ENERGY STORAGE FINANCEABILITY IN AUSTRALIA

nexa ADVISORY

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Clean Energy Investor Group

About Nexa Advisory

Nexa is a full-service advisory firm. We work with public and private clients including renewable energy developers, investors and climate impact philanthropists to help accelerate efforts towards a clean energy transition. We've been shaping the energy industry for over 20 years. With a proven track record across policy creation, advocacy, political risk assessment and project delivery, we're holistic in our approach and deliver solutions with commercial intent.

The Nexa Advisory team is a collaboration of passionate energy specialists, all committed to the successful transformation of Australia's energy markets. The team is focused on helping clients grasp the unpredicted opportunities the energy transformation will bring with trusted and innovative thinking and advice.

About Clean Energy Investor Group

CEIG represents domestic and global renewable energy developers and investors, with more than 16GW of installed renewable energy capacity across more than 76 power stations and a combined portfolio value of around $38 billion. CEIG members' project pipeline is estimated to be more than 46GW across Australia. CEIG strongly advocates for an efficient transition to clean energy with a focus on the stakeholders who can provide the long-term cost-effective capital required for this transition.

Acknowledgments

We want to thank all the various industry organisations and experts that have reviewed this report and provided contribution and feedback.

Contents

1. Executive Summary

Nexa Advisory, commissioned by the Clean Energy Investor Group (CEIG) and with support from Baringa Partners, has completed an extensive review of the energy storage market in Australia. This report sets out the challenges and opportunities within this sector, and provides actionable recommendations to address the obstacles faced by investors and developers.

Summary of Key Findings

Australia requires a significant growth in energy storage over the next decade to ensure a smooth transition.

- There is a growing need for electricity storage, of all durations, in the Australian power system. The Australian Energy Market Operator (AEMO) has indicated that 19 GW of storage will be needed in 2030. This requires significant growth in capacity, in just over five years, from the 1.4 GW of batteries and 1.6 GW of pumped hydro connected today. By 2050 it is estimated the system will need 57 GW of storage. However, only 12% is likely to be utility-scale, with AEMO projecting that the system will rely significantly on 'behind-the-meter' customer-owned storage.

Australia's Energy Storage market growth has been reliant on government support

- The number of utility-scale batteries connected to the power system has increased dramatically in the past year to 18 months, and this pace is likely to continue. However, over 50% of the currently connected batteries have required government support to progress, and new developments will also be reliant on state and federal government schemes to secure financing. This is particularly true for batteries with a duration of greater than 2 hours.

New services and markets are urgently needed to facilitate investment

- The current sources of revenue for storage are limited to provision of Frequency Control Ancillary Services (FCAS) and energy. The new storage-related services/roles, particularly those that can be provided by battery storage that would support the new clean power system are not being developed. While current rule changes for new system services are being delayed, there is no over-arching review of the technical and physical needs of the future system. This would allow storage developers to propose new services such as inertia, system strength, and voltage control. This contrasts with overseas power system operators that have already developed new services to support their changing systems.

Delivering on the necessary storage is challenging but critical

All sectors of the battery and storage market face challenges. However, the key issues differ according to the technology or storage duration – there is no cookie cutter solution.

Medium duration is critical to achieve the transition:

- Medium duration storage (4–12hrs) is critical to the energy transition, but challenging to deliver with current funding, technology choices, approval and development timeframes.
- More than 10GW of medium duration storage is needed by 2030 as identified by AEMO[1], but we are way behind where we need to be to deliver.
- To deliver this requires an accelerated, smooth investment pathway (with appropriate support such as underwriting) and coordinated delivery plan to meet the required timeframes.

Market certainty is key:

- Storage experts, CEIG members, and investors have identified that short duration batteries of 1–2 hours have minimal investment challenges. However, batteries of greater than 2-hours duration, particularly the upper range of short duration (3–4 hours), and medium duration batteries of 4–8 hours, face significant challenges given the lack of market certainty.
- Batteries of greater than 2–3 hours duration are not supported by the current ancillary service market since FCAS favours rapid response, short-duration assets.
- The current energy market and associated market for services do not favour longer duration storage. Speed of response is valued over energy availability.
- Revenue streams are more certain for short-duration batteries of 1–2 hours. However, sources of revenue are limited to energy arbitrage and provision of FCAS. Both these revenue streams are volatile. The bulk of revenue for a battery in the National Energy Market (NEM) today is secured via contingency and regulation FCAS (73%).
- While storage typically benefits from volatility in the energy market, new services and contracts for existing and new markets are missing.
- Contracts offered by AEMO for services are short, of the order of 2–3 years, which may be appropriate for assets that have paid down their original investment but is not supportive of new entrants or new technologies, such as batteries

Orderly retirement of thermal power stations critical to investment:

- The lack of clarity about when coal power stations will close and exit the system is deterring investors in storage because revenue streams are uncertain and difficult to model.

PPA Market needs more competition to traditional players:

- There is limited competition in the Power Purchasing Agreements (PPA) market which restricts the opportunity for revenue and limits financing opportunities. PPA are dominated by incumbents, mainly AGL and Origin, who have fossil fuel assets and their own batteries.
- Many financial institutions and lenders do not consider PPA off-take agreements (and subsequently lend or provide equity to the projects) unless the off-take party has a very high credit rating, creating a dependence on incumbent players.

1 https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2023/draft-2024-isp-consultation/draft-2024-isp.pdf?la=en

Research and Development in energy storage is critical to our future:

- The energy-only NEM has worked well, but has not adapted to the current and desired future increase in the penetration of renewable generation. Careful thought and consideration is needed to ensure we are not falling behind other countries in progressing the new service markets that will be needed in the >82 % renewable NEM.
- Research and development (R&D) in the energy sector in Australia is significantly underfunded, representing 0.019% of GDP. This is below the global average, and declining from a high in 2013. Additionally, over 34% (2021) of R&D funding is directed at fossil fuel, rather than at the technologies we need for a clean power system[2]. Only 5% of funding is going to storage technologies.

Operational and Approval Challenges

There are a number of operational issues related to the planning processes in each state. These mean that both the time and cost of progressing a planning application can be considerable.

- Storage projects are assessed under the same processes for renewable generation developments, as there is a lack of defined standards for energy storage and batteries. The differences in the technologies and their respective maturity are currently not reflected in planning processes and approvals. This creates further delays and unnecessary complexity.
- Securing a connection agreement via the Transmission Network Service Provider (TNSP) and AEMO can also take a considerable time and is complicated by their lack of understanding or modelling capability for batteries.
- TNSPs have conflicts of interest in that they compete with battery developers, by seeking to develop batteries themselves, potentially giving themselves preferential connections and tariffs.

2 https://iea.blob.core.windows.net/assets/02a7a120-564b-4057-ac6d-cf21587a30d9/Australia2023EnergyPolicyReview.pdf

Summary of recommendations

The following is a summary of the recommendations in this report. They are intended as a call to action to our federal and state governments. They seek to address obstacles faced by investors and developers in energy storage.

RECOMMENDATION 1:
Coal-fired power station closure certainty is pivotal

Certainty necessitates a balanced approach, combining both incentives and regulatory measures, to ensure a smooth and effective transition.

- A ministerial declaration on the dates for coal-fired power stations to cease operation would provide certainty for the owners and operators, AEMO (as the power system and market operator), and developers of new generation and storage projects.
- This should be coupled with a closure framework mechanism that facilitates a transparent and coherent process for managing the retirement of thermal generators.
- A mandatory assessment, yearly for 5 years, by AEMO of security and reliability before any power station is ordered to continue operation. This assessment must be publicly available and include a mandatory call for industry to offer alternative capacity solutions to extending the life of a coal-fired power station.
- When contracts are agreed to extend the life of thermal assets, terms must be transparent to market participants.

RECOMMENDATION 2:
Develop markets and contracts to facilitate investment

- Energy Ministers to direct the Australian Energy Market Commission (AEMC) and AEMO to:
  a] reassess rule changes which are creating further obstacles to batteries and energy storage, and explore ways to remove those barriers.
  b] undertake a review of potential new market services such as inertia, system strength, voltage control and others, that could be delivered by storage and provide additional revenue streams for the services storage can provide.
  c] establish contracts for existing markets — financial contracts for FCAS, peak energy, or a volatility index would help batteries gain better finance and lower equity returns.

We strongly encourage energy ministers to ensure that this reassessment process has a high degree of transparency and rigor, to ensure the desired clean energy transition outcomes.

RECOMMENDATION 3:
Invest in Long-Duration Energy Storage (LDES)

- Federal and state energy ministers should prioritise and fund research and development into LDES technologies in Australia, so that they are available in time. Specifically, support is needed for R&D programs for scalable long duration technologies, such as flow batteries and liquid air energy storage. The Australian Renewable Energy Agency (ARENA) and Clean Energy Finance Corporation (CEFC) funding should be leveraged.
- Federal and state energy ministers should invest in project planning and assessments of new Pumped Hydro Energy Storage (PHES), as it is an established LDES technology, but has a long lead time.

RECOMMENDATION 4:

Ensure transparency in Capacity Investment Scheme (CIS) mechanism development

This is a no regrets recommendation and can be prioritised as an immediate action.

- The development of the CIS mechanism must be conducted transparently with a feedback loop for lessons and program improvements. Stakeholders, including investors and developers, should be involved in this process to guarantee that the scheme effectively supports the energy transition.

RECOMMENDATION 5:

Energy ministers to ensure fit-for-purpose approvals for storage

- Energy ministers should prioritise all approval processes related to storage projects. This includes streamlining connections, environmental assessments and planning approvals.
- Specifically, we recommend that energy ministers direct their departments to provide storage specific guidance and the standards required by the various jurisdictional planning departments to minimise complexity and cost. For example, noise regulation is not fit-for-purpose. Wind farms have regulatory exemption for noise, and it would be useful to have something similar for battery storage.

RECOMMENDATION 6:

Federal and state government and industry should collaborate to support education and outreach

- Comprehensive education and outreach programs are required to raise awareness and understanding of storage across the finance sector. This should align with proposed outreach efforts pertaining to climate related financial disclosure regimes, including the upcoming changes to AFRS 1 and 2, and associated reporting obligations.

This should be an ongoing piece of work that requires joint effort across the industry stakeholder groups in partnership with government and investors.

RECOMMENDATION 7:

Federal government should ensure that Your Future, Your Super (YFYS) benchmarks facilitate investment

- The framework and benchmarks for YFYS should be designed to facilitate and encourage superannuation funds to invest in LDES.

2. Context

As the Australian electricity system transitions away from fossil fuel generation a "firming" technology is needed to make variable energy sources, such as wind and solar, "dispatchable".

There are a range of established energy storage technologies that can meet this need such as batteries and pumped hydro energy storage (PHES).

One of the many benefits of batteries is how rapidly they can be deployed. The first large-scale 100 MW battery in Australia was delivered in just over three months. Given suitable locations and a clear route to finance, battery projects offer a rapid solution to both energy capacity and system service needs.

While understanding the critical role that storage can play in the clean energy transition is well-developed, the financing arrangements are less clear. Experience in investing in large-scale batteries is nascent in Australia with a lack of clarity on the revenue streams and the path to secure income.

The business models for storage (with stacked and multiple income streams) are complex, and lithium-ion batteries have shorter life span than conventional or renewable generation projects. This means that key investors lack confidence in storage projects, which leads to them pricing in a risk premium that results in either a high financing cost that erodes projected value, or a failure to secure the financial close needed to progress a storage project.

To meet AEMO's Draft 2024 Integrated System Plan (ISP) Step Change scenario, we need a total of 19 GW of storage by 2030 and 57 GW by 2050. In 2030, the 2024 ISP indicates 10.4 GW of medium and shallow utility-scale batteries are needed (55% of all storage), falling to 7.4 GW in 2050 (12% of all storage). Currently we only have 1.4 GW battery capacity and a further 1.6 GW of pumped hydro energy storage.

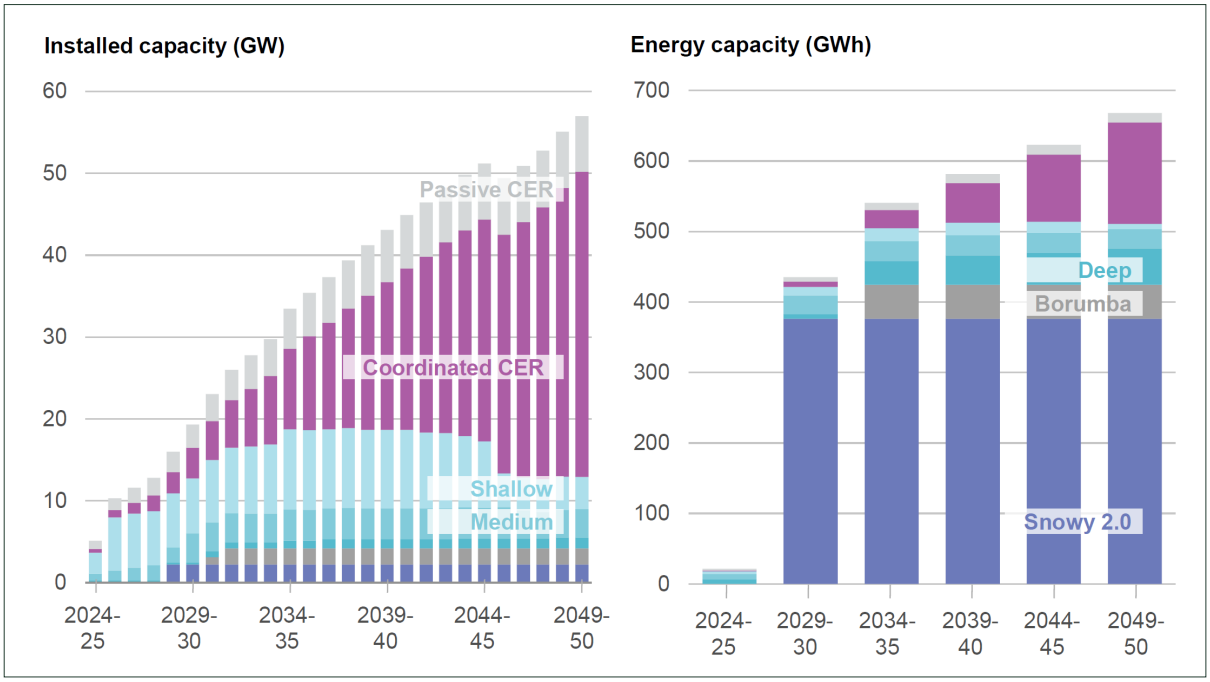
PHES is an established long duration energy storage that will be critical to support a fully decarbonised power system. While it is a well-established technology, the long lead times and environmental sensitivities mean that government support is needed to progress new projects.

This paper seeks to clearly define the challenges and propose policy solutions that are practical, and supported by industry and government, to improve the financeability of the storage assets that are critical for Australia to meet its decarbonisation objectives and ensure a secure, affordable and reliable energy system.

3. There is no clean energy transition without storage

The Draft 2024 ISP was published in December 2023. Under the Step Change scenario, storage requirements in the NEM are forecast to grow from today's 2 GW to 33 GW in 2034–35, rising to 57 GW of storage capacity in 2049–50.

Figure 1: Storage requirements for the NEM under the Draft 2024 ISP Step Change scenario[3]



AEMO defines storage in the ISP as, deep, medium, shallow, CER and passive CER.

Duration	Hours	Capacity 2025, GW	Capacity 2030, GW	Capacity 2035, GW	Capacity 2040, GW	Capacity 2050, GW
Deep (Snowy 2.0)	> 12	0.0	2.2	2.2	2.2	2.2
Deep (Qld)	> 12	0.0	0.0	2.0	2.0	2.0
Deep	> 12	0.2	0.2	0.9	1.1	1.3
Medium	4-12	0.8	3.6	3.8	3.8	3.5
Shallow	< 4	2.6	6.7	9.8	9.6	3.9
Coordinated CER	< 2	0.5	3.7	9.8	18.0	37.3
Passive CER		1.0	2.8	4.9	6.4	6.8
Total		**5**	**19**	**33**	**43**	**57**
Percentage behind the meter	< 2	20 %	35 %	44 %	50 %	79 %
Percentage medium utility	4-12	20 %	20 %	12 %	9 %	5 %
Percentage shallow utility	< 4	60 %	35 %	29 %	23 %	7 %

Table 1: Storage duration and capacity in draft 2024 ISP Step Change Scenario[4]

3 https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2023/draft-2024-isp-consultation/draft-2024-isp.pdf?la=en

4 https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2023/draft-2024-isp-consultation/supporting-materials/draft-2024-isp-chart-data.xlsx?la=en

In the 2024 ISP Step Change scenario, utility-scale grid-connected storage is forecast to represent 76% (485 GWh) and Consumer Energy Resources (CER) 24% (157 GWh) of the energy stored in the NEM in 2050. Perhaps more critically, in 2050, only 6% of the stored energy will be in short and medium storage (2–12 hour duration at 36 GWh).

The Snowy 2.0 and Borumba (Queensland) pumped hydro energy projects will hold over 60% of the stored energy in the NEM by 2050.[5]

Utility-scale grid-connected short and medium and storage is projected to decline in capacity out to 2050. This is because batteries have a relatively short life, and at the point of replacement (projected in the 2040s) AEMO indicates that behind-the-meter batteries will dominate. By 2050 nearly 80% of NEM storage capacity is expected to be behind-the-meter, with two thirds (37.3 GW) of that capacity able to be coordinated in a way that ensures system stability and reliability.[6]

However, there is an increasing problem of lack of trust between the market operator and the established energy industry, and Australians investing CER[7]. Without work to develop social licence AEMO's assumption that 37 GW of customer-owned behind-the-meter batteries will be available to the market and system may well not eventuate. Ensuring that utility-scale short- and medium-duration storage has a role beyond 2030 addresses the risk that social licence does not develop, which would render CER unavailable to the wider power system.

a] More rapid decarbonisation

The Step Change scenario assumes that the temperature change due to climate change is kept below 2 °C[8], rather than the commitment made by the Australian Government under the Paris Agreement to keep the temperature increase under 1.5 °C.[9]

AEMO have undertaken a sensitivity study that constrains the Step Change scenario to a below 1.5 °C temperature increase and have assessed the changes in generation that would be needed to achieve this, while retaining the same Optimal Development Pathway for transmission[10]. This results in a modest increase in the total capacity requirement for energy storage, with 36 GW in 2034–5 and 62 GW in 2054–55[11].

There is no change in behind-the-meter storage (CER) between the <2 °C and <1.5 °C versions of the Step Change scenario. However, there is a decrease in shallow duration (<4 hours) storage and a significant new requirement for "deep" duration storage (> 12 hours). This scenario would require an additional 3.2 GW by 2035 and an additional 3.7 GW by 2050 – this is beyond the capacity provided by Snowy 2.0 and Borumba schemes.

5 https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2023/draft-2024-isp-consultation/supporting-materials/draft-2024-isp-chart-data.xlsx?la=en

6 https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2023/draft-2024-isp-consultation/draft-2024-isp.pdf?la=en

7 https://nexaadvisory.com.au/site/wp-content/uploads/2023/10/Nexa-Distributed-Energy-Resources-paper-and-recommendations-04102023.pdf

8 https://aemo.com.au/-/media/files/major-publications/isp/2023/2023-inputs-assumptions-and-scenarios-report.pdf?la=en

9 https://www.dcceew.gov.au/about/news/aus-delivers-key-paris-agreement

10 https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2023/draft-2024-isp-consultation/appendices/a2-generation-and-storage-development-opportunities.pdf?la=en

11 https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2023/draft-2024-isp-consultation/supporting-materials/draft-2024-isp-generation-and-storage-outlook.zip?la=en

Duration	Capacity 2035 GW	Energy 2035 GWh	Capacity 2050 GW	Energy 2050 GWh
Deep (Snowy 2.0)	2.2	350	2.2	350
Deep (Qld)	2.0	48	2.0	48
Deep	3.4	116	5.0	168
Medium	5.0	38	6.1	48
Shallow	8.5	16	2.7	5
Coordinated CER	9.8	26	37.3	144
Passive CER	4.9	10	6.8	13
Total	**36**	**604**	**62**	**777**
ISP 2024: Step Change <2 °C	19	514	57	642
Percentage behind the meter	41 %	6 %	77 %	20 %
Percentage medium utility	14 %	6 %	10 %	6 %
Percentage shallow utility	24 %	3 %	4 %	1 %

Table 2: Storage duration and capacity needed to meet Paris Agreement (<1.5 °C) under the Step Change scenario

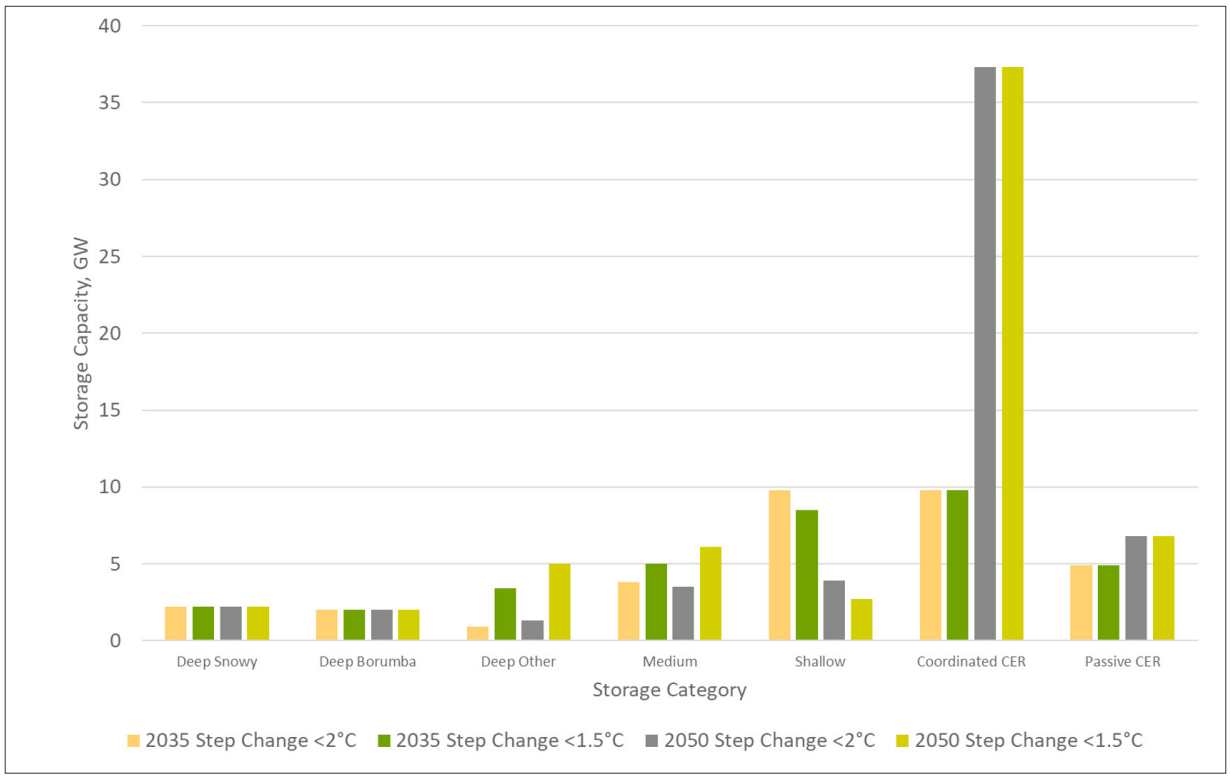


Figure 2: Comparison the storage requirements between the <2 °C and <1.5 °C sensitivities for Step Change scenario

Under a more rapidly decarbonised Step Change scenario, there is a small increase in the requirement for medium duration (4–12 hour) storage, with an additional 1.2 GW in 2030 and an additional 2.6 GW.

Given the additional storage requirements under an approach that ensures Australia meets its commitments under the Paris Agreement, a focus on supporting the delivery of long duration energy storage, of >4 hours and >12 hours, is needed[12].

12 https://ceig.org.au/decarbonising-australia-accelerating-our-energy-transition-with-a-credible-1-5-degree-c-scenario/

A word on gas

The Draft 2024 ISP places a significant reliance on new gas peaking plant, envisaging more installed gas plant capacity (16.7 GW) than is connected today (10 GW[13]) or was projected in the 2022 ISP (9.4 GW[14]).

This is even though:

a) Development of batteries is cost-competitive with gas peakers today[15]. However, the ancillary and reserve services that would provide the revenue streams to support new storage are missing and or can be high risk for investors in the NEM.

b) AEMO indicate in Appendix 4 of the Draft 2024 ISP[16] that the diversity provided by interconnection and utility solar PV in the interior of Australia are likely to cost-effectively resolve any very rare "dunkelflaute" events.

c) The current role of gas plant is already shifting from "baseload" to peaking capacity[17].

d) AEMO's own data demonstrates that the utilisation of gas plant has been falling year-on-year, implying a diminishing role for gas today and in the future[18].

Given all these points, the case for material new gas plant capacity appears to be over-stated in the Draft 2024 ISP.

13 https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/generation-information

14 https://aemo.com.au/-/media/files/major-publications/isp/2022/2022-documents/2022-integrated-system-plan-isp.pdf?la=en

15 https://www.csiro.au/en/research/technology-space/energy/energy-data-modelling/gencost

16 https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2023/draft-2024-isp-consultation/appendices/a4-system-operability.pdf?la=en

17 ibid

18 https://aemo.com.au/-/media/files/major-publications/qed/2023/qed-q3-2023-report pdf?la=en&hash=165E68BF9A6DAF100B56CFAAC437CE20

4. Overview of current situation for storage in the NEM

Current storage deployment in the NEM

Electricity storage in the NEM comprises batteries and pumped hydro energy storage. Current battery capacity in the NEM is 1.4 GW[19], with a further 1.6 GW of pumped hydro energy storage from three plants (Tumut 2, Wivenhoe and Shoalhaven)[20]

Category	Total battery capacity, MW	Percentage of all capacity
Existing	1,413	2.3 %
Committed	1,242	12.8 %
Anticipated	4,013	45.8 %
Proposed	55,236	21.3 %
TOTAL	**61,903**	**18.2 %**

A "committed" project is one that has financing, land, planning permission in place and that construction has either commenced or contracts signed. An "anticipated" meets three of the committed project criteria, but not all.

Table 3: Battery capacity in the NEM[21 22]

There are three battery projects at the commissioning stage:

Kennedy Energy Park (Qld)	2 MW / 4 MWh		ARENA	Windlab	
Queanbeyan (NSW)		10 MW / 20 MWh		GPG	
Torrens Island (SA)		250 MW / 250 MWh		AGL	Inertia

The five battery projects that are committed, total 1,242 MW / 2,413 MWh, with durations ranging from 1–2 hours. The Capital Battery (Neoen) has received support from the CEFC, the Broken Hill Battery (AGL) has received support from ARENA (grid forming) and the Waratah Super Battery (Akaysha Energy/Transgrid) has received funding support from the NSW and federal governments (CEFC/CIS).

All of the existing and committed batteries have a duration of 2 hours or less, making them short-duration assets. Of the battery projects listed as anticipated (4 GW) and publicly announced (proposed, 55 GW) projects, the majority are either 1 or 2-hour batteries, with only a few 4-hour batteries.

The current ancillary service market and energy market favours fast-response, short duration batteries[23].

A 50 MW / 400 MWh battery, with a duration of 8 hours was successful in the NSW Government's long duration storage tender announced in May 2023[24] and the further three battery projects announced in November 2023 are 2-hour duration with one 4-hour duration battery[25].

19 https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/generation_information/2023/nem-generation-information-oct-2023.xlsx?la=en

20 https://www.wsp.com/en-au/insights/a-new-dawn-for-pumped-hydro-in-australia

21 See https://www.aer.gov.au/system/files/AER%20-%20Cost%20benefit%20analysis%20guidelines%20-%2025%20August%202020.pdf for definitions of committed and anticipated projects.

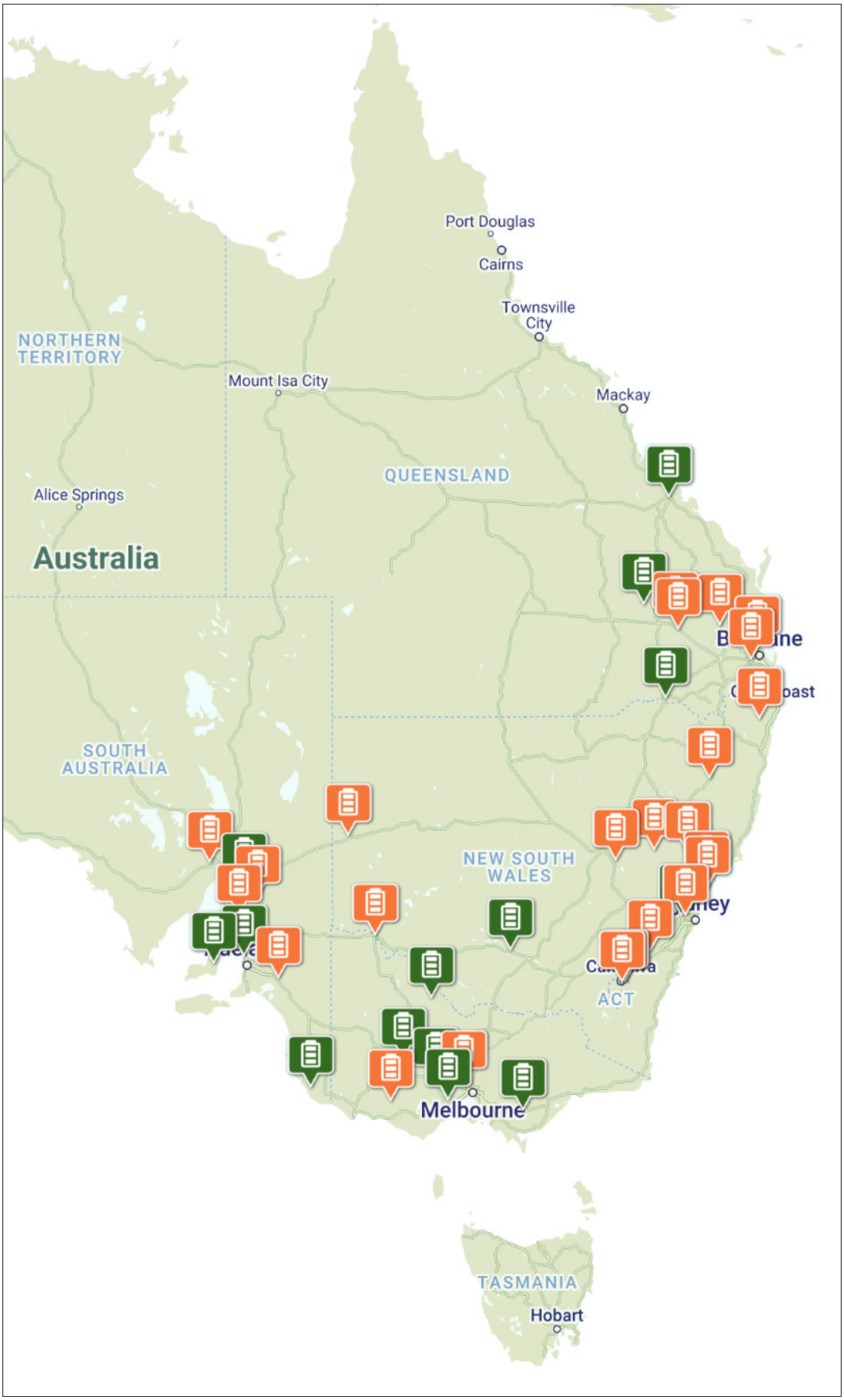
22 https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/generation_information/2023/nem-generation-information-oct-2023.xlsx?la=en

23 https://reneweconomy.com.au/eight-hour-big-battery-trumps-pumped-hydro-in-nsw-long-duration-storage-tender

24 https://www.rwe.com/en/press/rwe-renewables/2023-05-01-rwe-successful-in-australian-tender-with-long-duration-battery-storage-project/

25 https://reneweconomy.com.au/liddell-to-host-giant-battery-after-agl-and-akaysha-win-australias-biggest-capacity-tender/

Figure 3: Map of existing batteries (green) and batteries under construction (orange) in the NEM[26]



26 https://reneweconomy.com.au/big-battery-storage-map-of-australia/

Name	Owner/Operator	State	Capacity MW / MWh	Duration Hours	Operational date	Funding support	Services
Adelaide Desalination Plant	South Australian Water Corporation	SA	6 / 12	2:00	May 2022		FCAS
Ballarat Energy Storage System	Ausnet Transmission Group Pty Ltd / Energy Australia	VIC	30 / 30	1:00	Dec 2018	ARENA	FCAS; Energy
Bolivar Waste Water Treatment	South Australian Water Corporation	SA	2 / 5	2:30	Feb 2023		FCAS
Bouldercombe Battery project	Genex Power Limited	QLD	50 / 100	2:00	Nov 2023		Energy
Bulgana Green Power Hub BESS	Bulgana Wind Farm Pty Ltd	VIC	20 / 34	1:30	Nov 2021		FCAS; Energy
Christies Beach Wastewater Treatment Plant	South Australian Water Corporation	SA	2 / 4	2:00	Jan 2023		
Dalrymple BESS	ElectraNet / AGL	SA	30 / 9	0:20	Dec 2018	ARENA	FCAS; Energy
Darlington Point Energy Storage System	DPESS Pty Ltd	NSW	25 / 50	2:00	Aug 2023	ARENA	Energy
Gannawarra Energy Storage System	GESS ProjectCo	VIC	25 / 50	2:00	Oct 2018	ARENA	FCAS; Energy
Happy Valley Reservoir	South Australian Water Corporation	SA	4 / 9	2:15	Dec 2022		FCAS
Hazelwood Battery Energy Storage System	Hazelwood BESS Project Co Pty Ltd as trustee for the HBESS Asset Trust	VIC	200 / 150	0:45	Jun 2023		Energy
Hornsdale Power Reserve Unit 1	Hornsdale Power Reserve Pty Ltd Neoen	SA	50 / 61	1:15	Jul 2020	ARENA	FCAS; Energy
Hornsdale Power Reserve Unit 1	Hornsdale Power Reserve Pty Ltd Neoen	SA	100 / 117	1:10	Dec 2017	SA Govt; CEFC	FCAS; Energy
Lake Bonney Battery Energy Storage	Lake Bonney BESS Pty Limited (Infigen/Iberdrola)	SA	25 / 52	1:05	Oct 2019	ARENA	Energy; FCAS
Philip Island BESS	Mondo Power	VIC	5 / 10	2:00	May 2023	VIC Govt	Local energy
Riverina Energy Storage System 1	Edify Energy Pty Ltd	NSW	60 / 120	2:00	Feb 2023		Energy
Riverina Energy Storage System 2	RESS 2 Pty Ltd	NSW	65 / 130	2:00	Aug 2023		Energy
Victorian Big Battery	Victorian Big Battery Pty Ltd	VIC	300 / 450	1:30	Dec 2021	ARENA	Energy; FCAS
Wallgrove Grid Battery project	TransGrid	NSW	50 / 75	1:30	Dec 2021	ARENA	FCAS; Energy
Wandoan South BESS	Vena Evergy	QLD	100 / 150	1:30	Jul 2022		FCAS; Energy

Table 4: Existing and operational batteries in the NEM[27][28]

27 https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/generation_information/2023/nem-generation-information-oct-2023.xlsx?la=en

28 https://nembess.com/batteries

5. Current revenue opportunities for storage in the NEM

The large-scale batteries currently in the NEM range from 20 minutes to 2-hours in duration. Sources of revenue are limited to:

- The energy market (generation and load)
- Contingency Frequency Control Ancillary Service (FCAS-C)
- Regulation Frequency Control Ancillary Service (FCAS-R)

Over 50% of the revenue earnt to-date has been via FCAS-C at $211 million, with FCAS-R and energy at 23% and 27% respectively ($99 million and $111 million). Nearly 50% of the total battery income of $421 million has accrued to a single battery that had first mover advantage.

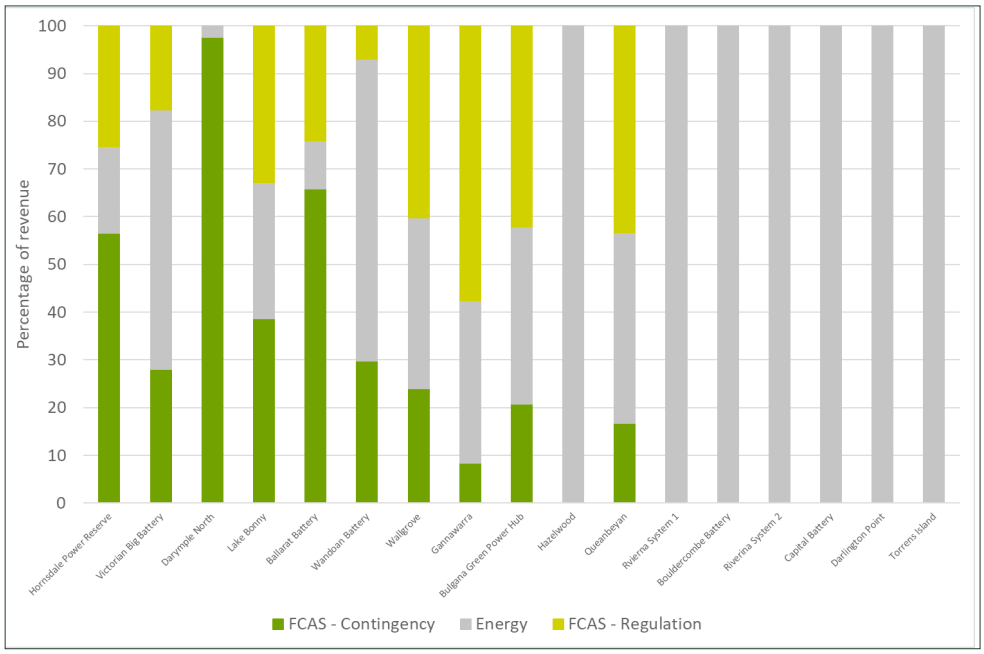


Figure 4: Sources of revenue for batteries in the NEM[29]

In October 2023, AEMO introduced 'Very Fast FCAS', a contingency 1 second raise and lower service.[30] The initial cap requirements for the Very Fast service were revised in November to 100 MW for lower and 225 MW for raise, with interest significantly above the caps (600 MW for lower and 700 MW for raise) and enablement generally meeting the required cap.[31]

Prices in the lower VF FCAS are about three times that of the entire FCAS lower suite and more than the regulation lower FCAS. FCAS participation can be stacked and ensures that participants are earning around $100 / MWh.[32]

Prices are higher for the VF FCAS lower because this is entirely provided by batteries, while the VF FCAS raise incorporates demand side response from load, as well as utility batteries and Virtual Power Plants (VPPs). However, the VF FCAS market is nascent and the number of providers is growing, which may depress prices in the longer term.

29 https://nembess.com/batteries

30 https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/ancillary-services/very-fast-fcas-market-transition

31 https://wattclarity.com.au/articles/2023/12/very-fast-fcas-markets-continue-to-grow/

32 https://www.gridcog.com/blog/frothing-over-very-fast-fcas

6. Current regulatory processes

There are a number of current and recent rule changes and approaches that are likely to impact investor certainty for new storage projects.

Integrating Energy Storage Systems (IESS) into the NEM

The Integrating Energy Storage Systems (IESS) into the NEM rule change (ERC0280)[33] was proposed by AEMO in August 2019. The rule change proposed a definition of storage in the Rules recognising the bi-directional nature of storage, thus creating a new "hybrid" participant combining both generation and storage (and load). The aim of this was to increase clarity and transparency for all stakeholders and remove barriers to entry for storage and hybrid facilities, so as to support the clean energy transition with storage to firm variable renewable energy generation.

The final rule was made in December 2021, with all components of it to be in force by June 2024. AEMO is currently working to fully operationalise the rule change[34].

However, the rule change did not address network charging for storage projects[35], with the AEMC indicating that further work would be required, and indicating that exempting batteries from import use of system charging did not meet the National Electricity Objective[36]. This is even though the final end customer will also pay the Transmission Use of System (TUoS) charge resulting in double dipping. For this reason, batteries are exempted TUoS (import) charges in the UK.[37]

Stakeholders clearly indicated their concerns about this in their responses to the various stages of the consultation, as such use of system charges continues to impact investment in battery storage[38,39].

While this rule change is yet to fully implemented, stakeholders believe it is unlikely to deliver on the aims of facilitating investments in and entry of new storage, and may actively disincentivise new storage projects.

Distribution network connected storage would need to pay both the TUoS and Distribution Use of System (DUoS) charges. The 2021 Access and Pricing Rule Change[40] now also allows Distribution Network Service Providers (DNSPs) to levy an export tariff resulting in storage being charged on import and export.

33 https://www.aemc.gov.au/rule-changes/integrating-energy-storage-systems-nem
34 https://aemo.com.au/en/initiatives/major-programs/integrating-energy-storage-systems-project
35 https://www.aemc.gov.au/sites/default/files/2021-12/1._final_determination_-_integrating_energy_storage_systems_into_the_nem.pdf
36 https://www.aemc.gov.au/sites/default/files/2021-12/5._fact_sheet_-_network_use_of_system_charges.pdf
37 https://www.ofgem.gov.uk/sites/default/files/docs/2019/12/full_decision_doc_updated.pdf
38 E.g., https://www.aemc.gov.au/sites/default/files/documents/a46._iberdrola.pdf
39 https://www.aemc.gov.au/sites/default/files/documents/a11._neoen.pdf
40 https://www.aemc.gov.au/rule-changes/access-pricing-and-incentive-arrangements-distributed-energy-resources

Clarifying mandatory primary frequency response obligations for bi-directional plant

The Clarifying Mandatory Primary Frequency Response (PFR) Obligations for Bi-directional Plant rule change (ERC0364)[41] was proposed by AEMO in August 2023. It seeks to obligate storage assets to provide mandatory PFR when charging and enabled for another ancillary service.

This rule change rapidly follows a previous rule change (ERC0274[42]) request from AEMO requiring batteries to provide mandatory PFR, which the AEMC did not support because it would discriminate against batteries. This is because charging a battery will be treated as a scheduled load, while scheduled loads (that are not batteries) are not required to provide mandatory PFR[43]. This approach by the AEMC was confirmed in a further rule change process on incentive arrangements for PFR (ERC0264[44]) and the final determination[45].

The re-prosecution of rule change requests, when no change has occurred in the power system, reduces certainty for investors in storage, delaying projects. It is not supported by stakeholders.

The draft determination[46] has concluded that batteries will be required to provide PRF when discharging, when charging and when enabled for regulation FCAS. Batteries will not have to provide PFR when at rest or when enabled for contingency FCAS.

All batteries will be required to comply with the rule from July 2024, with the Frequency Performance Payments (FPP) commencing in July 2025. The requirement to provide PFR a year before any FPP are available means that batteries will have to deliver a service without remuneration. While the AEMC hopes that the rule change will not decrease investor certainty or shorten battery life, it is likely to materially impact investment in batteries that would need to be scheduled.

Operational Security Mechanism, Essential System Services, Operational Reserve

There are a number of current and delayed rule change processes underway in the NEM. This includes the Operational Security Mechanism (OSM)[47] and Essential System Services (ESS)[48]. Both cover potential new services that would support the future low carbon power system.

While some of the proposed services were put forward by coal-fired power generators to create new markets for services they currently provide (e.g. inertia), and were specifically designed to support coal, new services will be needed. As such, work needs to progress on the techno-physical specifications for those new services so that new technology providers, such as storage, can develop their offerings.

The recent draft decision from the AEMC on the operational reserve rule change[49] has not resulted in a new operational reserve service, but has instead placed obligations on batteries in the NEM to share their state of charge (See page 24 for more detail).

41 https://www.aemc.gov.au/rule-changes/clarifying-mandatory-primary-frequency-response-obligations-bidirectional-plant

42 https://www.aemc.gov.au/rule-changes/mandatory-primary-frequency-response

43 https://www.aemc.gov.au/sites/default/files/2020-03/ERC0274%20-%20Mandatory%20PFR%20-%20Final%20Determination_PUBLISHED%2026MAR2020.pdf

44 https://www.aemc.gov.au/rule-changes/primary-frequency-response-incentive-arrangements

45 https://www.aemc.gov.au/sites/default/files/2022-09/PFR%20Incentive%20Arrangements_%20Final%20Determination_8SEPT2022.pdf

46 https://www.aemc.gov.au/rule-changes/clarifying-mandatory-primary-frequency-response-obligations-bidirectional-plant

47 https://www.aemc.gov.au/rule-changes/improving-security-frameworks-energy-transition

48 https://www.aemc.gov.au/rule-changes/efficient-provision-inertia

49 https://www.aemc.gov.au/sites/default/files/2023-12/Enhancing%20reserve%20information%20-%20draft%20determination.pdf

Electricity Network Ring-Fencing Arrangements

The electricity transmission and distribution network service providers are limited from undertaking from activities outside of owning and operating an electricity network by the Ring-Fencing Guidelines.

These guidelines[50,51] notionally limit the TNSPs and DNSPs from owning and operating batteries, classed as generation (or now bidirectional units, encompassing load and generation). However, the TNSPs and DNSPs can apply for a waiver to allow them to own and operate batteries in certain circumstances. The TNSP ring-fencing guideline was updated in 2023 to bring it into line with the more detailed DNSP ring-fencing guideline.

In the updated 2021 ring-fencing guideline for DNSPs the Australian Energy Regulator (AER) provided for a streamlined waiver application for DNSPs to apply to own and operate batteries[52]. The AER recognise that electricity network-ownership of batteries limits those delivered cost-competitively by third parties. However, on balance, the AER felt assessing waiver requests on a case-by-case basis would provide some protection to third party providers, while ensuring that the necessary storage was deployed.

Notwithstanding the AER's earlier concerns on DNSP-led batteries, in February 2023 the AER granted a class waiver to DNSPs[53] giving them blanket approval to invest in, own and operate distribution-connected batteries under the Federal Government's Community Battery program[54.]

A number of TNSPs have installed or are considering installing batteries, for instance the Electranet Dalrymple battery[55], Ausnet Services Ballarat battery (and a range of smaller batteries including Mallacoota, Yackandandah, Phillip Island)[56], Transgrid Waratah Super Battery[57] (Deer Park Battery[58]). With the AER granting ring-fencing waivers for aspects of the operation of the batteries by the TNSP[59].

Concerns remain that TNSPs and DNSPs may give themselves more beneficial connection arrangements and use of system charges than third parties,[60] and that there is a significant information asymmetry that allows the electricity networks to locate a battery to maximise their income[61,62]. The AER proposed a rule change in July 2023 that would add negotiated transmission services to the ring-fencing guideline and that is now being fast-tracked by the AEMC[63].

50 https://www.aer.gov.au/documents/aer-ring-fencing-guideline-electricity-transmission-version-4-march-2023

51 https://www.aer.gov.au/documents/aer-ring-fencing-guideline-electricity-distribution-version-3-3-november-2021

52 https://www.aer.gov.au/documents/aer-ring-fencing-new-energy-storage-devices-waiver-application-template-may-2023

53 https://www.aer.gov.au/news/articles/communications/aer-grants-class-ring-fencing-waiver-allow-distribution-businesses-apply-funding-under-commonwealth-governments-community-batteries-household-solar-program

54 https://www.dcceew.gov.au/energy/renewable/community-batteries

55 https://www.electranet.com.au/wp-content/uploads/2021/01/ENA-Innovation-Award-2019-ElectraNet-Application-for-ESCRI-SA.pdf

56 https://www.ausnetservices.com.au/projects-and-innovation/battery-storage

57 https://www.transgrid.com.au/media-publications/news-articles/transgrid-welcomes-super-battery-planning-approval-to-secure-energy-supply

58 https://infrastructurepipeline.org/project/deer-park-battery

59 https://www.electranet.com.au/wp-content/uploads/2021/01/ESCRI-SA-Project-Summary-Report-The-Journey-to-Financial-Close-May-2018.pdf

60 https://www.aer.gov.au/system/files/01_Acacia%20Energy_11012023_Redacted.pdf

61 https://www.aer.gov.au/documents/aer-ring-fencing-guideline-explanatory-statement-electricity-distribution-version-3-november-2021

62 https://www.aer.gov.au/industry/registers/determinations/waratah-super-battery-project-network-augmentation-and-sips-control-system-non-contestable

63 https://www.aemc.gov.au/rule-changes/expanding-transmission-ring-fencing-framework#:~:text=Overview,to%20include%20negotiated%20transmission%20services

7. Why definitions matter

There are a broad range of electrical energy storage technologies with differing discharge durations and maturities. The Baringa report for the Clean Energy Investor Group[64] defined the different storage durations as:

Description	Duration	AEMO description in ISP
Short duration storage	<4-hour discharge	Shallow
Medium duration storage	4–12 hours of discharge	Medium
Long duration storage	>12-hour discharge	Deep

Table 5: Definitions of energy storage durations

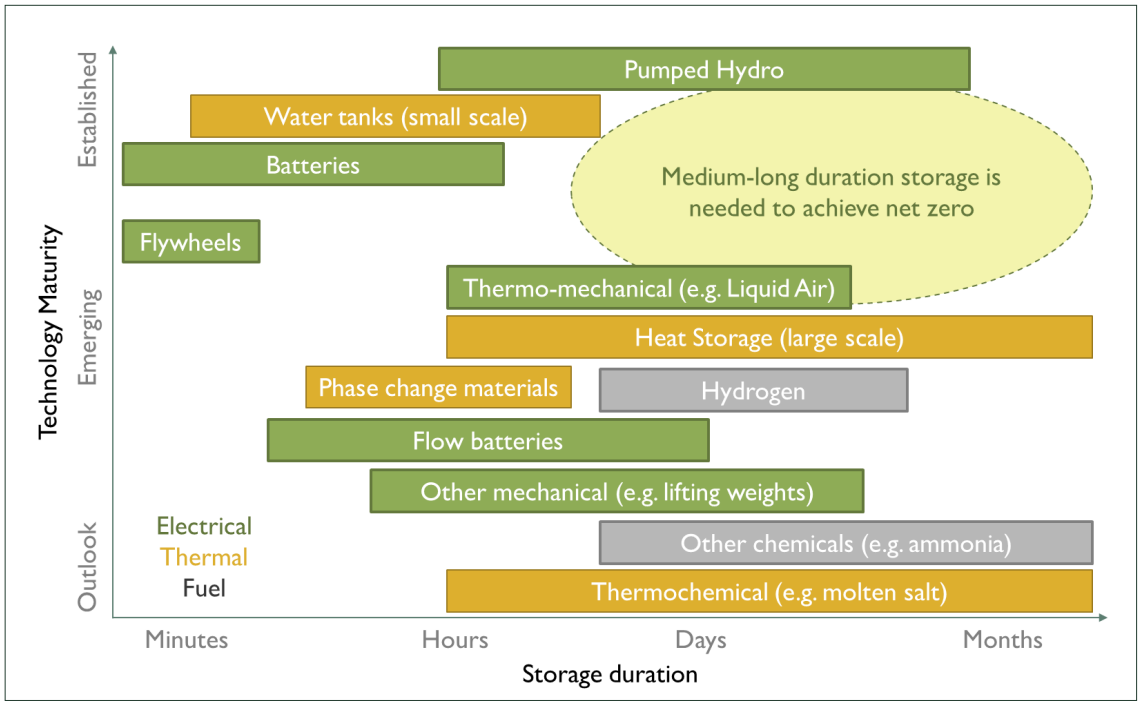
As AEMO identify in the Draft 2024 ISP, a variety of storage durations will be needed to support the secure operation of the future power system.

Shorter duration storage will provide current system services, such as FCAS, and new services such as ramping and dynamic frequency control.

Medium duration storage combines the ability (dependent on design and technology) to respond rapidly, providing ancillary services in the same way as short duration storage, while also meeting shorter-term demand issues (4–8 hours) such as minimum and peak demand situations, although the services (value) for this support are not yet in the market.

Long duration storage of 8–12 hours or more, particularly seasonal storage over multiple days, will be needed to meet demand during weather-induced supply shortfalls. While interconnection and demand side flexibility will help manage these shortfall situations, established long duration storage technologies will also be critical.

Figure 5: Storage technology by duration and maturity, showing innovation gap[65]



64 https://ceig.org.au/wp-content/uploads/2024/03/CEIG_Baringa_Investing-in-storage_final-report_V2_0.pdf

65 https://ukesr.supergenstorage.org/chapters/energy-storage-technologies

8. Challenges for storage in the NEM

The Baringa report[66] identified that short duration storage with durations of 1–2 hours, currently most likely to be Lithium-ion batteries, are financeable today and utilise a mature technology.

Energy storage with durations of greater than 2 hours, but less than 4 hours, is close to being financeable depending on the business model (equity funders are more likely to support a 4-hour battery than debt financiers). Again, the technology focus is entirely on Lithium-ion batteries.

Beyond 4-hours duration securing finance becomes an issue. Some developers are of the view that 6-hour duration Lithium-ion batteries would be financeable if there was an enforceable regulatory scheme that ensured that coal-fired power stations closed in a structured way, with no extensions, to provide more investment and revenue certainty.

However, electrical energy storage beyond 6 hours is not financeable in the current funding market and electricity market and will need government intervention. As identified in Figure 5 (above), PHES is the only established LDES available today. However, while there are many suitable sites for new PHES projects in Australia[67,68], there may be environmental concerns to overcome and the long lead time for delivery means that support is required now to ensure that new capacity is available when needed.

Figure 5 (above) also identifies a gap in additional technologies that can provide LDES. Support for new and emerging LDES technologies would accelerate their development and subsequent deployment — many of which are likely to be less geographically constrained than new PHES.

a] Financeability Challenges

More than 10GW of medium duration storage is needed by 2030 as identified by AEMO[69]. This requires a smooth investment pathway and delivery plan.

Storage experts, CEIG members, and investors have identified that short duration batteries of 1–2 hours have minimal investment challenges. However, batteries of greater than 2-hours duration, particularly the upper range of short duration batteries (3–4 hours), and medium duration batteries of 4–8 hours, face significant challenges.

While there are a broad range of support options available to storage developers, that introduces complexity. Over half of the batteries operating in the NEM today have received financial support (of varying types) from ARENA, CEFC and governments. The recent NSW Energy Roadmap tenders for storage, supported through the Long-term Energy Service Agreements (LTESA), were over-subscribed because the LTESA is strongly supported by industry as a robust approach to delivering battery projects of various durations.

The upper range of medium duration batteries, between 8–12 hours, and long duration storage (or "deep" storage) of greater than 12 hours, experience complex challenges beyond financeability. Storage of 8 hours duration and longer may not be effectively delivered by batteries and requires specific government focus on technology development and support, today, to ensure that long duration storage is available in the future.[70,71]

66 https://ceig.org.au/wp-content/uploads/2024/03/CEIG_Baringa_Investing-in-storage_final-report_V2_0.pdf

67 https://arena.gov.au/assets/2018/10/ANU-STORES-An-Atlas-of-Pumped-Hydro-Energy-Storage-The-Complete-Atlas.pdf

68 https://royalsoc.org.au/images/pdf/journal/155-2-Blakers.pdf

69 https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2023/draft-2024-isp-consultation/draft-2024-isp.pdf?la=en

70 https://nexaadvisory.com.au/site/wp-content/uploads/2023/07/Nexa-Advisory-Eraring-can-be-closed-on-schedule-Report-24072023.pdf

71 https://ceig.org.au/decarbonising-australia-accelerating-our-energy-transition-with-a-credible-1-5-degree-c-scenario/

Different investors have different risk appetites. Debt finance typically requires more surety than equity finance. As such, equity finance is beginning to move into 4–6-hour duration batteries, while debt finance is more comfortable in the established 1–2-hour duration battery space.

Given the number of challenges to securing a robust long-term revenue stream for a storage project, financeability presents the most significant investment barrier.

b] Revenue Barriers

Uncertainty of the closure of coal-fired power stations and a push for a growing reliance on gas peakers makes forecasting revenue for storage challenging. Both coal-fired power stations and gas plant can compete with batteries in the energy and ancillary services market, without the need to pay down investment costs.

The majority of investors in storage require a secure and reliable revenue stream. While revenue from energy and FCAS does provide income, the volatility and uncertainty in the NEM makes these revenue streams difficult to predict over the lifetime of a battery project. As a result, most developers rely on off-take agreements to secure a stable revenue stream. This is especially the case for batteries over the 2-hour duration — 4-hour batteries are becoming viable to some investors, but an off-take contract is key to meet the requirements of most financiers.

Without access to a bankable revenue stream over the lifetime of the asset (typically 10–15 years) securing finance for any storage project may be challenging.

Revenue streams are more certain for short-duration batteries of 1–2 hours. However, sources of revenue are limited to energy arbitrage and provision of FCAS, and the balance between the sources is variable. The bulk of revenue for a battery in the NEM today is secured via contingency and regulation FCAS (73%).

Longer duration batteries of greater than 2-hours duration are not supported by the current ancillary service market since FCAS favours rapid response, short-duration assets. Nor are they supported by current energy market design. There is increasing volatility in the NEM, but it is not sufficient to drive investment.

The continued uncertainty over the closure of coal-fired power stations, which currently provide primary frequency response and FCAS, also erodes the potential revenue for new technologies, particularly batteries, and introduces complexities in determining the long-term viability of a battery project.

Limited Contracting

Long-term PPAs are another source of secure revenue that would be attractive to financiers. However, the nascent nature of storage PPAs and off-take contracts means that developers and contract parties are going through a learning curve on their value. Financial institutions typically require off-take contracts as a condition for financing battery storage projects as they guarantee a certain level of revenue over the life of the contract, reducing the financial risk undertaken by the investor and the developer.

PPA are dominated by traditional players who have fossil fuel assets and their own batteries. Many financial institutions and lenders might not consider PPA off-take agreements (and subsequently not lend or provide equity to the projects) unless the counterparty has a very high credit rating, this again leads back to the incumbent players. This monopsony in those seeking PPAs, limits the negotiating power of the battery developer and the lack of competition typically leads to the incumbents capturing most of the benefits, reducing the revenue that flows to the developer and increasing investment risk.

While there are newer and more innovative small off-takers who might offer more favourable terms, working with them presents its own set of challenges, such as filling the financial gaps not covered by these agreements and limited experience with battery projects.

Additionally, off-takers are sometimes not prepared to wait until the battery project is constructed or commissioned and require the developer to sign the PPA prior to these critical milestones, ensuring the developer takes on more risk.

This limited competition in the PPA market restricts the opportunity for revenue and limits financing opportunities. There is a critical need to grow experience in investing in batteries, while the reliance on gas peakers for hedging contracts limits the opportunity for batteries to participate in this area. A broader range of contracts (hedges, swaps etc.) needs to be developed that are suitable for storage projects.

Missing Markets

Both coal and gas are high carbon and need to play a rapidly diminishing role in the power system, making way for advanced inverter connected generation and batteries. The new services that will be needed to support the clean power system are yet to be defined physically, such as inertia, so that they are available from new technologies in time for the retirement of coal-fired power stations.

While storage benefits from volatility in the energy market, new services and contracts for existing and new markets are missing.

Lack of progress by AEMO on identifying the technical specification for the services needed in a low carbon power system, and an increasing reliance on new gas plant to provide power system reliability, is hampering the clean transition and limiting opportunities for the new technologies to enter the market. AEMO needs to specify the techno-physical requirements of the 100% renewable power system (as has been done internationally, such as in Ireland and the UK) to allow participants to develop the services and capabilities to meet those specifications.

There are number of missing revenue opportunities that could be provided through new or updated ancillary services. This includes the already proposed inertia ancillary service[72], a new reserve service (operational) and a reserve service (strategic), with the latter supporting LDES.

A rule change proposal was submitted in December 2021, proposing a new inertia service[73]. This rule was initiated in March 2023, but has since been delayed by the AEMC[74] while it progresses the Operational Security Mechanism[75] covering the provision of "synchronous" services and "essential system" services.

An operational reserve service was proposed in March 2020[76] and after many delays, the AEMC made a draft determination in December 2023 not to progress with the proposed rule[77]. Instead, the AEMC has proposed to place obligations on battery operators to publicly share their state of charge. No other generation technology is obliged to share the state of their fuel reserves publicly[78]. Even in aggregate, this information is commercially sensitive and could provide insights to competitors on how a battery might behave in the market, penalising a specific new technology.

72 https://www.aemc.gov.au/rule-changes/efficient-provision-inertia
73 https://www.aemc.gov.au/sites/default/files/2021-12/ERC0339%20Rule%20change%20request%20pending.pdf
74 https://www.aemc.gov.au/rule-changes/efficient-provision-inertia
75 https://www.aemc.gov.au/rule-changes/improving-security-frameworks-energy-transition
76 https://www.aemc.gov.au/sites/default/files/2020-03/ERC0295%20Rule%20change%20request.pdf
77 https://www.aemc.gov.au/sites/default/files/2023-12/Enhancing%20reserve%20information%20-%20draft%20determination.pdf
78 https://www.aemc.gov.au/sites/default/files/2024-02/AGL_0.pdf

In June 2020 a ramping service was proposed but[79], again, in a much-delayed process, the AEMC, in its draft determination, stated that while an operating reserve market could manage power system risks, it considers that it would not offer any material performance improvements relative to the current arrangements[80].

Overseas power systems, with lower penetrations of renewable generation than in the NEM, have already progressed reserve and ramping services (see the section on the UK, page 26).

Additionally, the contracts offered by AEMO for services are short, of the order of 2–3 years, which may be appropriate for assets that have paid down their original investment but is not supportive of new entrants or new technologies, such as batteries. The capacity of batteries will degrade over their lifetime, which needs to be accommodated in long term contracts.

Capacity mechanism redeliberation is unnecessary

The ongoing deliberation of a capacity mechanism creates significant uncertainty that acts as a brake on investment in storage because both coal-fired power stations and gas plant can compete with batteries in the energy and ancillary services market, without the need to pay down investment costs. There has been no evidence presented that a new capacity market is an efficient way to bring on new storage capacity. In fact, the capacity markets in Australia and internationally underpin prolonging the life of existing coal and gas assets, rather than delivering new capacity, like storage. Additionally, modelling, based on the Western Australian capacity market[81], demonstrated that introducing a capacity market in the NEM will result in driving up bills by up to $430 per household per year.

The UK experience (see page 29) illustrates that only existing coal- and gas -fired generators have benefited from their capacity market. Coal-fired generation will be phased out in the UK in 2025, which has prevented it from participating in the capacity auctions for years beyond 2025. However, gas-fired generation represented 68% of the successful capacity in the most recent year ahead auction, with batteries representing just 3%.

The energy-only NEM has worked well, but has not adapted to the current and desired future increase in the penetration of renewable generation. Careful thought and consideration are needed to ensure we are not falling behind other countries in progressing the new service markets that will be needed in the >82% renewable NEM.

The Need for Speed

The focus on speed rather than duration of response, such as for FCAS, results in deployment of very short duration batteries (1–2-hour duration). For battery durations of longer than 2-hours, consideration of service offerings and contract arrangements is needed. For storage durations >8 hours, specific government support will be needed.

Lack of energy market knowledge

There are very limited number of financiers that have a strong knowledge of storage technologies and their revenue opportunities in the NEM. This inhibits, or at least delays, investment through a misunderstanding of risk.

79 https://www.aemc.gov.au/sites/default/files/2020-06/ERC0307%20Rule%20change%20request%20pending.pdf

80 https://www.aemc.gov.au/rule-changes/enhancing-reserve-information-formerly-operating-reserves

81 ESB-Proposal-to-Require-Consumers-to-Pay-Generators-a-Capacity-Payment_August-2021 (1).pdf

New investors

There are currently restrictions on the types of investments that are appropriate for particular types of funds, such as superannuation funds.

Superannuation funds, with over $1 trillion to invest, could play a significant role in supporting the clean energy transition, but the current performance-based legislative framework YFYS[82] may not enable investment and work is needed to provide quality pipeline of investment opportunities suitable for these funds[83].

Consideration should be given to establishing a mechanism within the YFYS performance benchmarks that recognises investments in green and sustainable technologies, including LDES is vital.

Adjustments to the YFYS framework would enable the superannuation sector to participate more in the energy transition, and reduce the risks associated with superannuation funds retaining more investments in higher transition risk assets. At present there is a focus on pursuit of 'benchmark hugging' strategies, rather than assets evidencing transition benefits, greater long-term yields and lower risk in the long term.

The recent release of the Australian Government's green bond framework[84] offers a new strategic instrument for the financing of electricity assets, including storage, to progress Australian government green goals.

See Appendix 2 (page 36) for detail on the barriers raised by stakeholders

c] Operational and Approval Challenges

The investment challenges described above represent the most significant barriers to new >2-hour duration batteries entering the market. However, there are additional challenges related to the operational aspects and delivery of a new battery project. These include:

- Planning application costs and processing times
- Securing a connection
- TNSPs competing to own and operate batteries

Planning Applications and Assessments

The planning application and assessment process can pose a barrier to investment given the time taken to approve and the cost of the planning application.

Developers may wish to stage a storage project to provide flexibility and responsiveness to changing energy market and ancillary service revenue streams. The increase in capacity needed to expand a battery from 2-hour duration to 4-hour duration will result in significantly higher planning costs in some states.

Storage projects are assessed under the same processes as renewable generation developments, as there is a lack of defined standards for energy storage and batteries. The differences and maturity in the technologies are currently not reflected in planning processes and approvals. This creates further delays and unnecessary complexity. For example, noise regulation for energy storage is not fit-for-purpose adding further complexity to the planning approvals.

PHES projects, given their large size and potential environmental impacts are likely to be subject to extended planning approvals processes.

82 https://ministers.treasury.gov.au/ministers/stephen-jones-2022/media-releases/your-future-your-super-review-outcomes

83 https://i3-invest.com/2023/12/energy-transition-key-play-for-super-funds/

84 https://www.aofm.gov.au/sites/default/files/2023-12-05/Green%20Bond%20Framework_WEB.pdf

Securing a connection

To secure a connection to the transmission system a storage proponent is reliant on both AEMO as the Transmission System Operator (TSO) and the relevant TNSP to undertake modelling and provide the technical requirements for any connection.

The processes at TNSPs and AEMO are complex and prolonged for renewable generation, with each new project requiring adjustments to those projects that have already commenced the connection process. This prolongs the connection process.

The application of Generator Technical Standards (GTS) may not be appropriate for a stand-alone utility-scale battery with an advanced inverter. While TSO and TNSP experience with connecting batteries is developing, there are still relatively few batteries in the NEM resulting in connections teams having limited experience in accommodating batteries on the power system.

While the IESS rule change was intended to facilitate the addition of storage behind a renewable generation connection, in practice the addition of storage to an already established generating site and connection is complex and risks impacting the existing connection standards and arrangements. This means that any anticipated efficiencies in time and cost, that leverage existing infrastructure and connections, are lost.

Additionally, the required new transmission lines needed to connect both renewable generation and storage to the market are not being built for a range of complex reasons that include delays related to the regulatory framework, the reliance on regulated monopoly TNSPs to build new transmission and social licence issues[85]. This means that where a connection is possible, the storage may be constrained, even though the battery may be able to provide services that mitigate constraints (virtual transmission) or support the GTS of a neighbouring renewable generator and support the operation of the power system through the provision of inertia and system strength services.

Slow Processes

The complexity of working with AEMO and the time taken to secure approval to provide FCAS at an AEMO-specified level, through testing and modelling, makes determining likely future revenue for a battery difficult. It would be helpful if an early estimate of likely accepted capacity for FCAS could be provided by AEMO to support engagement with financiers.

TNSPs competing to own and operate batteries

TNSPs (and DNSPs) are being granted ring-fencing waivers by the AER to own and operate batteries. This allows TNSPs an unfair advantage over third party providers of batteries.

TNSPs are the gateway for new third-party battery providers to secure a connection and also control the level and approach to use of system charging. Use of system charges can have a significant impact on battery revenue. This is particularly the case for batteries wishing to connect at the distribution level since the DNSPs can level a use of system charge not only on import but also on export[86].

85 https://nexaadvisory.com.au/site/wp-content/uploads/2022/04/Removing-transmission-roadblocks-discussion-paper-080422.pdf

86 https://www.aemc.gov.au/rule-changes/access-pricing-and-incentive-arrangements-distributed-energy-resources

d] Other Challenges

The Global Race

There is a global race to decarbonisation that means we are also competing at a global level for equipment, battery technology and skilled resources. The renewable energy sector is facing significant supply chain issues, impacting the time and cost-effective delivery of new projects. This is particularly true for new utility-scale stationary battery projects, which are competing with the rapidly expanding transport space for battery cells.

Poor Innovation

R&D in the energy sector in Australia is significantly underfunded, representing 0.019% of GDP, below the global average, and declining from a high in 2013. Additionally, over 34% (2021) of R&D funding is directed at fossil fuel activities, rather than at the technologies we need for a clean power system[87]. Only 5% of funding is going to storage.

As highlighted earlier, (page 21 and Figure 5) medium- to long-duration storage requires development to ensure that the technology is available and connected to the system in time.

Established electricity storage technologies with a discharge duration of 8 hours or longer are limited. While very large batteries are an option for long duration storage, the only established such technology is PHES. However, while there are suitable geographic locations community concerns about environmental damage may make securing sites difficult.

Additionally, holding back storage capacity from the market, to always ensure that a specified energy capacity can be delivered on the limited occasions it is required, will result in limited revenue opportunities in an energy-only market and consideration needs to be given to valuing availability, not just utilisation.

87 https://iea.blob.core.windows.net/assets/02a7a120-564b-4057-ac6d-cf21587a30d9/Australia2023EnergyPolicyReview.pdf

9. There is a lot to learn from the UK

The Great Britain (GB) Transmission System Operator, National Grid Electricity System Operator (NGESO), responsible for power system operation on the UK mainland (England, Wales and Scotland), was the first to introduce an ancillary service specifically for batteries in 2016[88].

Following an Ofgem-funded innovation trial of a 6 MW / 10 MWh battery that allowed NGESO to assess the potential of a large battery to provide ancillary services[89], the sub-second Enhanced Frequency Response (EFR) service was developed. The 2016 tender for 200 MW, resulted in eight accepted projects, ranging in capacity from 10–49 MW and an average price of £9.44 / MWh ($18.60 / MWh). The tender was significantly oversubscribed and cleared significantly below the anticipated price of £50 / MWh[90]. EFR was developed in collaboration with industry, offered a four-year contract and limited revenue stacking opportunities (Triad management and capacity market).

New Ancillary Services

ERF gave batteries a solid start in the UK power system and since then NGESO has been evolving its ancillary service requirements, commencing a reform process in 2021, and creating of a range of technology neytral new services that offer opportunities for batteries, although mainly in the short duration sector[91].

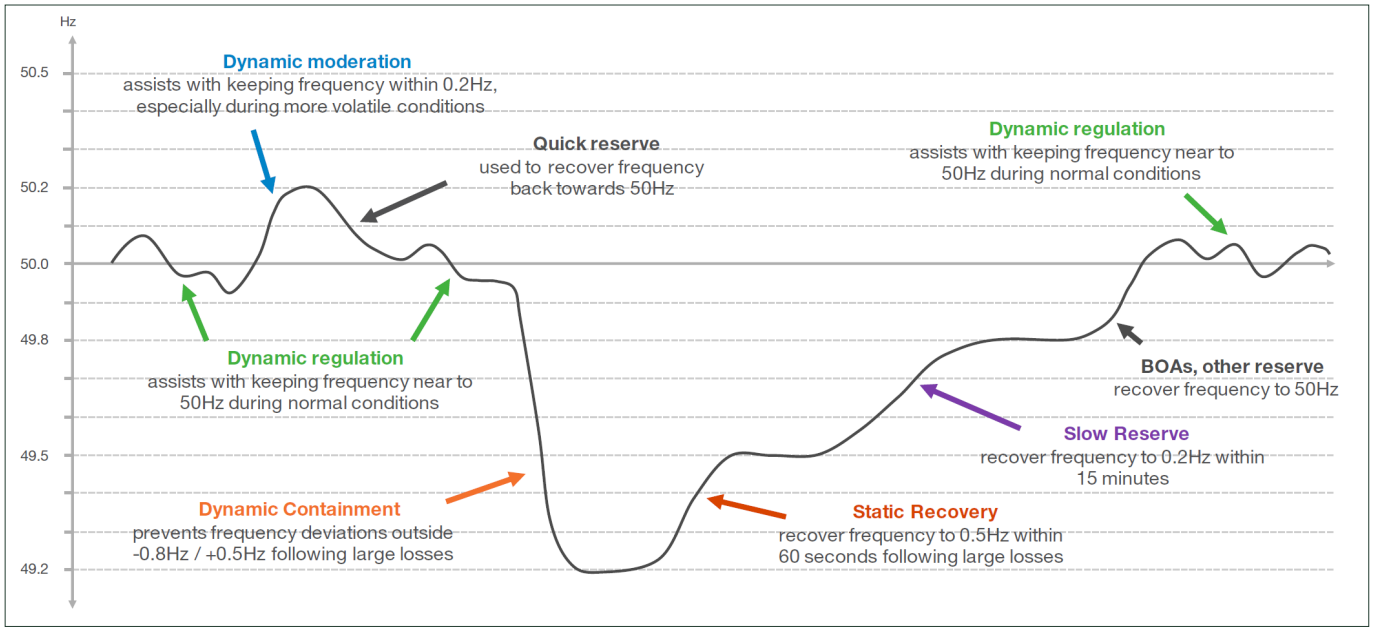


Figure 6: NGESO Operability Strategy for frequency management[92]

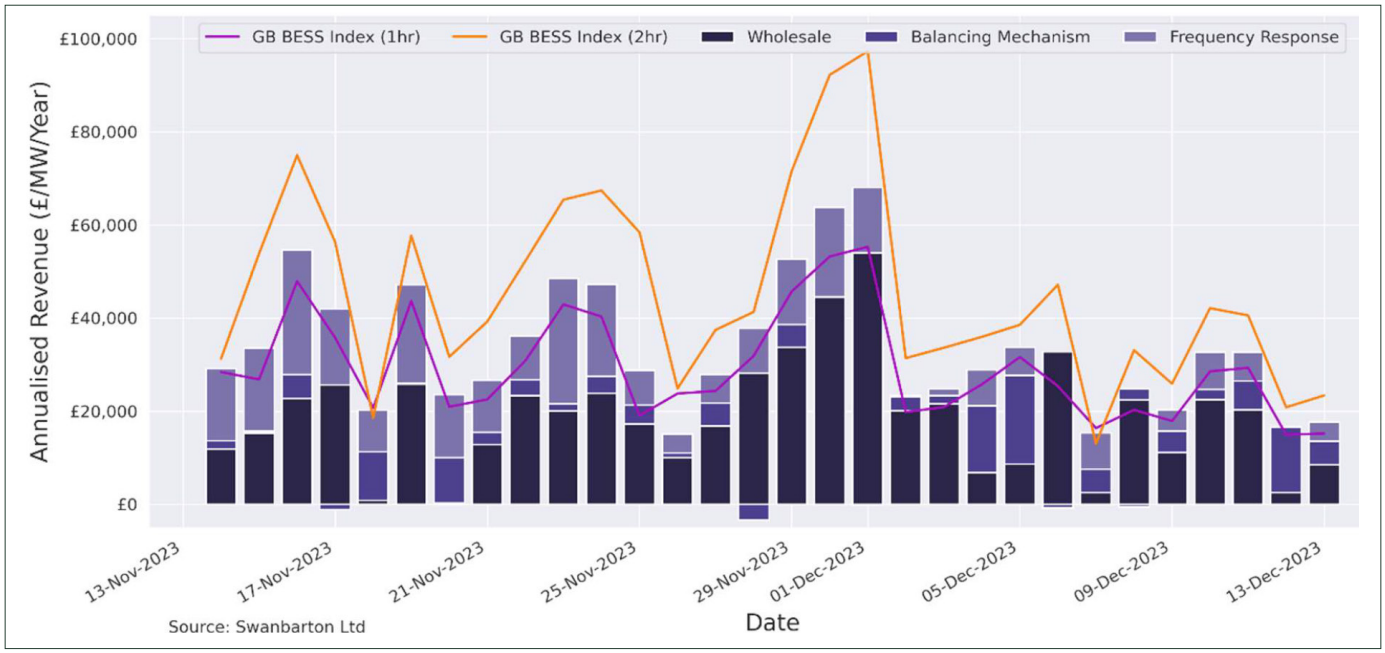
The dynamic services all provide an opportunity for short duration batteries, with Dynamic Containment High and Dynamic Regulation Low providing an average of 36% of battery revenue in the UK.

88 https://www.nationalgrid.com/sites/default/files/documents/Enhanced%20Frequency%20Response%20FAQs%20v5.0_.pdf
89 https://www.bbc.com/news/uk-england-beds-bucks-herts-30476591
90 https://www.current-news.co.uk/two-years-on-battery-storage-and-new-oppportunities/
91 https://www.nationalgrideso.com/industry-information/balancing-services/reserve-services
92 https://www.nationalgrideso.com/document/273801/download

The new reserve services, Quick Reserve and Slow Reserve, were new for 2023, replacing previous frequency management services (Fast Reserve and Short-Term Operating Reserve, respectively). Quick Reserve is a pre-fault service working with Dynamic Containment, ramping up over 1 minute to full delivery over 15 minutes and is likely to provide an opportunity for batteries. Slow Reserve is a post-fault service, again working with Dynamic Containment, ramping up over 15 minutes to full delivery over up 2 hours. The slow ramp up time means Slow Reserve could be provided by a range of technologies such as gas plant, so is less likely to be optimal for batteries.

NGESO is anticipating 300 MW to 1.4 GW of Quick Reserve will be required, depending on system conditions, with 1 GW to 1.4 GW of Slow Reserve required[93].

Figure 7: Annualised battery income in the UK



An assessment of battery revenue in the UK over Q2 and Q3 of 2023 shows the volatility of income streams with an average of 49% derived from providing dynamic frequency services, 39% via energy wholesale and 11% from the Balancing Mechanism[94].

Capacity Market

The GB Capacity Market (CM) was introduced in 2014 to support the delivery of new long-duration capacity (>4 hours), with auctions 1-year and 4-years ahead of need in the specified delivery year. The CM also needed to comply with UK legislation phasing out all coal-fired power stations by 2025, meaning that no coal -fired generation could be accepted in the T-4 auction for 2025 in 2021.

While initially the CM accepted capacity from batteries, in 2016 amendments were introduced to the legislation to derate batteries, given the significant number of batteries that had contracted, but with only 30-minute duration (the EFR minimum duration requirement and the duration required to pass the CM availability tests). This has resulted in a 1-hour duration battery being derated to 11% of its bid capacity, while a 9-hour battery is derated to 76% of its bid capacity (a diesel generation set is derated to 95% of its bid capacity)[95].

93 https://modoenergy.com/research/8222

94 https://nexaadvisory.com.au/deep-dive-into-energy-storage-in-the-uk/

95 ibid

Additionally, while the CM offers a 15-year contract, the non-delivery penalties are onerous and for a battery that period is likely to be close to the warranted life and as such will likely encompass the period in which there is a reduction in the capacity of the battery.

The CM is technology neutral, with the stated goal is energy security. In practice this means that existing gas plant is favoured in CM auctions, with 45% of the T-1 capacity in the latest auction being gas versus 11% for batteries. In the latest T-4 auction gas secured 68% of the capacity and batteries just 3%.

Reforms to the CM in 2023 require high carbon plant, such as gas, to reduce emissions, while new emission standards will be introduced to limit reliance on high carbon plant and to incentivise low carbon capacity, to ensure that the CM supports the UK net zero targets[96].

Other than innovation funding for energy storage (e.g. programs for LDES[97]) there are no specific incentives for storage. Instead, NGESO has focused on identifying changing power system needs and developing the new ancillary services needed to support it. Typically, these services are technology neutral but provide revenue streams for batteries of varying robustness. They do tend to facilitate the participation of short duration storage.

The UK government have identified a critical need for LDES to replace gas plant and have a current policy development consultation[98] on a proposed cap and floor mechanism with an established technology stream (TRL 9) for LDES of 100 MW / 600 MWh minimum, and a stream for novel technologies (TRL 8) for LDES of a minimum 50 MW / 300 MWh.

Other approaches internationally[99]

Ireland and Northern Ireland

In 2011 the Transmission System Operators in Ireland and Northern Island, EirGrid and SONI respectively, commenced a design process to ensure the secure and safe operation of their power systems with increasing levels of variable renewable generation[100]. This resulted in a range of new services, including Ramping Margin services that are designed to balance variations in wind generation[101]. The Ramping Margins have a long ramp up periods of 1–8 hours, with a duration of 2–8 hours, indicating that storage would be competing with other technologies, such as interconnectors.

Texas

The Electric Reliability Council of Texas (ERCOT) is in the process of developing a Dispatchable Reliability Reserve Service (DRRS) for delivery in December 2024[102]. The DRRS has a notice period of 2 hours and a minimum delivery duration of 4 hours and will be procured in day-ahead and real-time markets.

96 https://www.gov.uk/government/news/reforms-outlined-for-britains-capacity-market-to-secure-a-clean-energy-future?utm_medium=email&utm_campaign=govuk-notifications-topic&utm_source

97 https://www.gov.uk/government/collections/longer-duration-energy-storage-demonstration-lodes-competition

98 https://assets.publishing.service.gov.uk/media/659bde4dd7737c000ef3351a/long-duration-electricity-storage-policy-framework-consultation.pdf

99 https://ceig.org.au/wp-content/uploads/2024/03/CEIG_Baringa_Investing-in-storage_final-report_V2_0.pdf

100 https://www.eirgridgroup.com/site-files/library/EirGrid/DS3-Programme-Overview-2014.pdf

101 https://www.eirgridgroup.com/site-files/library/EirGrid/New-Ramping-Product-Workshop_310322.pdf

102 https://www.ercot.com/files/docs/2023/07/21/DRRS-for-Workshop-07272023.pptx

10. Recommendations: A call to action to progress storage at scale in Australia

Australia needs to build 19 GW of storage by 2030. This is significant growth in just over five years, from the 1.4 GW of batteries connected today (plus 1.6 GW of pumped hydro).

While the number of utility-scale batteries connected to the power system has increased and continues to grow, over 50% of the currently connected batteries have required support to progress. New developments are relying on state and federal government schemes to secure financing, and support is critical for batteries with a duration of greater than 2 hours.

The challenges, as we have articulated in the report, are a key barrier to the successful growth of the energy storage market in Australia. The current sources of revenue are limited to provision of FCAS and a growing role in energy. The new services needed to support the clean power system are not being developed, with decisions on rule changes actively preventing the development of markets in inertia and reserve. This contrasts with overseas power system operators that have already enhanced and developed the new services to support their changing power systems.

We recommend that federal and state governments address obstacles faced by investors and developers in energy storage in the following ways:

RECOMMENDATION 1:

Coal-fired power station closure certainty is pivotal

Certainty on the closure dates of the coal-fired power stations necessitates a balanced approach, combining both incentives and regulatory measures, to ensure a smooth and effective transition. This is critical to ensuring certainty for investors and will provide the signals to enable investment in appropriate market solutions. We recommend:

- A ministerial declaration on the dates for coal-fired power stations to cease operation would provide certainty for the owners and operators, AEMO (as the power system and market operator), and developers of new generation and storage projects.
- This should be coupled with a closure framework mechanism that facilitate a transparent and coherent process for managing the retirement of thermal generators. The design of the OEM should:
  - Be structured in a way that avoids deterring new investments and incorporates robust safeguards to shield consumers from unnecessary costs.
  - Involve a heightened focus on evaluating whether innovation and clean technologies can effectively address concerns related to reliability.
  - Ensure that the OEM Framework cannot be exploited by thermal generators, preventing unfair opportunities for incumbents to seek compensation at consumers' expense; and
  - A mandatory assessment, yearly for five years, by AEMO of security and reliability before any power station is ordered to continue operation. This assessment must be publicly available and include a mandatory call for industry to offer alternative capacity solutions to extending the life of a power station.
- When contracts are agreed to extend the life of thermal assets, terms must be transparent to market participants.

RECOMMENDATION 2:

Develop markets and contracts to facilitate investment

We call on Energy Ministers to direct the AEMC and AEMO to work with investors in and developers of storage in a transparent way to:

a] reassess rule changes that are creating further obstacles to batteries and energy storage, and ways to remove those barriers. This includes:

- i Integrating Energy Storage Systems (IESS) into the NEM rule change (ERC0280)
- ii. Clarifying Mandatory Primary Frequency Response (PFR) Obligations for Bidirectional Plant rule change (ERC0364)
- iii Operational Security Mechanism (ERC0290) encompassing: efficient provision of inertia (ERC0339), ramping services (ERC0306); Operating reserves (ERC0295) and FCAS.

b] undertake a review of potential new market services that seek to compensate storage owners and provide additional revenue streams for the ancillary services provided, including inertia, system strength, and voltage control. This includes a reassessment of the recent operating reserve rule change draft determination (ERC0295) by the AEMC which has ruled out a reserve service.

c] establish contracts for existing markets- financial contracts for FCAS, peak energy, or a volatility index would help batteries gain better finance and lower equity returns.

We strongly encourage energy ministers to ensure that this process is transparent and rigorous so that it can yield the desired outcomes.

RECOMMENDATION 3:

Invest Long-Duration Energy Storage (LDES)

1] Federal and state energy ministers should prioritise and fund research and development for LDES technologies in Australia. Specifically, support is needed for R&D programs for scalable long duration technologies, such as flow batteries and liquid air energy storage. ARENA and CEFC funding should be leveraged.

There is currently a significant gap that requires immediate government attention, if we are to ensure the required LDES is in place over the next decade to meet AEMO projections in the 2024 Draft ISP. This will be pivotal in advancing the capabilities and efficiency of energy storage solutions and promoting long term innovation.

2] Federal and state energy ministers need to step in and support the scale needed in long duration storage, this includes PHES projects. While PHES is a mature technology, the environmental complexities may limit delivery at the scale and in the timeframe required. This means governments need to commit to projects 10 years ahead of when they would be required in the market to ensure these project are delivered in time.

RECOMMENDATION 4:

Ensure transparency in CIS mechanism development

The development of the CIS mechanism must be conducted transparently, with a feedback loop for lessons and program improvements. Stakeholders, including investors and developers, should be involved in this process to guarantee that the scheme effectively supports the energy transition.

The CIS proposes the utilisation of a collar strategy, establishing net revenue thresholds with both floors and ceilings. The LTESA approach in NSW has proven very attractive to investors and developers, and having been in effect for a considerable period, offers valuable insights on schemes that provide investor confidence. The further development of the CIS could benefit from integration of lessons and insights from this approach.

We strongly recommend energy ministers direct the Department of Climate Change Energy, the Environment and Water (DCCEEW) to engage with investors and developers to ensure that the mechanism is effective and achieves the intended investment results, especially in energy storage.

This is a no regrets recommendation and can be prioritised as an immediate action.

RECOMMENDATION 5:

Energy ministers to ensure fit-for-purpose approvals for storage

We call on energy ministers to prioritise all approval processes related to storage projects. This includes stream lining connections, environmental assessments and planning approvals.

Specifically, we recommend that energy ministers direct their departments to provide storage specific related guidance and the standards required by the various jurisdictional planning departments to minimise complexity and cost. For example, noise regulation is not fit-for-purpose. Wind farms have regulatory exemption for noise, and it would be useful to have something similar for battery storage.

RECOMMENDATION 6:

Federal and state governments should collaborate with industry to support education and outreach

Comprehensive education and outreach programs are required to raise awareness and understanding of storage across the financing sector.

This should align with proposed outreach efforts pertaining to climate related financial disclosure regimes, including the upcoming changes to AFRS 1 and 2, and associated reporting obligations.

This should be an ongoing joint initiative between the federal and state government, battery developers, energy storage and battery investors, and key organisation groups. It would be designed to promote collaboration, and include workshops and informational campaigns to raise awareness and foster a better understanding to help guide financing and risk mitigation.

RECOMMENDATION 7:

Federal government should ensure that YFYS benchmarks facilitate investment

The federal government should ensure that the current work on refining the YFYS frameworks facilitates the Australian superannuation industry's investment in Australia's clean energy transformation. Incorporating alternative weighting factors into the YFYS benchmarks will enable funds invested in long duration sustainable environmental projects to recalibrate their performance scores towards Australia's energy goals, with minimal transition risks.

This would acknowledge the critical contribution of superannuation investment to progressing the transition, and also the capability of these investments to generate long-term financial returns for funds and their members.

Appendix 1:
Barriers to energy storage deployment in the NEM

Barrier	Description	Impact	Duration impacted	Scale
Focus on power not energy/duration	The focus on MW capacity rather than duration/capacity (MWh) means that market incentives/services drive short duration, rapid response technologies	Missing revenue opportunity	Long >4 hours	Most
Missing Ancillary Services	Reserve Service	Missing revenue opportunity	All	All
	Inertia Service	Missing revenue opportunity	All	All
	Dunkelflaute (energy and duration)	Missing revenue opportunity	Long >6–8 hours	Some
	System restart service	Missing revenue opportunity	Some	Some
	AEMO adaptation to changing system physics (services needed; amount of any given service needed; modelling capability particularly for storage different durations)	Missing revenue opportunity	All	All
	Lack of certainty in being allowed to provide service by AEMO (FCAS). Have to await AEMO assessment. Estimate would help with financing project	Revenue certainty	All (<4 hour)	Some
Short-term contracts	AEMO offer only 2–3 year contracts for provision of ancillary services	Revenue certainty	All	
Power Purchasing Agreements & Caps	Need secure revenue to progress project financing	Revenue certainty	All	All
	Lack of diversity due to financiers high credit rating leading back to big 3 incumbent monopsony	Revenue certainty	All	All
	Contract holders won't wait for construction so more risk held by developers in early phases	Revenue certainty		
Ringfencing (TNSP/DNSP/Retailers/Govts)	Storage providers are competing with multiple other parties that have advantages (playing field not level)	Revenue certainty	All	All
Lack of contracts/hedges for batteries	Lack of products, lack of contract parties, lack of awareness	Revenue certainty	All	
Need for volatility	Energy storage responds well to the energy volatility provided by the energy only market, but desire to limit volatility (esp. for customers) reduces revenue opportunities	Revenue certainty	All	All

Barrier	Description	Impact	Duration impacted	Scale
Transmission delays	Lack of transmission and constraints limit ability to connect.	Revenue certainty	All	All
Use of System charges (Distribution a particular problem)	Have to negotiate import UoS at transmission level. DNSP less accommodating and can charge on import and export, often prohibitive	Revenue certainty	All	All
Complexity of incentives	LTESA – Locks down/limits project.	Revenue certainty (delays)	All	All
	CIS – limit on income and no limit on clawback.	Revenue certainty	Some	Some
	CIS – design uncertainty (debt vs equity)	Revenue certainty	Medium to long	
	Too many schemes with varying requirements. Needs a lot of people internally to assess and progress	Revenue certainty	All	Some
	Frequency Service – value dropping for FCAS as more providers enter the market. Limited opportunities to diversify revenues	Revenue falling	All	All
Interaction of water and energy	Lack of internal government policy alignment means that water may be taken away from generation/storage	Revenue loss	Long >8 hours	Niche (PHES only)
Delaying coal closures	Causes investor uncertainty, delays the inevitable need to address core power system requirements (services)	Securing finance		
Missing revenue opportunity	All	All		
Connection issues	Connection process slow. Can't progress project without connection. Problems particularly with coordination at transmission level with multiple parties	Securing finance	All	All
Financier awareness	Risk appetites and understanding of storage limited	Securing finance	Most	Some
Access to investors	Some investors are prevented from supporting the clean energy transition (e.g. Super funds)	Securing finance	All	
Significant number of rule changes underway	Large number of rule changes on foot, many with consequences for battery projects (IESS, OSM, ESS, MPFR)	Certainty	All	All
Supply chains	Pushes up project costs	Financing issue	All	All
Planning applications	Complex and prolonged. Varies by state, particularly complex in NSW	Delays project	All (PHES in particular)	All

Table A2.1: Detailed barriers drawn from interviews with battery developers and experts

Appendix 2:
Review of current policies and support programs for batteries

This is based on the timing of the report and the currency will change due to the influx of ongoing reviews.

Australian Renewable Energy Agency

The Australian Renewable Energy Agency (ARENA) was established in 2012 and is a government owned and funded entity. ARENA has funded over 40 projects focused on batteries throughout Australia, with support of $273 million. In addition, the 2021–22 Large Scale Battery Storage Round has allocated a further $176 million of support for a further eight battery projects, of which four are under construction[103].

The developers and projects ARENA has selected for support are:

- AGL: a new 250 MW / 500 MWh battery in Liddell, NSW (under construction)
- FRV: a new 250 MW / 550 MWh battery in Gnarwarre, VIC.
- Neoen: retrofitting the 300 MW / 450 MWh Victorian Big Battery in Moorabool, VIC (under construction)
- Neoen: a new 200 MW / 400 MWh battery in Hopeland, QLD (under construction)
- Neoen: a new 200 MW / 400 MWh battery in Blyth, SA (under construction)
- Origin: a new 300 MW / 900 MWh battery in Mortlake, VIC
- Risen: a new 200 MW / 400 MWh battery in Bungama, SA.
- TagEnergy: a new 300 MW / 600 MWh battery in Mount Fox QLD.

All of the supported batteries are under 2 hours duration, bar the Origin Mortlake battery (3-hour duration). Only the Neoen projects have advanced to financial close and construction, perhaps indicative of their extensive experience in Australia.

Clean Energy Finance Corporation

The Clean Energy Finance Corporation (CEFC) is a government owned and funded entity that provides a range of financial support to clean energy projects[104]. Since being established in 2012 the CEFC has provided $344.2 million of support to battery projects, including most recently $100 million for the Transgrid Waratah Super Battery, $35.5 million for the Neoen Capital Battery and a $50 million upgrade to the Neoen Hornsdale Power Reserve (with the CEFC providing up to $50 million for the original Neoen South Australian “big battery” in 2019) [105].

Direct government support

The federal government and a number of state governments have set targets for the delivery of new storage capacity. Additionally, some states have specific funding programs for storage, but long duration is not a primary focus outside of Queensland and NSW.

103 https://arena.gov.au/news/arena-backs-eight-grid-scale-batteries-worth-2–7-billion/

104 https://www.cefc.com.au/

105 https://www.cefc.com.au/media/l4igzbpf/cefc_ar23_web_sml.pdf

State	Target	Investment
Federal	Under the Capacity Investment Scheme, 9 GW	
Australian Capital Territory	No target	
New South Wales	2.0 GW by 2030 (plus 75% of Snowy 2.0)	
Victoria	2.6 GW by 2030; 6.3 GW by 2035	$130 million
South Australia	No target	
Queensland	At least 12 GW by 2035	$6 billion for PHES
Tasmania	No target (Battery of the Nation)	
Western Australia	No target	$2.3 billion for storage
Northern Territory	No target	

Table A3.1: Government support for storage [106 107 108 109]

Community battery program

In 2022, the federal government committed $200 million to community batteries[110], with the majority of funding progressed through ARENA. The batteries supported through this program are not expected to be either long duration or of significant power, but will contribute to the total storage capacity in the system and may compete with large-scale batteries to provide ancillary services.

Focus on NSW Renewable Energy Action Plan

Outside of the federally funded and owned Snowy 2.0 scheme that allocates capacity to NSW, the NSW Renewable Energy Action Plan does include support for long duration storage through the LTESA and planned and tendered for by AEMO Services[111].

The first tender round in September 2022 resulted in the acceptance of a 50 MW / 400 MWh, 8-hour duration lithium-ion battery[112], with a further 980 MW / 2790 MWh batteries supported in round two (plus a range of Virtual Power Plant batteries totalling 95 MW / 190 MWh via Enel X).

The LTESA is a contract-for-difference-like arrangement, with tenderers bidding a strike price for energy supplied, and defined percentages for "top-ups" and "clawbacks", ensuring the storage developer has a secure revenue stream.

Tender Round	Project	Developer	MW	MWh	Duration	Delivery
1	Limondale	RWE	50	400	8 hours	2025
2	Liddell	AGL Energy	500	1,000	2 hours	2025
	Orana	Akaysha Energy	415	1,660	4 hours	20225
	Smithfield	Iberdrola Australia	65	130	2 hours	2025

Table A3.2: Battery projects securing LTESA in NSW[113, 114]

106 https://minister.dcceew.gov.au/bowen/media-releases/delivering-more-reliable-energy-all-australians
107 https://www.premier.vic.gov.au/australias-biggest-renewable-energy-storage-targets
108 https://www.pv-magazine-australia.com/2023/06/05/queensland-looks-to-legislate-80-renewable-energy-by-2035
109 https://www.innovationaus.com/wa-budget-delivers-2-8bn-battery-and-renewables-package/
110 https://www.dcceew.gov.au/about/news/community-battery-grant-guidelines-now-available
111 https://aemoservices.com.au/en/tenders/tender-round-3-generation-and-long-duration-storage
112 https://www.rwe.com/en/press/rwe-renewables/2023-05-01-rwe-successful-in-australian-tender-with-long-duration-battery-storage-project/
113 https://www.rwe.com/en/press/rwe-renewables/2023-05-01-rwe-successful-in-australian-tender-with-long-duration-battery-storage-project/
114 https://reneweconomy.com.au/liddell-to-host-giant-battery-after-agl-and-akaysha-win-australias-biggest-capacity-tender/

Focus on Tasmanian "Battery of the Nation"

Hydro Tasmania is seeking to redevelop aging hydro-electric generation assets as PHES[115]. This would involve upgrading the Tarraleah scheme. The financial viability of the "Battery of the Nation" is very dependent on the delivery of the Tasmania to Victoria interconnector, Marinus Link, which is receiving federal funding support via Rewiring the Nation but has been scaled back to a single undersea cable[116].

PHES is potential competitor to long-duration batteries (see Appendix 2) and has received support from both the previous federal government[117] and ARENA[118].

Capacity Investment Scheme

The Capacity Investment Scheme (CIS) was originally announced in August 2023 to support the delivery of 6 GW of "dispatchable" clean energy focusing on energy storage (batteries). Phase one of the CIS has supported tenders in NSW for just over 1 GW of storage[119] from six projects, and a tender process in South Australia and Victoria[120]. The NSW tender round attracted 3.3 GW of bid capacity indicating that both the LTESA and CIS models, based on contracts for difference[121], are appealing to storage developers.

An expansion of the CIS was announced in November 2023, encompassing support for renewable generation (23 GW) and a further 3 GW of storage[122] and will commence with a tender for storage in Victoria and South Australia.

115 https://www.hydro.com.au/clean-energy/battery-of-the-nation

116 https://minister.dcceew.gov.au/bowen/media-releases/joint-media-release-investing-future-tasmanian-energy-marinus-link

117 https://www.minister.industry.gov.au/ministers/taylor/media-releases/significant-new-investment-regional-tasmania-deliver-affordable-and-reliable-energy-mainland

118 https://arena.gov.au/projects/battery-of-the-nation-future-state-nem-analysis/

119 https://www.environment.nsw.gov.au/news/capacity-investment-scheme-supports-nsw-to-deliver-cleaner-energy

120 https://www.energy.gov.au/government-priorities/energy-supply/capacity-investment-scheme

121 https://theconversation.com/the-government-will-underwrite-risky-investments-in-renewables-heres-why-thats-a-good-idea-218427

122 https://minister.dcceew.gov.au/bowen/media-releases/delivering-more-reliable-energy-all-australians

www.nexaadvisory.com.au

info@nexaadvisory.com.au

nexa ADVISORY