Department of Climate Change, Energy, the Environment and Water

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Review of Long Duration Storage (Part 6 of the Electricity Infrastructure Investment Act 2020)

Consultation Paper

May 2024

Acknowledgement of Country

The Department Climate Change, Energy, the Environment and Water acknowledges that it stands on Aboriginal land. We acknowledge the Traditional Custodians of the land and we show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

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Acronyms and abbreviations

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ARENA	Australian Renewable Energy Agency
A-CAES	Advanced-Compressed Air Energy Storage
BESS	Battery Energy Storage System
CIS	Capacity Investment Scheme
DCCEEW	The NSW Government Department of Climate Change, Energy, Environment and Water (formerly the Office of Energy and Climate Change)
EII Act	Electricity Infrastructure Investment Act 2020 (NSW)
ESOO	Electricity Statement of Opportunities
FCAS	Frequency Control Ancillary Services
GW	Gigawatts
GWh	Gigawatt hours
IIO	Infrastructure Investment Objectives
IRM	Interim Reliability Measure
ISP	Integrated System Plan
LTESA	Long-Term Energy Service Agreement
LDES	Long Duration Energy Storage
LDS	Long Duration Storage
MW	Megawatts

NEM	National Electricity Market
NER	National Electricity Rules
PHRGP	Pumped Hydro Recoverable Grants Program
RETA	Renewable Energy Transformation Agreement
TRL	Technology Readiness Level
USE	Unserved Energy
VPP	Virtual Power Plant
VRE	Variable Renewable Energy

1 Executive summary

Over the next 10 years, three of the state's four remaining coal-fired power stations are expected to retire. If these power stations are not replaced before they retire, the consequences are high prices for consumers, reliability risks and impacts to the economy. The lowest cost replacement to meet NSW electricity needs is a mix of wind and solar generation, storage, firming and network infrastructure.

The NSW Electricity Infrastructure Roadmap (the Roadmap)[1] establishes minimum objectives to deliver at least 12 gigawatts (GW) of renewable energy generation and 2 GW and 16 gigawatt hours (GWh) of long duration storage (LDS) by 2030. Under the *Electricity Infrastructure Investment Act 2020* (EII Act), LDS is defined as storage units with a registered capacity that can be dispatched for at least 8 hours and is scheduled by AEMO in the central dispatch process under the National Electricity Rules (NER) (EII Act, Section 43 (1)(b)).

The scale and pace of infrastructure investment required to meet our future energy needs is unprecedented. Longer duration storage is expected to become increasingly important to the electricity market to maintain a reliable supply for consumers, assist energy retailers to manage price risk and store electricity that would otherwise be curtailed because of network constraints or excess supply.

This consultation paper is part of a review into the current definition of LDS the NSW Government is conducting in response to the independent Electricity Supply and Reliability Check Up (the Check Up)[2]. To support this review, the NSW Government engaged AEMO Services Limited (AEMO Services) to provide advice on the value of LDS to NSW.

In 2023, the Commonwealth Government announced an expansion of the Capacity Investment Scheme (CIS) to target a total of 32 GW of new capacity nationally by 2030[3]. In 2023, Energy Ministers agreed that the CIS will continue to be delivered working with state systems, including the Roadmap's Long Term Energy Service Agreements (LTESA). Currently, the Commonwealth and NSW Governments are negotiating the interaction between the CIS and the Roadmap.

This consultation paper is seeking feedback on:

1. Potentially reducing the minimum duration of LDS infrastructure to lower the cost to consumers of achieving the Roadmap's 2030 infrastructure objectives.

[1] https://www.energy.nsw.gov.au/nsw-plans-and-progress/major-state-projects/electricity-infrastructure-roadmap

[2] https://www.energy.nsw.gov.au/sites/default/files/2023-09/NSW_Electricity_Supply_and_Reliability_CheckUp_Marsden_Jacob_Report_2023.pdf

[3] About the Capacity Investment Scheme - DCCEEW

2. Mechanisms to encourage longer duration storage infrastructure to mitigate against future reliability gaps.
3. Options to aggregate infrastructure to accelerate additional storage infrastructure.

The next NSW Roadmap Tender (Tender Round 5) for LDS is scheduled to be released in Q2 2024, and is out of scope for this review.

Any potential changes from this review will not impact the eligibility or merit assessment of NSW Roadmap Tender Round 5.

2 How to make a submission

The NSW Department Climate Change, Energy, the Environment and Water (DCCEEW) is undertaking a review into the storage requirements of the NSW market including LDS. DCCEEW is seeking feedback on potential amendments to the definition of LDS including the duration and threshold for registered capacity. Submissions are welcome from all interested parties.

Submissions will close at 11:59 pm AEST on Tuesday 18 June 2024.

All submissions must be in Word or PDF format and emailed directly to lds.review@dpie.nsw.gov.au.

Please include 'Your Name/Organisation - LDS Review Consultation Feedback' in the email subject line. Please ensure that you answer the questions identified in this consultation paper.

A briefing session will be held on Thursday 30 May 2024. Details to join the virtual briefing session are available on our website.

The NSW Government is committed to an open and transparent consultation process. All consultation submissions will be made publicly available on the DCCEEW website, except where it has been requested that the submission remain confidential.

If you would like for your entire submission, or any part therein, remain confidential, please clearly state this in your submission. All personal information and details from submissions made by individuals will be removed prior to publication. Unless otherwise stated, it will be assumed that all information provided is not considered intellectual property of the respondent.

Please note that even if you state that you do not wish certain information to be published, there may be legal circumstances that require the NSW Government to release some information, for example, under the Government Information (Public Access) Act 2009. If you have any questions regarding this please contact lds.review@dpie.nsw.gov.au.

3 Context and scope

3.1 The NSW Electricity Infrastructure Roadmap

Over the next 10 years, three of the state's four remaining coal-fired power stations are expected to retire. These three power stations combined represent around 60-70 per cent of NSW's electricity generation. If generation from these power stations is not replaced before they retire, consumers will be faced with high electricity prices, reliability risks as well as broader impacts to the economy.

The lowest cost replacement to meet NSW electricity needs is a mix of wind and solar generation, storage, firming and network infrastructure.

The Australian Energy Market Operator's (AEMO's) Draft 2024 Integrated System Plan (ISP)[4] forecasts an Optimal Development Pathway where a total of 24 GW of wind and utility-scale solar capacity, and 11 GW of storage capacity (including consumer batteries and Snowy 2.0), will be required in NSW by 2030. In addition, another 6 GW of wind and utility-scale solar, and 8 GW of storage, will be required by 2040. For context, in 2023, NSW had around 6 GW of wind and large scale solar and 2.2 GW of utility scale storage.

The scale and pace of infrastructure investment required to meet our future energy needs is unprecedented.

In 2019, the bipartisan Electricity Infrastructure Roadmap (the Roadmap)[5] was released which is the state's 20-year plan to transform our electricity system into one that is cheap, clean, and reliable. The Roadmap provides the framework to address the challenges of transforming the electricity network and driving investment in replacement, large-scale electricity infrastructure ensuring more secure, reliable, and affordable electricity for consumers. The Roadmap is enabled by the EII Act.

The EII Act provides mechanisms to coordinate investment in at least 12 GW of renewable energy generation and 2 GW of LDS (in addition to Snowy 2.0) by 2030; beyond projects committed before 2020. In addition, the EII Act provides pathways to support sufficient firming infrastructure to maintain reliability by meeting the Energy Security Target and to support network infrastructure needed to connect these projects back to load centres.

[4] AEMO | Draft 2024 ISP Consultation, supporting materials 'Draft 2024 ISP generation and storage outlook', based on Core Scenario 'Step Change' (CDP11)

[5] The NSW Electricity Infrastructure Roadmap: https://www.energy.nsw.gov.au/sites/default/files/2022-08/NSW%20Electricity%20Infrastructure%20Roadmap%20-%20Detailed%20Report.pdf

3.2 The NSW Electricity Supply and Reliability Check Up

In May 2023, the NSW Government commissioned an independent Electricity Supply and Reliability Check Up (the Check Up)[6] by Marsden Jacob Associates. The Check Up report was delivered in August 2023, and outlined 54 recommendations to ensure that the Roadmap delivery was kept on track. In September 2023, the NSW Government responded to the Check Up and, accepted 50 recommendations. This included the Roadmap implementation and the electricity sector's transition being identified as a strategic whole-of-Government priority.

The Check Up recommended a review into the LDS requirements of the NSW market and if required consideration of amendments to the definition of LDS. This recommendation was based on current trajectories that it is very unlikely the 2 GW LDS target in the EII Act will be achieved if it is based on pumped hydro infrastructure only, and that more consideration on the definition of LDS needs to be undertaken to encourage greater technology diversification to meet the state's storage needs.

Table 1: Recommendation 28 of the Electricity Supply and Reliability Check Up

Check Up Recommendation No. 28	NSW Govt. Response
That considering the slow development of long-duration storage (LDS), the Government commission a review by the Consumer Trustee (CT) into the storage requirements of the NSW market and consider amendments to the definition of LDS in the Roadmap legislation.	Accept

In November 2023, through the *Energy Legislation Amendment Bill 2023* the NSW Government chose to clarify in the EII Act that the Roadmap minimum objective means at least 16 GWh of storage by 2030 (being the product of 2 GW of capacity that can be dispatched for at least 8 hours) (Section 44(3)(b)). This was amended to recognise the need to provide longer term storage to ensure that the reliability needs are met.

3.3 NSW Roadmap Tenders

Under the Roadmap, AEMO Services acts as the Consumer Trustee and runs competitive tenders for Long-Term Energy Service Agreements (LTESAs). These Roadmap Tenders support the investment, construction and operation of renewable generation, long duration storage and firming infrastructure.

[6] www.energy.nsw.gov.au/nsw-plans-and-progress/regulation-and-policy/electricity-supply-and-reliability-check

AEMO Services has scheduled tenders as part of its 10-year Tender Plan to ensure the minimum objectives of the Roadmap are achieved at the lowest cost to consumers.[7] AEMO Services has scheduled LDS tenders annually, and generation tenders biannually.

To date, four NSW Roadmap Tender Rounds have been released each with a specific focus on eligible infrastructure. The outcomes of Tender Rounds 1, 2, and 3 have been announced. From the announced Rounds, 5.8 GW of new generation, 1 GW of firming and 574 MW of LDS infrastructure projects have been successful in being awarded LTESAs.

Two Tenders Rounds (1 and 3) have awarded LTESAs to four LDS projects with a cumulative 574 MW/ 4,592 MWh storage capacity. Several batteries and one advanced compressed air energy storage (A-CAES) project have been awarded LDS LTESAs, each of which can dispatch electricity for 8 hours (Table 2).

Table 2: Projects successful in being awarded LDS LTESAs at April 2024

Tender Round	Proponent	Project Name	Technology	MW/MWh	Operational date
1 (Sep 2022)	RWE Renewables Australia	Limondale BESS	Lithium-ion BESS	50 MW/ 400 MWh+ (8 hours +)	December 2024
3 (May 2023)	A-CAES NSW Pty Ltd	Silver City Energy Storage	Advanced-compressed air energy storage system (A-CAES)	200 MW/ 1,600 MWh (8 hours)	Before 2028
3 (May 2023)	Lightsource Development Services Australia	Goulburn River BESS	Lithium-ion BESS as part of a hybrid project	49 MW/ 392 MWh (8 hours)	Before 2028
3 (May 2023)	Ark Energy Projects	Richmond Valley BESS	Lithium-ion BESS	275 MW/ 2,200 MWh (8 hours)	Before 2028

Although no pumped hydro project has received an LTESA, the NSW Government has provided support to pumped hydro projects through other avenues including the $50 million Pumped Hydro Recoverable Grants Program (PHRGP). This program awarded recoverable grants to six pumped hydro projects with a combined capacity of over 2.5 GW to support pre-investment activities, establish project feasibility and develop a strategic business case to support competitive bids for LTESAs under future NSW Roadmap Tender Rounds for LDS.[8]

The NSW Roadmap Tender Round 2 sought firming infrastructure and demand response, and awarded LTESAs to a total of six projects (4 firming projects), which are required to be operational by December 2025. Tender Round 2 originally sought 380 MW under the Roadmap and was

[7] https://aemoservices.com.au/-/media/services/files/publications/iio-report/2023/2023-iio-report-december_final.pdf?la=en

[8] Pumped Hydro Recoverable Grants | EnergyCo (nsw.gov.au)

expanded to tender for an additional 550 MW of firming infrastructure through the Australian Government's CIS. This tender marked the first CIS investment in NSW.

Table 3: Projects awarded firming LTESA under the NSW Roadmap Tender Round 2, partially supported by the Australian Government's Capacity Investment Scheme

Proponent	Project Name	Technology	MW/ MWh
AGL Energy	Liddell BESS	Lithium-ion battery	500 MW/ 1,000 MWh (2 hours)
Akaysha Energy	Orana BESS	Lithium-ion battery	415 MW/ 1,660 MWh (4 hours)
Iberdrola Energy	Smithfield BESS	Lithium-ion battery	65 MW/ 130 MWh (2 hours)
Enel X Australia	Virtual Power Plant (VPP)	Demand Response	95 MW comprising three separate VPPs (50MW, 20 MW, and 25 MW). Minimum dispatch duration of 2 hrs.

3.4 LDS Development Pathway

The 20-year Development Pathway outlined in AEMO Services' 2023 Infrastructure Investment Objectives (IIO) Report[9] forecasts that an additional 1,426 MW of LDS capacity will be required to achieve the legislated minimum objective for LDS by 2030 (Figure 1).

Based on the Development Pathway, the 10-year Roadmap Tender Plan outlines that competitive tenders for LDS LTESAs are required in Q2 2024 and Q2 2025, with an indicative tender size of 1 GW each. If these tenders do not result in adequate capacity, then annual contingency tenders are proposed commencing in Q2 2026 until the minimum objectives are met.

[9] https://aemoservices.com.au/-/media/services/files/publications/iio-report/2023/2023-iio-report-december_final.pdf?la=en

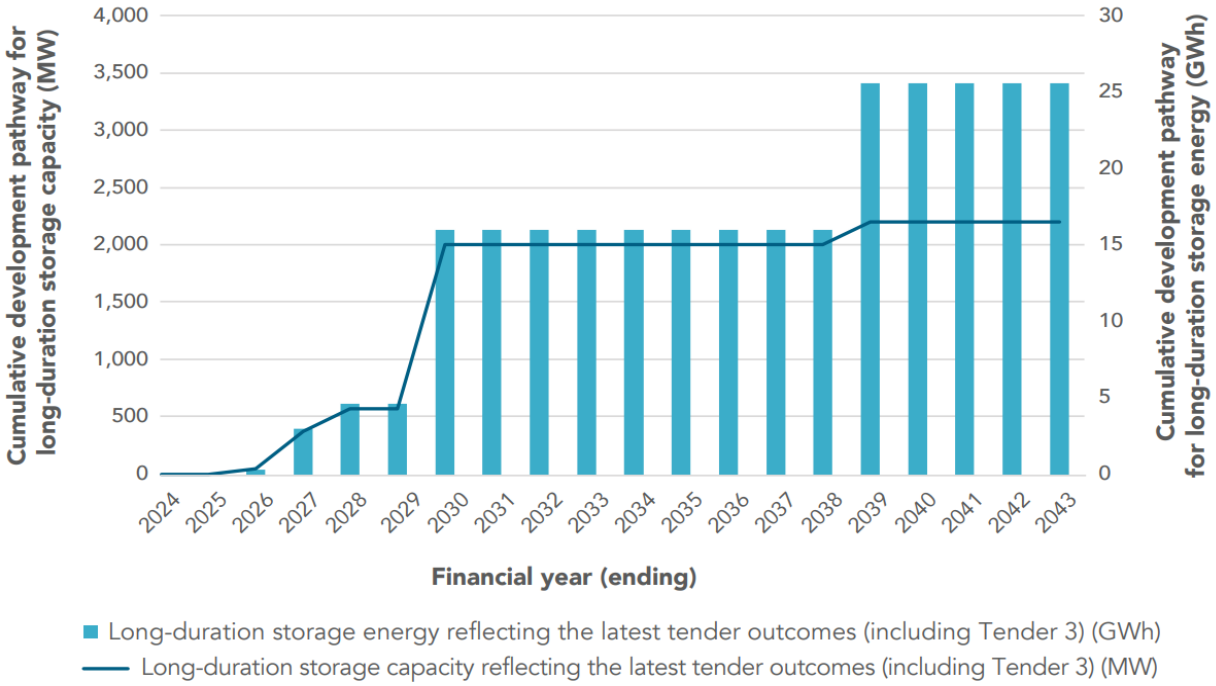

Figure 1: NSW LDS Development Pathway as outlined in the 2023 Infrastructure Investment Objectives (IIO) Report

3.5 The Commonwealth's Capacity Investment Scheme

In 2022, the Commonwealth Government announced the Capacity Investment Scheme (CIS) to encourage new investment in renewable dispatchable storage capacity nationally.

In November 2023, the Commonwealth Government announced a major expansion to the CIS, increasing the committed target to a total of 32 GW, made up of 9 GW of dispatchable storage and 23 GW of renewable generation to be delivered nationally by 2030.[10] This expansion is intended to support the Commonwealth Government's target of 82 per cent renewable electricity by 2030, and to fill expected reliability gaps as ageing coal power stations exit the grid.

In 2023, Energy Ministers agreed that the "*Capacity Investment Scheme will continue to be delivered working with state systems, including the NSW Electricity Infrastructure Roadmap (Long Term Energy Service Agreements)*".[11] As a result, the NSW and Commonwealth Governments are currently negotiating how the Roadmap delivery and CIS will interact in practice.

The Commonwealth Government is currently undertaking consultation on the proposed design of the expanded CIS program.[12] Based on previous consultation feedback, it is expected eligibility for

[10] https://www.dcceew.gov.au/energy/renewable/capacity-investment-scheme

[11] https://www.energy.gov.au/sites/default/files/2023-11/ECMC%20Communique_24%20Nov%202023.docx

[12] https://consult.dcceew.gov.au/expanded-capacity-investment-scheme-cis-design-paper

the expanded CIS program will include a minimum duration of 2 hours for dispatchable capacity, in alignment with the South Australia and Victoria tender eligibility criterion.

The expanded Commonwealth Government CIS is planned to be rolled out through competitive national tenders from 2024 to 2027 on a biannual basis. The Commonwealth Government proposes in the consultation paper that the CIS generation tenders in 2024 and 2025 will align with the NSW Roadmap Tender Round schedule. The Commonwealth Government is proposing that the planned 2024 CIS tenders will be held in:[13]

- Q2 2024, targeting 6 GW of renewable capacity projects, and
- Q4 2024, targeting 4 GW of renewable capacity and 3 GW of dispatchable capacity.

[13] Capacity Investment Scheme - Implementation Design Paper.pdf (storage.googleapis.com)

4 Potential reforms for consultation

This consultation paper is seeking feedback to support the review into the LDS requirements of the NSW market, which has been informed by modelling conducted by AEMO Services.

This consultation is seeking feedback on:

- Potentially reducing the minimum duration of LDS infrastructure to lower the cost to consumers of achieving the Roadmap's 2030 infrastructure objectives.
- Mechanisms to encourage longer duration storage infrastructure to mitigate against future reliability gaps.
- Options to aggregate infrastructure to accelerate additional storage infrastructure.

Any potential changes from this review will not impact the eligibility or merit assessment of NSW Roadmap Tender Round 5.

4.1 NSW long duration storage definition

In NSW, LDS infrastructure is defined under Part 6, Division 1, Section 43(1)(b) of the EII Act. The breakout box below provides an excerpt from the EII Act.

> Long-duration storage infrastructure for storage of electricity that—
>
> i) consists of storage units with a registered capacity that can be dispatched for at least 8 hours, and
>
> ii) is scheduled by AEMO in the central dispatch process under the National Electricity Rules,
>
> *registered capacity* has the same meaning as in Chapter 4A of the National Electricity Rules.

The central dispatch is a central-coordination process operated by AEMO to conduct the National Electricity Market (NEM). Projects must be registered with AEMO as scheduled or semi-scheduled units to participate in the central dispatch.

Generators (including storage) bid price-based offers to produce electricity up to their registered capacity into the market at five-minute intervals. The central dispatch orders generator offers with the objective to dispatch the lowest cost mix of generators to meet expected demand. Fulfilling demand through this auction process ensures generator dispatch price transparency and drives competitive bidding behaviour to achieve the lowest wholesale energy price, known as the spot price, for retailers and consumers. Short, five-minute settlement intervals provide accurate signals for the value of fast responsive technologies.

Registered capacity refers to the MW capacity of a generator as listed in the NEM Registration and Exemption List by AEMO. Infrastructure with a capacity of less than 5 MW are not required to register with AEMO and do not typically appear in the NEM Registration and Exemption List. Registration of infrastructure with nameplate capacity of 5 MW or greater ensures central visibility of grid connections, enabling AEMO to balance system supply and demand needs while maintaining system security and voltage stability.

This is how LDS is defined in NSW. As part of this review, the NSW Government reviewed other schemes to support LDS and found there is no widely accepted definition or duration of LDS infrastructure. Parameters for LDS appear to be specific to each jurisdiction's policy framework. The breakout box below provides some international examples.

Case Study: UK and United States long duration storage policies

In January 2024, the United Kingdom Government consulted on a proposed policy framework to drive investment in long duration electricity storage (LDES).[14] The framework's objective is to drive additionality of LDES through investment support in projects that are technologically feasible but not otherwise financially viable. To drive technology diversification, the LDES framework includes two-streams, each with a cap and floor revenue scheme, that can invest in 'established technologies' with a Technology Readiness Level (TRL) of 9 and, separately, 'novel technologies' with a TRL of 8.

Both streams require a minimum storage dispatch duration of 6 hours. As the framework's objective is to drive additionality through technology diversification, both streams exclude lithium-ion battery energy storage systems (BESS) which are already considered to be financially competitive. The United Kingdom energy market differs from the NSW energy market, and provides additional revenue streams to support BESS projects.

Similarly, in the United States, the State of California's LDES Program provides investment support for the "development of non-Lithium-ion energy storage technologies to foster diversity and competition in the market."[15] Meanwhile, through the Long Duration Storage Shot initiative, the United States Department of Energy defines long duration storage as a minimum of 10 hours or more dispatch duration.[16] These programs are focussed on technology demonstration rather than deployment.

[14] Long duration electricity storage consultation: designing a policy framework to enable investment (publishing.service.gov.uk)

[15] Long Duration Energy Storage Program | California Energy Commission

[16] [16] https://www.energy.gov/eere/long-duration-storage-shot (para. 2)

4.2 Duration of long duration storage infrastructure

To support this review, the NSW Government commissioned AEMO Services to provide advice on the storage requirements for NSW. This advice considered:

- The distribution of duration for new storage projects that is required to meet the reliability standard and the minimum objective of 2 GW/ 16 GWh in the absence of an minimum 8-hour duration constraint.
- A comparison of the expected cost to consumers of these scenarios.

The complete report from AEMO Services is provided alongside this consultation paper on the NSW Government webpage.

AEMO Services used AEMO's 2023 Electricity Statement of Opportunities (ESOO) methodology to calculate the additional firm capacity (in MW) required to reduce the annual expected unserved energy (USE) to the Interim Reliability Measure (IRM) and reliability standard. AEMO Services used the ESOO Central Scenario to explore the storage durations needed to close the forecasted firm, unconstrained reliability gap in 2030. It found that almost all (96 per cent) the expected USE events are less than 8 hours, and the majority (63 per cent) are less than or equal to 4 hours. The distribution of USE events by number of hours is shown in the figure below.

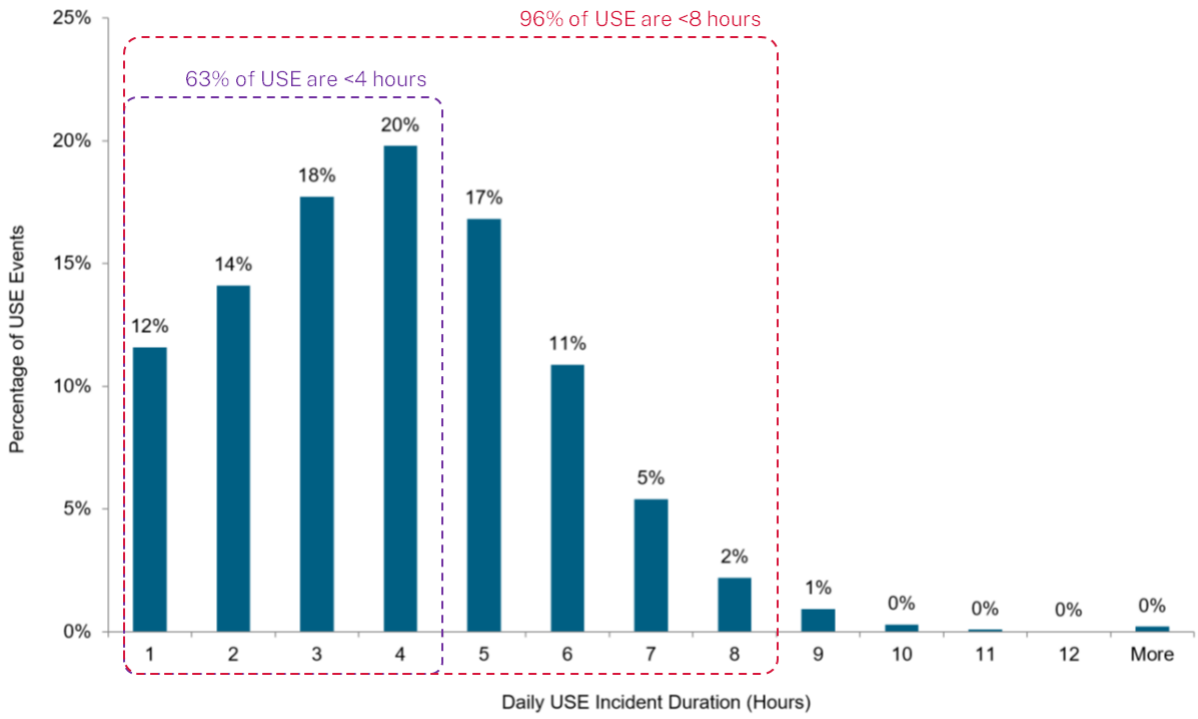

Figure 2: AEMO Services modelled duration of forecast unserved energy (USE) events in 2030

AEMO Services explored different portfolios for duration of storages to identify build costs and potential costs of LTESA payments. It found portfolios which consist of only short durations (2 hours) or only deep durations (24 hours and 48 hours) would have a higher build cost to meet the forecast reliability needs and meet the IRM in 2030.

Storage portfolios limited to the current LDS infrastructure (8-hour and above) build more depth than is forecast to be necessary to meet reliability needs in 2030. Longer duration storage typically has a significant advantage in achieving lower costs per unit of energy ($/GWh). However, this advantage is negated as longer duration portfolios pays for depth (more GWh per GW) that may not be economically utilised, potentially resulting in higher costs to consumers (Figure 3).

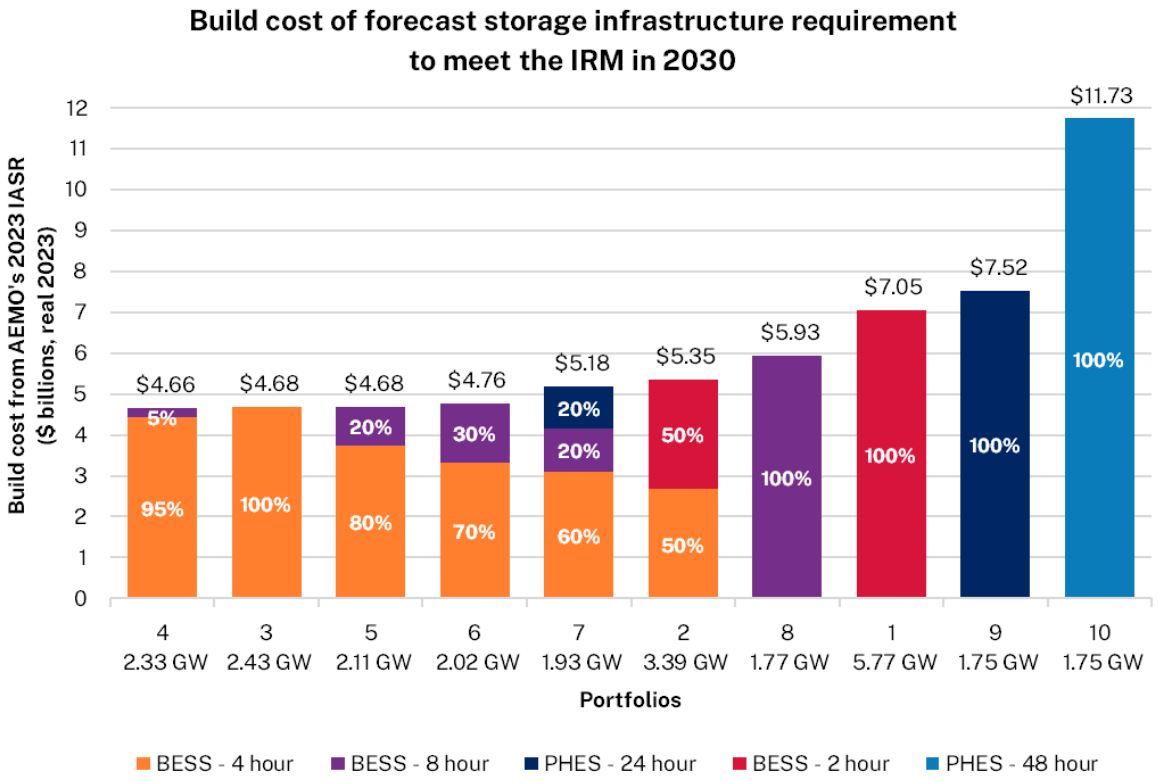

Figure 3: AEMO Services modelled absolute build cost of forecast storage infrastructure requirement to meet the IRM in 2030

In contrast, portfolios with a mixed configuration of 4 hours and 8 hours storage represent lower overall build costs and provide a balance of rated capacity with energy storage. The analysis also indicates that, for storage with durations less than 8 hours, LTESA liabilities are lower which is linked to the ability of shorter duration projects to cost-effectively participate in a range of markets.

Overall, AEMO Services' results indicate that greater flexibility in the duration of LDS infrastructure could meet reliability standards at a lower cost to consumers. AEMO Services also argues there is a need for deep duration infrastructure to mitigate the risk of low probability, high impact events (referred to herein as 'tail-risks'). The ESOO methodology does not include a range of circumstances

which have implications on the occurrence of USE events. Therefore, the value of longer-duration and deep storage in mitigating tail-risks may be underestimated in the reliability analysis.

The breakout box shows AEMO Services' recommendations based on its analysis.

Overall, based on this work and the expertise as the Consumer Trustee, AEMO Services recommends that the NSW Government consider two objectives for change.

1) Provide more flexibility in tenders for LDS infrastructure to meet the reliability standard, by reducing the minimum duration to 4 hours.
2) Continue to signal to investors the long-term need for storage with a duration of 8 hours or more to mitigate tail-risks, including provisions to:
    a) Require the Consumer Trustee, when recommending LTESAs for LDS, to preference projects of 8 hours or more; and/or,
    b) Limit the Consumer Trustee's ability to recommend projects with a duration of less than 8 hours to circumstances where this is prudent to address near-term reliability risks.

Considering AEMO Services' advice in conjunction with previous tender outcomes, the NSW Government is seeking feedback on enabling flexibility in duration of LDS infrastructure to meet forecast reliability gaps now and into the future. This is particularly relevant as we move through the energy transition and expect system needs to change.

Longer duration infrastructure may be required to maintain reliability into the future. AEMO Services has proposed requirements for the Consumer Trustee to preference projects with durations of 8 hours or more when recommending LDS LTESAs. Or alternatively, to limit the Consumer Trustee's ability to recommend projects less than 8 hours to circumstances where shorter-term reliability risks are identified.

Questions for stakeholders

Question 1: What is an appropriate minimum duration for long duration storage infrastructure in NSW for 2030? Please outline why.

Question 2: Should the Minister have regulation making powers to change the minimum duration of long duration storage infrastructure over time? Please outline why or why not.

4.3 Encouraging investment in longer duration storage infrastructure

An objective of the EII Act is to provide greater investment certainty and Section 3 (1)(c) includes to *"encourage investment in new generation, storage, network and related infrastructure by reducing risk for investors".*

AEMO Services' recommendation for more flexibility in how it tenders for LDS infrastructure has the potential to undermine the viability of longer duration storage projects that are currently in development. AEMO Services has recommended any change to duration is accompanied with reforms to continue to encourage investment in longer duration projects. This section of the consultation paper examines how to reduce risk for investors in LDS projects by providing more regulatory certainty.

AEMO Services' role as the NSW Consumer Trustee's is to independently plan how to meet the infrastructure investment objectives and enable NSW's energy transition in the best interest of consumers. It coordinates investments in new energy infrastructure across generation, storage and firming by administering Roadmap Tender Rounds and awarding LTESAs.

For LDS, AEMO Services has so far focussed on achieving the 2 GW minimum objective for 2030. But the LDS infrastructure objective is longer term than this, and AEMO Services' IIO Report identifies a development pathway that includes more investment in LDS in the 2030s. There is potential for the NSW Government to make this investment need more certain for investors and the Consumer Trustee.

AEMO Services considers an LDS project's impact on the electricity system. In the 2023 Tender Round for LDS, AEMO Services considered LDS impacts on:

- Merit Criteria 1: Financial Value including the daily spread in wholesale prices, ability to reduce economic curtailment of variable renewables and expected impact on wholesale prices under a range of future scenarios.
- Merit Criteria 3: Impact on the Electricity System including ability to provide essential system services including system strength.

There are arguably more benefits from LDS to NSW electricity consumers than considered to date. Longer duration projects will arguably provide greater system resilience to low probability high impact USE events.

As well as economic curtailment, LDS can reduce technical curtailment of renewables if they are well located in the network. This could unlock more network capacity or help to avoid investment in network infrastructure.

If AEMO Services were to consider these and other benefits, longer duration and well-located storages would be more competitive in tenders.

AEMO Services' analysis indicates that shorter duration projects have the capability to meet 2030 infrastructure investment objectives at lower costs to consumers because of their ability to participate in existing markets.

Storage technologies that are more suitable for shorter dispatch durations, such as lithium-ion batteries, are more mature in current markets. Batteries appear to have lower inherent risk and greater installation replicability that enables shorter project lead times.

Longer duration technologies that require detailed feasibility studies including geotechnical investigation, such as pumped hydro and compressed air, face comparatively higher inherent risk and uncertainty, and typically require longer lead times.

Under current market conditions, equipping a project with additional storage duration over 4 hours is likely to have diminishing returns. Receiving an LTESA could be the difference between a project proceeding as a short duration project or extending to 8 hours of storage.

The challenge NSW faces is finding a cost-efficient path between addressing near-term system needs in meeting 2030 targets and building the storage and system strength infrastructure required for a high penetration of variable renewable energy (VRE) system in the 2030s which is likely to require longer durations of storage.

If AEMO Services were to discount the capacity of shorter duration projects in its merit assessment, it could provide a competitive advantage to longer duration projects. If projects are cost effective, on balance more longer duration storage projects would be successful in Roadmap tenders.

Beyond 2030, system needs are less certain and are highly dependent on how long coal-fired power stations continue to operate, and in what form. This uncertainty impacts investment decisions for long lead time projects with longer durations of storage such as pumped hydro and compressed air. It may be difficult for investors to value long duration storage before the markets exist for the system services they provide.

In 2022, the Reliability Panel (the Panel) found that the nature and characteristics of reliability risks may change towards the end of 2028. In April 2024, the Panel released a draft review of the form of the reliability standard, including modelling the forecast durations of USE events.[17] The Panel's modelling found that in financial years 2035 to 2040, 96 per cent of USE events are less than 6 hours in duration. The longest USE events are 14 hours or less in duration and no USE events of more than one full day occur.

[17] Review of the form of the reliability standard and APC | AEMC

The report's analysis also found the mean USE event duration increases to around 7 hours as VRE penetration increases to 75 per cent in the NEM. The median duration of USE events increases to a maximum 4 hours when VRE reaches (and exceeds) 65 per cent penetration.

This indicates that beyond 2030, system needs for LDS may remain around the 8-hour duration to address USE events.

If the legislation were to prescribe another minimum objective for LDS after 2030, investors and AEMO Services could have more certainty about the potential role of longer duration projects which are likely to require longer lead times.

Questions for stakeholders

Question 3: How can the infrastructure objectives and LDS tenders be improved to support a diverse range of long duration storage projects? Are new measures required, such as:

- Requiring the Consumer Trustee to explicitly consider the benefits of duration in calculating financial value to consumers.
- Requiring the Consumer Trustee to discount the capacity of projects with duration less than 8 hours (if allowed) as though the duration is 8 hours when calculating financial value to consumers.
- Establishing a minimum LDS objective for 2035 to provide more certainty for proponents with long lead time projects.

4.4 Aggregation of long duration storage infrastructure

The EII Act outlines that LDS infrastructure must consist of storage units that can dispatch their registered capacity for at least 8 hours. As discussed above, this typically rules out projects less than 5 MW as they would not normally appear in the NEM Registration and Exemption List.

Interest in community battery projects is rapidly growing. Round 1 of the Australian Renewable Energy Agency's (ARENA's) Community Batteries Funding Program received over 140 expressions of interests from all states and territories. These applications combined represented $3.5 billion of battery deployment projects seeking $1.3 billion in grant funding. Shortlisted applicants were required to install a minimum of five community batteries, between 50 kW and 5 MW in capacity on the distribution network.[18]

Between 2021 and 2023, Ausgrid conducted a trial by installing three community batteries across its network.[19] An additional grant was received from the Australian Government to deliver an additional

[18] https://arena.gov.au/news/strong-demand-for-community-batteries-across-australia/

[19] https://www.ausgrid.com.au/In-your-community/Community-Batteries/Community-battery-trial

six community batteries on the network. Endeavour Energy is also conducting a community battery trial on its network.[20]

As most community batteries are less than 5 MW in capacity, registration with AEMO is not required. To further accelerate community batteries and maximise their contribution to firm capacity, storage units which have an individual asset capacity of less than 5 MW could be aggregated to form an aggregated storage unit of greater than 5 MW. This would enable registration of the aggregated storage unit and the associated capacity with AEMO in the NEM Registration and Exemption List.

These projects would also not currently participate in central dispatch. However, the Australian Energy Market Commission is progressing a rule change request from AEMO for a 'scheduled lite' mechanism into the NEM. The mechanism aims to integrate non-scheduled price-response resources (such as VPPs) into the NEM market scheduling process. The outcome of this rule change would be improved efficiency of the system and reducing costs to consumers. For the resources, it would enable them to participate in more markets as scheduled resources. The draft determination is expected to be published in July 2024.[21]

Community batteries and VPPs are closer to customer load and can provide network services that improve network reliability and security. This means they may provide more value to consumers than utility scale storage projects.

If these projects store electrical energy, can dispatch for the minimum duration, are registered in the NEM Registration and Exemption List, and participate in AEMO's central dispatch, they can arguably meet the scope of LDS.

Questions for stakeholders

Question 4: Should the NSW Government introduce amendments to the LDS definition to clarify it can include aggregated LDS infrastructure across multiple sites? Should aggregated LDS infrastructure need to register on AEMO's NEM Registration and Exemption List and participate in central dispatch? Please outline why or why not.

[20] https://www.endeavourenergy.com.au/in-the-community/communitybattery/trial-participation

[21] Integrating price-responsive resources into the NEM | AEMC