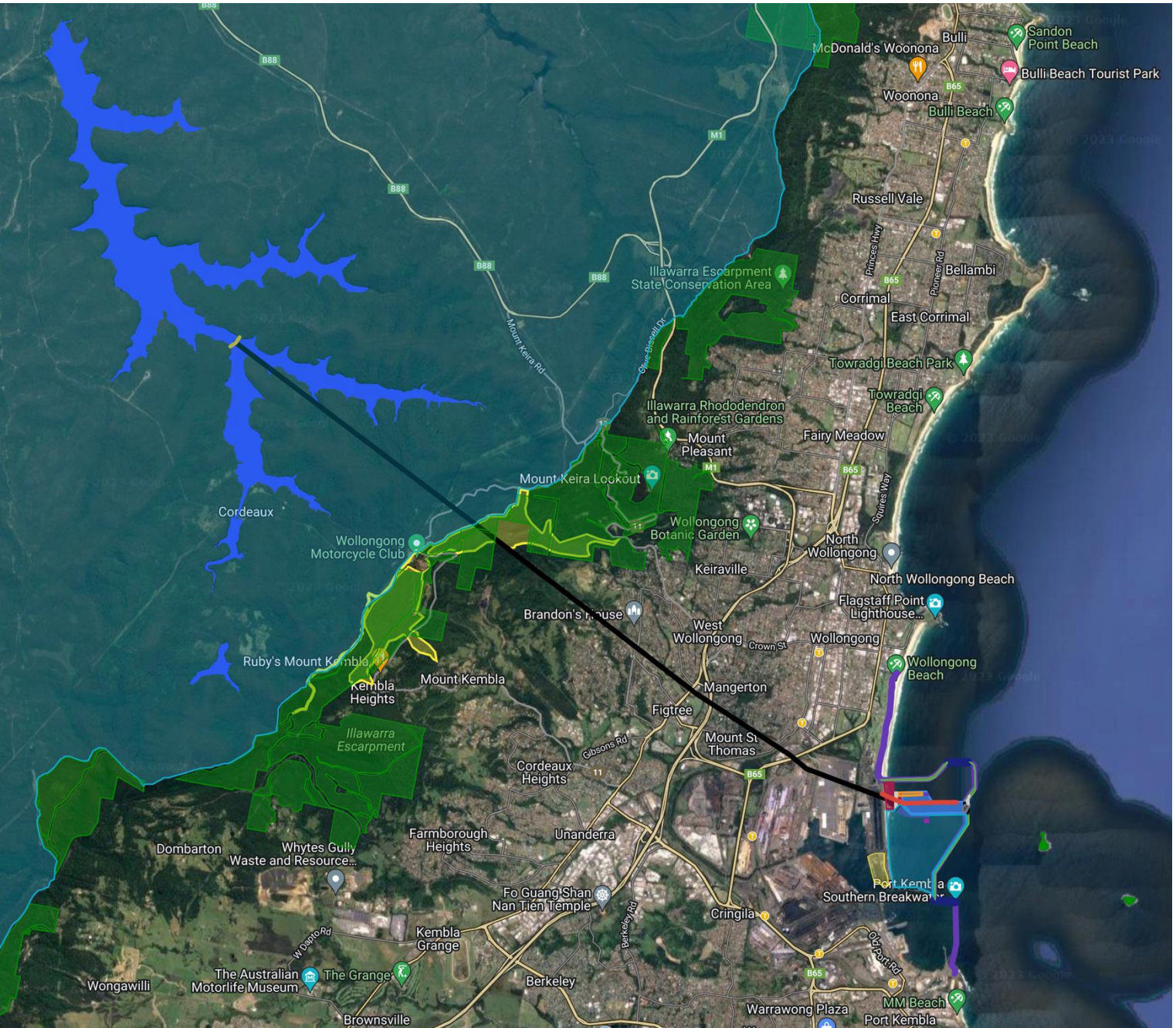
- Energy security and firm power for decarbonisation
- Water security and flood mitigation
- Clean industry growth
- Community

https://mc2.au/

Engineering options consultants reports complete;

Pumped Hydro,
Lower reservoir and port,
Environment
Project management
Initial grid transmission study for Illawarra REZ
Financial analysis

mc² Energy



Port Kembla Pumped Hydro

mc² Energy GHD ILF CONSULTING ENGINEERS AMOG

2 GW, 35 GWh or 17.5 hrs at max capacity

Port Kembla Pumped Hydro utilizes the existing Cordeaux reservoir, at 300m elevation. It will connect to a new lower freshwater reservoir created in the ocean adjacent to Port Kembla Coal Terminal.

The large diameter tunnel connecting the two reservoirs will have a new underground powerhouse for six reversible pump-generator turbines.

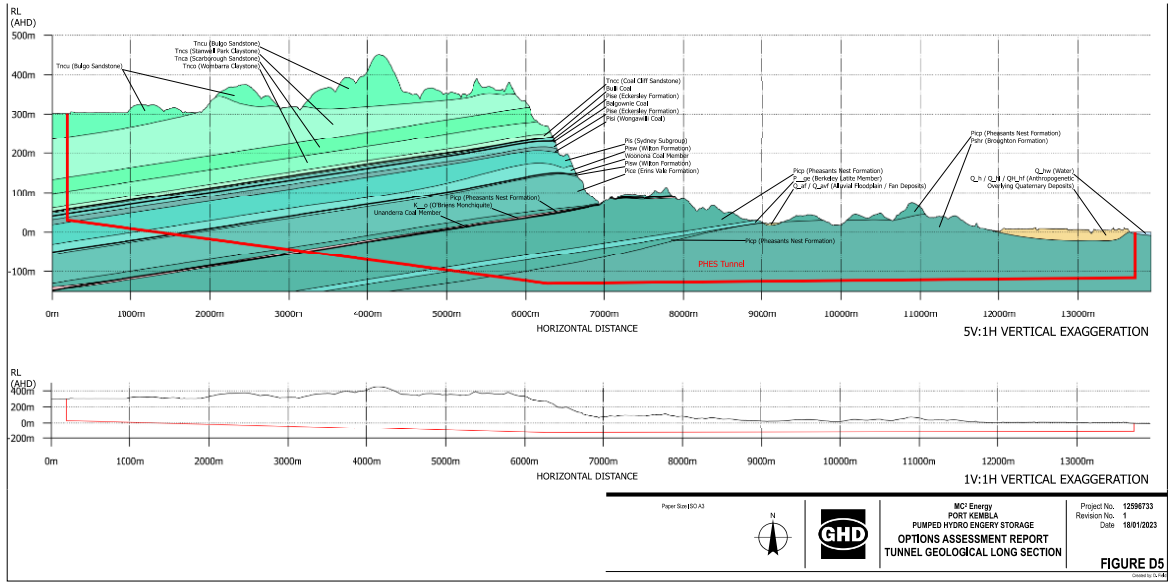
Port Kembla Pumped Hydro

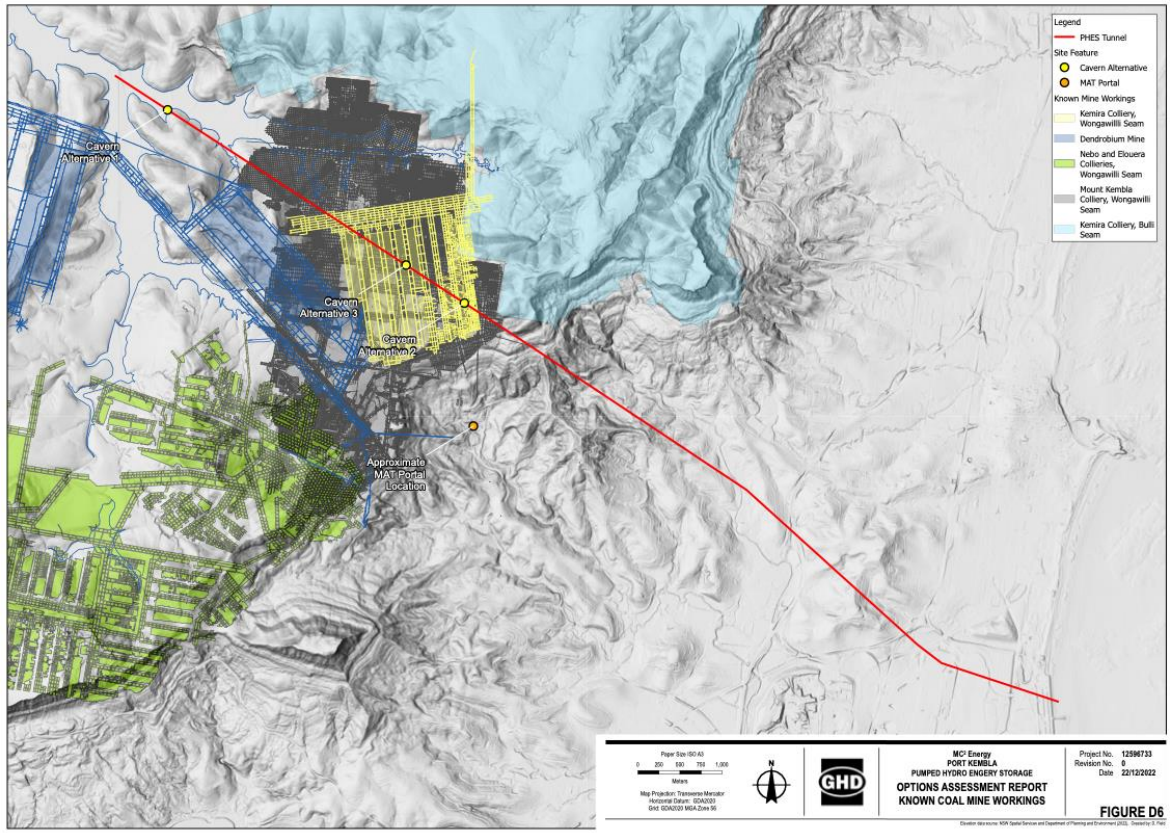
Options studies

2 GW, 35 GWh or 17.5 hrs at max capacity

6 options considered, with the preferred;

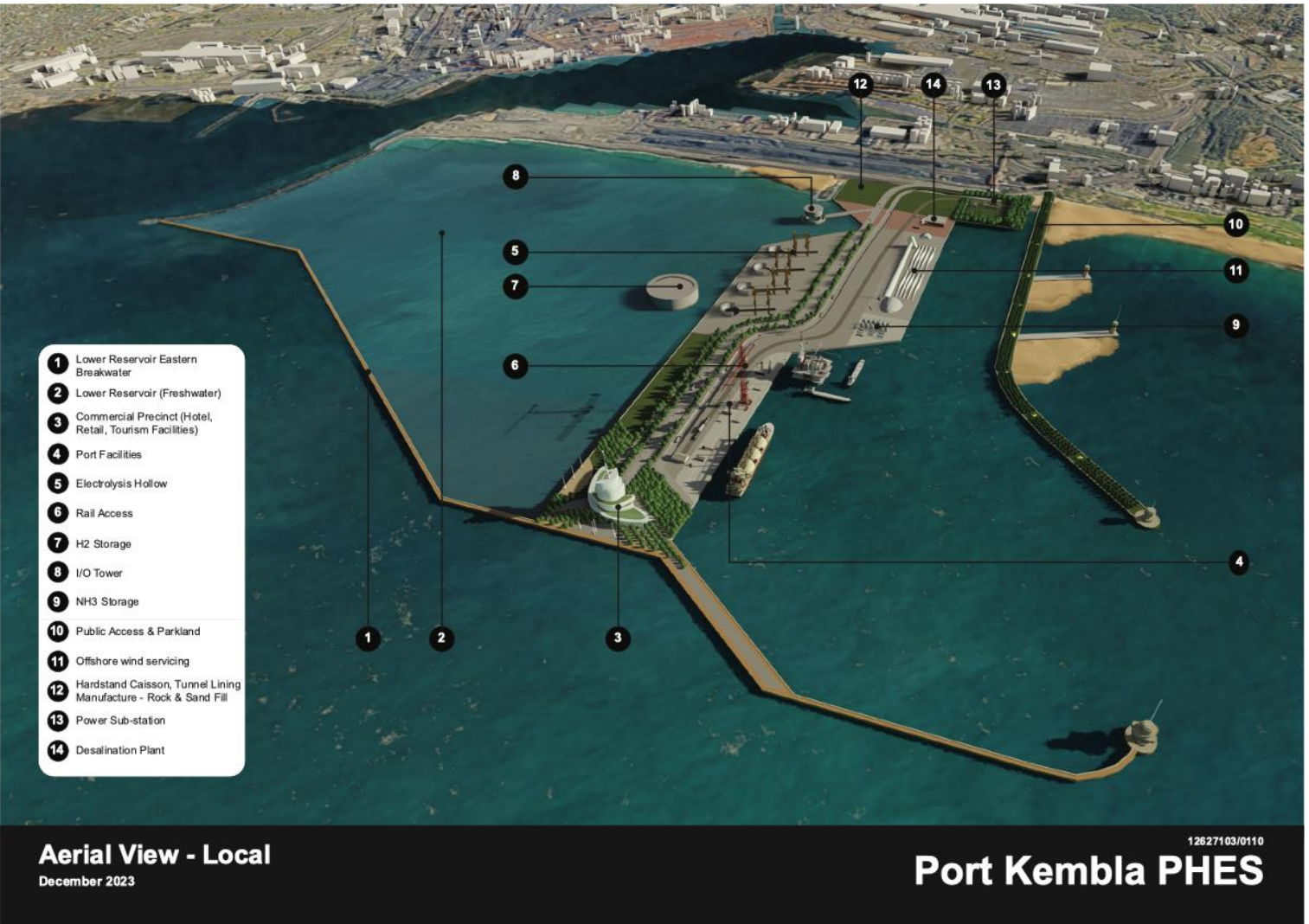
- Single large tunnel at 15m diameter
- Turbine cavern under escarpment
- Large flow rate ~800 m^3/s, 2,880 ML/hr
- Capital cost estimate $6 bn Pumped Hydro
- Capital cost estimate $2.5 bn Port & Lower res
- 10 years to complete





Why does energy storage matter to the Illawarra ?

Construction of the reservoir and port allows a development space of up to 90 ha with multiple levels below sea-level at the Eastern end -25m AHD.



Original use concepts for PKPH (2023)

Large energy storage 2GW 35GWh to provide low-cost flexible, firm power to industry and community

Provision of FCAS (Frequency Control Ancilliary Services) + System Strength, Inertia, System Security

High-capacity power transmission network connection for offshore wind to Sydney and local industry

Deep water port facilities to support;

- Offshore wind
- Clean fuels production, storage and export eg. H_2 NH_3

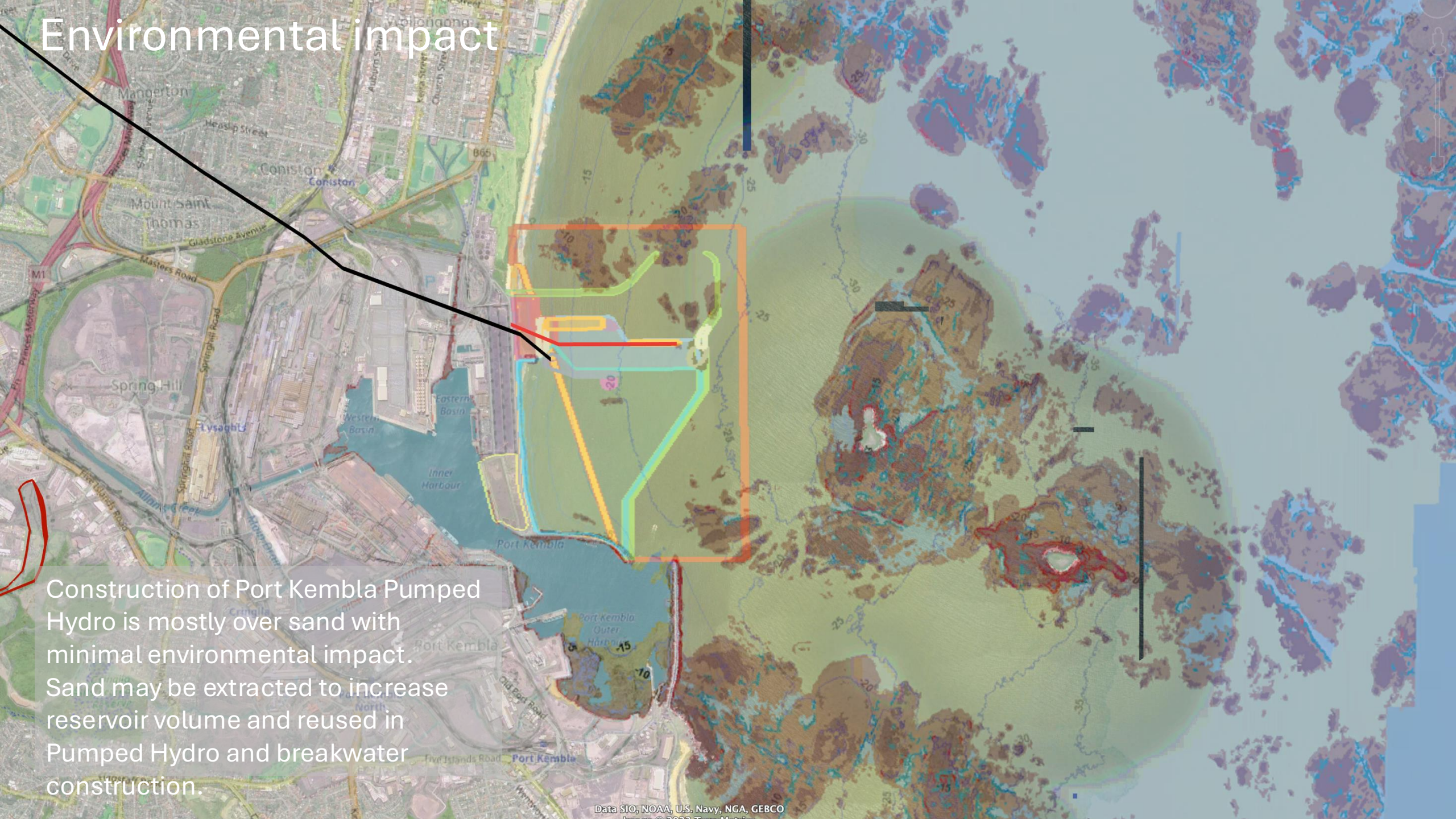
Green iron production to feed steelworks

Seawater desalination to augment Sydney's growing demand

Creation of new public spaces for recreation, commercial and industrial development around lower reservoir

Creation of new recreation and education facilities near Cordeaux reservoir with public connections (bike paths, walking tracks) around upper reservoir

Environmental impact



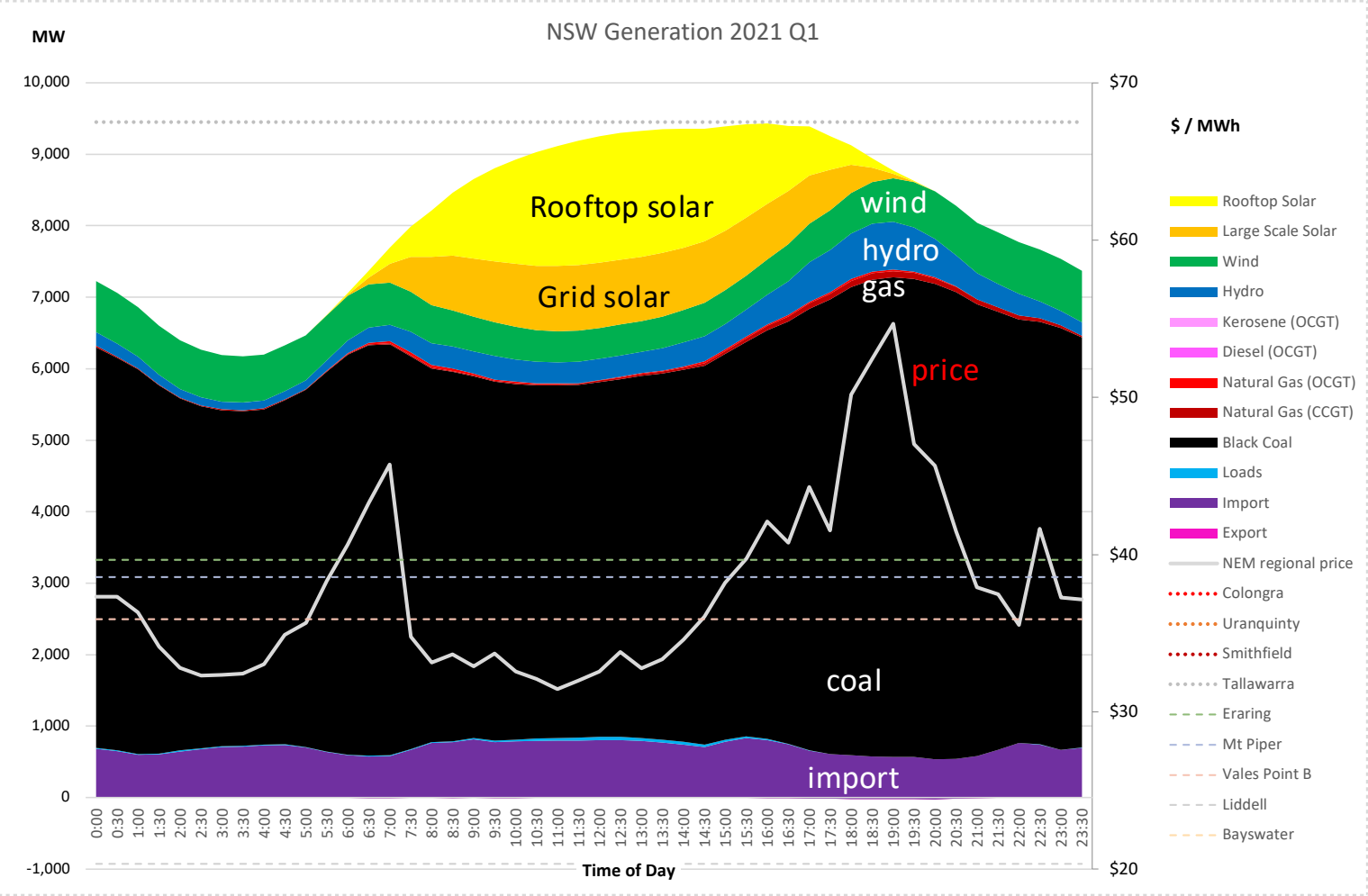
Construction of Port Kembla Pumped Hydro is mostly over sand with minimal environmental impact. Sand may be extracted to increase reservoir volume and reused in Pumped Hydro and breakwater construction.

Wholesale electricity prices in the National Electricity Market (NEM) are set by supply and demand.

The major components of the NSW energy transition to renewable energy plus storage will be complete by 2040.

NSW Time-of-Day generation mix Q1 2021

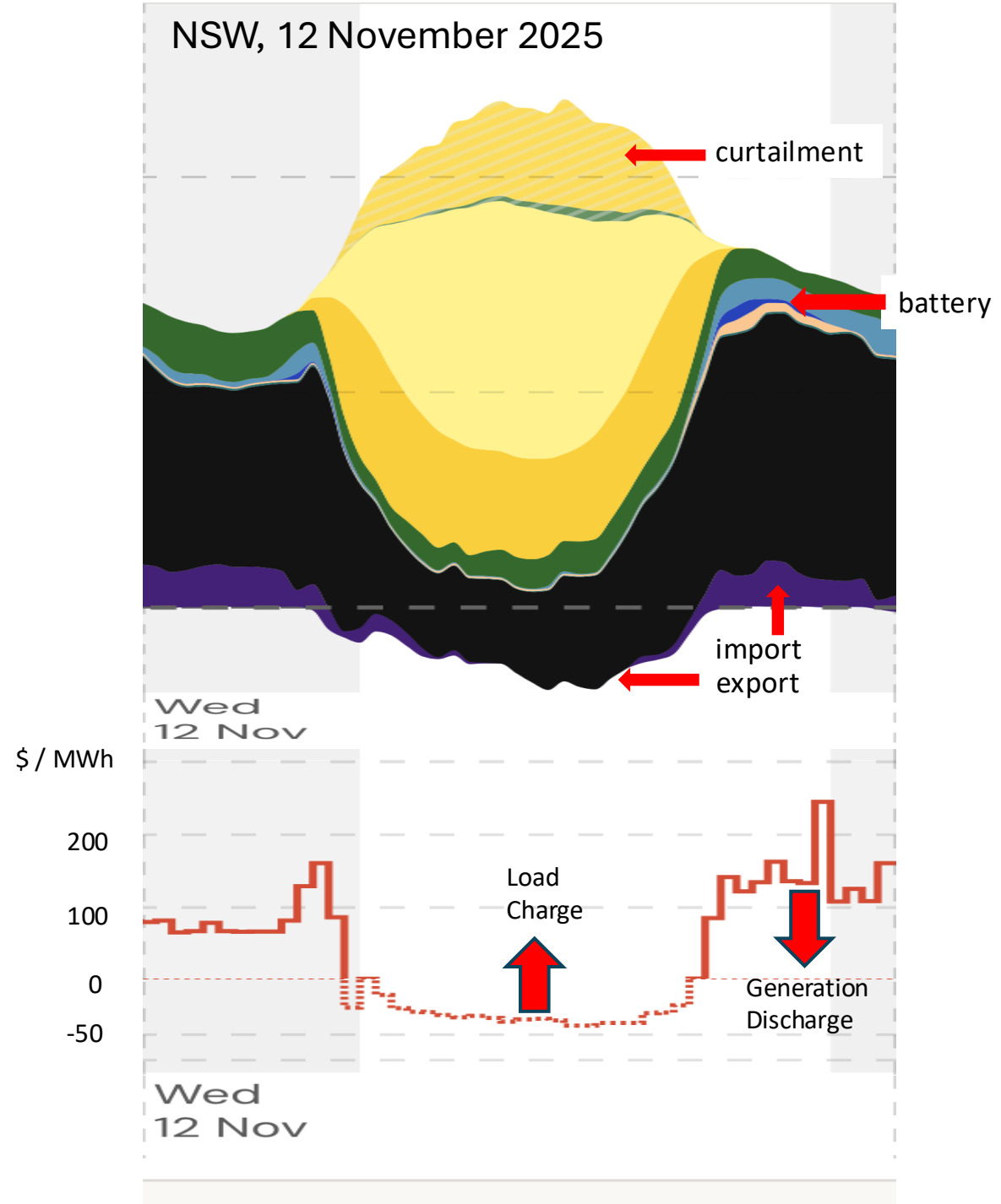
source: AEMO QED



Average NSW Time-of-Day Fuel Q1 2021

Coal dominates completely,
with around 800MW imported from QLD

Renewables have a small effect on ToD price
$30 - $55/MWh in 2021



Energy storage

Power = instantaneous measure of electricity in watts
ie gigawatts GW or 1,000,000,000 watts

Energy = the continuous delivery of power for a time period, hour
ie an amount of energy or a gigawatt hour GWh

Capacity factor = % of time operating at maximum capacity
PKPH 10% CF = 2.0 GW x 2.4hrs = 4.8 GWh

Arbitrage Revenue = average price $ per MWh x average daily generation 4,800 MWh x 365 days

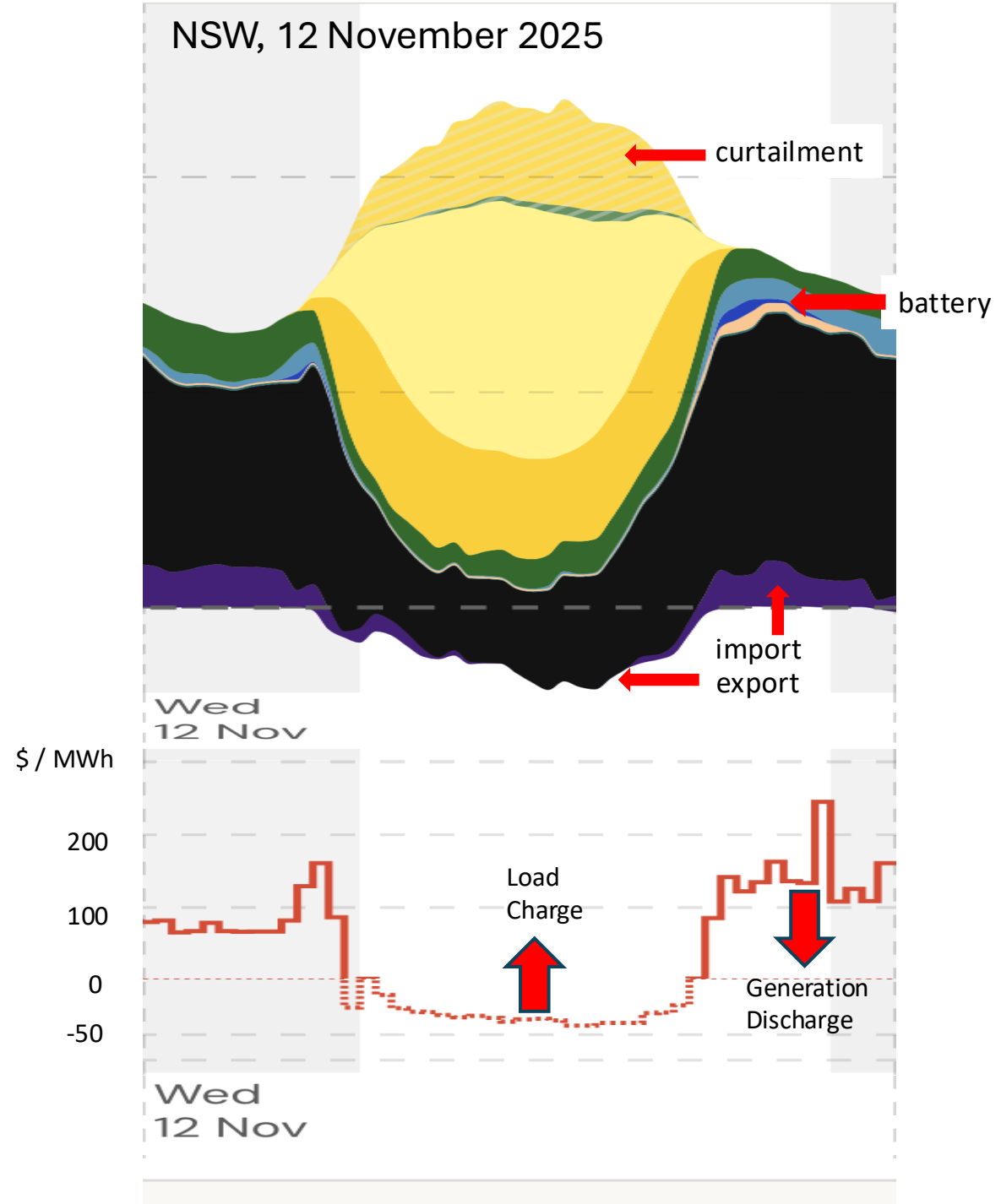
Curtailment = forced shut off by Australian Energy Market Operator (AEMO) from NEM
Because grid supply must = grid demand

A large Pumped Hydro has a large price effect ;

- **increasing daytime prices by buying electricity for pumps**
- **decreasing peak & nighttime prices by selling electricity**

However, this reduces the arbitrage revenue for investors, making investment unattractive

Consumers benefit at investors expense



National Electricity Market (NEM)

All generators wish to maximise revenue.

All generators receive the same price as the marginal generator ie the highest price bid to meet demand.

A large integrated energy company with coal, gas, hydro, and battery assets can restrict supply of flexible (marginal) generation (gas, hydro, battery,) to drive price higher

A large Pumped Hydro has a large price effect ;

- **increasing daytime prices by buying electricity for pumps**
- **decreasing peak & nighttime prices by selling electricity**

This effect has a large benefit for consumers lowering prices when energy is scarce, avoiding extreme 100x prices up to $20,000 / MWh

Regular daily operation of a large Pumped Hydro provides abundant power when it’s needed, keeping price low

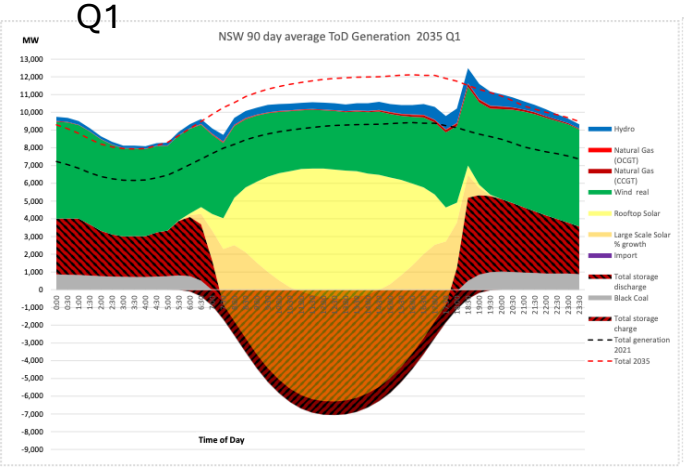
To achieve grid stability and security it is necessary to absorb excess solar and wind in the middle of the day and generate that power in the night to replace coal generators. This is a fundamental change from a peaking market to a time shift market.

NSW 2035 AEMO Integrated System Plan (ISP) data scaling projections for solar, wind uptake and coal closure.

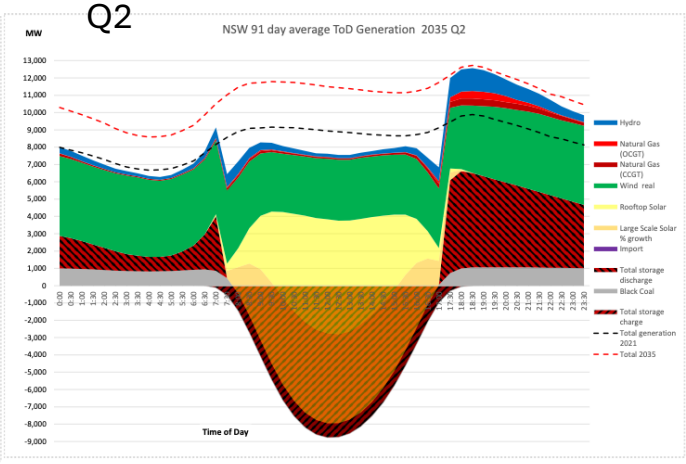
The required energy storage (GWh) is estimated by scaling % increase or decrease from 2025 time of day profiles to meet 2035 demand.

NSW NEM 2035

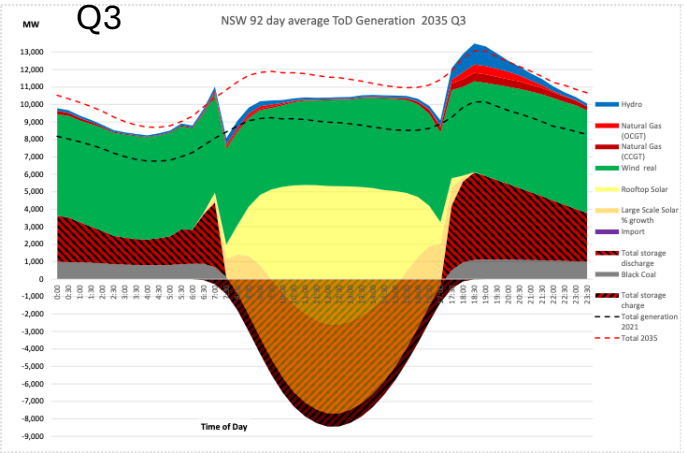
Q1



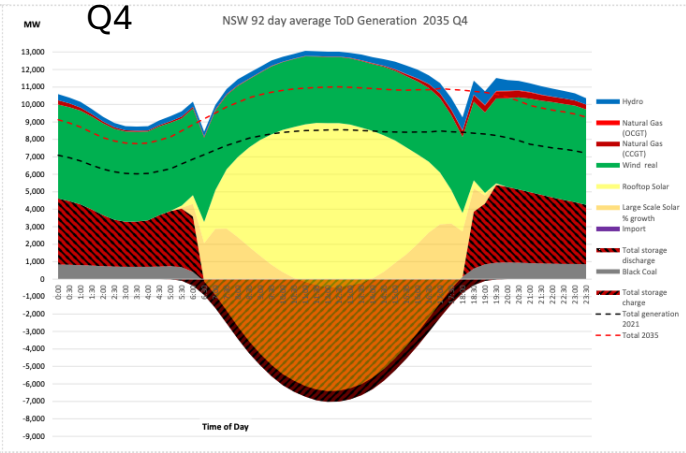
Q2



Q3



Q4



Averaging over a quarter (90 days) smooths out frequent daily extremes

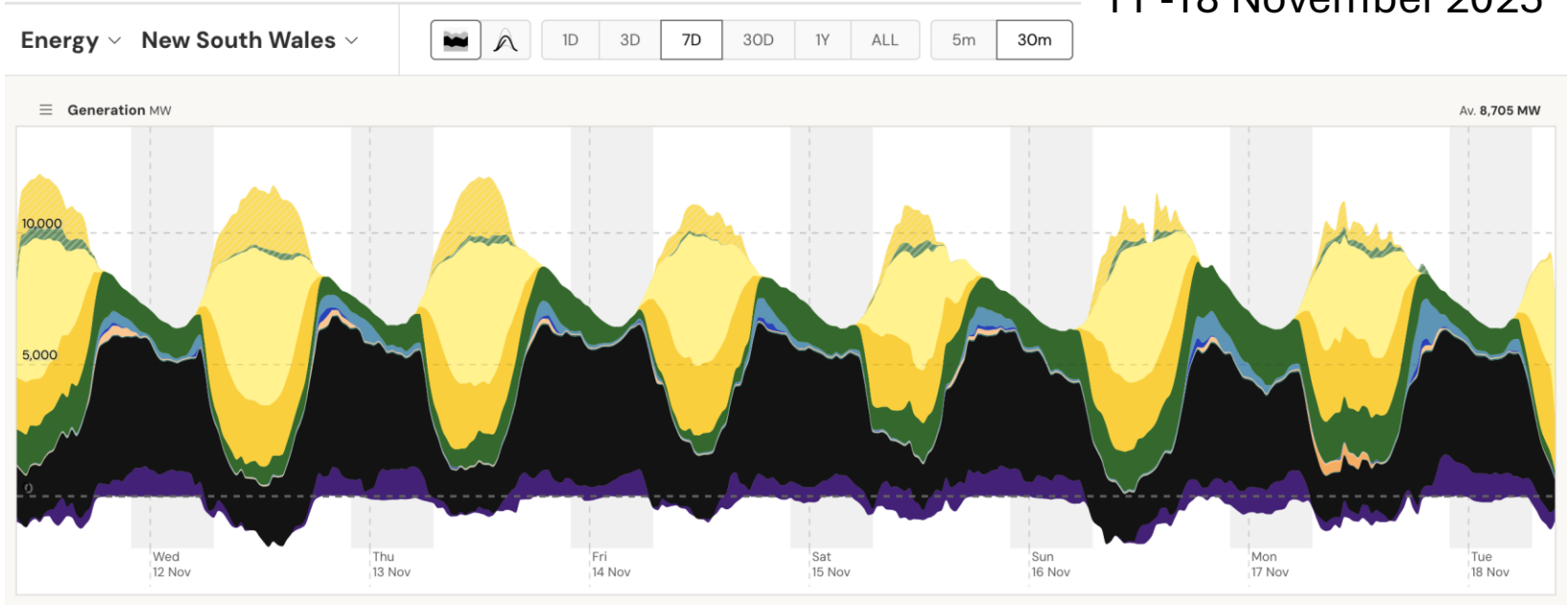
Seasonal variation shows a strong Winter Q2 deficit of solar & wind generation requiring greater energy storage

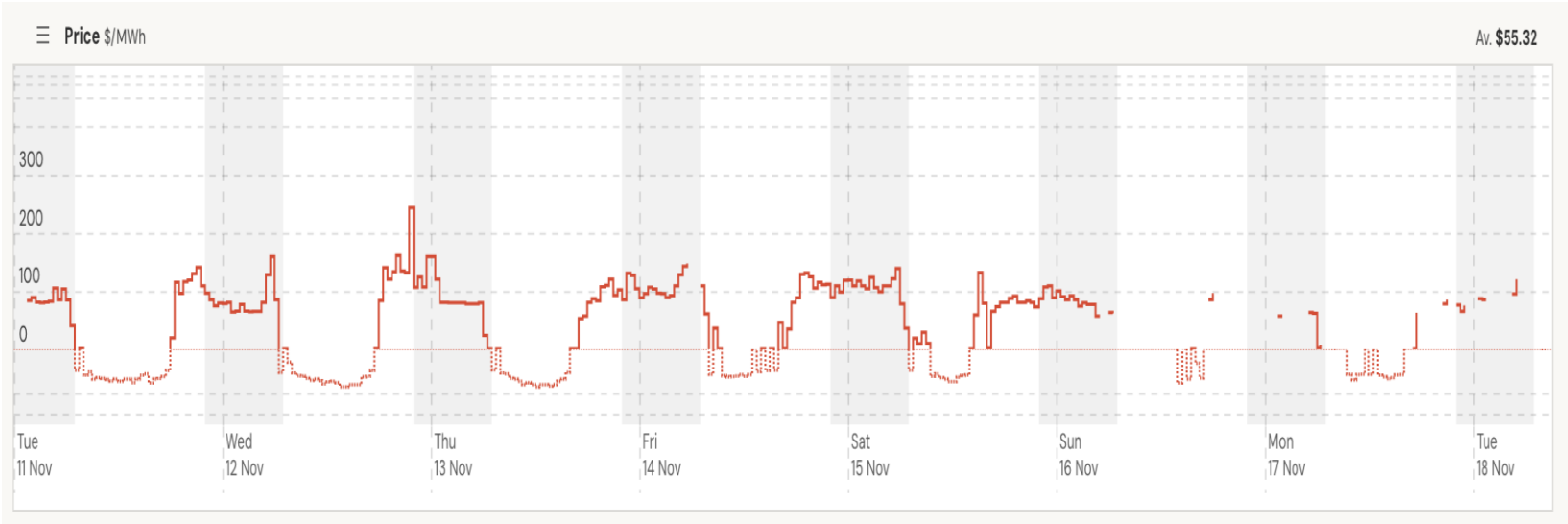
Only Spring Q4 shows a projected energy surplus

Demand growth coming from new data centers, industrial loads (Aluminium, Iron, Ammonia, Hydrogen), transport (EV charging 20% increase) and household electrification will require a much greater build of solar, wind and storage than anticipated in the ISP.

Open Electricity

11 -18 November 2025





-ve daytime prices

Large curtailment of solar by forcing coal onto grid

Rooftop solar expected to be curtailed (backstop) by 2028

Nighttime import from QLD VIC

NSW NEM 27 November – 4 December 2025 Average Summer Week (24hr) Curtailment 6.8% (24hr)

Open Electricity

Tracker Facilities Scenarios Records Analysis About

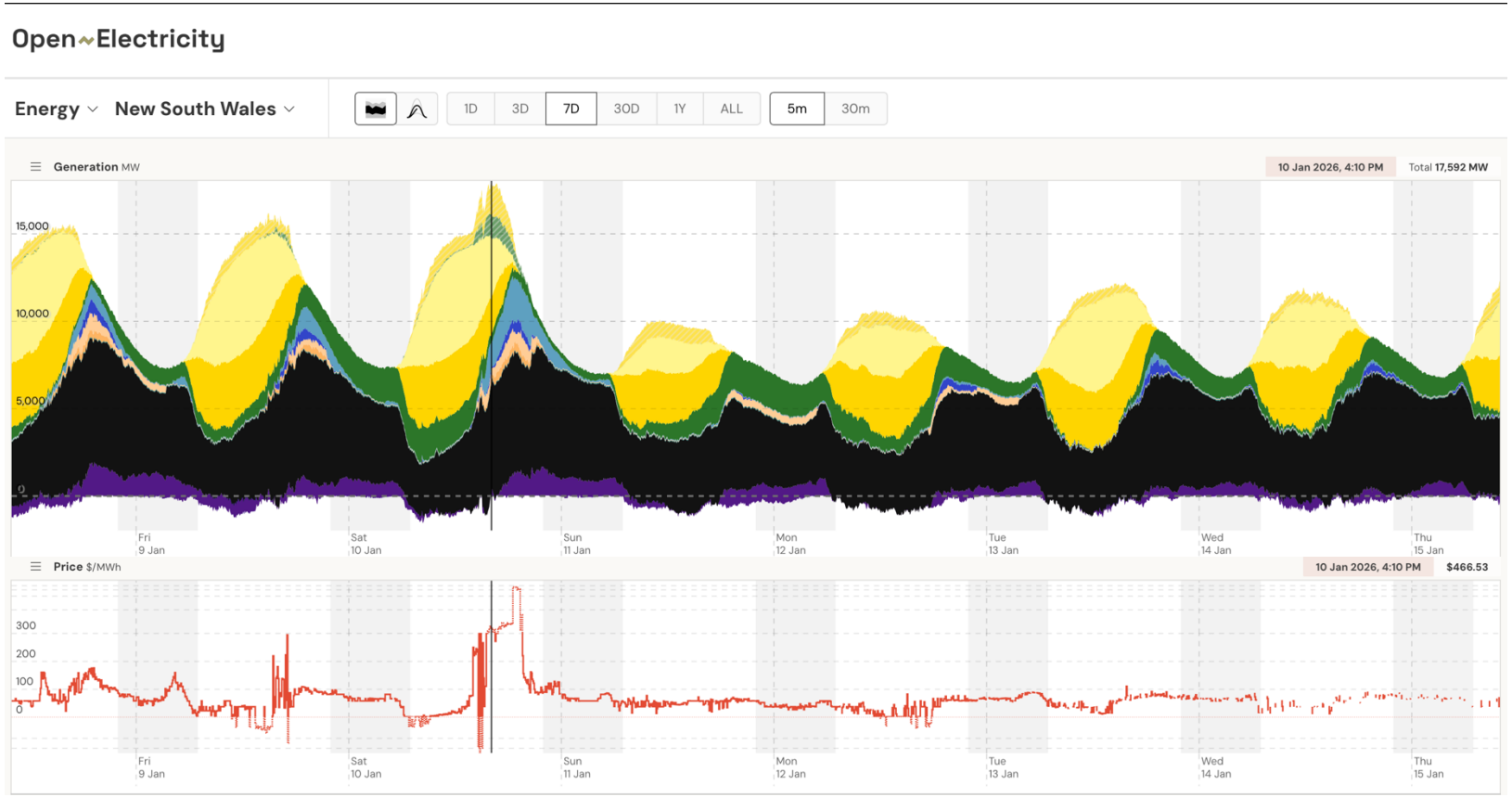
Consumption

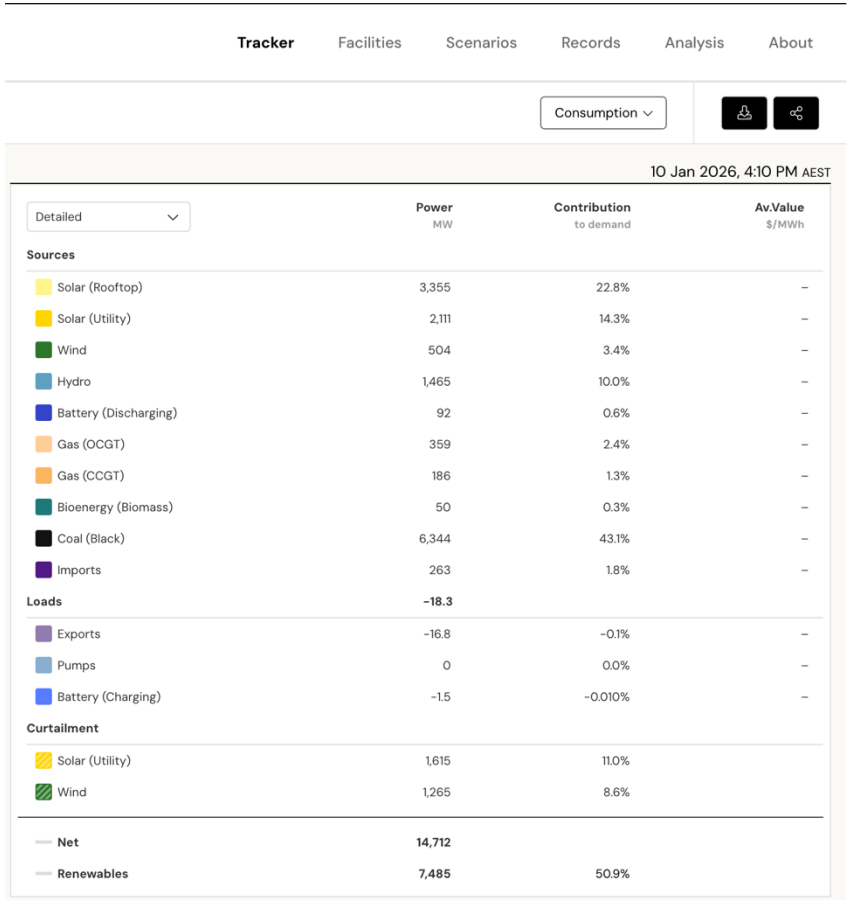
27 Nov 2025, 10:00 AM – 4 Dec 2025, 10:00 AM AEST

Detailed	Energy GWh	Contribution to demand	Av.Value $/MWh
Sources			
Solar (Rooftop)	301	18.5%	-$13.44
Solar (Utility)	206	12.7%	-$2.53
Wind	155	9.5%	$35.28
Hydro	33	2.0%	$115.71
Battery (Discharging)	9.0	0.6%	$49.44
Gas (OCGT)	6.7	0.4%	$87.27
Gas (CCGT)	4.5	0.3%	$137.39
Bioenergy (Biomass)	6.1	0.4%	$65.94
Coal (Black)	737	45.4%	$71.46
Imports	92	5.7%	$74.90
Loads	**100**		
Exports	74	4.6%	$12.55
Pumps	13.4	0.8%	-$18.11
Battery (Charging)	11.8	0.7%	$1.18
Curtailment			
Solar (Utility)	94	5.8%	
Wind	16.7	1.0%	
Net	**1,649**		
Renewables	**704**	47.6%	

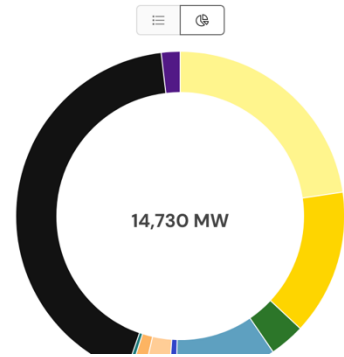
Price	Average Summer Week	$58 / MWh			
Curtailment	Average Summer Week	Solar 94 GWh 5.8%,	Wind 16.7 MW 1.0%		
Battery	Average Summer Week	Battery discharge	9 GWh	0.6%	$49
Hydro	Average Summer Week	Hydro	33 GWh	2.0%	$115
Gas	Average Summer Week	Gas	11 GWh	0.7%	$110
Coal	Average Summer Week	Coal	737 GWh	45.4%	$71

NSW NEM 9 – 15 January 2026 Heatwave Saturday 10 Jan Peak Curtailment 19.6%

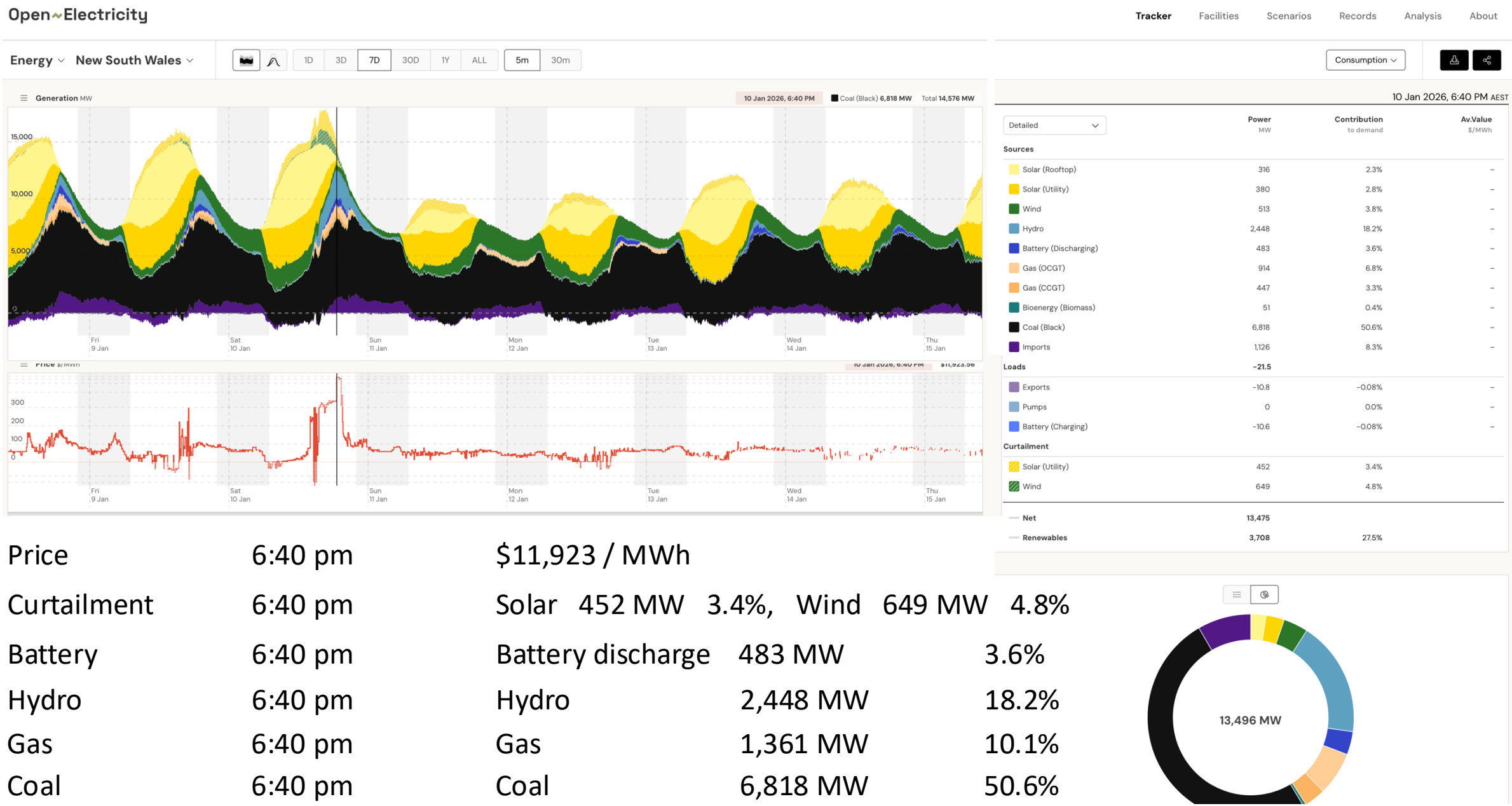




Price	4:10 pm	$466 / MWh		
Curtailment	4:10 pm	Solar 1,615 MW	11.0%,	Wind 1,265 MW 8.6%
Battery	4:10 pm	Battery discharge	92 MW	0.6%
Hydro	4:10 pm	Hydro	1,465 MW	10.0%
Gas	4:10 pm	Gas	555 MW	3.7%
Coal	4:10 pm	Coal	6,344 MW	43.1%

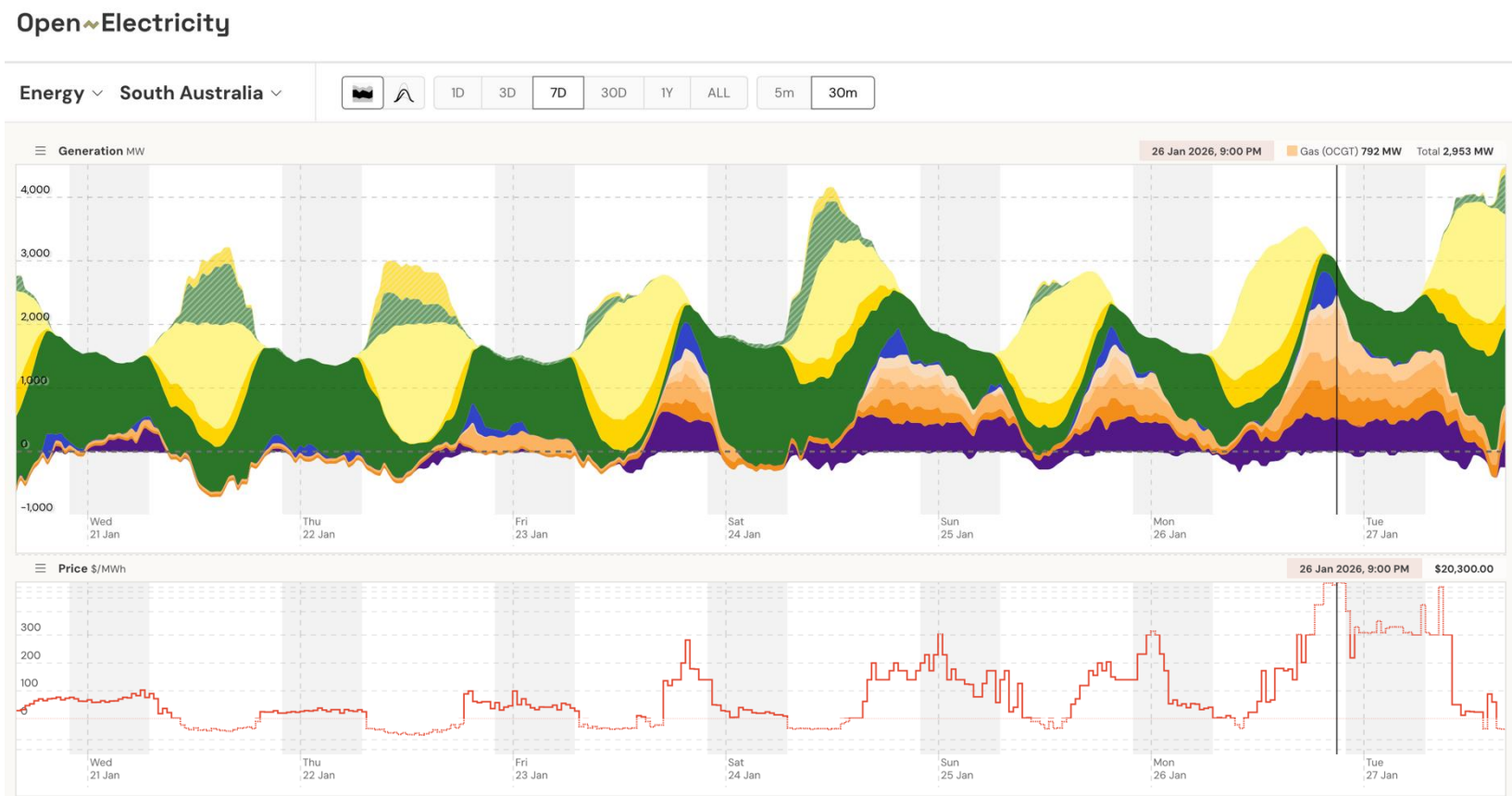


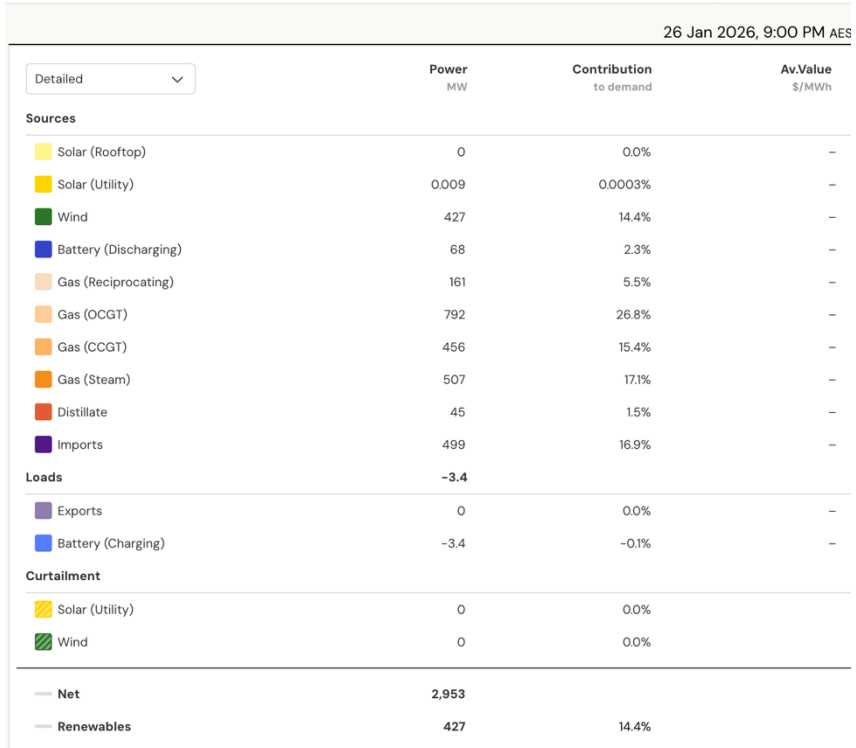
NSW NEM 9 – 15 January 2026 Heatwave Saturday 10 Jan Peak Price $11,923 / MWh

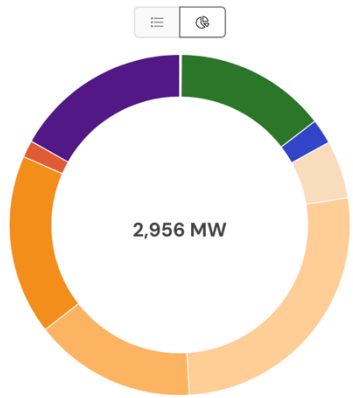


Price	6:40 pm	$11,923 / MWh		
Curtailment	6:40 pm	Solar 452 MW	3.4%, Wind 649 MW	4.8%
Battery	6:40 pm	Battery discharge	483 MW	3.6%
Hydro	6:40 pm	Hydro	2,448 MW	18.2%
Gas	6:40 pm	Gas	1,361 MW	10.1%
Coal	6:40 pm	Coal	6,818 MW	50.6%

SA NEM 21 – 27 January 2026 Fossil Fuel Backup Peak Price $20,300 / MWh 9pm 26/1/26







Price	9:00 pm	$20,300 / MWh		
Curtailment	9:00 pm	Solar 0 MW	0.0%, Wind 427 MW	14.4%
Battery	9:00 pm	Battery discharge	68 MW	2.3%
Hydro	9:00 pm	Hydro	0 MW	0.0%
Gas	9:00 pm	Gas	1,816 MW	64.8%
Coal	9:00 pm	VIC Imports	499 MW	16.9%

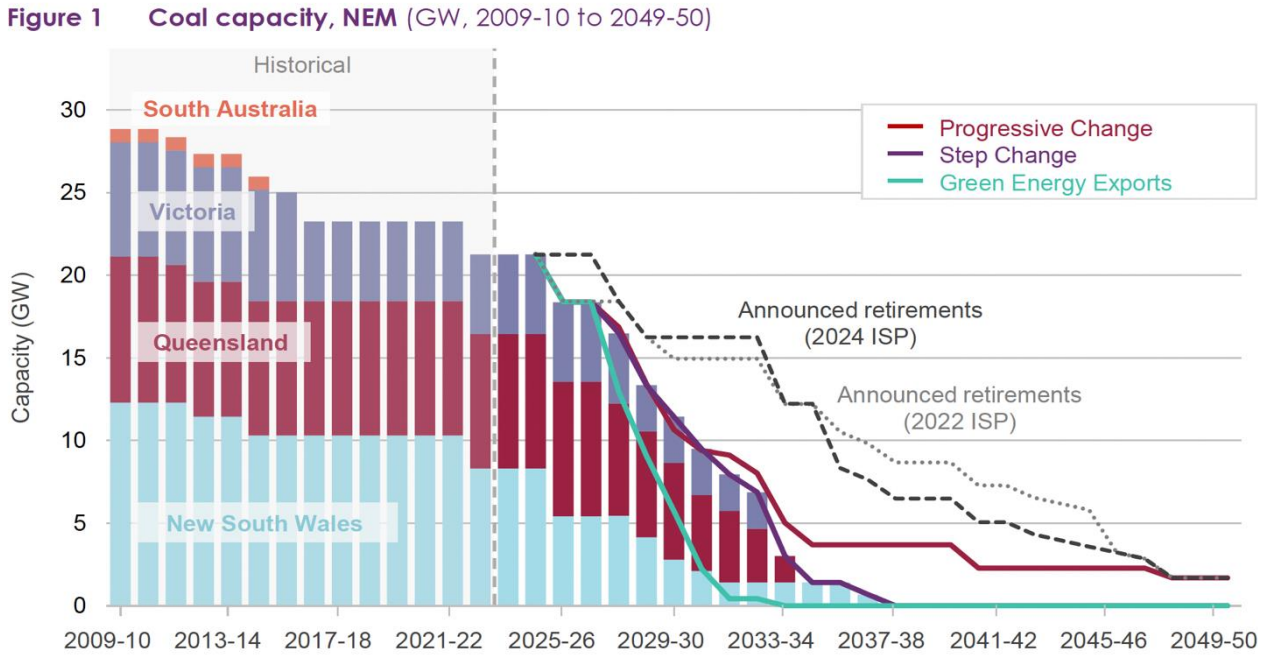
AEMO ISP timeline for coal generator closure

The last NSW coal generator is expected to close in 2039-40.

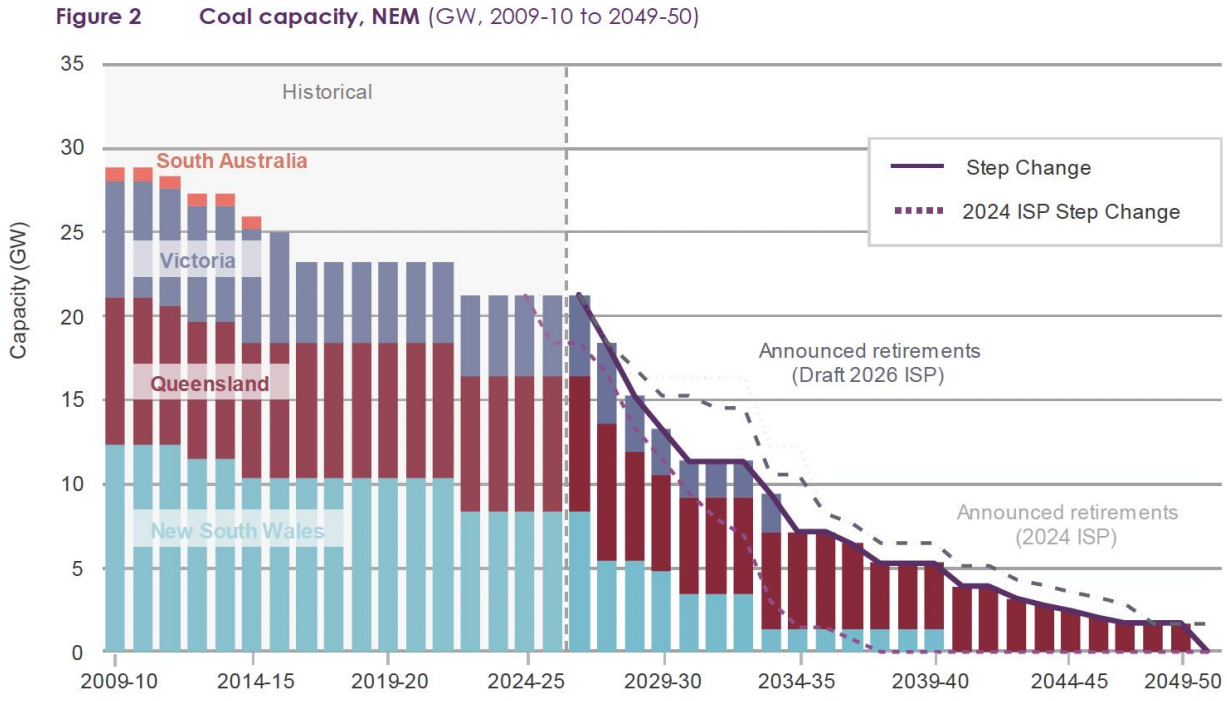
The largest change is in QLD where coal generation has been extended by 10 years by the new QLD Government.

As coal generators close the system risk rises, particularly if insufficient firm capacity is built to provide system security for all weather conditions.

AEMO 2024 ISP



AEMO draft 2026 ISP

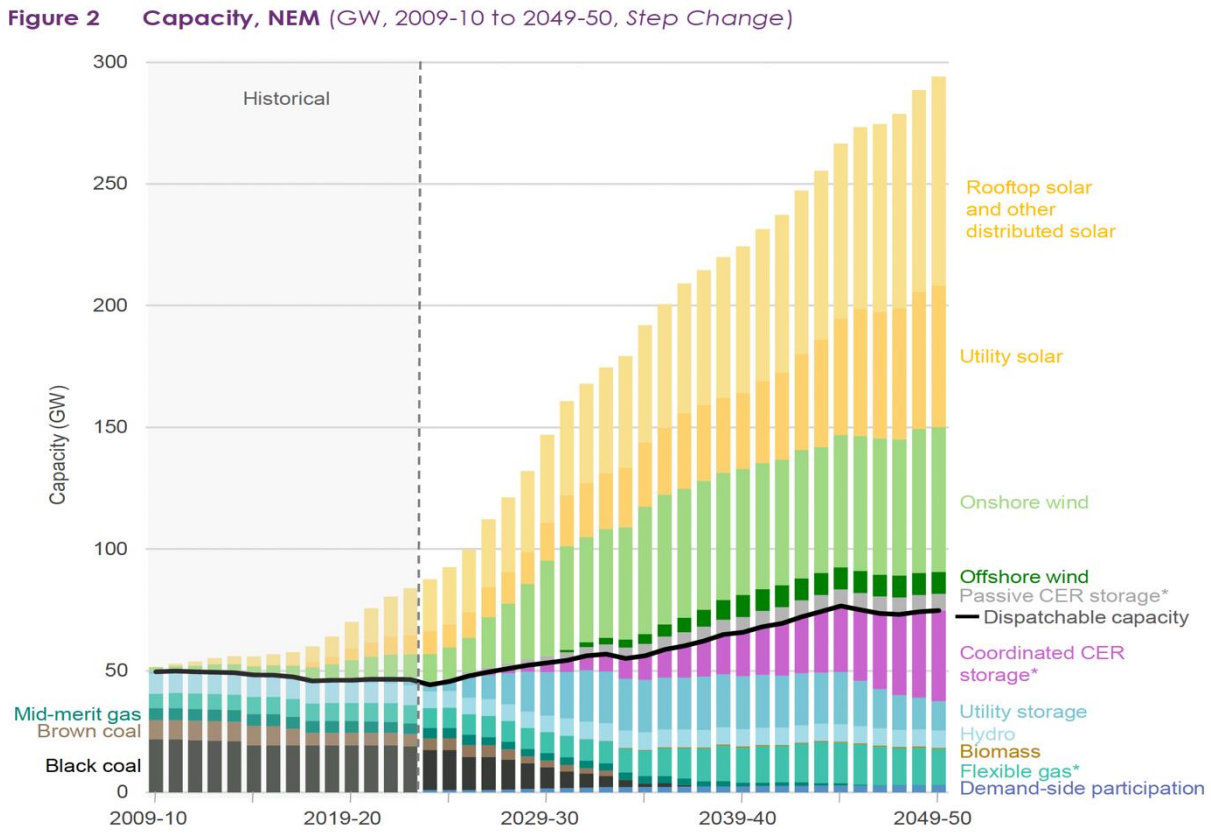


AEMO ISP future energy mix

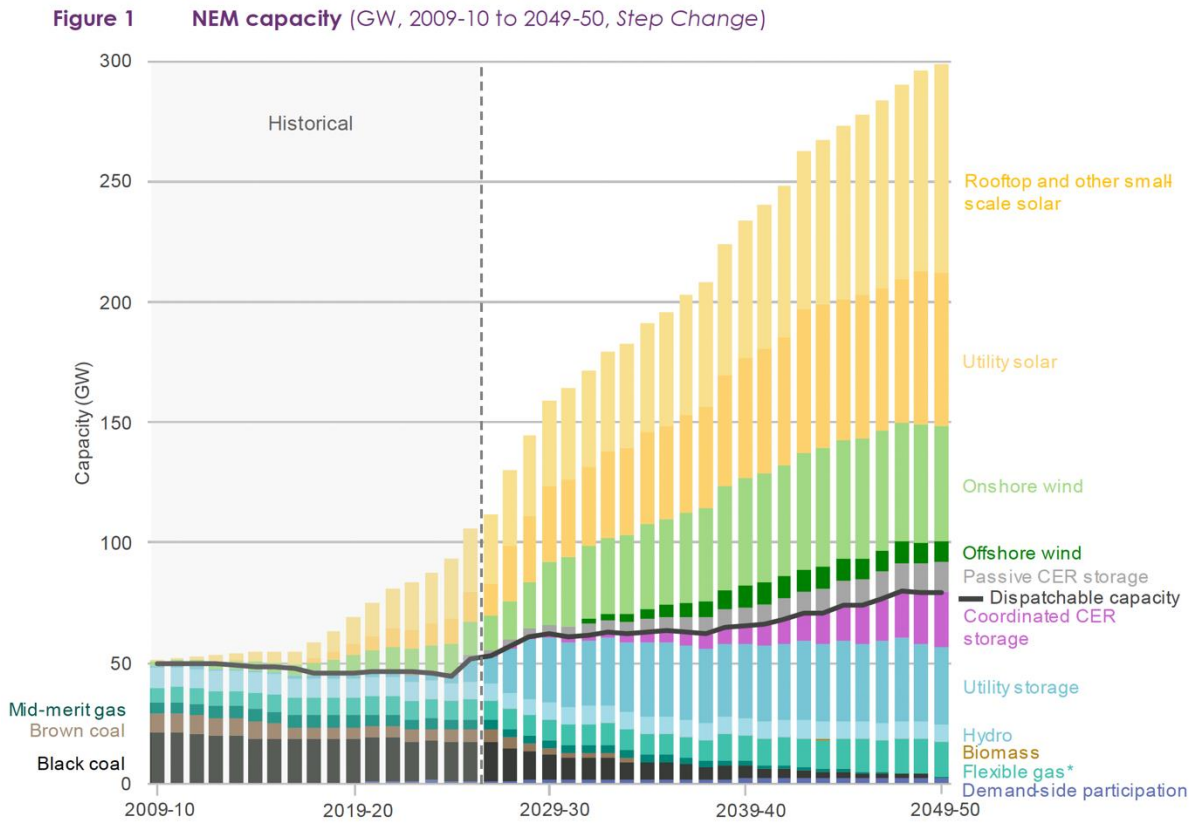
Total projected NEM generation capacity in 2050 does not change significantly from 2024 to 2026

The largest change is the the loss of coordinated CER (community energy resources) substituted by much greater Utility storage

AEMO 2024 ISP



AEMO draft 2026 ISP



How much energy storage capacity (GW & GWh) is necessary to replace all NSW coal generators?

As a rule of thumb, energy storage (GWh) capacity needs to be about 3x on-demand generation, to replace coal and bridge the gap for 3 consecutive cloudy days in winter, a "dunkelflaute" event

Average weather dependent renewable generation does not represent real daily maxima and minima, 0 – 100% capacity, nor seasonal VRE variation.

Average NSW 2025 Coal generation per day

Q1 122GWh
Q2 123GWh
Q3 126GWh
Q4 113GWh

The Cheaper Home Batteries Program (CHBP) is expected to deliver a national total of 40 GWh (NSW ~14 GWh) of additional storage capacity by 2030.

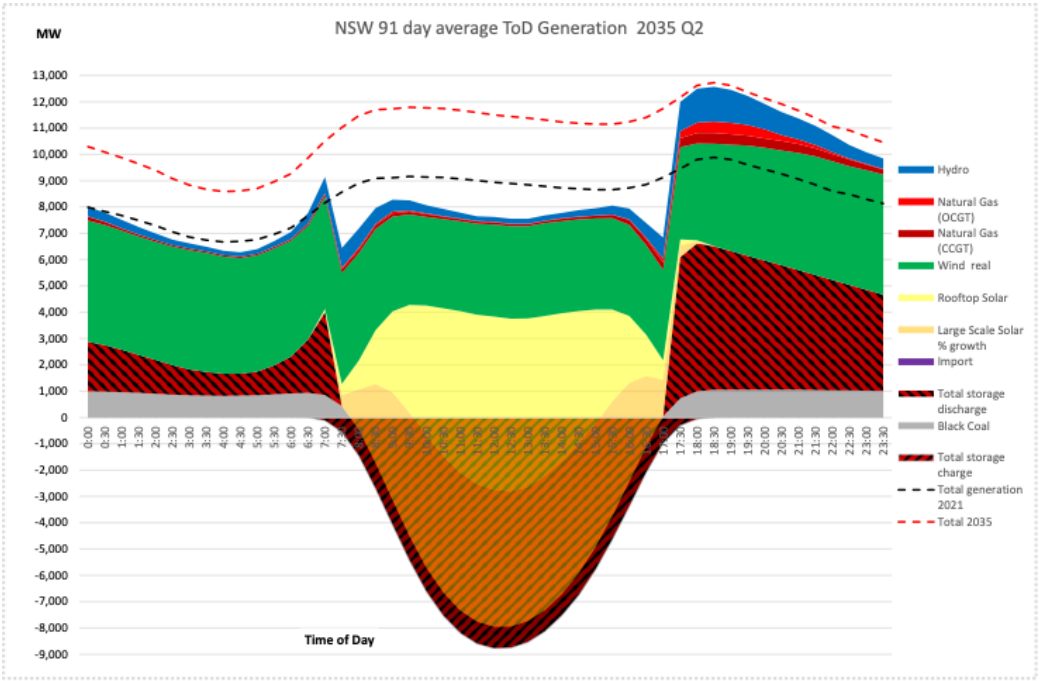
The Capacity Investment Scheme (CIS) provides a total national target of 14 GW (NSW ~5.6 GW ~18 GWh, 3.2 hrs) of shallow energy storage capacity (battery) to be delivered by 2030.

The NSW Long-Term Energy Service Agreement (LTESA) scheme has supported a total of 30 GWh of medium (> 8 hrs, 10.8 hrs) energy storage with 2.77 GW of power capacity.

Electricity Services Entry Mechanism (ESEM) contracts is a National Program

Proposed energy storage additions to 2030
NSW maximum capacity = 1 cycle ~ 1 day

CHBP		14GWh		battery
CIS	5.6GW	18GWh	3.2hrs	battery
LTESA	2.8GW	30GWh	10.8hrs	battery
ESEM	??	??	??	??
Snowy 2	2.2GW	40GWh	18hrs	Pumped Hydro
PKPH	2.0GW	35GWh	17.5hrs	Pumped Hydro
Total	**10.6GW**	**102GWh x 0.8 = 82GWh**		

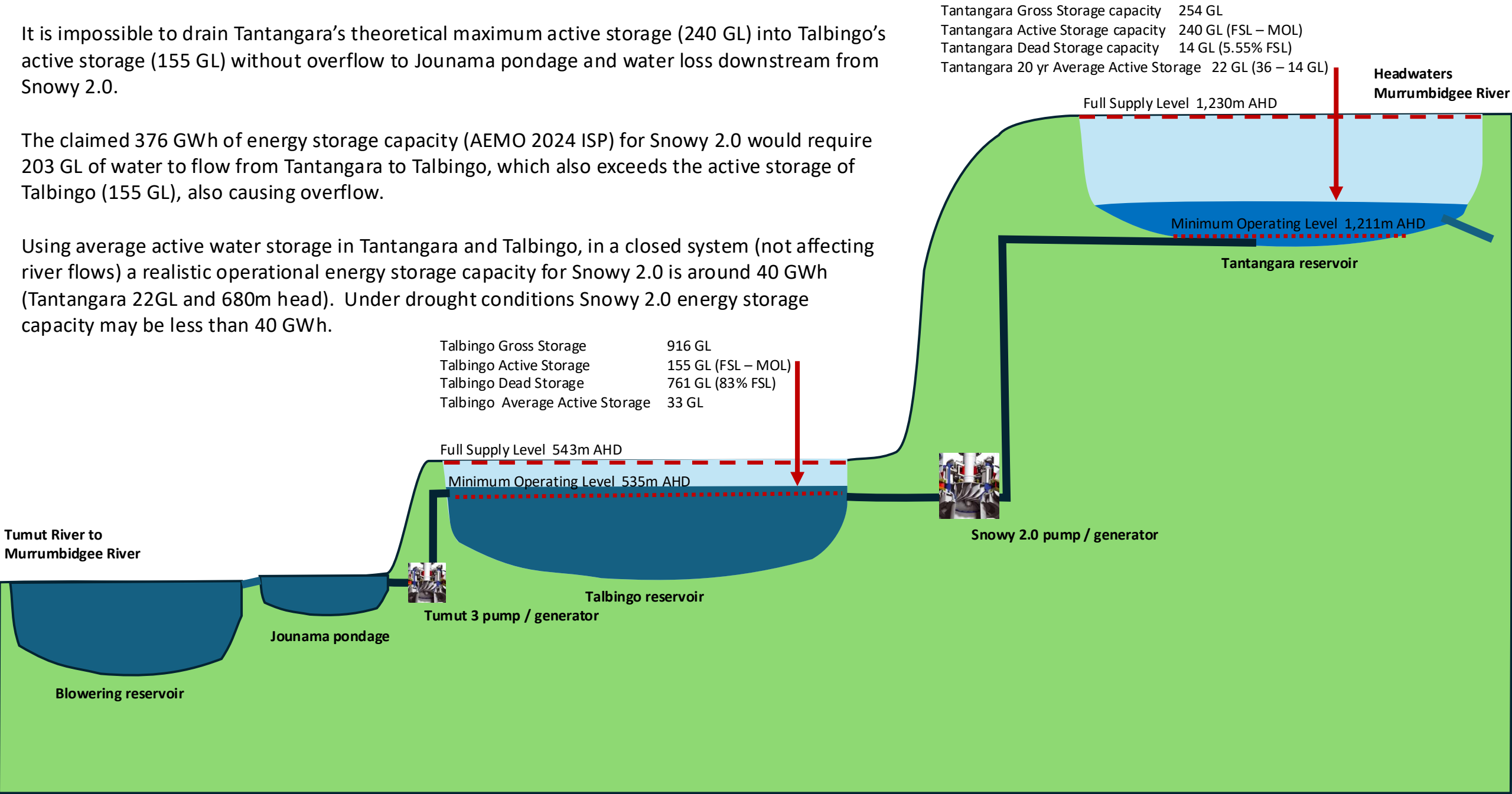


Snowy 2.0 has around 40 GWh of storage, not 350 GWh

It is impossible to drain Tantangara's theoretical maximum active storage (240 GL) into Talbingo's active storage (155 GL) without overflow to Jounama pondage and water loss downstream from Snowy 2.0.

The claimed 376 GWh of energy storage capacity (AEMO 2024 ISP) for Snowy 2.0 would require 203 GL of water to flow from Tantangara to Talbingo, which also exceeds the active storage of Talbingo (155 GL), also causing overflow.

Using average active water storage in Tantangara and Talbingo, in a closed system (not affecting river flows) a realistic operational energy storage capacity for Snowy 2.0 is around 40 GWh (Tantangara 22GL and 680m head). Under drought conditions Snowy 2.0 energy storage capacity may be less than 40 GWh.



AEMO draft 2026 ISP future storage mix

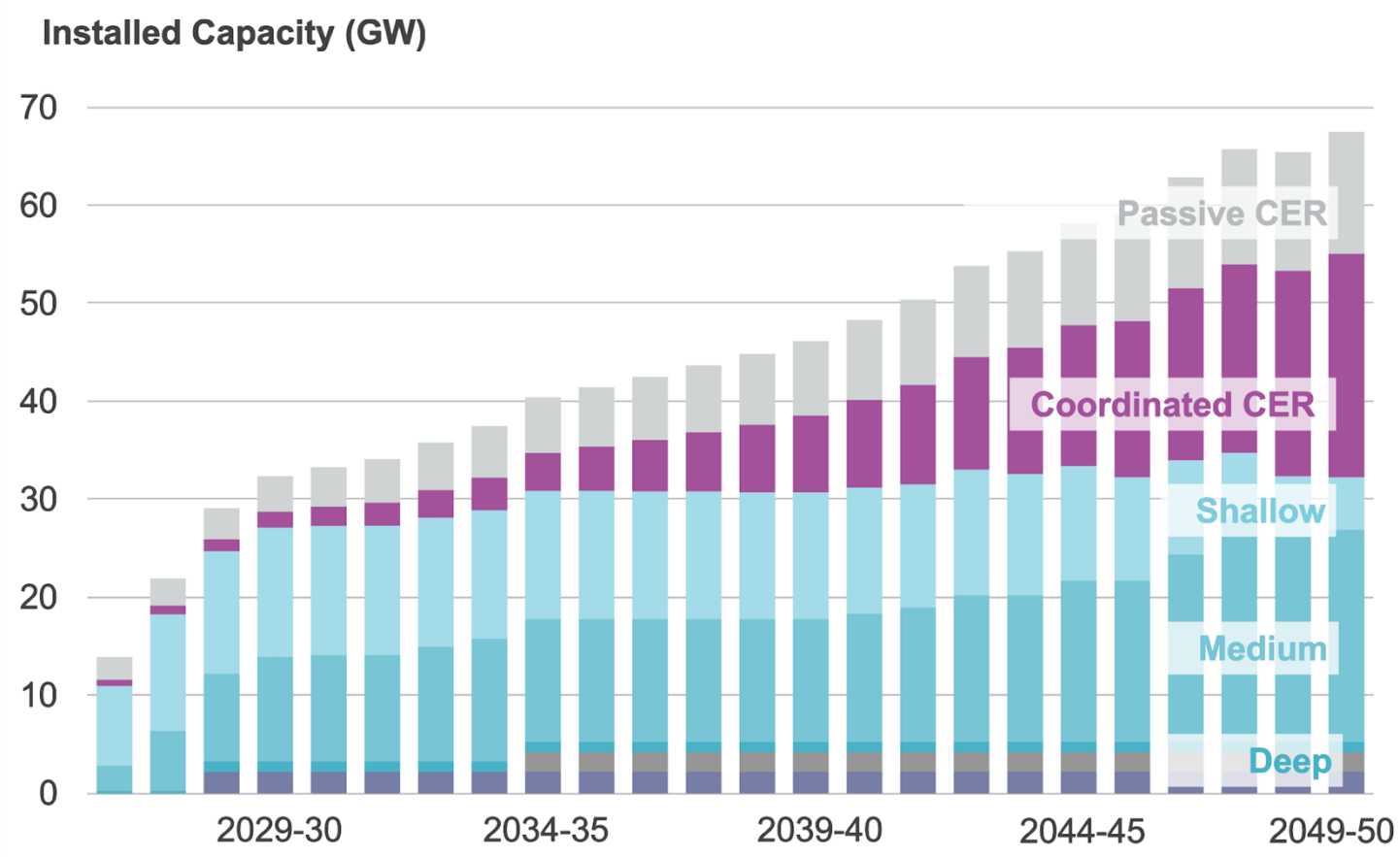
Shallow storage: utility-scale storage, …, to dispatch electricity for less than four hours (grid battery , < 4hrs duration).

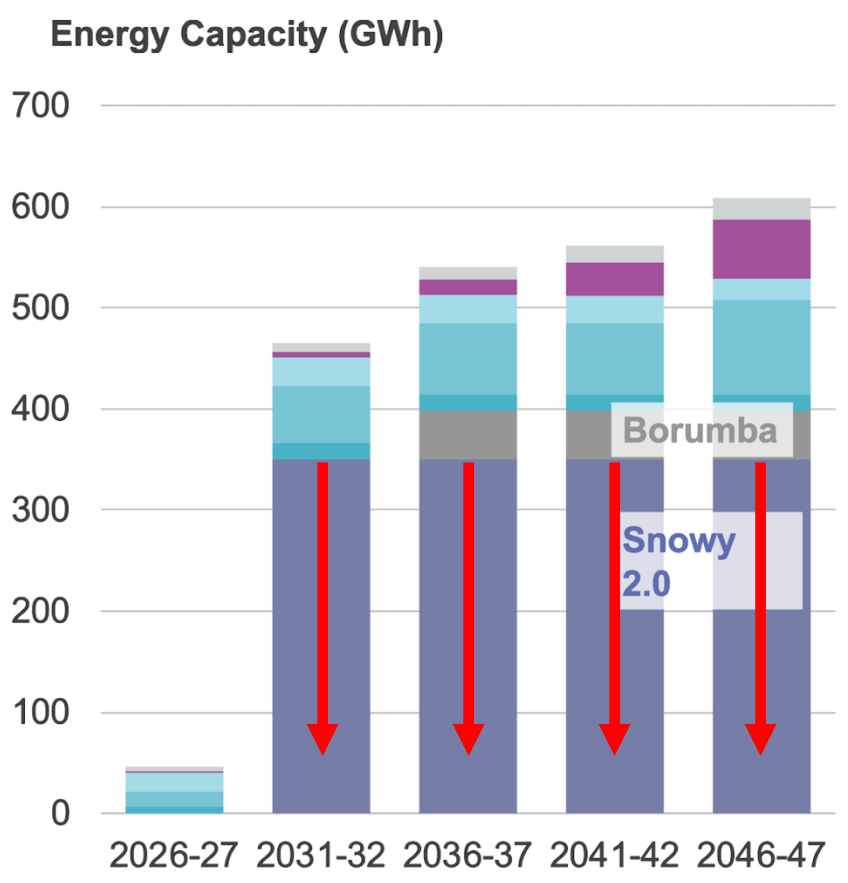
Medium storage: to dispatch electricity for four to 12 hours.

All storage underwritten by CIS (4hrs) or NSW LTESA (> 8hrs) has been grid battery not pumped hydro.

Deep storage: strategic reserves that can dispatch electricity for more than 12 hours.

For example, Snowy 2.0 would provide ~~350~~ GWh, ~40 GWh could provide 2.2 GW continuously for a < day, (18.2 hrs)

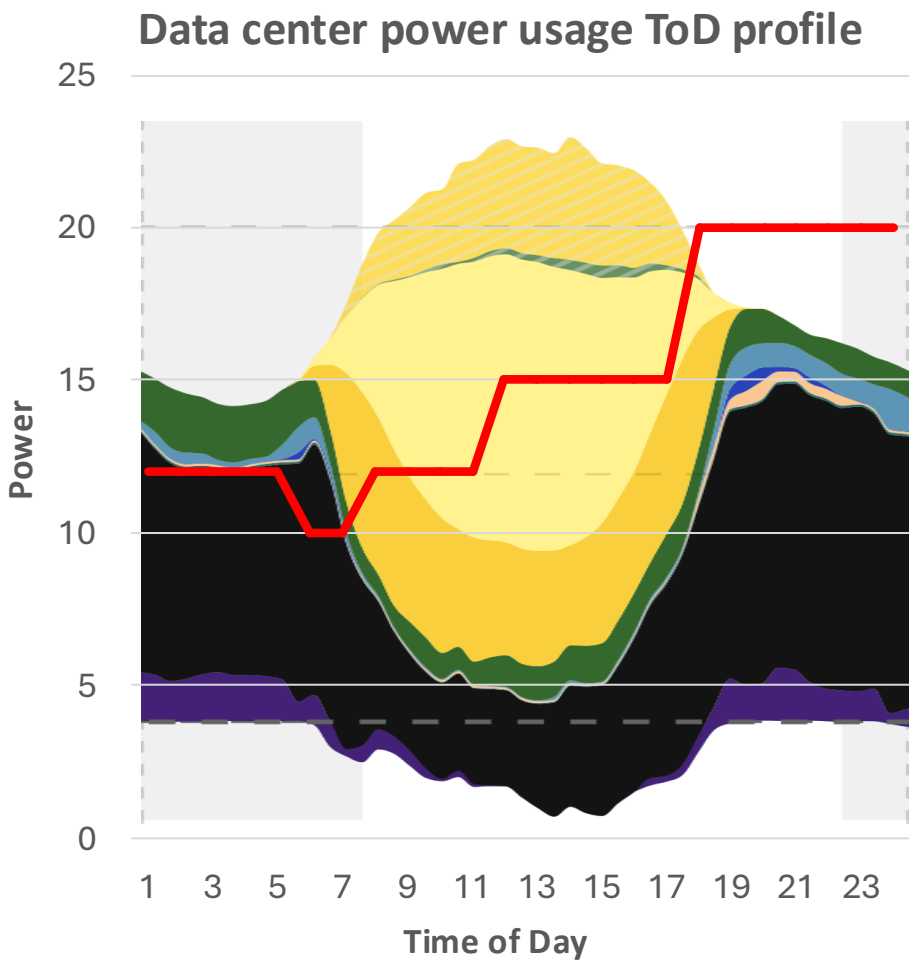




Demand Growth; AEMO's 2025 Electricity Statement of Opportunities

AEMO forecasts a 28% increase in operational electricity consumption within the National Electricity Market (NEM) from 2025 to 2035, rising from 178 TWh to approximately 229 TWh.

Data center inflexible loads cause power scarcity during peak demand lifting power prices for all.

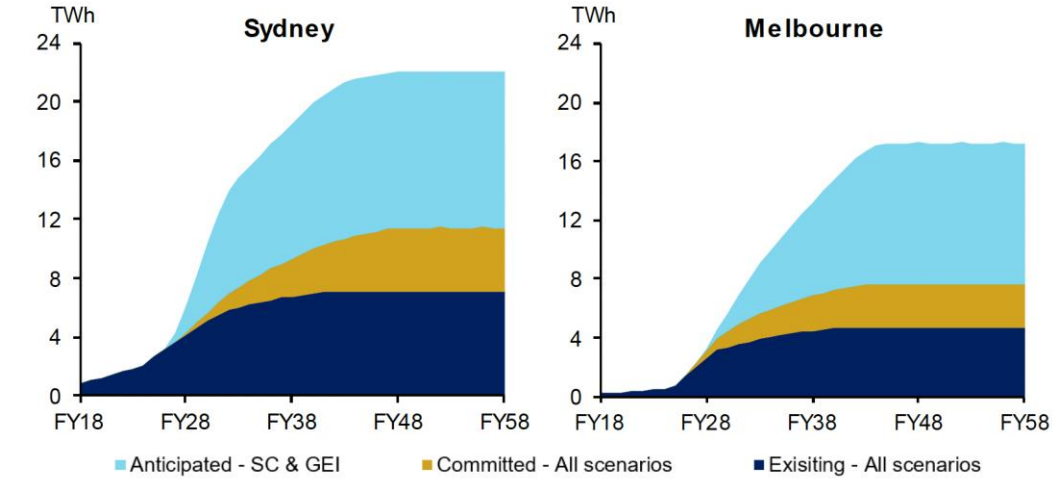


https://theconversation.com/how-utilities-are-working-to-meet-ai-data-centers-voracious-appetite-for-electricity-240196

Annual NSW data center loads of 20TWh by 2038, increase daily demand (212GWh) in 2025 by 55GWh or 26%

Data center firming demand is greater than
PKPH capacity at 35GWh
Snowy 2.0 capacity at 40GWh

Fig. 2. Existing, committed & anticipated project consumption, Sydney & Melbourne



Source: Oxford Economics Australia based on AEMO data.

https://www.aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2024/2025-iasr-scenarios/final-docs/oxford-economics-australia-data-centre-energy-consumption-report.pdf

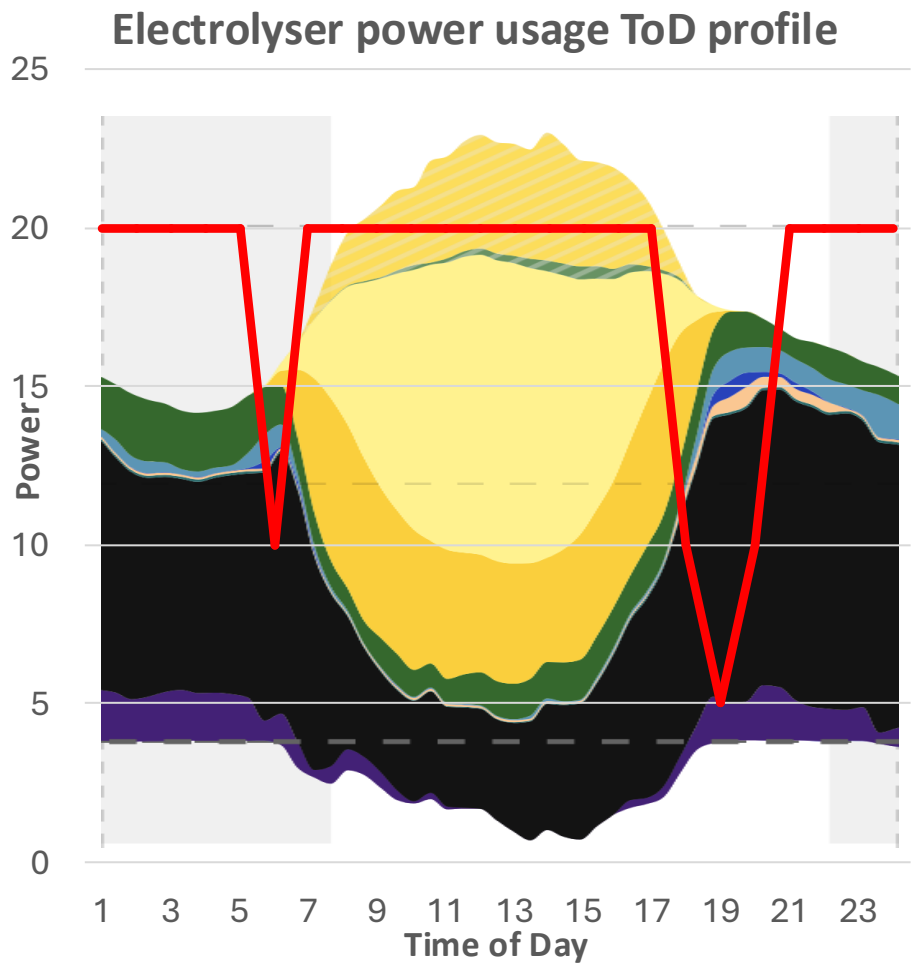
Demand Growth

Electrolysers use electricity to produce hydrogen, ammonia, iron and other products without producing CO_2 emissions.

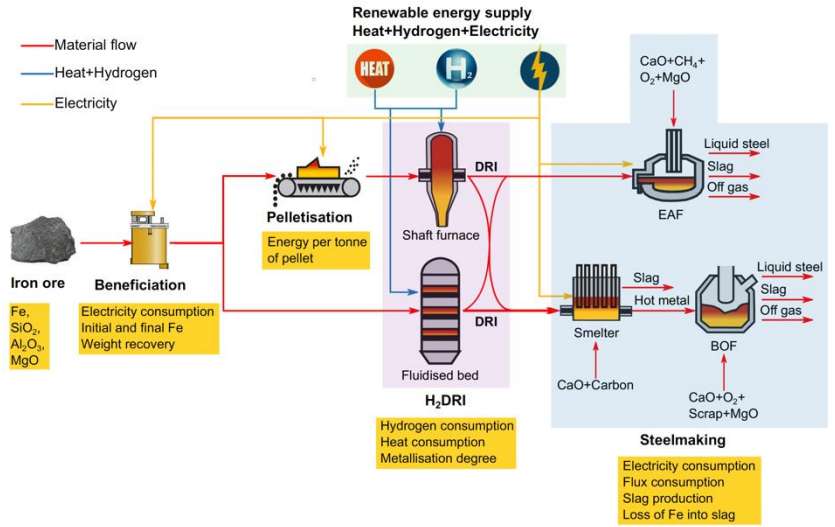
Electrolyser flexible loads reduce consumption when demand is high providing abundant power to the grid, lowering prices.

Port Kembla Pumped Hydro has a 90 : 10 capacity factor cost advantage.

Port Kembla has a location advantage supplying firm power (90% capacity factor) from local Pumped Hydro
Port Kembla Pumped Hydro can supply the NSW grid during peak demand the remaining 10% of time (2.4hrs/day at max power)



Hydrogen Direct Reduction Iron (H_2 DRI)
4.2 - 4.6 MWh / t Fe
Process efficiency < 50%



Production of green steel from low-grade ores: An end-to-end techno-economic assessment

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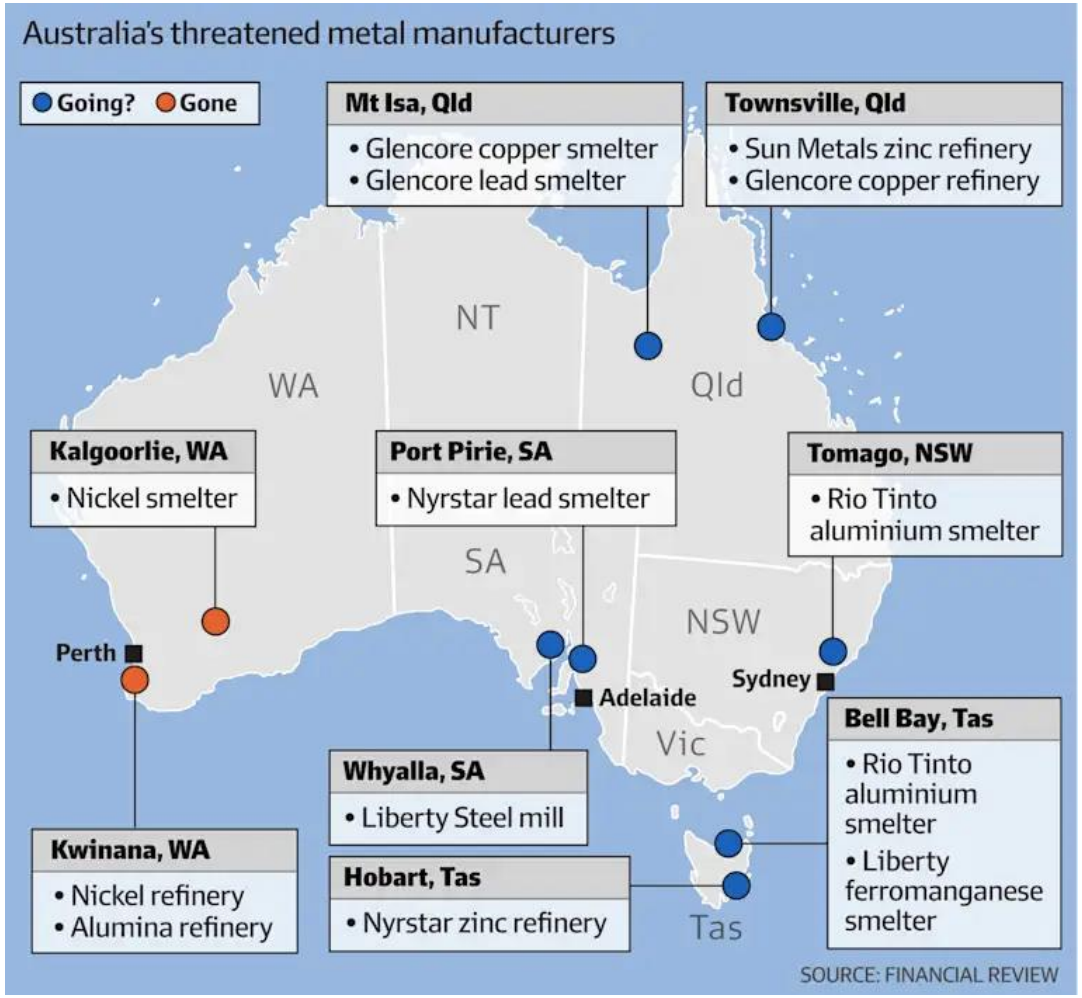
https://doi.org/10.1016/j.crsus.2024.100301

Australian primary metal production is struggling in 2025

Government intervention has been necessary to maintain metal production and regional jobs

Government intervention is necessary to build low-cost firm power to maintain energy intensive industries



https://www.afr.com/companies/mining/queensland-refinery-slumps-to-57m-loss-in-year-of-pain-for-processing-20250624-p5ma16

Sun Metals Zinc and Copper refinery

Queensland refinery slumps to $57m loss in year of pain for processing

AFR 25 June 2025

Rio Tinto Tomago Aluminium smelter

Rio pushes for 'eye-watering' Tomago bailout

AFR 6 June 2025

Minns confirms talks to save Tomago aluminium smelter

AFR 12 June 2025

Whyalla Steelworks placed in administration SA Gov

Whyalla administrators in credit stand-off with Gupta's InfraBuild

AFR 25 May 2025

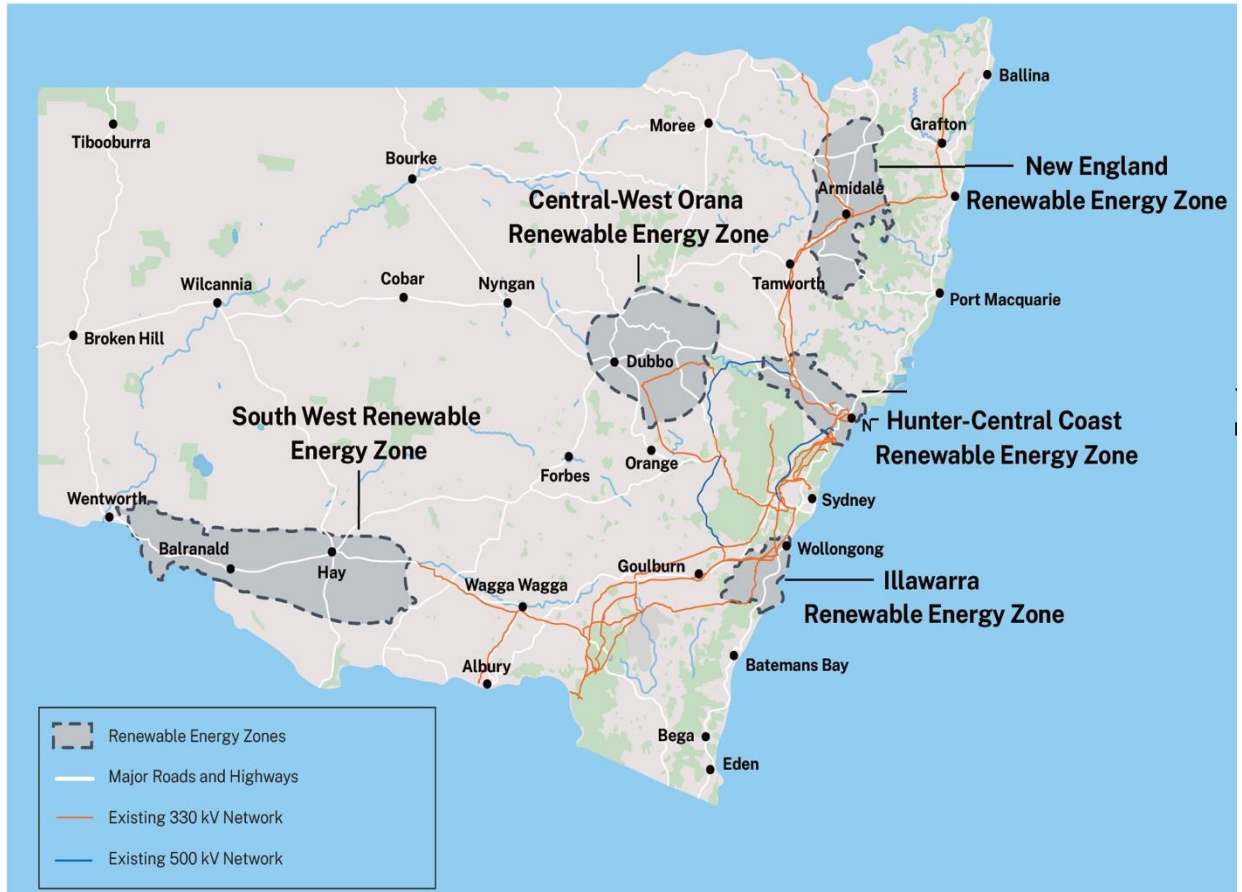
Hobart Zinc refinery

Nyrstar warns of 'urgent, serious' risk of smelter closure

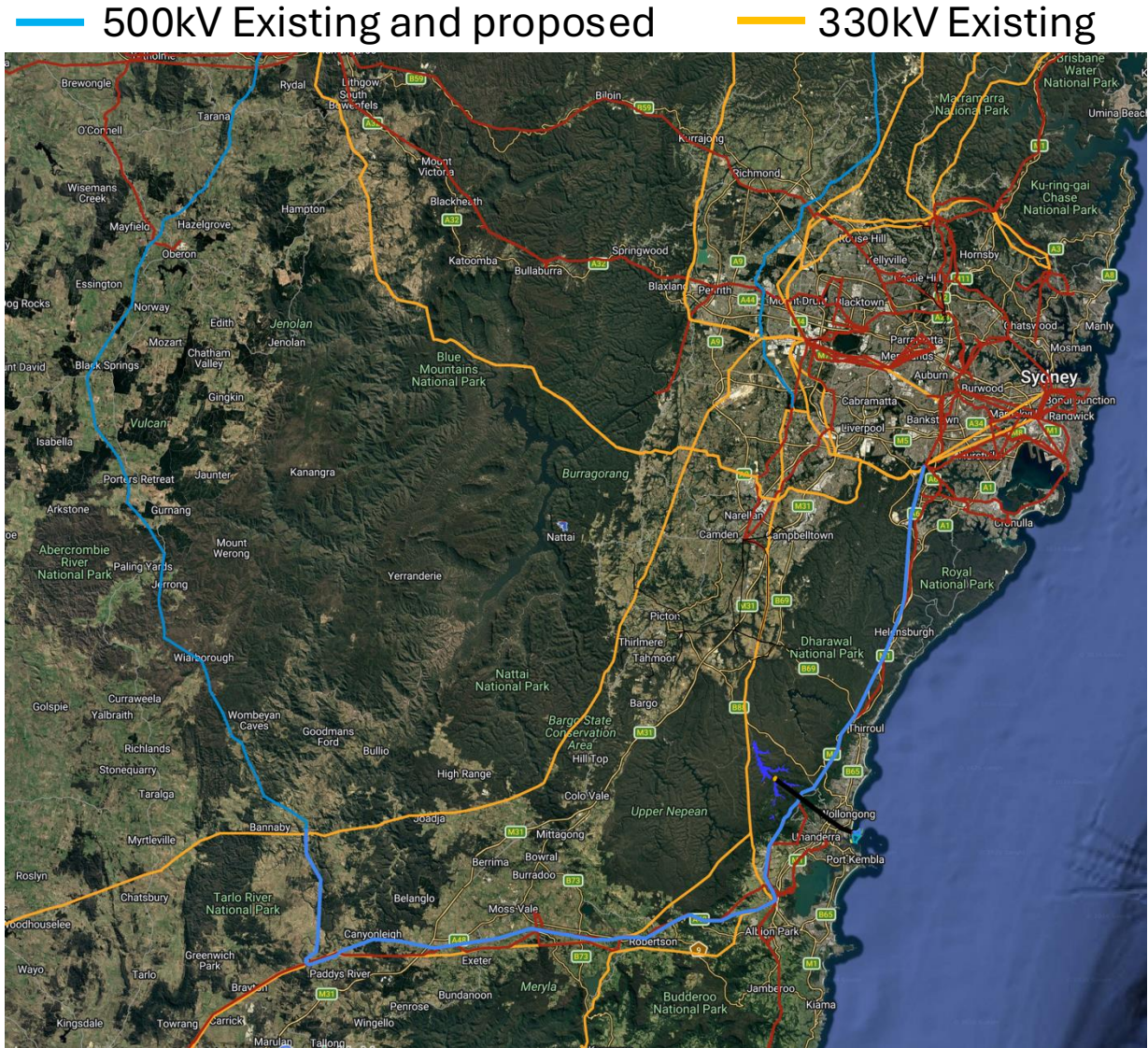
AFR 1 July 2025

Benefits to NSW and Illawarra (2) Location

- Locating major energy storage close to Sydney's rooftop solar generation and nighttime load minimises transmission build. Hume link ($6bn) connects Snowy 2.0, opposed by community
- Locating major energy storage on the path to SW Renewable Energy Zone and EnergyConnect (SA) constrained transmission helps expand SW REZ capacity, with community support.



- BlueScope requires ~1,500 MW firm power to decarbonise. Locating energy storage nearby reduces firm power cost.

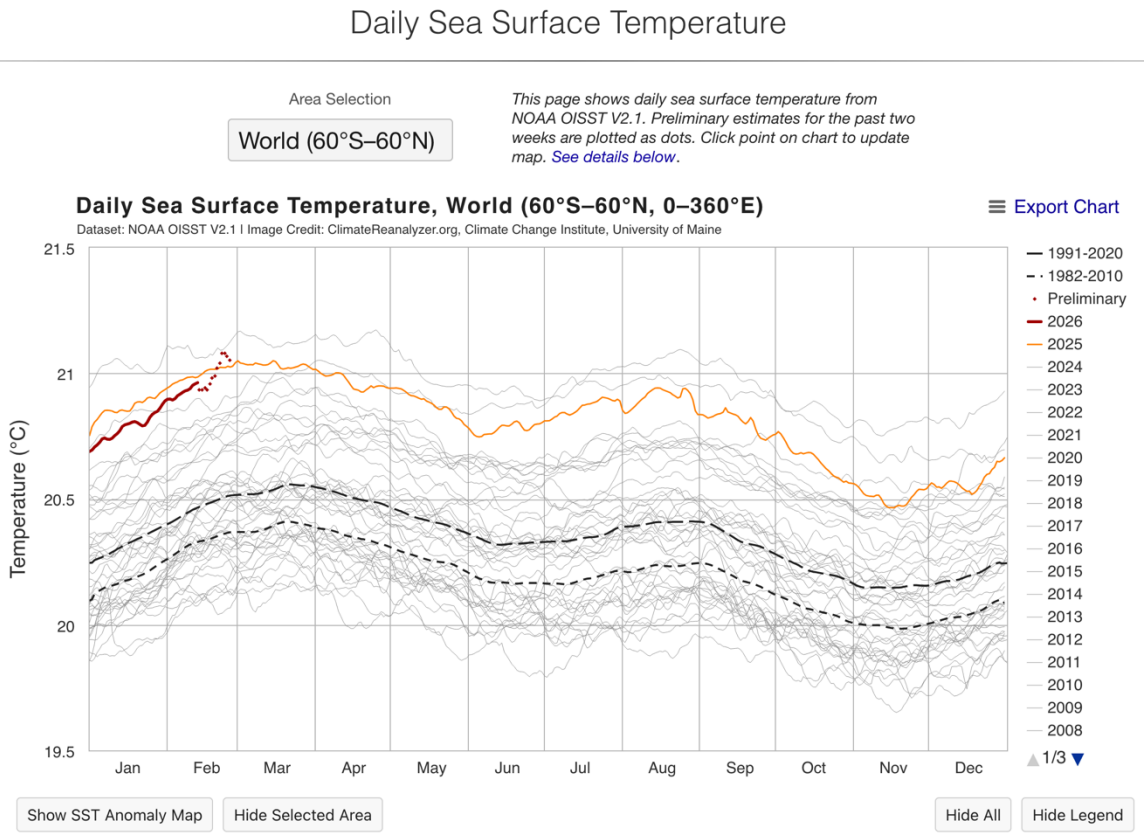


Water security

Extreme global sea surface temperature and air temperature in 2023, 2024, 2025 suggests more extreme weather and climate impacting Sydney's water supply with climate change

Seawater desalination
Shared infrastructure lowers the cost of implementing desalination

- Sydney will require a major upgrade to water supply and water security
- Former NSW Gov announced 2nd desalination plant in the Illawarra in 2020, then shelved plans when rain filled reservoirs
- A major Pumped Hydro at Port Kembla provides shared facilities;
  - High capacity (2,880 ML/hr) tunnel to Cordeaux reservoir
  - Increases freshwater storage capacity and management options
  - Direct independent 2 GW firm power supply
  - Electricity transmission infrastructure
  - Multi-year scalable water supply contracts



Water security

“Sydney’s running out of water, and we haven’t been paying attention”

https://www.smh.com.au/environment/climate-change/sydney-s-running-out-of-water-and-we-haven-t-been-paying-attention-20230830-p5e0jn.html September 4, 2023

NSW Government has announced Warragamba Dam wall will not be raised and storage levels must be reduced for flood mitigation.

This will exacerbate Sydney’s water security.

The Greater Sydney Drought Response Plan sets out how Sydney Water, WaterNSW and the NSW Government will work together to respond to droughts in the future.

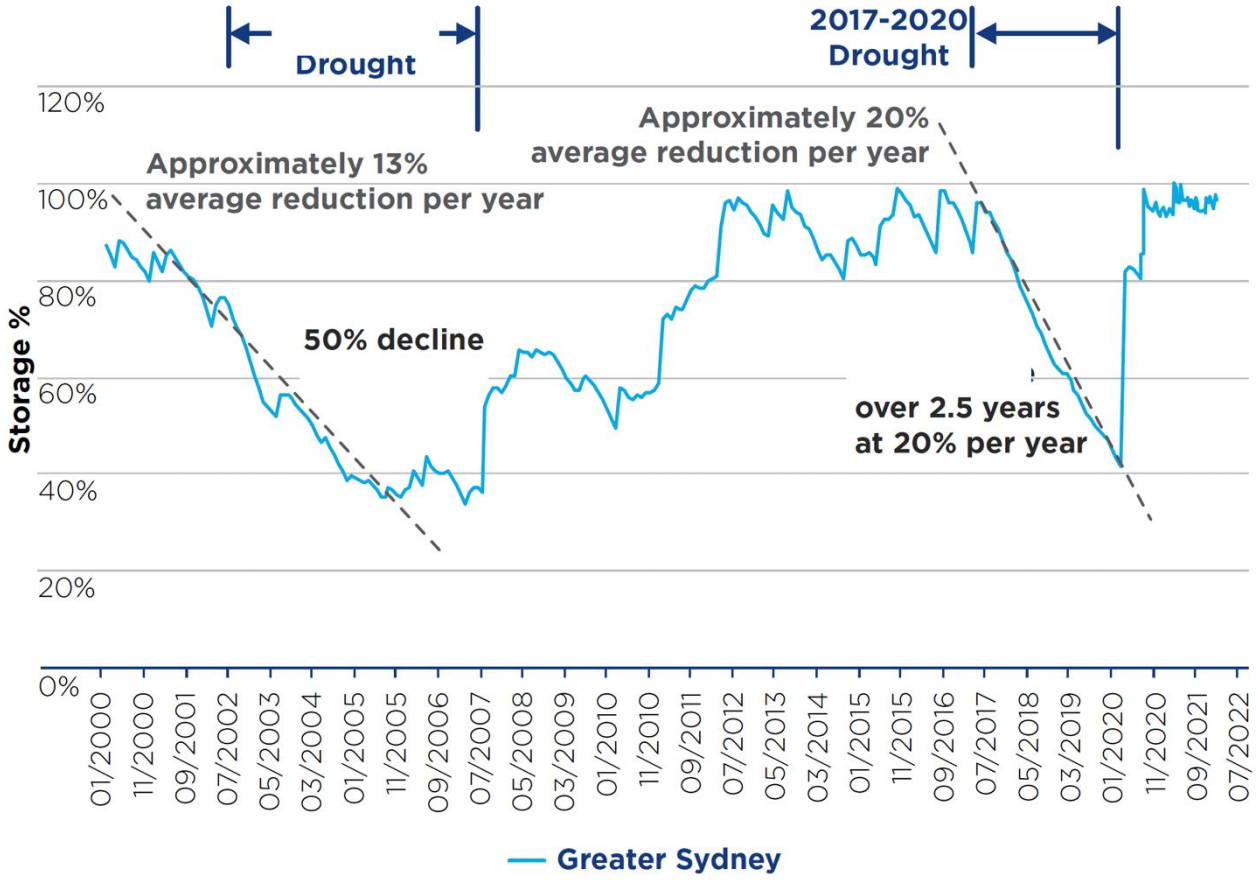
The Greater Sydney Drought Response Plan does not discuss options for augmenting Sydney’s water supply and security under likely climate change scenarios.

The GSDRP says “… there is a need for an adaptive plan that allows decisions and actions to adjust to observed conditions, growth, supply challenges, and to the broader context.”

GSDRP Response; “… supply augmentation requirements to ensure additional rainfall independent supply is deliverable before or in the next drought.”

Greater Sydney Drought Response Plan August 2022

Figure 1. Declining dam levels during the last two droughts



Flood mitigation

Western Sydney suffered multiple recent floods,

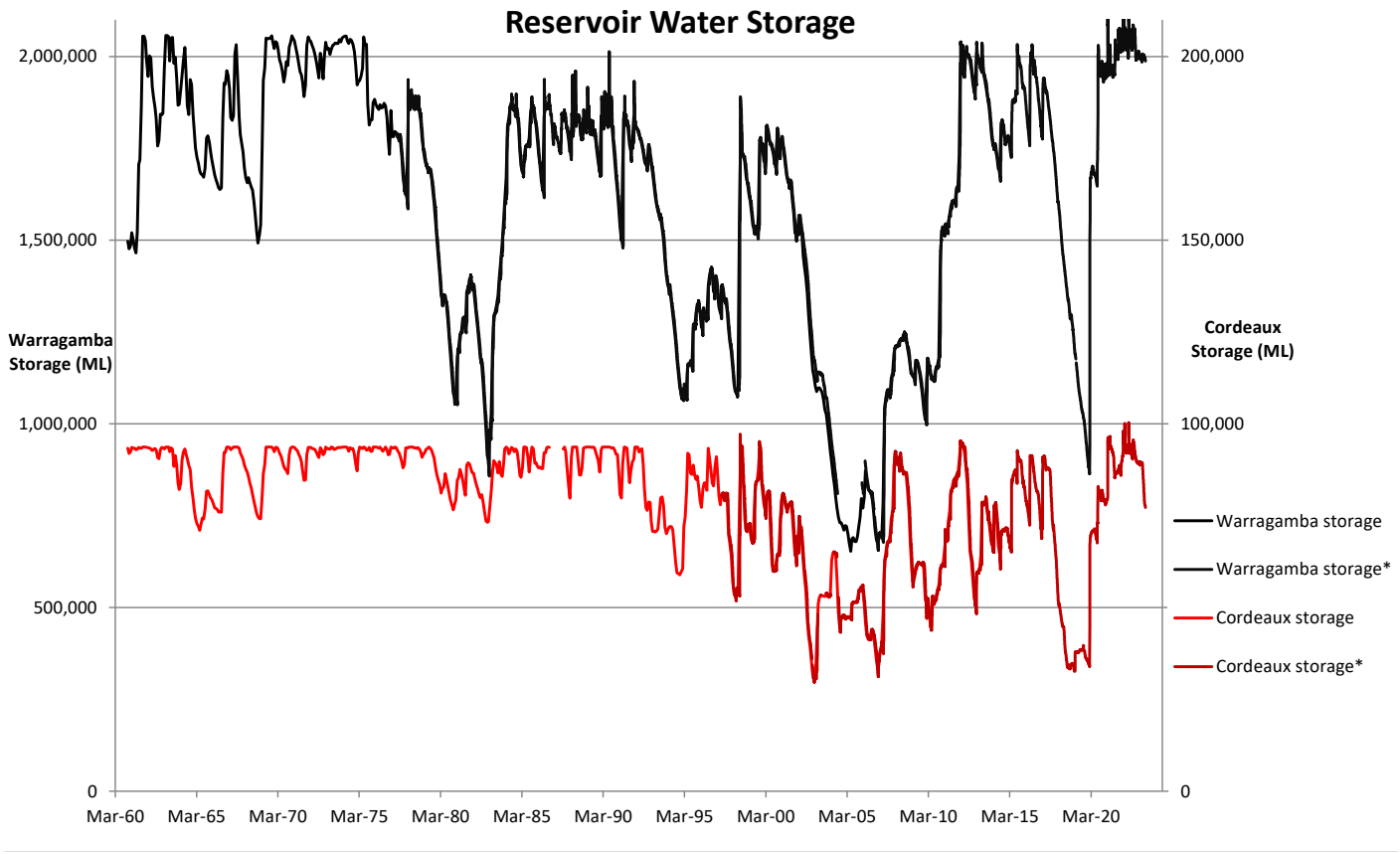
- March 2021: "One-in-100-Year" event,
- July 2022: major Hawkesbury-Nepean Flood
- February 2026: flash flooding

Flood mitigation

- A large capacity tunnel to the ocean, provided by Port Kembla Pumped Hydro can drain to the ocean 75% of Cordeaux reservoir in 24 hours, to relieve flooding along Nepean, then Hawkesbury Rivers

- Other reservoirs, Avon and Cataract may be connected underground through old mine workings to augment flood mitigation

- Increased storage capacity and storm relief (to ocean) provide management tools to capture a greater proportion of rainfall, rather than flows downstream, by manipulating water levels

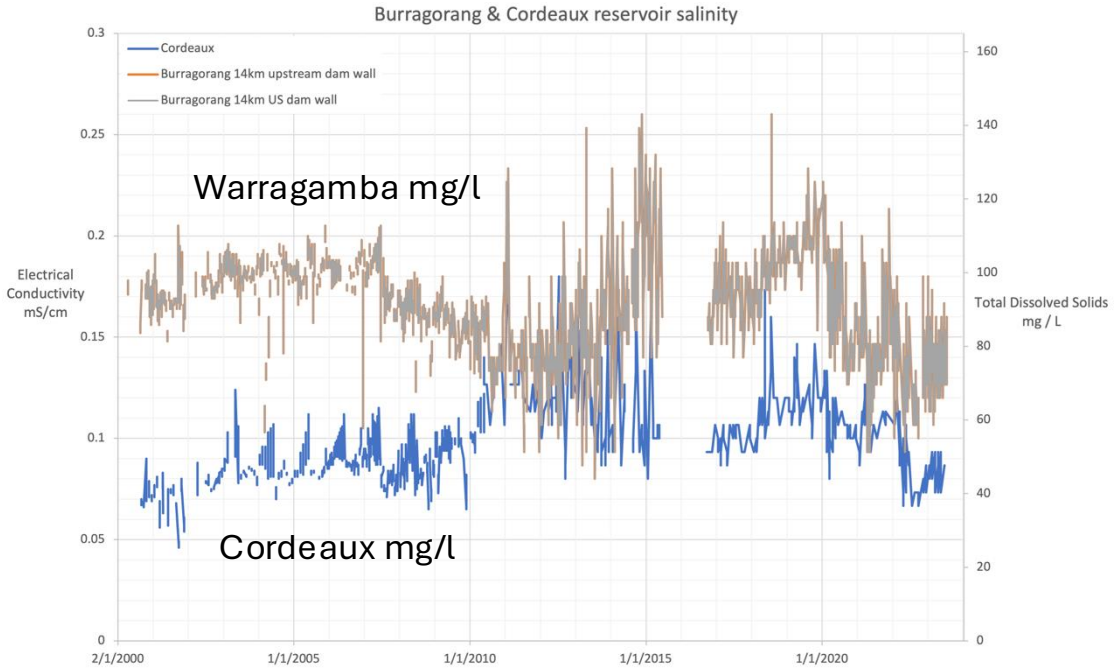


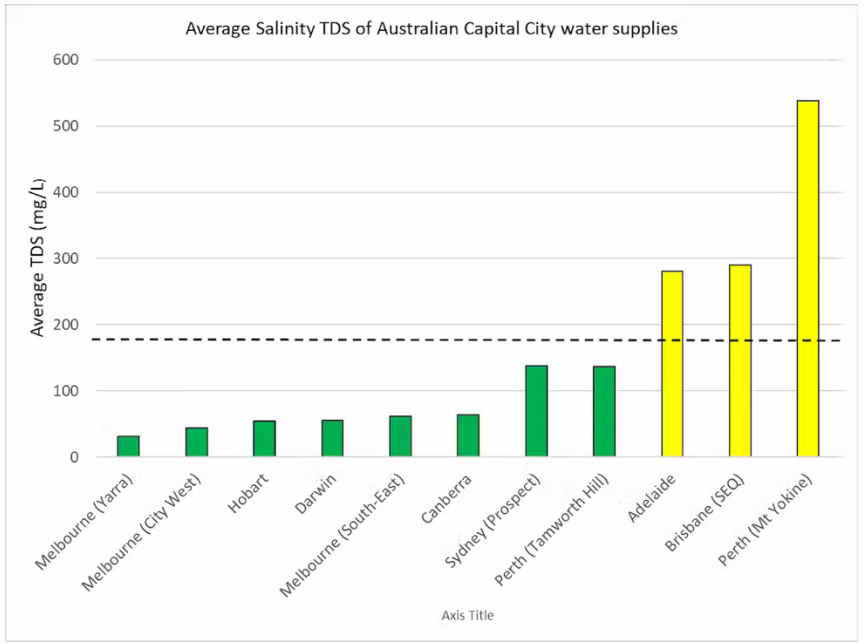
Water quality

Lake Burragorang and Cordeaux have low salinity that will not change if the Port Kembla Pumped Hydro connects to Sydney's water supply network

Reservoir salinity

- If large scale desalination supplies new water to the PKPH lower reservoir, then is pumped to Cordeaux reservoir, salinity may decrease depending on the climatic need for desalination operation.
- PKPH breakwater design, to prevent overtopping in a 1 in 10 year return storm, will raise the height by 18.6m to ensure salinity is well within Australian Drinking Water Guidelines (500 mg/l).
- Cordeaux reservoir (94GL) plus PKPH lower reservoir (48GL) forms 5.5% of Sydney's water storage capacity. Proportional dilution in Sydney's water storage network of a rare potential overtopping event, would change salinity by ~15 mg/l or within the existing annual variability. Similarly, desalination may marginally decrease salinity when operating.



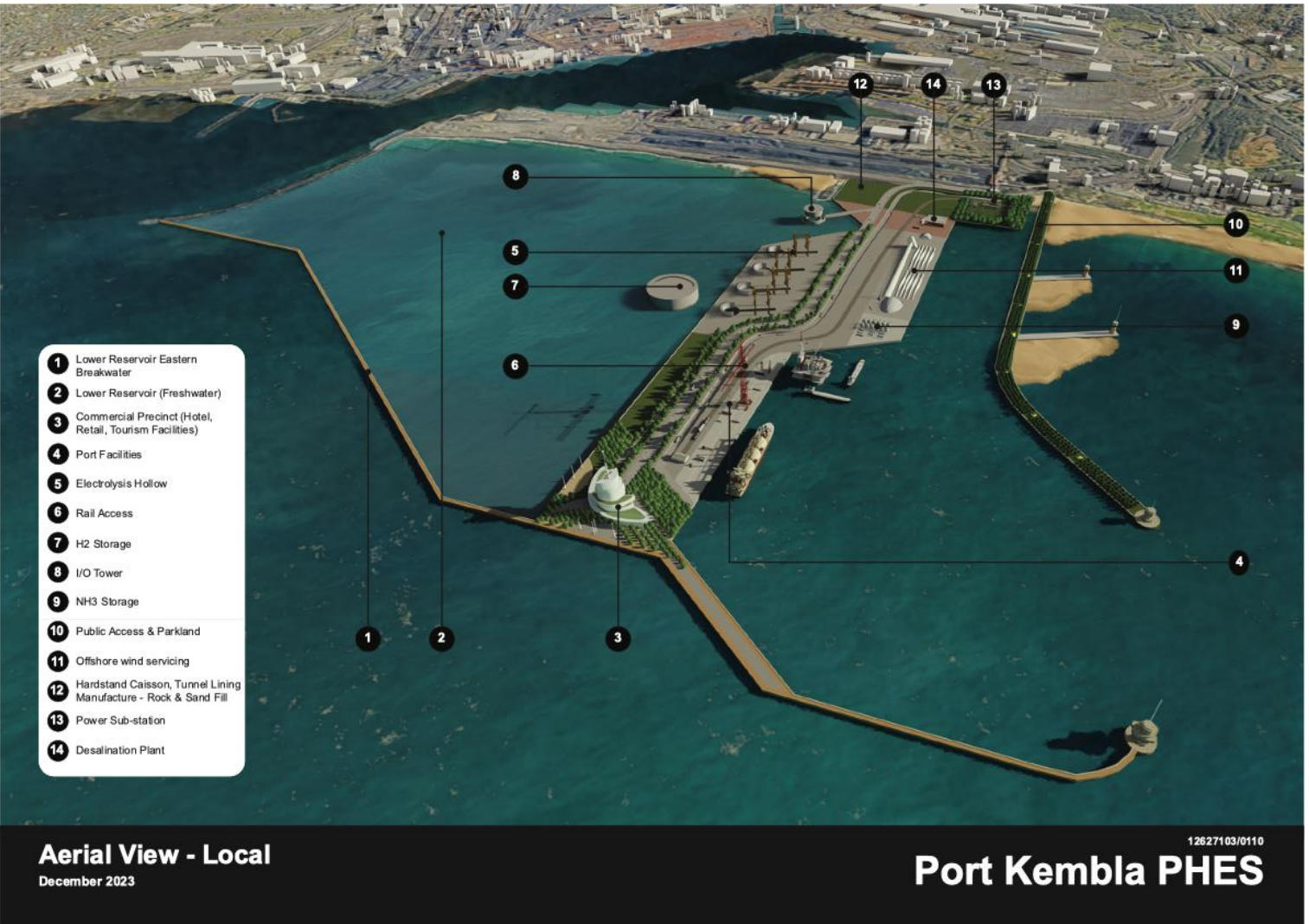


Source; Wright, I.A., Reynolds, J., Ryan, M., *Your drinking water could be saltier than you think (even if you live in a capital)*, The Conversation, 12-12-2018

Why does energy storage matter to the Illawarra ?

Construction of the reservoir and port allows a development space of up to 90ha with multiple levels below sea-level at the Eastern end -25m AHD.

Offshore development space is unzoned. BlueScope space is industrial.



Revised use concepts for PKPH (2026)

Large energy storage 2GW 35GWh to provide low-cost flexible, firm power to industry and community

Provision of FCAS (Frequency Control Ancilliary Services) + System Strength, Inertia, System Security

High-capacity power transmission network connection for offshore wind to Sydney and local industry

Deep water port facilities to support;

- ~~Offshore wind~~
- Clean fuels production, storage and export eg. H_2 NH_3
- Cruise Ships

Green iron production to feed steelworks (flexible)

Data centres (inflexible)

Seawater desalination to augment Sydney's growing demand (flexible)

90 ha of vacant unzoned "land" may be created offshore for ~40,000 new homes.
Rosehill Racecourse 57 ha, for 25,000 homes, land value $5bn

Creation of new public spaces for recreation, commercial and industrial development around lower reservoir

Creation of new recreation and education facilities near Cordeaux reservoir with public connections (bike paths, walking tracks) around upper reservoir

What is the vision for the Illawarra in 2040 ? how do we get there ?

The Illawarra REZ needs actionable projects rather than generalized vision statements to achieve goals and targets by 2040.

The Illawarra community needs to be involved with Government and project developers to help shape the future.

Port Kembla Pumped Hydro and associated activities provide a good start.

Are Government energy policy and programs adequate to fulfil the energy transition ambition of low-cost, secure, renewable power for consumers and industries? …