

India's Curtailment Paradox

Can Storage Turn Solar Surplus into Bankable Flexibility?



AI-generated editorial illustration prepared for Firstgreen; not a photograph of a specific project.

India's renewable-power challenge is entering a new phase. The system can have excess solar electricity during the day and still face deficits after sunset. In August 2026, the source snapshot used for this analysis reported 668 MU of renewable curtailment, including 523 MU of solar. Yet demand and non-solar-hour stress remained high. The apparent contradiction is really a question of timing, location and flexibility. Storage can help - but only where curtailed electricity is physically accessible, contractually usable and worth enough when discharged to recover the battery's lifecycle cost.

*“The grid does not necessarily have an energy shortage.
It has a time-and-location mismatch.”*

668 MU

Renewable curtailment

August 2026 source snapshot.

78.3%

Solar share of curtailment

523 MU of the 668 MU total.

3.27×

Reported price ratio

INR 5.30 non-solar vs INR 1.62 solar.

What this means

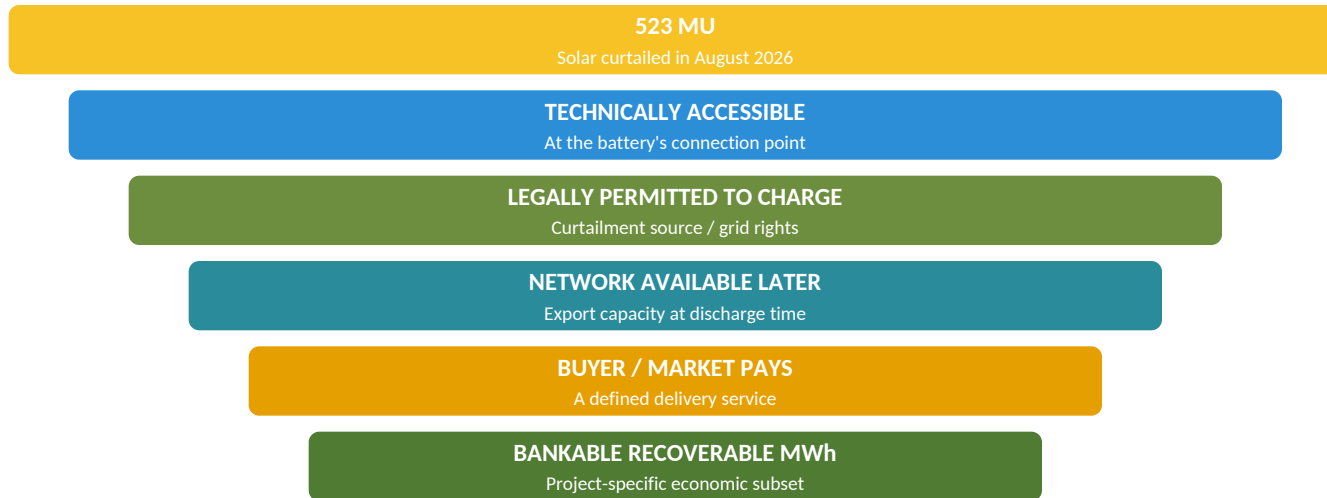
Annual energy can be abundant while flexibility remains scarce. The investment case depends on whether curtailed energy can be shifted into a paid later-hour service.

A more flexible grid can turn today's curtailment into tomorrow's cleaner, more reliable power.

Which Curtailed MWh Can Actually Be Stored?

From theoretical curtailment to bankable recoverable energy.

EXHIBIT 01 | From curtailed solar to bankable recoverable energy



AI-generated editorial illustration: storage can shift energy in time, but it cannot remove every network constraint.

Why geography and grid topology matter

- Curtailment is location-specific and varies by state, grid node and connection point.
- A battery cannot recover energy that was never generated or that is unavailable behind another constraint.
- The economically optimal storage level may be far below 100% curtailment recovery.

EXHIBIT 02 | Indicative 4-hour storage scale at different recovery levels

25%
3,712 MWh

928 MW @ 4h

50%
7,423 MWh

1,856 MW @ 4h

75%
11,135 MWh

2,784 MW @ 4h

100%
14,846 MWh

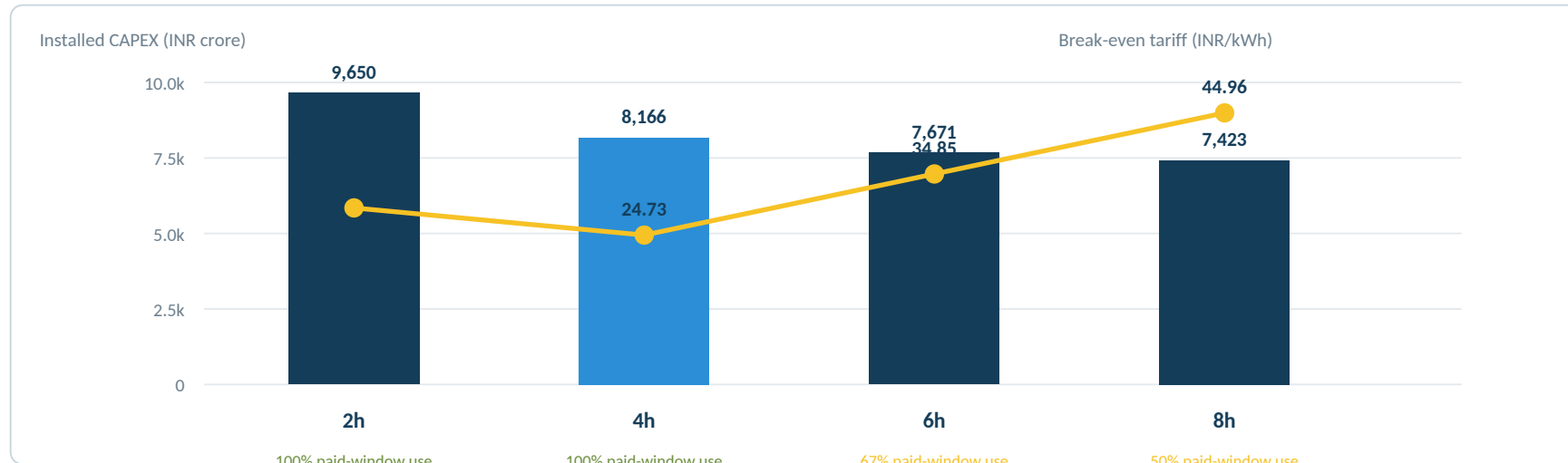
3,712 MW @ 4h

Not every curtailed MWh can be stored - only a subset is technically, contractually and commercially recoverable.

How Many Battery Hours Does the Contract Actually Need?

A six-hour battery is not automatically worth more than a four-hour battery.

EXHIBIT 03 | Break-even tariff, installed CAPEX and paid-window utilisation by duration



AI-generated editorial illustration of utility-scale BESS at sunset.

Duration is not value

A longer battery creates value only if there is a paid service window, market spread or reliability requirement that uses the additional hours.

Investment implication

In the base Firstgreen screen, four hours has the lowest break-even tariff because it matches the four-hour paid delivery window. Two hours carries higher power-related CAPEX. Six and eight hours reduce MW equipment but leave part of the stored energy outside the paid window, lowering utilisation. The result does not establish a universal four-hour optimum: multiple cycles, ancillary services, grid charging or a different delivery block can change the economics.

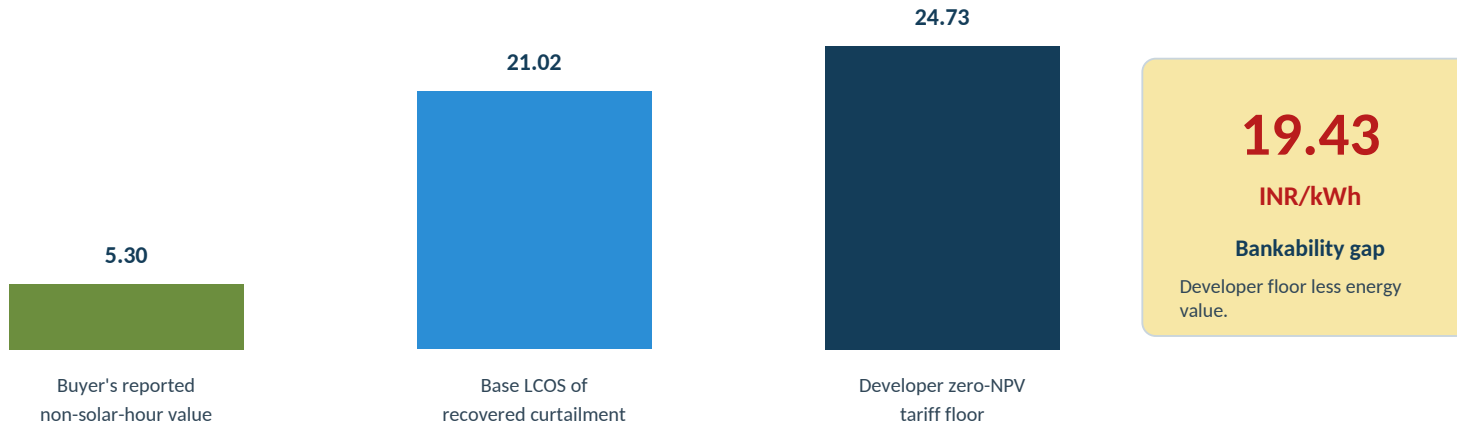
The lowest-cost storage is the duration that matches a clearly defined system need.

The Storage Cost Is Higher Than the Energy Value

Curtailment recovery is one revenue stream - not a complete storage business model.

In the base scenario, the levelised cost of recovered curtailment is materially higher than the reported non-solar-hour energy value. This does not mean storage has no system value; it means curtailment recovery alone cannot carry the asset. Merchant arbitrage, ancillary services, capacity payments, firm-delivery contracts, lower battery costs or higher utilisation are needed to close the bankability gap.

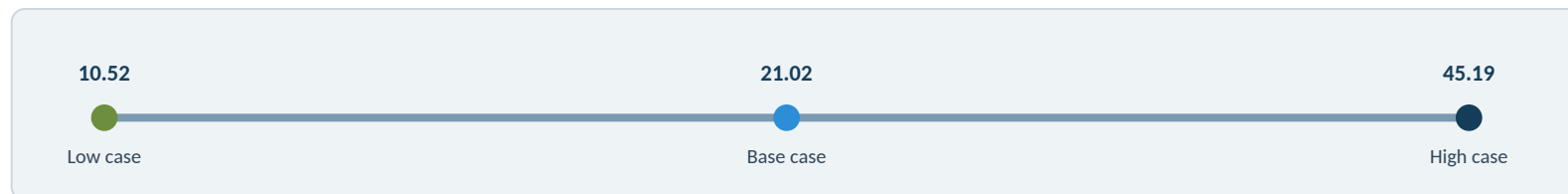
EXHIBIT 04 | Buyer value versus developer cost - base case



Three ways to close the gap

- Lower battery cost**
Technology, scale, localisation and lower financing cost.
- Higher utilisation**
Arbitrage, ancillary services, capacity or firm-delivery revenue.
- Capacity / firmness payment**
Explicit payment for reliability and system flexibility.

EXHIBIT 05 | LCOS range (INR/kWh)



Why the range is wide

LCOS is highly sensitive to installed cost, round-trip efficiency, stressed-day utilisation, availability and financing. These are scenario outputs - not market forecasts.

The storage investment case improves when multiple value streams are combined - but double counting must be avoided.

The Battery Becomes Bankable in the Contract

Clear rights, risks and payment structures turn technical potential into financeable flexibility.

The commercial value of storage depends as much on the PPA as on the technology. From the first curtailed MWh to final settlement, the contract must define who may charge, who bears degradation and forecast risk, what counts as an excusable grid event, and how the service is paid.

EXHIBIT 06 | From curtailment to settlement - key PPA questions

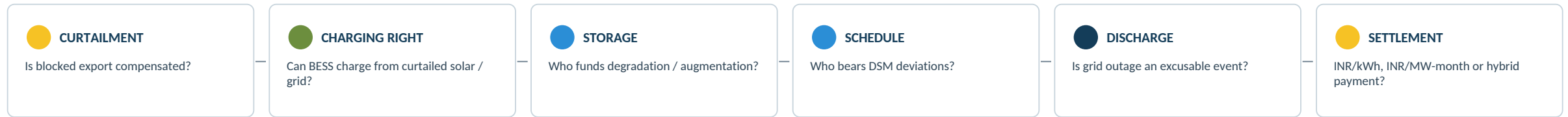


EXHIBIT 07 | Illustrative risk allocation and tariff impact

Risk	Typical owner	Illustrative tariff impact
Curtailment uncompensated	Seller	0.10-0.15 INR/kWh
Charging-energy price risk	Seller	0.10-0.20 INR/kWh
Grid outage at discharge	Buyer / Shared	0.05-0.15 INR/kWh
Battery degradation	Seller	0.08-0.12 INR/kWh
Forecast error / DSM	Seller	0.05-0.10 INR/kWh
Availability penalties	Seller	0.05-0.10 INR/kWh
Change in law / regulatory	Shared	0.03-0.10 INR/kWh

Why the PPA is critical

A well-designed contract can convert curtailed energy into a financeable revenue stream by providing charging rights, clear curtailment treatment, settlement rules and availability obligations. Without a bankable contract, even technically valuable storage projects can remain uneconomic.

FIRSTGREEN SCENARIO

Quantified risk reserve: INR 0.675/kWh

Storage becomes investable when contracts, markets and grid operations work together.

From Curtailed Energy to Bankable Flexibility

A more resilient, affordable and cleaner power system is within reach.

India does not need to store every curtailed MWh. The objective should be to identify the subset of curtailed renewable electricity that can be economically shifted into a paid system need. That requires better 15-minute curtailment data, connection-level analysis, storage rights, transmission access and commercial contracts that reward timing and availability. Storage should therefore be evaluated alongside transmission, flexible demand, thermal flexibility and improved scheduling - not as a standalone cure for renewable curtailment.



AI-generated editorial illustration of utility-scale battery storage at sunset.

“The next flexibility market should pay for when electricity is available - not only how much is generated.”

A more flexible future



Better data

15-minute, location-specific curtailment and price signals



Integrated planning

Storage, transmission, demand and thermal flexibility



Bankable contracts

Clear rights, risks and payment mechanisms

About Firstgreen

First Green Consulting Private Limited is a renewable-energy and sustainability advisory firm working across solar, battery energy storage, power-market analysis, project design, commercial structuring and digital-energy solutions. Our work supports developers, utilities, C&I consumers and investors across the renewable-energy project lifecycle - from feasibility and system design through commercial analysis, performance optimisation and digital operations.

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Selected capabilities

- Solar & BESS Advisory - feasibility, DPRs, design optimisation, storage sizing
- Power Markets & Commercial Strategy - PPA structuring, open access, RTC / FDRE, merchant and C&I analysis
- Digital Energy & TwinPro - SCADA integration, asset digitalisation, performance analytics, digital twins
- Sustainability Advisory - LEED, IGBC, TRUE, energy and carbon strategy

The next flexibility market should pay for timing, availability and reliability - not only annual energy.