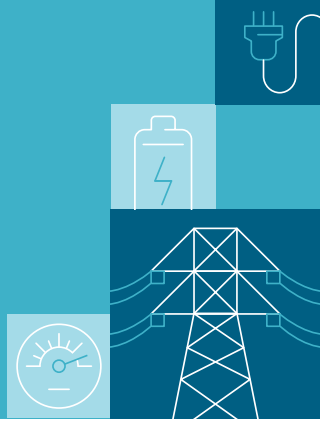
AEMO SERVICES

Consumer Trustee

Market Briefing Note

The financial value of long duration storage projects



Purpose of this Document

This market briefing note sets out information relating to the financial value of long-duration storage (LDS) projects to NSW electricity customers.

This market briefing note contributes towards a response to a question often asked of AEMO Services by developers and investors - "what is the value of our project to NSW electricity consumers?" Our response to this question is broken down into three briefing notes:

1. Information on the financial value for generation projects.
2. Information on the financial value for LDS projects (this note).
3. Information on the value of electricity over time that impacts the financial value of projects.

By sharing this information with the market, AEMO Services intends to help projects understand the financial value of their projects to NSW electricity customers and provide competitive bids.

What you need to know when preparing your bid

To score high in MC1 (financial value), projects need to demonstrate strong financial value, measured as the difference between benefits and cost. Per information in this document, projects will demonstrate high financial value predominantly through a low-value Annuity Cap (AC) and Net Revenue Threshold (NRT) Bid.

A **Financial Value Bid's most influential factors are expected to be the AC, any commitments to forfeit exercising the option in certain years, and/or a shorter contract term**. Additional value is expected to be recognised in longer storage duration projects.

Tender Guidelines

The Tender Guidelines are the single source of information for proponents seeking to understand how AEMO Services will assess Bids in Tender Round 1. AEMO Services intends to assess Bids against eight Merit Criteria under a two-step process, as detailed in the Tender Guidelines. In summary:

- Project Bids are sought from proponents and are assessed against six non-financial Merit Criteria, such as their impact on the electricity system, and regional economic development.
- Project Bids are shortlisted, and Financial Value Bids sought and assessed against:
  - Merit Criterion 1 – Financial Value.
  - Merit Criterion 2 – Commercial departures.

Merit Criterion 1 – Financial Value is used in the assessment of both Long-Term Energy Service Agreements (LTESAs) and Access Rights.

AEMO Services will make recommendations on projects to receive a LTESA and/or an Access Right based on a combined evaluation against all eight Merit Criteria detailed in the Tender Guidelines with financial value (Merit Criterion 1) being the primary consideration.

Note, the description of financial value in this market briefing is not an exhaustive or comprehensive summary of the evaluation process. AEMO Services retains discretion to score and assess Bids and make recommendations. It will not be held to a rigid assessment formula or policy, to ensure that it is satisfied that any recommendations it makes are in the long-term financial interests of NSW electricity consumers and otherwise consistent with statutory requirements.

Overview of the Financial Value of an LDS Project

The financial value of an LDS project can be summarised in Financial Value Components, which can then be tested against a diverse set of modelled electricity market scenarios. To best understand the value of an LDS project, the modelled scenarios should represent a variety of future electricity market outcomes. Measured against the Financial Value Components, an attractive LDS project will provide financial value under many future electricity market outcomes. A less attractive LDS project may only provide financial value under a small number of future electricity market outcomes.

Under this model, financial value incorporates the components defined below.

The calculation method for each component is described on pages 3 to 5.

Projects incentivised to enter the market through an LDS LTESA and/or Access Right are expected to put downward pressure on wholesale electricity costs. The incremental market benefits will be estimated by modelling the wholesale price impact of the project compared to a future where the project does not exist, assuming generic revenue maximising behaviour.

An LDS Project is expected to participate in the wholesale electricity market, contracts markets and/or ancillary services markets. These benefits are expected to be passed on to NSW electricity consumers.

Access fees are paid by projects that gain an Access Right and connect in a REZ where a declared access scheme applies. The component of the Access Fee that relates to offsetting the costs of the REZ are modelled as an income for the Scheme Financial Vehicle (SFV).[4]

Estimated by determining the financial value of avoided Unserved Energy (USE), using data from the latest AEMO Electricity Statement of Opportunities (ESOO) and Value of Lost Load (VOLL).

LDS projects are expected to have a positive impact on system reliability, with the potential to reduce the likelihood of USE events and thereby the potential to reduce any reliability-associated costs to consumers.

Estimated cost impact on the SFV incurred by the exercising of the LTESA, considering the Annuity Cap (AC) and NRT Bid terms, as well as the relative potential wholesale market revenues of the project in relation to its storage duration and load potential,[7] to estimate expected costs. Costs are zeroed in periods where proponents have elected to forgo the LTESA option.

The LTESA cost reflects costs incurred by the SFV, passed onto NSW consumers via Distribution Use of System (DUOS) charges.

Calculated across multiple scenarios as described on page 6.

1. The financial value assessment will align with the requirements in *Electricity Infrastructure Investment Act 2020*, section 48(2) and *Electricity Infrastructure Investment Regulation 2021*, clause 26(4).
2. Relevant to EII Regulation s26(4)(a)(e)
3. Relevant to EII Regulation s26(4)(b)(d)(e)
4. The SFV will be an entity established to intermediate cash flows between LTESA Projects and Distribution Network Service Providers (and ultimately, NSW electricity consumers). It will establish and maintain the Electricity Infrastructure Fund set out in Part 7 of the EII Act to manage the cash inflows and outflows.
5. Relevant to EII Regulation s26(4)(e)
6. Relevant to EII Regulation s26(4)(c)(d)
7. Placing load on the grid at times of excess supply can reduce economic curtailment of generators and assist thermal plant to operate more efficiently by ensuring that they can operate at above their minimum stable level. It may therefore be recognised as a benefit in our evaluation model for certain scenarios.

Financial Value Components Deep Dive

Wholesale Electricity Cost and Market Benefit

The impact on the wholesale electricity market of each project Bidding for an LDS LTESA and/or Access Right can be considered through the following steps:

1. Wholesale electricity costs in NSW estimated using a counterfactual case without the project in an electricity market model, i.e. a future where the project does not exist.
2. Several wholesale price scenarios based on a generic 100 MW LDS project with differing storage duration and load vs. no load scenarios will be modelled, then normalised by MW to find the per MW wholesale price reduction from storage projects of differing durations and load characteristics.
3. These wholesale price benefits will be interpolated for each individual LDS project Bid by aligning the LDS project Bid characteristics (duration, capacity, load/no-load) with the generic project scenarios.

The wholesale electricity cost with the project included can be subtracted from the wholesale electricity cost without the project to determine the project's net impact on NSW wholesale electricity costs (which have a net impact for NSW customers), per the below:

$$\frac{(LoadCost_{Without} - LoadCost_{With})}{Modelled\ Capacity}$$

Where:

- $LoadCost_{Without}$ is the forecast of NSW consumer costs using the market impact assessment model with no additional LDS project.
- $LoadCost_{With}$ is the forecast of NSW consumer costs using the market impact assessment model with an addition project at the specified duration and with/without load.
- $Modelled\ Capacity$ is the notional nameplate capacity used for the storage objects in the market impact assessment. This is set to 100 MW. Indexing is used to compute the $/MW impact on NSW electricity consumer costs.

Access fees

Where applicable, Access Fees will be a fixed, annual benefit to the SFV, applied on a capacity basis, and consist of:

- A component that contributes to the cost of the infrastructure.
- Components that go to supporting community and employment initiatives.

The component of the Access Fee that relates to community and employment initiatives should be deducted from the Access Fee for the purpose of estimating a project's financial value.

Impact on Unserved Energy

The impact of an additional LDS project on potential USE can be used to reflect the potential cost savings of reduced reliability-associated costs.

Projects are differentiated in their ability to reduce USE and associated costs. Projects with longer durations may be able to reduce USE to a greater extent than shorter duration projects.

Cost savings can be calculated using an estimate of the number of USE events of varying durations, extracted from the most recent annual AEMO ESOO. The USE metric will be calculated for each project for each of the 10 years in the ESOO horizon.

The financial impact of an LDS project in reducing the quantum (in MWh) of USE can be calculated using the VOLL. The USE value is indexed by the project's capacity to achieve a $/MW figure.

Net LTESA cost

This component on financial value is relevant where an LDS project also has an LTESA which creates a cost for NSW electricity customers. The costs ultimately incurred by the Scheme Financial Vehicle (SFV) (and therefore NSW consumers) due to the LTESA can be determined by two key components, representing the maximum potential costs that may be incurred in a year and the potential for these costs to be lower. These are described as:

1. **Maximum SFV Annuity Cost**
   The Annuity Cap (AC) is expected to be a Bid term based on a project's revenue expectation and represents the maximum payment in a year from the SFV to an LDS LTESA project. All projects with over 8 hours of storage are considered equally capable of defending cap contracts, providing Frequency Control Ancillary Services (FCAS), and providing similar contracted system services. The AC is therefore directly comparable across projects after normalising for MW, with a higher AC representing a higher potential maximum liability for the SFV.

   The AC is the upper bound of potential costs to the SFV and should be given significantly more weight when considering the expected costs of an LDS LTESA project to the SFV. Projects with a higher AC create significantly higher risks for NSW electricity customers and, under some future electricity market scenario, these risks will translate into higher costs to NSW electricity customers. Because of this, the AC should be the main determinant for assessing the potential costs of an LTESA.

2. **Net Revenue Threshold (NRT)**
   The NRT of a project is a Bid term and is expected to represent the revenue requirement for a project to achieve a target return for investors. It is assumed that NRT is based on a project's cost, funding gap and target return requirement. NRT is the threshold for operational revenues, below which a project is a cost to the SFV.[8]

Unlike the AC, NRT is not a directly comparable term across projects as it is linked to both power capacity and duration. This means that longer duration projects could potentially offset a higher NRT through higher market revenues.

To standardise NRT and allow a comparison across projects, a duration-based benchmark can be applied to ensure a fair comparison of the NRT term. This benchmarking process is summarised as:

- Using electricity market modelling, a benchmark for potential energy arbitrage revenues (defined as PEAR) is calculated per MW, as energy arbitrage is a key revenue component where and the amount of duration beyond 8 hours is expected to be a differentiating factor.
- The PEAR is subtracted from the NRT to find the forecast residual revenue gap. A further potential non-energy market revenue estimate (defined as PNER) is also developed to reflect the non-energy market revenues per MW that all projects could receive. Together PEAR and PNER are defined as Potential Revenue (PR), a proxy for Net Operational Revenues (NOR).
- NRT is then normalised by capacity to determine the potentially lower than (maximum) AC costs incurred by the LTESA, factoring the potential revenues of the project. This metric is comparable across projects.

As noted above, when considering LTESA costs, the assessment framework can also consider the AC alone across projects.

8. Revenues above the NRT are shared between the project and the SFV. This is also intended to be reflected in the assessment.

Estimating the potential cost of an LDS LTESA

These components are brought together in the formulae below, used to estimate LDS LTESA costs.

Potential revenue is defined as:

$$PR_{year=y} = PEAR_y + PNER$$

Where:

- PR is the estimate for Potential Revenues in a given year.
- $PEAR_y$ is the estimate of Potential Energy Arbitrage Revenues for a 1 MW storage facility at the project's duration extracted from the market impact assessment model (in $/MW). Longer duration projects will be assigned a higher PEAR. This is scenario based and hence will take on a range of values.
- $PNER$ is a constant number representing Potential Non Energy Revenues that all projects can receive (in $/MW).

$$CostEstimate_y = \begin{cases} AC \ \ if\ PR_y \leq NRT - AC \\ AC - 0.75(PR - (NRT - AC)) \ \ if \ \ NRT - AC < PR_y \leq NRT + \frac{AC}{3} \\ 0\ if\ NRT + \frac{AC}{3} < PR \end{cases}$$

The LTESA cost estimate reflects the LDS LTESA contract structure,[9] and is defined as:
Where:

- AC is the Annuity Cap (in $) bid in by the project for a given year, converted to $/MW.
- NRT is the Net Revenue Threshold (in $/MW) bid in by the project for a given year.
- MW is the registered capacity of the project.

Interpreting the Formulae:

The cost estimate equation is designed to reflect the LDS LTESA structure while driving competition in the two Bid terms (AC and NRT), by estimating a project's expected LTESA cost as the lowest of the AC and the difference between NRT and potential revenues.

If a project Bids a highly competitive AC, it is in a favourable position as this is likely to bind and be considered a low-cost Bid. A competitive NRT is not guaranteed to bind as there may be market modelling scenarios with low PEARs resulting in AC being the binding factor, putting a high weight on the proponent's AC Bid. Competition in the process is expected to drive down both parameters.

As described projects may have revenue streams other than wholesale market revenue. This framework does not predict the cashflow of individual contracts, and it is up to proponents to Bid their LTESA terms competitively, and in a way that reflects their other revenue sources.

$PEAR_y$ helps to assign additional value to projects with higher durations to recognise that their NRT could be higher than a lower duration project if new-build (driven by potentially higher capital costs) and they should not be penalised for this. It will not necessarily flow through to the AC as the project's certainty over revenues is not expected to be a function of duration. Duration is expected to mainly impact a project's energy market arbitrage revenues while other revenues are more closely linked to nameplate capacity.

PNER is an additional estimate which is consistent for all projects on a per MW basis. It represents the potential of the project to earn non-energy market revenues such as FCAS market revenues. It is added to overcome a limitation of the equation in that NRT – PEAR may not bind as significant revenues are excluded from the analysis. PNER will be determined in advance of each Tender Round, from a benchmark of observed revenues from existing projects.

9. If net revenues are below NRT minus AC, the LTES Operator receives the full AC. The LDS LTESA annuity payment is reduced by 75% of every additional dollar of revenues above NRT minus AC. This is reflected in the formula as the additional term 0.75 x (PR-(NRT-AC)). This adjustment ensures that the LTES Operator continues to be incentivised to earn market revenues by retaining some of the additional net revenues it earns. As a result, the point above which the annuity payment is equal to zero is slightly above the NRT, and is equal to NRT + $\frac{AC}{3}$

Scenario Based Analysis

As shown on page 3, the wholesale market benefit and the LTESA cost are subject to forecast assumptions.

The PEAR value, for instance, and thus LTESA cost are strongly depended on the assumptions on future electricity spot prices.

Due to the long-term nature of the LTESAs and high uncertainty in the market, financial value should incorporate scenario-based analysis to test how the relative performance of projects varies under different future market conditions. For example, a scenario with high spot price volatility could show relatively higher benefits/ lower costs, compared to a scenario with less spot price volatility.

Using multiple scenarios allows for the evaluation of financial value to highlight projects that deliver financial value across a range of plausible market outcomes.

For example, five different electricity price scenarios could be considered. These scenarios could explore a range of equilibrium and non-equilibrium outcomes, to reflect a combination of 'perfect foresight' futures and imperfect and more volatile futures (incl. non-equilibrium outcomes) and test the relative value of storage durations across projects.

Scenarios could be ascribed a weight according to a view of the most likely future outcomes. The central scenario (we have published AEMO Services' view of the value of electricity over time) will not include the minimum legislative objectives (in line with the generation framework) to avoid the development pathway influencing the outcome of the tender. Across all scenarios, all existing, committed and previously successful LTESA projects are included in the forecasts.

Example Calculations (next page)

As an illustrative example, a calculation of each Financial Value Component is shown against four generic projects. Please note that the numbers used in the example on the next page are illustrative and fictitious. Three of the examples are nominally storage with load and representative of potential projects that may be chemical batteries, compressed air storage, pumped hydro or other similar technologies that charge from and discharge into the grid. Storage with no grid load is also included in the table below and is representative of potential projects such as waste-to-energy, solar thermal, biomass or other eligible technology showing similar characteristics.

		Project type			
		Storage with grid load	Storage with grid load	Storage with grid load	Storage with no grid load
Project characteristics	Project size (MW)	100	150	150	100
	Duration (hrs.)	8	8	24	8
Evaluation framework calculations (illustrative examples)					
Wholesale market benefits	NSW load cost (pre-Project, $m)				5,000.5
	NSW load cost (post-Project, normalised by MW, $m)	5,000.4	5,000.3	5,000.1	5,000.2
	Benefit estimate calculation (normalised by MW, $m)	5,000.5 – 5,000.4 = 0.1	5,000.5 – 5,000.3 = 0.2	5,000.5 – 5,000.1 = 0.4	5,000.5 – 5,000.2 = 0.3
Avoided USE	Reduction in USE (MWh)	1,900	4,500	5,550	1,900
	Valuation of USE ($m/MWh)				0.02
	Benefit estimate ($m/MW)	1,900 x 0.02 ÷ 100 = 0.38	4,500 x 0.02 ÷ 150 = 0.60	5,550 x 0.02 ÷ 150 = 0.74	1,900 x 0.02 ÷ 100 = 0.38
LTESA cost	Project Cost estimate ($m)	(0.30)	(0.30)	(0.59)	(0.50)
	Project repayment ($m)	0.05	0.05	Nil	0.05
	Cost estimate ($m)	(0.25)	(0.25)	(0.59)	(0.45)
Evaluation framework financial value (illustrative examples)					
Value	Financial value ($m) = sum of wholesale market benefits, avoided USE and LTESA costs	0.1 + 0.38 + (-0.25) = 0.23	0.2 + 0.60 + (-0.25) = 0.55	0.4 + 0.74 + (-0.59) = 0.55	0.3 + 0.38 + (-0.45) = 0.23

This publication has been prepared by AEMO Services using information available at 14 October 2022.