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ENERGY RESEARCH

Economics of standalone battery storage in India

March 2025

Introduction to the Aurora team and key information for today's session

Debabrata Ghosh
Head of India

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Lead, Flexible Energy

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Senior Analyst, Research

Aurora's bespoke offerings

For more information on scenario analysis, site-specific asset economics including comparison of revenue models, bespoke forecasting, competitor analysis and auction bidding support, please reach out at **mrunal.karnik@auroraer.com**.

Aurora provides market leading forecasts & data-driven intelligence to power the global energy transition

AURORA

- Power markets
- Renewables & PPAs
- Storage
- Grid & Congestion
- Electric vehicles
- Hydrogen (H_2)
- Carbon (CO_2)
- Natural gas

We are investing heavily in setting up **global hub** in India with a **100+** sized team.

15 offices
and New York coming soon

900+
market experts

1000+
clients

250+
transactions supported in 2024

Sources: Aurora Energy Research

Our market leading models underpin a comprehensive range of seamlessly integrated services to best suit your needs

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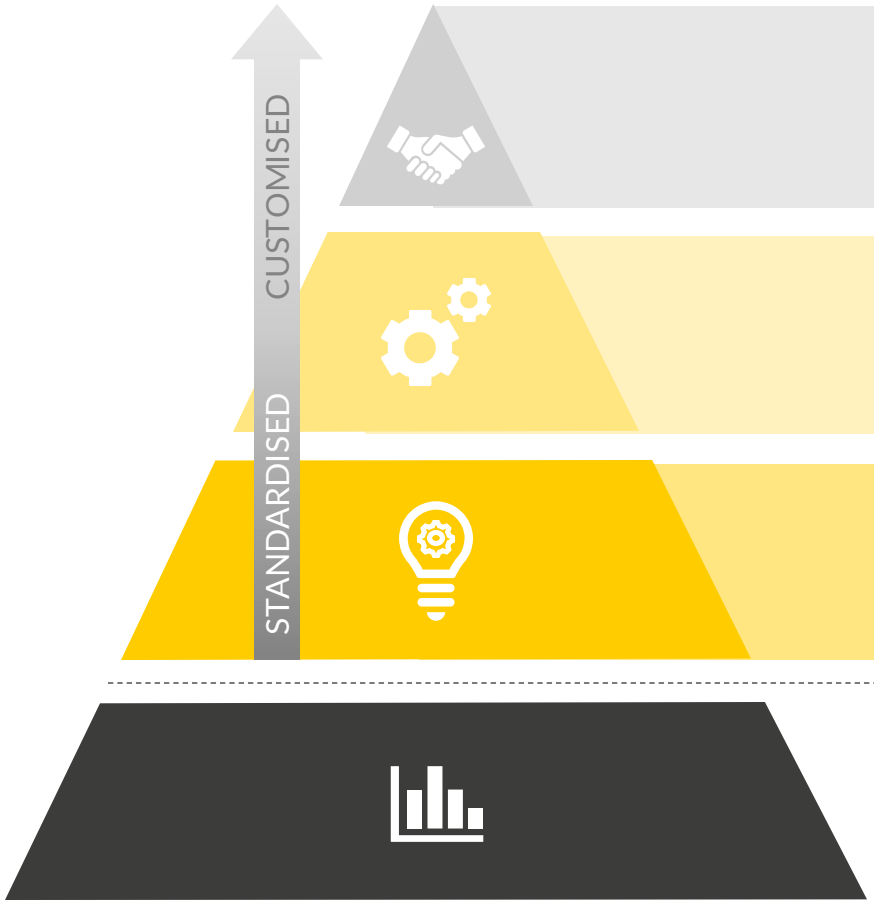
Aurora's product and service catalogue



Advisory

Access tailored expert advice and analytics for your crucial projects

Trusted advice and dedicated support for strategy, investments, transactions and policy engagement

2,000+ projects globally

Software Solutions

Make standard analysis bespoke through direct access to our models

Unique SaaS subscriptions to create your own scenarios and asset-specific investment cases

150+ company licenses

Subscription Analytics

Receive regularly updated forecasts, sample investment cases and timely deep-dives

Industry-standard outlook reports, bankable price forecasts and strategic insights for power and commodities

1,000+ subscribing companies

Models & Data

Market-leading models for power, gas, hydrogen, carbon, oil & coal markets

Proprietary and continuously updated cutting-edge models populated with highest quality curated datasets

Developed over 10 years, 140+ dedicated modellers

Sources: Aurora Energy Research

This session will present Aurora's Central battery investment cases for India, followed by upside cases under a Messy Transition scenario in May

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Dec 2024

- **First full, detailed Power & Renewables market report**

Aurora's detailed, long-term view on the power market in India, containing:

- Aurora's central scenario

Alternative scenario analysis to explore sensitivity to:

- Lower GDP growth

Feb 2025

- **Batteries Group Meeting: the economics of Standalone BESS in India**
  - Economics of battery storage
  - Business models for batteries
  - Impact of the expected policy changes like de-regulation of ancillary markets, DAM price caps

Today's session

May 2025

- **Messy Transition Group Meeting: Potential impact of unforeseen shocks**
  - Supply chain constraints, fuel shortages, or commodity price spikes
- **Economics of Co-located Batteries**
  - Analysis of hybrid tenders in Aurora Central and Messy Transition scenarios

Jul 2025

- **FDRE[1] & other complex tenders or contracts:**
  - Economics of FDRE or Peaking Power assets
  - Portfolio design for FDRE or Peaking Power auctions
  - Business models, key policies and regulations and their impact on FDRE or Peaking Power auctions

Nov 2025

- **Complex hybrid and storage portfolio optimisation 2.0:**
  - Can batteries replace wind in a portfolio?
  - What is the optimal sizing for batteries in portfolios?
  - Addition of batteries on existing vanilla or hybrid renewables assets to minimise penalties

Key releases

Reports

Power market forecast update
April

Update of Central and Low scenarios, with new Messy Transition and High scenarios

- Additional sensitivity analysis of the forecast to low wind speeds

Power market forecast update
July

Power market forecast update
October

1st flexible energy report
Q4 2025

First full, detailed Flexible Energy Report

- Battery economics in India, impact of location, duration, cycle target, and entry years on battery IRRs
- Impact of grid constraints

Software

Amun
February

1) Firm and Dispatchable Renewable Energy.

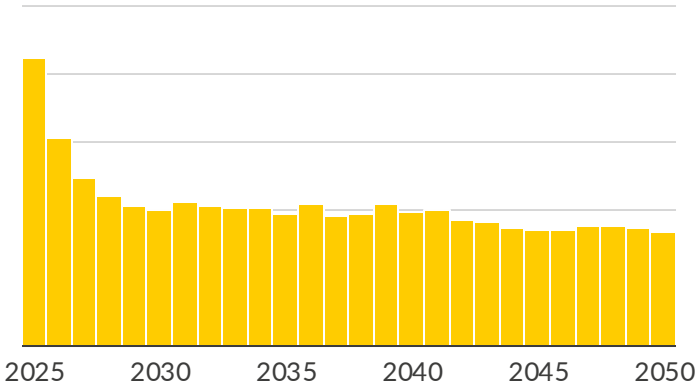
Sources: Aurora Energy Research

We offer tailored battery support for strategy, development and transactions

Services		Deliverable
1	**Battery revenue assessment**	▪ Bespoke site-specific forecast of key revenue streams for batteries (2025-2050) based on battery (duration, efficiency, cycling target, AC vs. DC) and solar technology (profile)
2	**Battery optimal sizing**	▪ IRR sensitivities based on size, duration and target cycling rates
3	**Colocation benefits assessment**	▪ Market report covering the upsides resulting from co-location of a battery asset with a wind or solar asset (baseload PPA, portfolio effect, risk hedging)
4	**Buy-side support for battery acquisition**	▪ VDR review, market analysis, long-term volume forecast, probability of success, transfer sheet, regulatory overview
5	**Battery auctions bidding support**	▪ Battery auction price forecast in countries with standalone battery subsidies
6	**C&I transaction support**	▪ Strategic asset-specific report, delivering in-depth insights into regulatory frameworks, portfolio optimisation, contract structuring, and related critical aspects

Illustrations

1 **Battery revenues**



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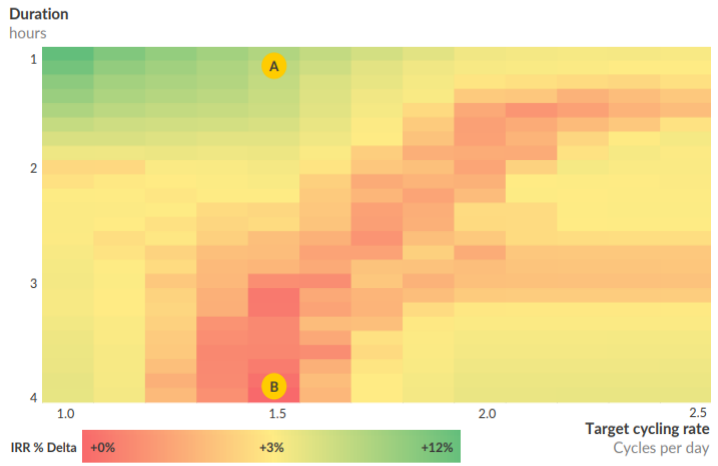

Sources: Aurora Energy Research

Agenda

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Aurora's battery modelling methodology

- How does the battery dispatch model interact with Aurora's power market model?
- What stages are involved in the battery dispatch process?

State of battery storage in India

- Why is there a need for storage in India?
- Which states are announcing tenders for battery storage?
- What are the common business models observed in recent tenders?

Standalone battery economics

- What are the economics for 2- and 4-hour batteries in different price zones in India?
- How do IRRs vary with changing cycling rate and commissioning date?

Merchant returns for batteries materially exceed those based on recent tenders for standalone batteries

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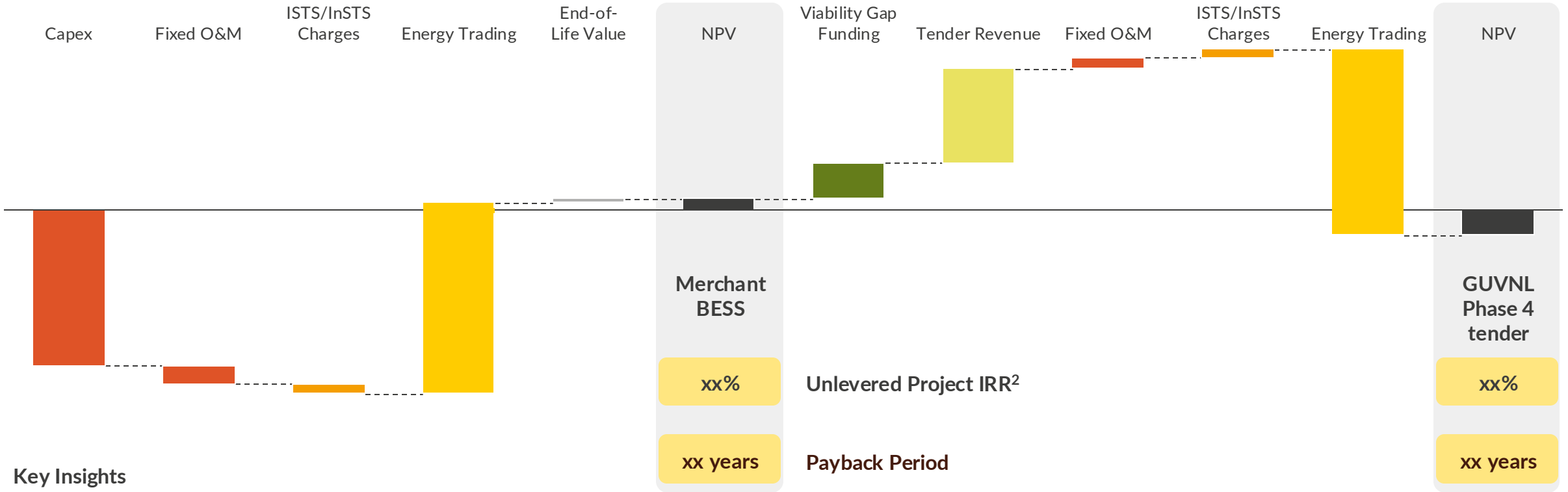
Economics for a merchant BESS asset commissioning in 2026 in Gujarat in comparison to a BESS asset commissioned under GUVNL Phase-IV standalone BESS tender
Present value[1], ₹/kW (real 2023)



Key Insights

- IRRs for a 2-hour, 2 cycle battery entering the system in 2026 are xx percentage points higher than the returns based on GUVNL's phase 4 tender.
- Tender participants are potentially bidding in with optimistic expectations of CAPEX or pessimistic expectations of merchant returns.
- Stable revenues from the tender, although lower than the more volatile merchant returns, can unlock debt financing.

Costs | ISTS/InSTS Charges | Energy Trading | End-of-Life Value | Viability Gap Funding | Tender Revenue | NPV

1) Discount rate of 12.5%; 2) Pre-tax, in real terms.

Source: GUVNL, Aurora Energy Research

Unique, proprietary, in-house modelling capabilities underpin Aurora's superior analysis

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Commodities (AER-GAS) ↔ **Power markets (AER-ES)** → **Battery asset dispatch (Chronos)**

INPUTS

- Technology
- Policy
- Demand
- Commodity prices[1]
- Weather patterns

Dispatch model

- 30-minute granularity
- Iterative modelling
- Dynamic dispatch of plant
- Endogenous interconnector flows

Continuous iteration until an equilibrium is reached

Investment decisions module

- Capacity market modelling
- Capacity build / exit / mothballing
- IRR / NPV driven
- Detailed technology assessments

OUTPUTS

- Capacity mix
- Generation mix
- Wholesale market prices
- Electric vehicle charging
- Profit / Loss and NPV

INPUTS

- AER-ES modelled half-hourly prices, including:
  - Day Ahead Market
  - Green Day Ahead Market
  - Real Time Market
- Battery configuration and operating constraints.

OUTPUTS

- Half-hourly dispatch decisions based on imperfect foresight.
- Margins and trading volume in each of the key markets.

1) Gas, coal, oil and carbon prices fundamentally modelled in-house with fully integrated commodities and gas market model.

Sources: Aurora Energy Research

Chronos dispatches battery through a two-stage process, a reflection of the market's operation across day-ahead and intraday markets

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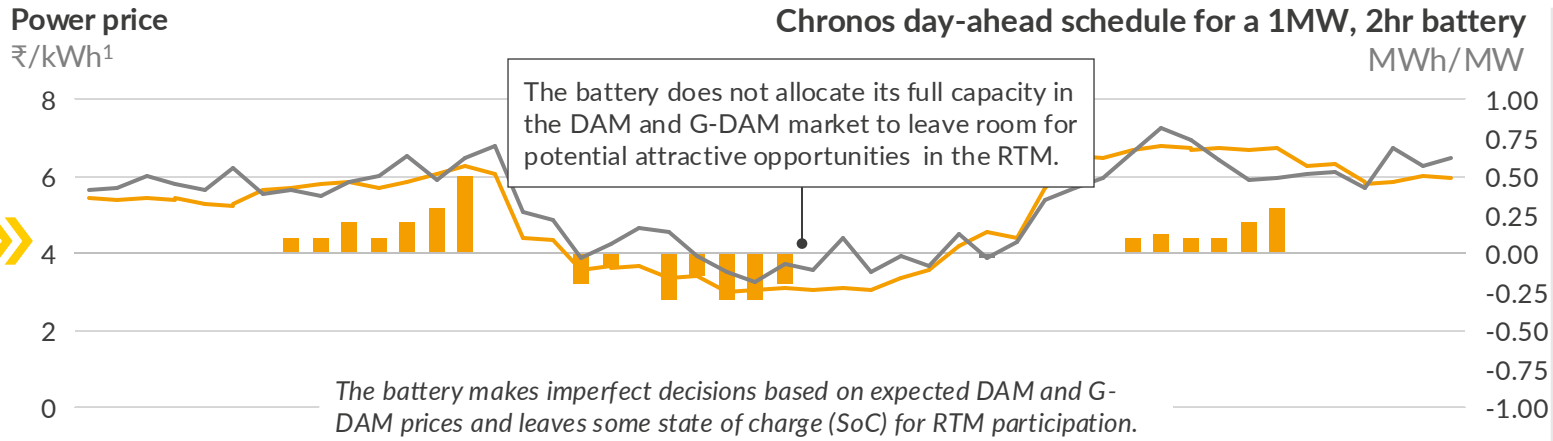
Stage 1: Scheduling phase

INPUT

- AER-ES half-hourly expected Day-Ahead Market price.
- AER-ES half-hourly expected Green Day-Ahead Market price.
- Chronos previous day's end-of-day state of charge.



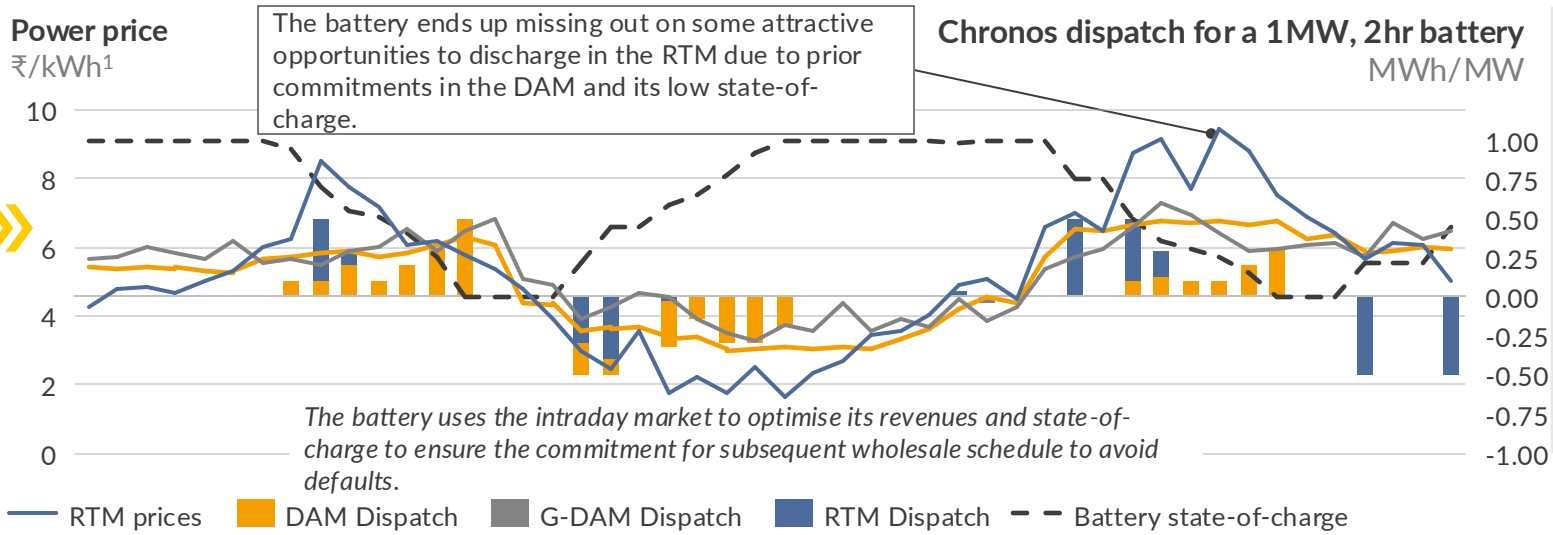
OUTPUT

- Energy schedule for the wholesale, Day-Ahead and Green Day-Ahead Markets.

Stage 2: Dispatch phase

INPUT

- Energy schedule for the wholesale, Day-Ahead and Green Day-Ahead Markets.
- AER-ES half-hourly Real Time Market price.
- Chronos previous day's end-of-day state of charge.



OUTPUT

- Energy revenue settlement for wholesale Day-Ahead, Green Day-Ahead, and Real Time Markets.
- End-of-day state of charge.

Stage 1 begins for the next day

1) Discharging/export actions are shown as positive, while charging/import actions are shown as negative.

Sources: Aurora Energy Research

Case study: In GB, we leveraged our model to identify the optimal sizing of renewables and battery relative to grid connection to optimise project IRR

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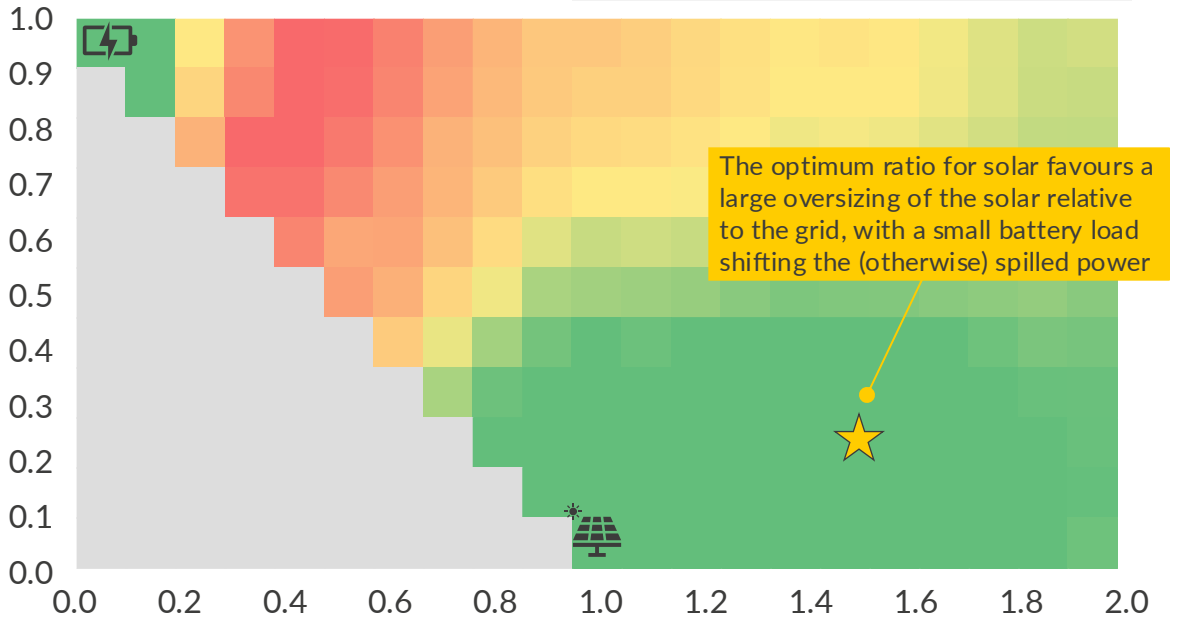
IRR[1], solar PV and 2h battery, 2030 entry

Battery sizing
kW, relative to 1kW grid connection

Optimal sizing ratio
1.5 | 0.2 | 1.0



DC solar PV sizing
kW, relative to 1kW grid connection

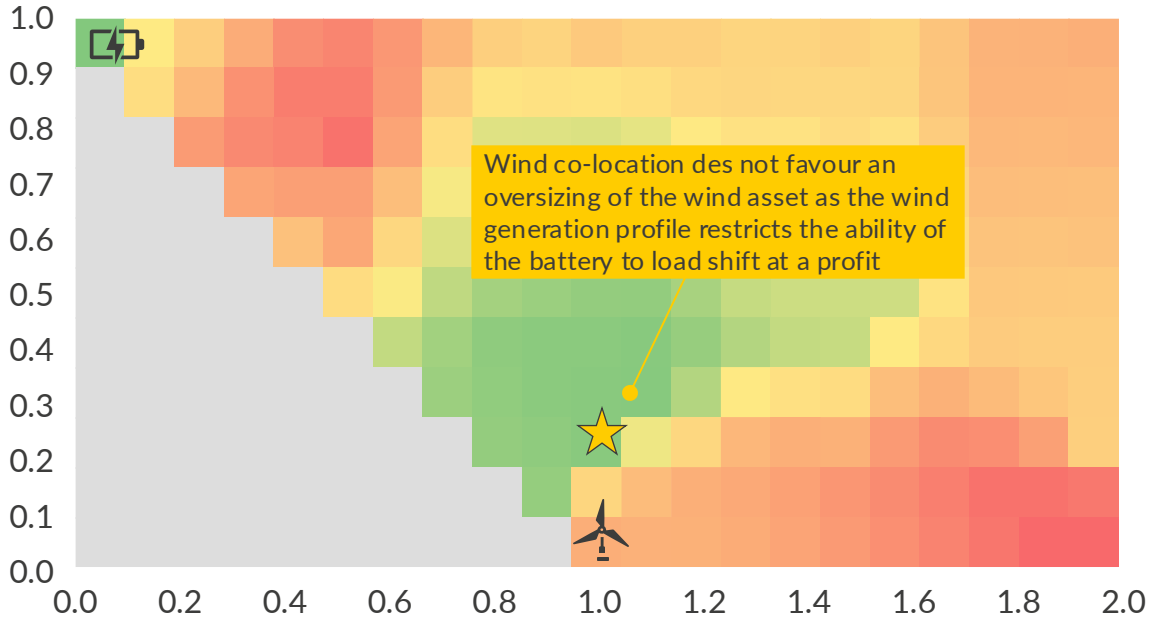
IRR[1] of RES and battery, %
High — Low
Key:

Standalone battery | Standalone solar PV | Standalone wind | Optimal sizing

IRR[1], wind and 2h battery, 2030 entry

Battery sizing
kW, relative to 1kW grid connection

Optimal sizing ratio
1.0 | 0.2 | 1.0



AC wind sizing
kW, relative to 1kW grid connection

IRR[1] of RES and battery, %
High — Low
Key:

1) Assuming 30-year lifetime for renewable asset, and 15 years for the battery with refurbishment after 15 years. Assumes 15-year capacity market contract from year of entry. IRRs shown pre-tax and do not consider any financial costs.

Sources: Aurora Energy Research

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Standalone battery economics

- What are the economics for 2- and 4-hour batteries in different price zones in India?
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Storage will play a critical role in managing the hourly mismatch between supply and demand, driven by the growth in renewables capacity and demand

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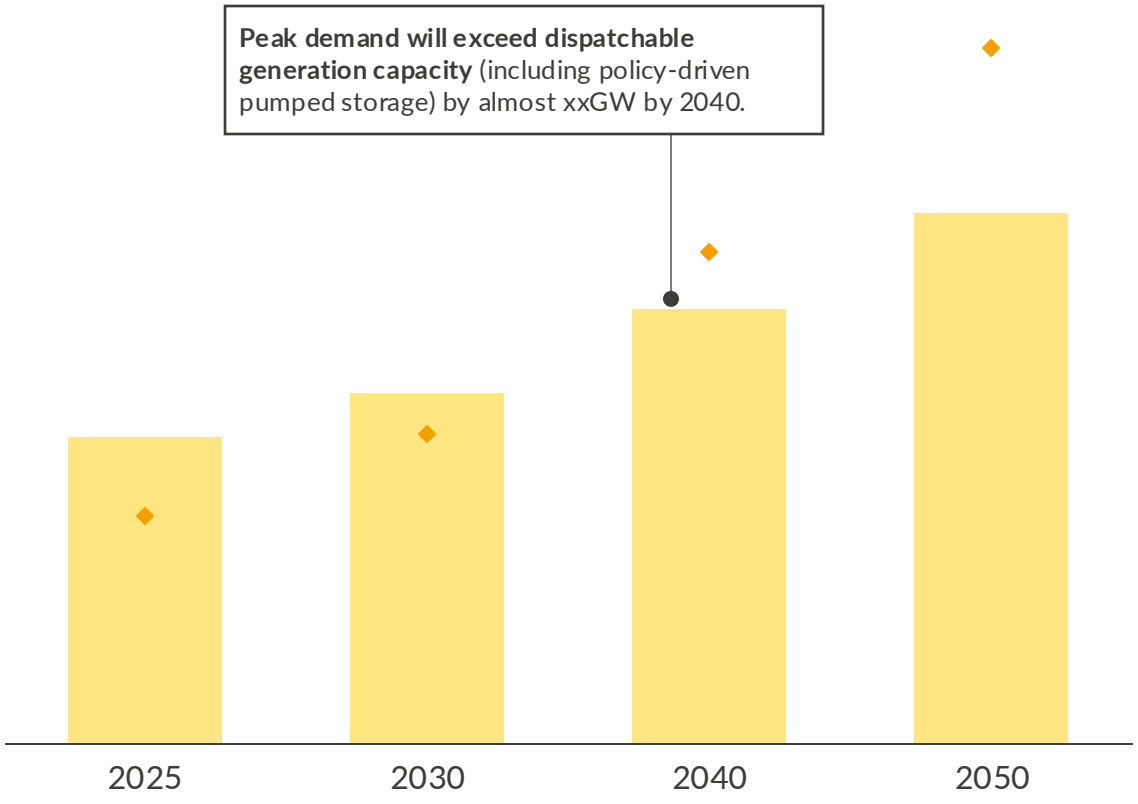
1 Dispatchable generation capacity will lag the growth in rapidly rising peak demand; peak demand will be greater than dispatchable capacity by 2040

Dispatchable generation capacity and peak demand

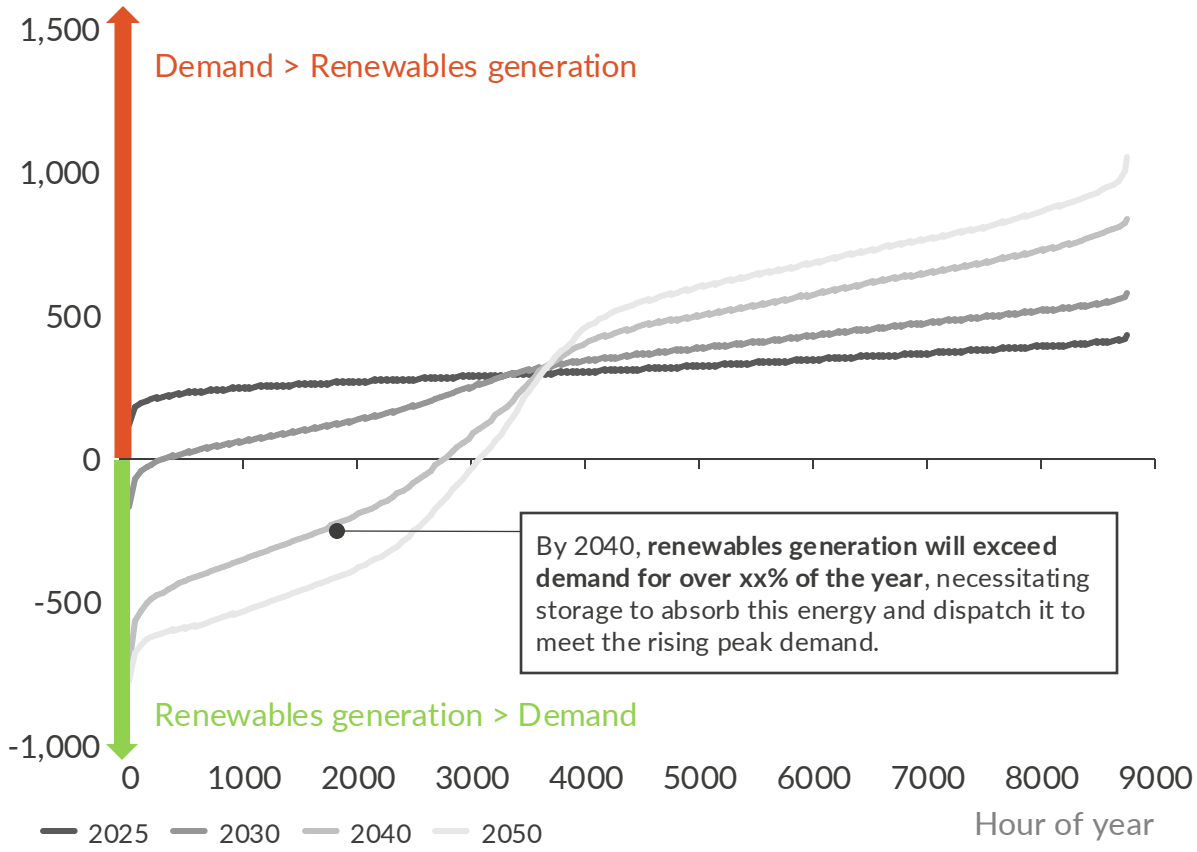
GW



2 Flexibility is critical in integrating the rapidly expanding renewable capacity and bridging the gap between supply and demand

Residual demand[2]

GW



1) Includes nuclear, coal, gas turbines, reservoir hydro and pumped storage; 2) Residual demand is the demand net of renewable technologies like solar PV and wind.

Sources: Aurora Energy Research

2024 saw 4.3GW of standalone BESS tenders, with key trends emerging in terms of project costs, location of projects and business models used

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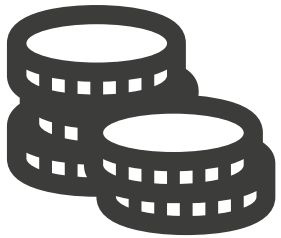
x *Deep dive ahead*

Standalone BESS tender volume

- 4.3GW of standalone BESS tenders were issued in 2024, compared to 0.9GW in 2022 and 2023 combined.
- Upcoming battery tenders aim to procure 4-8 hours of storage, signaling demand for longer-duration solutions.

18% Of the tendered BESS capacity had durations longer than 2-hours[1,2]

1



BESS project costs

- Battery system cost has fallen sharply over the last 2 years driven by decline in Chinese Li-ion cell prices.
- We expect the projects costs to further decline by % over the next five years based on our view of supply chains and regulations.

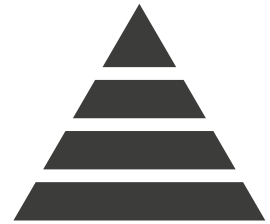
56% decline in price of Li-ion cells in China between 2022 and 2024

Locations of BESS projects

- There is a greater need for BESS assets in regions with higher renewable deployment to aid grid stability and renewable integration.
- States like Gujarat, Maharashtra, and Rajasthan have a greater need for batteries.

80% of standalone BESS capacity tendered in these 3 states[1,2]

2



Business models

- Tenders announced so far have had a variety of business models, ranging from BOO (Build, Own, and Operate), to BOOT (Build, Own, Operate, and Transfer), to EPC (Engineering, Procurement, and Construction).
- Each model offers varying levels of risk-return profiles to developers.

67% of tenders announced in 2024 were under the BOO model[1]

1) Tender cancelled or under appeal are not considered; 2) Tenders open for > 1 year are considered on hold in absence of any notification clarifying status.

Sources: Aurora Energy Research

1 Aurora independently researches all aspects of battery CAPEX both globally and in India

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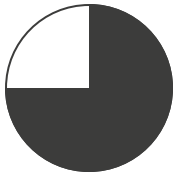
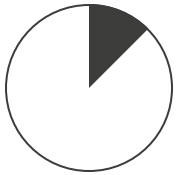
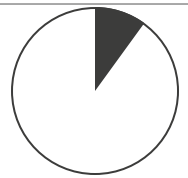
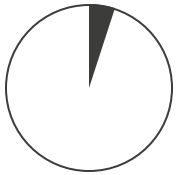
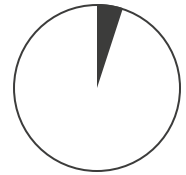
Total Project Cost

Battery system	Electrical and structural BoS[3] hardware	Connection costs	EPC[5] soft costs	Development costs
Containerised[1] battery storage systems include: ▪ **Cells** – anode, cathode, electrolyte, separator. ▪ **Modules** – cells in an external frame for protection. ▪ **Management systems** – regulate safety and operation. ▪ **HVAC[2], fire suppression, racking.**	**External to the battery:** ▪ **Inverters** – convert AC/DC during charging/discharging, a key BoS cost. ▪ **Control & protection** – monitoring systems. ▪ **Electrical BoS** – cabling, MV transformer, auxiliary power. ▪ **Structural** – foundations, fencing.	Electrical connection costs (to distribution or transmission network)[4]: including: ▪ **Design**, cabling, transformers, **substation upgrades**, testing. ▪ Varies by **network type** (transmission vs distribution), **voltage**, region, and **local** infrastructure **needs**	Costs of designing and constructing the site, including: ▪ **Engineering consultants** – electrical engineers, project manager and other specialists. ▪ **Construction labour** – electrical and structural. ▪ Overhead and profits for construction contractors.	Costs involved in development including: ▪ **Project acquisition.** ▪ **Connection and planning** studies. ▪ **Land acquisition** and control. ▪ **Overhead** and **profit.**
Approximate share in total battery CAPEX					
Recent cost trend	↓↓	↓	↔	↔	↔

Deep dive ahead

1) Typically ~40ft containers of ~2 MWh capacity, although they are trending to 20ft containers and higher MWh capacities, and trending to a single DC block (batteries and PCS in same container) to optimise space; 2) Heating, ventilation and air conditioning; 3) Balance of System; 4) Inclusive of all contestable works (can be undertaken by network operator or independent provider) and non-contestable works (can only be undertaken by network operator); 5) Engineering, Procurement and Construction.

Sources: Aurora Energy Research, NREL, O. Schmidt et al, IRENA, STA, ADB, McKinsey and Company

1 Battery system cost has fallen sharply over the last 2 years driven by declining manufacturing costs and increased competition

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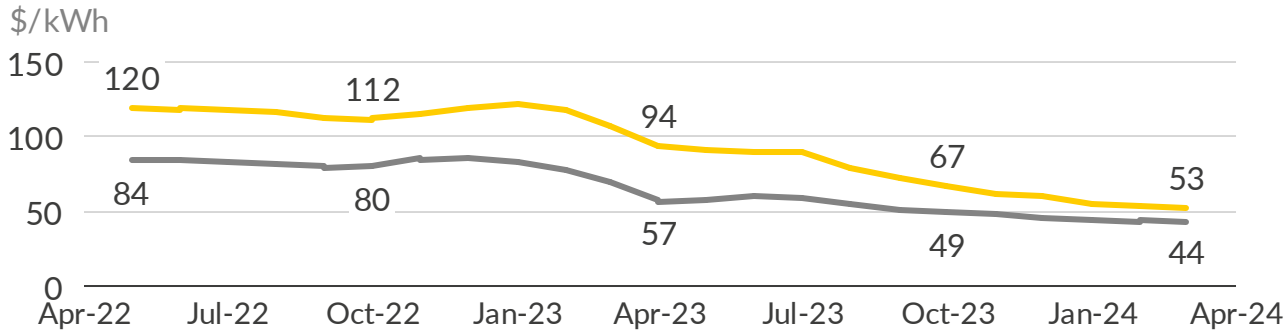
Key drivers of battery system cost

Price of Li-ion cells in China and manufacturing cost



Historical drivers

- Manufacturing costs have declined ~49% since their peak in December 2022 driven by lower Lithium prices and process improvements.
- Producer margins have reduced due to increased competition.

Expected future drivers

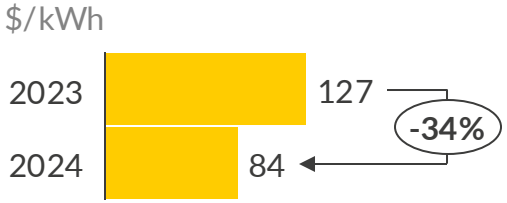
- Trump's tariffs on imports from China is expected to reduce American demand for Chinese cells, leading to oversupply in other markets.
- China's stimulus driven electric vehicle demand growth can lead to increase in demand for Li-ion batteries.

Total container cost

Total landed cost of battery system

Li-ion cells | **Racks and BMS[1]** | **Rest of container** | **Freight and insurance** | **Basic Customs Duty** | **GST**

Total container cost in China



- The FOB[2] price for a battery container in China is around **$70/kWh** before accounting for oversizing.
- Typically, **oversizing of 15-20%** is considered to account for degradation of the battery over its lifecycle.
- Container cost may vary based on the size of the supplier.

Basic Customs Duty

- Currently the Basic Customs Duty for imported batteries is 11-20% based on the HSN codes used.
- The government's focus on localising supply chains could lead to an increase in Basic Customs Duty as domestic manufacturing capacity increases.

Li-ion cell spot price — Cell manufacturing costs

1) Battery Management System; 2) Free-on-board.

Sources: Aurora Energy Research, Bloomberg

1 Our forward view on CAPEX hinges on trends in 6 key factors covering raw material costs, manufacturing costs and import duties

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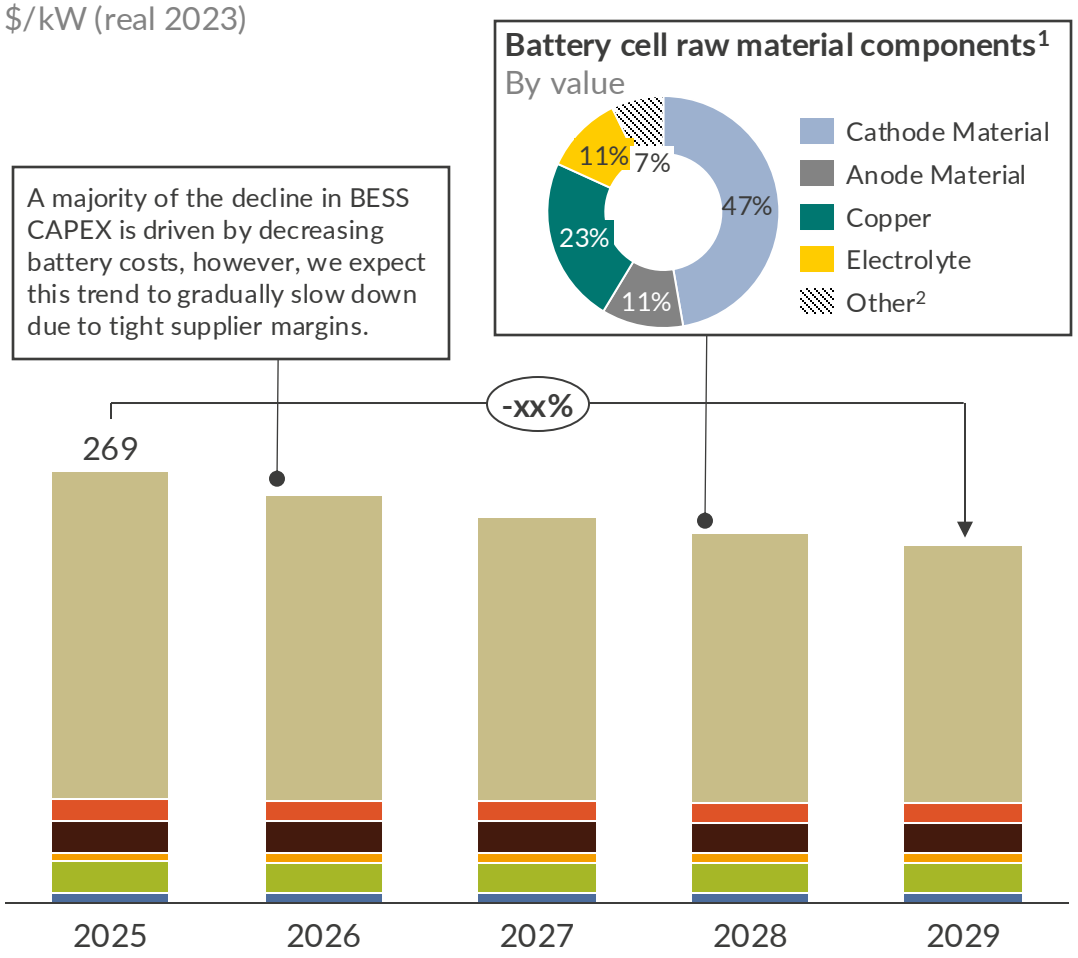
Battery CAPEX costs, 2-hour batteries
$/kW (real 2023)

A majority of the decline in BESS CAPEX is driven by decreasing battery costs, however, we expect this trend to gradually slow down due to tight supplier margins.



Battery cell raw material components[1]
By value

Key drivers	Short-term price expectations[3]		Impacted components
Lithium (cathode) prices	Lithium prices are expected to decline due to persisting overcapacity, decline in demand from the US, and lower than expected EV demand.	↓	Battery system, inverters
Graphite (anode) prices	Graphite prices are expected to decrease due to persisting Chinese overcapacity and development of new capacity outside China to de-risk supply.	↓	Battery system
Manufacturers' overheads	Manufactures are focussed on lowering manufacturing and finance costs through automation, process improvements and vertical integration.	↓	Battery system
Copper prices	Copper prices are expected to decrease due to Chinese real estate deflation and US tariffs reducing export demand.	↓	Battery system, inverters
Aluminium prices	Aluminium prices are expected to remain stable due to the impact of rising alumina prices, and high-capacity utilisation and offsetting impact of reducing American demand due to US tariffs.	↔	Inverters
Basic Customs Duty	Customs Duty on inverters are increased to 20% from 5% in the 2021 Budget. Any increase in Basic Customs Duty to promote domestic battery manufacturing would lead to an increase in landed costs.	↑	Battery system, inverters

1) Illustrative material value split for Lithium-Iron Phosphate (LFP) batteries (dominant technology in most markets). Based on material prices up to September 2024. 2) Other category includes aluminium and other structural materials used to construct battery pack; 3) Price expectations are specific to China as we expect the cell demands in the short-term to be met through imports.
Sources: Aurora Energy Research

2 There are 5 key business models possible for battery deployment in India, today's session focusses on standalone merchant batteries

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Standalone

Government/DISCOM-backed contracts

- Tenders by DISCOMs and Renewable Energy Implementing Agencies (REIAs)[1] to procure BESS capacity.
- The tenders are based on a capacity tolling model
- E.g. Tenders by GUVNL, NTPC.

Aurora's offerings

- Bid advisory support through bespoke site-specific analysis.
- Battery optimal sizing support.

Merchant

- BESS capacity set up to purely trade in wholesale and ancillary markets.
- Main revenue streams are wholesale arbitrage, and ancillary service payments.
- In some markets, capacity payments provide an additional revenue stream.

Aurora's offerings

- Merchant investment cases through Flexible Energy Report.
- Bespoke site-specific valuations.

Focus of today's session

Co-located with renewables

Commercial & Industrial contracts

- Co-located battery storage and renewables PPAs with C&I clients to provide round the clock renewable power or black-start support.
- C&I contracts have fixed payment structure with possible upside from feeding excess energy to grid.

Aurora's offerings

- Bespoke site-specific valuations and PPA fair price evaluation.
- Battery optimal sizing support for contract requirements.

Government/DISCOM-backed contracts

- Tenders by DISCOMs and REIAs[1] to procure co-located battery and renewables or hybrid capacity.
- The tenders provide fixed payments for energy with availability requirements.
- E.g. Tenders by KREDL, SECI.

Aurora's offerings

- Bid advisory support through bespoke site-specific analysis.
- Optimal renewables and storage sizing support.

Merchant

- Co-located capacity set up to purely trade in wholesale and ancillary markets.
- Co-locating assets can enable no-cost charging opportunities for the battery, along with unlocking some CAPEX savings due to shared infrastructure.

Aurora's offerings

- Merchant investment cases through Flexible Energy Report.
- Bespoke site-specific valuations.

Focus of the next session

1) Renewable Energy Implementing Agencies (REIAs) are designated by Ministry Of New and Renewable Energy.

Sources: Aurora Energy Research

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- How do IRRs vary with changing cycling rate and commissioning date?

Through granular analysis, IRRs can be maximised by optimising entry year, duration, and cycling rate

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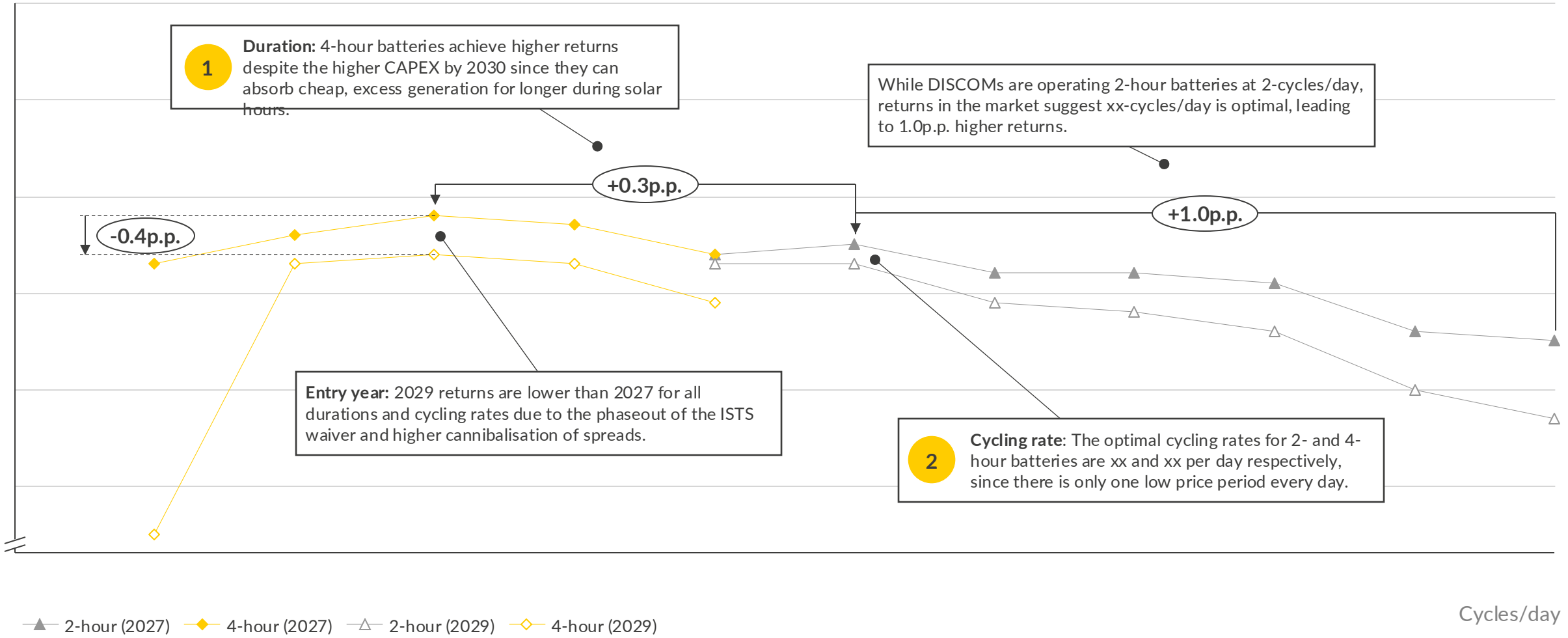
x *Deep dive ahead*

IRRs for 2- and 4-hour batteries commissioning in W2 in 2027 and 2029
% (unlevered, pre-tax, real)



Sources: Aurora Energy Research

1 IRRs for 4-hour batteries commissioning in 2027 are xx p.p. higher than 2-hour batteries as the need for longer duration storage rises with solar deployment

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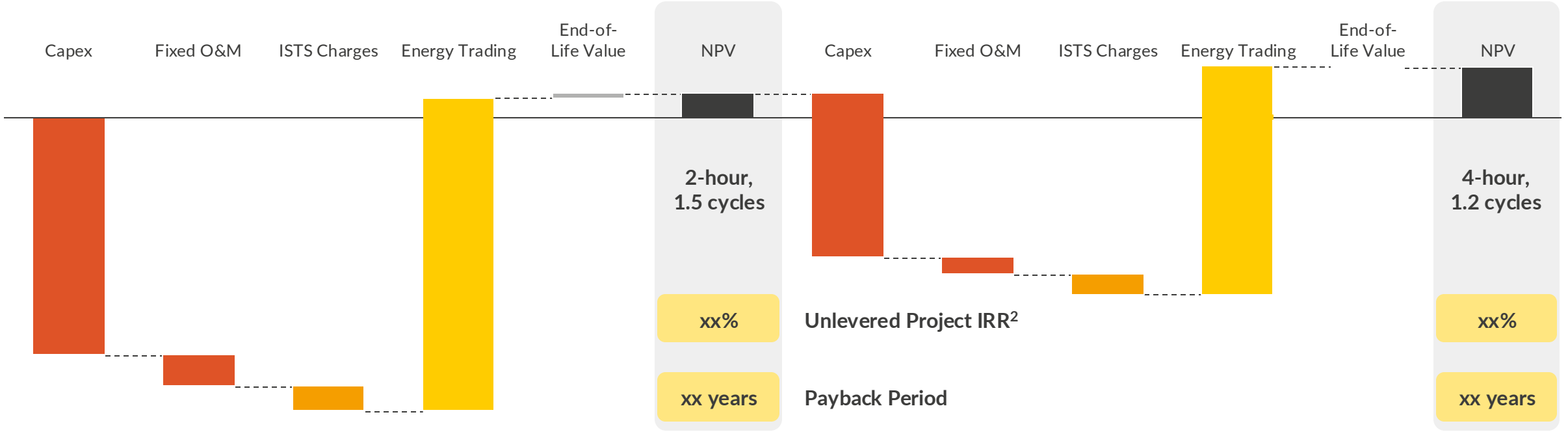
Economics for a new-build BESS asset commissioning in 2027 in W2 (Gujarat or Maharashtra)
Present value[1], ₹/kW (real 2023)



- 4-hour batteries outperform 2-hour batteries as they are more effective in serving system requirements of longer duration storage.
- Batteries with a longer duration are able to charge up more of excess solar generation around mid-day, and discharge over a longer period during the evening peak, resulting in better captured spreads.
- The NPV of costs increases by 67% on increasing the duration from 2-hours to 4-hours, while the NPV of energy trading revenues increases by 73%.

Costs ISTS Charges Energy Trading End-of-Life Value NPV

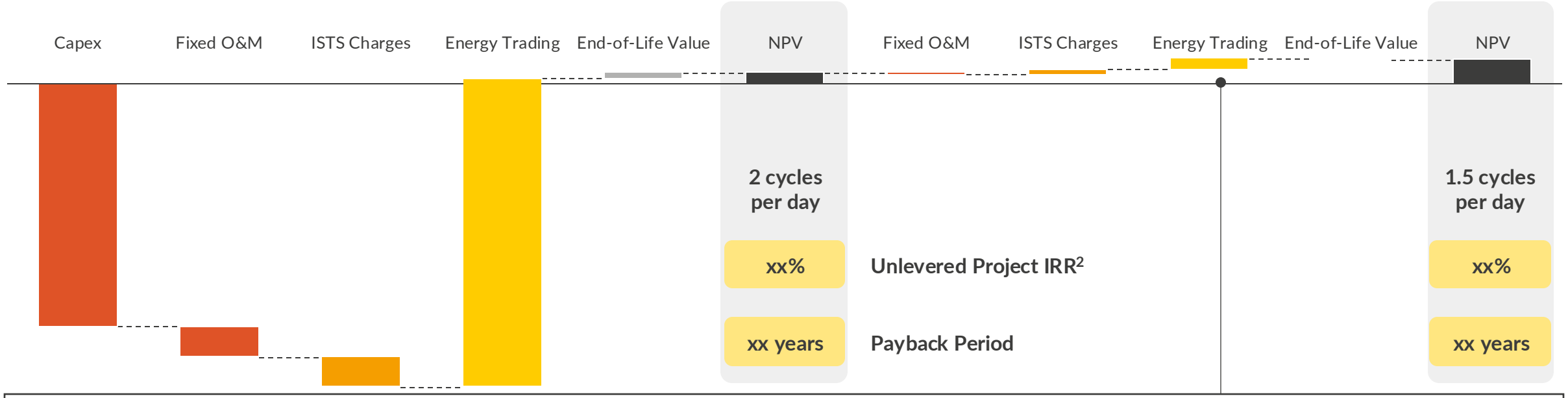
1) Discount rate of 12.5%; 2) Pre-tax, in real terms.

Source: Aurora Energy Research

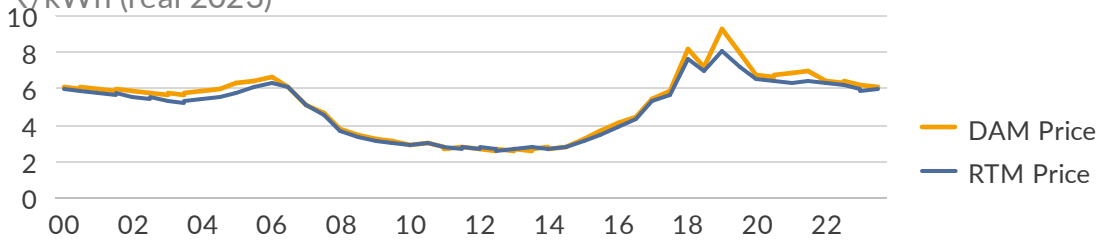
2 The lack of two low-price periods in the daily DAM prices results in 2-hour 1.5-cycle batteries having xx p.p. higher IRRs than 2-hour 2-cycle batteries

AURORA

Economics for a new-build 2-hour BESS asset commissioning in 2027 in W2 (Gujarat or Maharashtra)
Present value[1], ₹/kW (real 2023)



Power price by hour of day for year of entry (2027)
₹/kWh (real 2023)



- Standalone 2-hour battery economics improve on decreasing the number of cycles per day from 2 to 1.5 due to increased energy trading returns.
- The intraday shape of power prices has a pronounced duck curve, with lower prices in the middle of the day and higher prices in the morning and evening.
- As a result of this shape, the battery finds it difficult to complete 2 cycles in a day.

Costs | ISTS Charges | Energy Trading | End-of-Life Value | NPV

1) Discount rate of 12.5%; 2) Pre-tax, in real terms.

Source: Aurora Energy Research

Rajasthan (N2) and Gujarat (W2) offer the highest returns for standalone BESS projects as solar deployment drives RTM volatility higher

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Battery project financials by COD and duration

Entry year	Scenario	Duration	Cycles per day	Project IRR[2] (%)		
				N2	*W2*	*S1*
2027	Central	2-hour	2 cycles			
2029	Central	2-hour	2 cycles			
2027	Central	2-hour	1.5 cycles			
2029	Central	2-hour	1.5 cycles			
2027	Central	4-hour	1 cycle			
2029	Central	4-hour	1 cycle			
2027	Central	4-hour	1.2 cycles			
2029	Central	4-hour	1.2 cycles			

1) Discount rate of 12.5%; 2) Pre-tax, in real terms.

Sources: Aurora Energy Research

Upcoming power market reforms like the introduction of market-based procurement of ancillary services should improve battery economics

AURORA

x *Deep dive ahead*

Policies affecting the economics of battery storage in India

	Policy	Description	Impact on BESS economics
	Market procurement of ancillary services	In 2023, CERC allowed market-based procurement for Tertiary Reserve Ancillary Services through the power exchanges, with plans to introduce Secondary Reserve on the exchanges in the near future.	●
	Resource adequacy planning	In 2023, the Ministry of Power issued "Resource Adequacy Guidelines" to ensure State DISCOMs procure capacity to ensure security of supply. Resource Adequacy mandates can increase BESS procurement through tenders.	●
	Energy Storage Obligations (ESOs)	Energy Storage Obligations mandate that a minimum share of electricity be procured from renewable energy through storage. ESOs incentivise DISCOMs and Open Access C&I customers to contract battery capacity.	●
1	DAM price cap	The power exchanges have a price cap of **₹10/kWh in the DAM[1] and RTM,** and **₹20/kWh in the HP-DAM.** The price caps limit arbitrage opportunities for batteries, reducing their gross margins.	●
	ISTS waivers	The ISTS waiver is expected to be gradually phased out for projects commissioned post-June 2025, which will reduce project competitiveness.	●
	Viability Gap Funding[4]	Viability Gap Funding provides financial support of up to 40% of the capital cost for BESS projects which provide at least 85% of their capacity to DISCOMs, reducing the capital investments for developers.	●
	Advisory for co-locating ESS with solar power projects	The CEA has advised to incorporate a **minimum of 2 hours of co-located ESS**, equivalent to 10% of installed solar project capacities, in future solar tenders. Distribution licensees have been advised to consider 2-hour storage mandates for rooftop solar. Increase in co-located ESS can reduce price spreads with negative impact on arbitrage.	●
	Domestic manufacturing mandates for BESS[5]	Potential mandates to source cells locally for BESS assets could lead to project delays or increased costs due to low domestic manufacturing capacity.	●

Impact on BESS economics ● Positive ● Negative

1) Day Ahead Market; 2) High Price – Day Ahead Market; 3) Interstate Transmission System; 4) The selection of BESS developers for Viability Gap Funding grants is mandated to be carried out through a competitive bidding process; 5) Domestic manufacturing mandates for BESS have not been introduced yet.

Sources: Aurora Energy Research, CERC, Ministry of Power

1 Sensitivity analysis: The price cap leads to xx p.p. decrease in returns for a 2-hour 2-cycle battery commissioning in W2 in 2027

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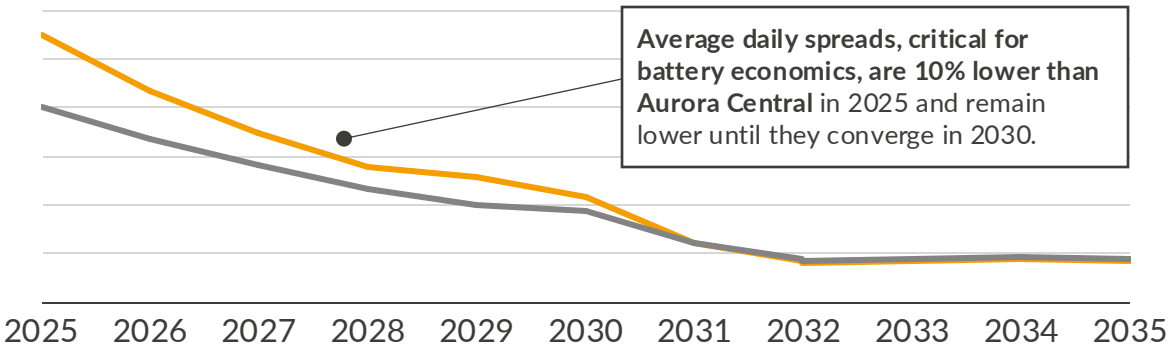
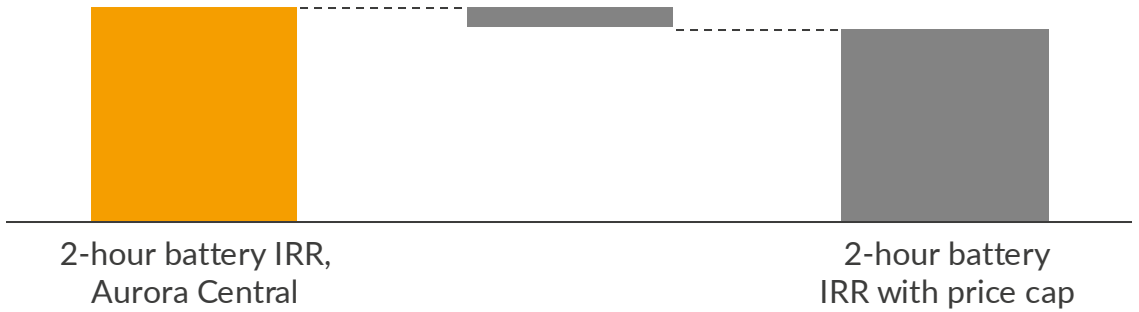
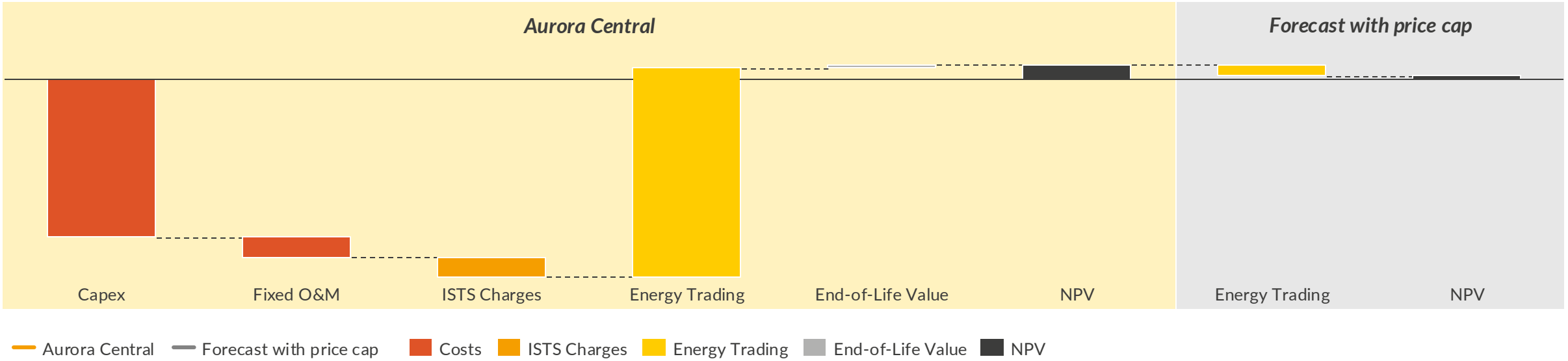
Average daily spread with price cap, relative to Aurora Central
₹/kWh (real 2023)



BESS IRRs[1] in W2 with price cap, relative to Aurora Central
%



Present value of cashflows for a 2-hour, 2 cycle BESS asset in W2
₹/kW (real 2023)



1) Pre-tax, unlevered, in real terms.

Sources: Aurora Energy Research

Key takeaways

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Global experiences show that batteries typically rely on stacking revenue streams from a number of markets; ancillary markets can be an attractive source of revenue in the initial years of the project.

Most markets see some form of contracted long-term revenues, e.g. tolling agreements or capacity markets, forming a part of the revenue stack, unlocking debt financing for batteries and lowering the cost of capital; allowing access to merchant upside for equity.

Batteries participating in DISCOM tenders may have a lower cost of capital, but they also secure far lower returns: a battery securing a GUVNL Phase IV tender would achieve an unlevered IRR[1] of xx%, whereas a similar merchant asset could have achieved xx%.

4-hour batteries achieve higher returns than 2-hour batteries as they are able to discharge over longer durations during the evening and morning price peaks; 4-hour batteries operating at xx cycles per day achieve the highest unlevered IRR[1].

The government has a key role to play in enabling the deployment of batteries in India – reforms like allowing batteries to participate in Secondary Reserve will help, certainty around the wholesale price caps will play a key role in unlocking investment.

1) Pre-tax, real.

Indian Power & Renewables Subscription Service:

Key market analyses and forecasts for all participants in the Indian power market

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Quarterly Data and Market Reports:

- **All the latest trends and forecasts-** recent developments, full policy and technology outlook
- **Key market outcomes to 2060**- Capacity, Generation, DAM price outlook modelled at 30-min granularity for each of 13 zones
- **Regional and technological detail-** prices and generation by zone
- **Scenario analyses-** 3-5 consistent scenarios with key sensitives
- **Investment case analyses-** cost and revenue streams under different scenarios
- **Data in excel-** all forecast data easily downloadable in Excel format
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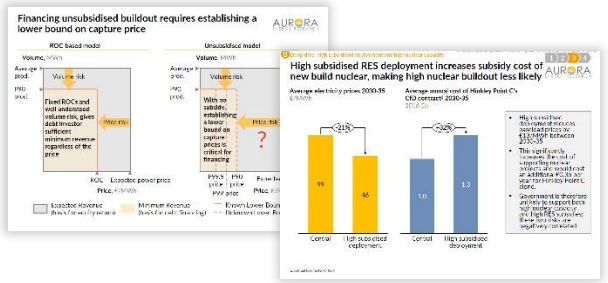
Quarterly Strategic Insight Reports and Group Meetings:

- **In-depth thematic reports on topical issues for the power, renewable & storage industry**
- **Four client roundtable workshops in Delhi/ Mumbai per year to network and discuss hot topics**
- **Topics based on client demand, e.g.**
  - **Battery investment cases**
  - **Complex peak shaped/ FDRE tender optimization**
  - **C&I – novel structuring, data centers**
  - **Grid curtailment**



Regular interaction through Workshops and bilateral support:

- **Bilateral workshops** to discuss specific issues on the market that are of particular interest to you.
- **Ongoing support** from our experts to address any questions about Aurora's forecasts or the market more broadly – helps your team save time by speaking with one of our experts.
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All Intelligence for a successful business, based on bankable forecasts

Source: Aurora Energy Research

Details and disclaimer

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