FDRE in India 2026: Sizing, Curtailment Risk and Bankable Hybrid Design

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A practitioner guide to FDRE in India 2026: hybrid sizing, delivered tariff maths, curtailment, storage economics and bankable design.

India's FDRE market in 2026 is no longer about proving that hybrid renewable energy can win bids. That has already happened. The harder question now is whether a given FDRE configuration can deliver contracted power reliably across seasons, manage curtailment and transmission constraints, and still remain financeable after accounting for storage degradation, auxiliary losses, and mismatch between P50 modelling and actual dispatch conditions.

For developers, the challenge is to avoid under-sizing storage and over-promising firmness. For C&I buyers and utilities, the challenge is to read through headline tariffs and test whether the project design can sustain delivery obligations through monsoon variability, low-wind windows, and grid back-down events. For lenders, FDRE underwriting in 2026 requires a more granular view of plant design, scheduling philosophy, and downside cases than a standard standalone solar or wind project.

This article looks at FDRE from a bankability and design perspective, with a focus on tariff formation, sizing logic, curtailment risk, and practical structuring choices in India.

What FDRE means in India in 2026

FDRE, or firm and dispatchable renewable energy, typically refers to renewable power supply that is shaped to meet a predefined delivery profile with tighter availability commitments than conventional plain-vanilla solar or wind PPAs. In Indian tenders, FDRE structures generally combine solar, wind and BESS, though some variants use hydro balancing or external procurement flexibility.

Unlike vanilla RTC structures, FDRE contracts usually define specific time blocks, annual or monthly availability thresholds, and penalties linked to under-supply against schedule. In practical terms, this means project economics depend not only on annual generation, but on when generation occurs, how much can be shifted, and how often the asset portfolio must protect itself against deficits through storage discharge or market purchases.

By 2026, key market drivers include:

- SECI and state-level hybrid procurement structures that favour shaped renewable supply
- Improved transmission planning under the Green Energy Corridor framework, though congestion remains material in high-buildout states
- Falling battery system costs relative to 2023-24 levels, but still high enough that every incremental hour of storage must justify itself
- Tighter lender scrutiny on resource correlation, curtailment assumptions, and guaranteed delivery profiles
- Growing utility preference for dispatchable clean power blocks rather than pure CUF-maximised generation

A developer can no longer treat storage as an add-on. In FDRE, storage is part of the core production architecture.

The sizing problem: solar, wind and battery must be optimised together

The single biggest error in FDRE development is starting with a tariff target and then reverse-fitting storage. A bankable approach starts with the delivery profile and stress-tests the resource stack required to meet it.

In India 2026, many viable FDRE projects are using solar-to-wind AC capacity ratios in the range of 1:0.8 to 1:1.5 depending on site quality, evacuation access, and the target delivery block. Battery duration often lands in the 2 to 4 hour range for most tender-driven designs, though some high-firmness structures need more storage-equivalent flexibility when wind seasonality is weak or when the delivery obligation extends deep into evening and early morning blocks.

A practical sizing workflow usually asks the following questions in order:

- What is the contracted hourly or block-wise delivery obligation?
- What is the allowed annual and monthly deviation band?
- How correlated are the wind and solar resources at the chosen site pair?
- What is the expected monsoon contribution from wind, and how reliable is it in weak years?
- How much storage cycling is required in a P50 year and in a P90 downside case?
- What proportion of deficits would need market purchases if storage is exhausted?
- How much clipping or surplus generation is economically acceptable?

In many Indian hybrid cases, the least-cost design is not the one with the highest annual renewable generation. It is the one that minimises the cost of delivered compliant energy after considering battery round-trip losses, degradation, curtailment, and penalty exposure.

For example, a 250 MW FDRE obligation may appear supportable with a high-solar configuration and a 2-hour battery if modelled on average-year conditions. But once low-radiation monsoon days, weak evening wind, and transmission back-down assumptions are applied, the storage system may need to cycle more aggressively, causing faster degradation and greater replacement capex risk. In some cases, adding more wind capacity rather than more battery duration improves lifecycle economics. In others, oversizing solar is cheaper than procuring additional night-time market energy. The answer is always site- and contract-specific.

Delivered tariff maths is driven by utilisation, not just capex

Headline FDRE tariffs are often discussed as if they are just a weighted average of solar, wind and battery capex. That is misleading. The real tariff is a function of delivered MWh under the contract rules.

The main cost blocks in 2026 typically include:

- Solar capex, often around Rs 3.2-4.0 crore/MW depending on module selection, tracker design, BOS scope and location
- Wind capex, often around Rs 6.2-7.5 crore/MW depending on turbine rating, hub height, logistics and state
- Utility-scale BESS capex, often around Rs 2.2-3.2 crore/MWh installed for AC-integrated systems depending on chemistry, augmentation plan, PCS architecture and balance of plant
- Interconnection and transmission infrastructure including pooling, bay extension, and dedicated line costs
- Land and enabling infrastructure
- O&M, inverter and PCS replacement, battery augmentation, insurance and working capital

- Cost of market purchases in deficit intervals, if allowed under the contract structure

The more important variables, however, are these:

- Battery throughput per year
- Effective round-trip efficiency at actual operating conditions
- Curtailment incidence during high-generation hours
- Renewable surplus that cannot be monetised
- Number of shortage intervals avoided due to higher storage or better wind complementarity
- Degradation-adjusted delivery over the PPA term

If a project uses a 2-hour BESS but requires frequent double-cycling in some seasons, the levelised cost of useful shifted energy can rise sharply. Similarly, if a project relies on high daytime solar overbuild but faces grid back-down during those same hours, the apparent advantage of cheaper solar capex erodes.

For many 2026 FDRE bid cases, a difference of just 2-3 percentage points in annual compliant delivery ratio can determine whether equity returns remain acceptable. This is why developers increasingly use hourly and sub-hourly simulations over 15-25 year periods with degradation and augmentation logic, rather than simple annual energy balancing.

Curtailment and transmission risk are now central to bankability

Curtailment can no longer be treated as a generic downside assumption. In FDRE, curtailment changes the physics of delivery.

There are at least four distinct curtailment channels that matter:

- Grid congestion at state or ISTS evacuation nodes
- Local substation or line constraints during simultaneous high injection
- System operator back-down instructions during low demand or security events
- Internal curtailment caused by DC/AC mismatch, battery charging limits, or co-located evacuation bottlenecks

A solar-plus-wind-plus-BESS project may have attractive annual generation on paper, but if the site experiences repeated evacuation stress during peak solar hours, the battery may not fully charge on days when it is most needed. That then affects evening delivery reliability. In other words, curtailment upstream becomes firmness risk downstream.

From a lender's perspective in 2026, the following diligence points are critical:

- Node-specific transmission readiness and historical congestion pattern
- Queue position and evacuation sharing assumptions
- State-level curtailment behaviour and compensation enforceability under the PPA
- Accuracy of loss assumptions from plant to delivery point
- Charging priority logic between merchant surplus and contractual firmness obligations
- Battery augmentation schedule and whether that capex is fully funded in the base case

Developers should also distinguish between must-run assumptions and actual realized dispatch conditions. While renewable projects benefit from policy support, practical grid operation often depends on local network realities. A model that assumes negligible curtailment in a saturated renewable corridor is not financeable.

Contract design can make or break an FDRE project

Two projects with similar hardware can have very different risk profiles based on contract structure. Buyers and developers should focus on clauses that directly affect operational flexibility and downside cash flow.

The most material provisions usually include:

- Definition of firmness and allowable annual/monthly/hourly deviation
- Treatment of force majeure versus resource shortfall
- Penalty formula for under-delivery and any cap on liquidated damages
- Settlement basis: scheduled energy, delivered energy, or netted energy after losses
- Permission to procure balancing energy from market sources
- Curtailment compensation and deemed generation provisions
- Change-in-law treatment for charges, transmission, scheduling and market participation
- Forecasting and scheduling responsibility allocation

Some FDRE structures are effectively pure generation commitments with stiff downside risk. Others allow enough market procurement flexibility to protect delivery compliance, though that introduces open-market price risk. If the contract permits balancing through exchange purchases, then the economics must include realistic peak-period purchase prices, not annual average market rates.

In 2026, this has become particularly relevant as evening scarcity pricing and ancillary-linked volatility can widen sharply during stressed periods. A project that depends on frequent external purchases to maintain firmness may clear a bid, but it may not remain profitable.

What lenders and investors are asking in 2026

Credit committees are asking more sophisticated questions on FDRE than they did even 18 months ago. The due-diligence standard is converging toward a hybrid of renewable project finance and flexible-capacity underwriting.

Typical lender concerns include:

- Is the wind-solar resource complementarity based on concurrent long-term data sets or stitched averages?
- What share of contracted delivery comes from stored energy versus direct generation?
- How sensitive is DSCR to one weak wind season or one year of elevated curtailment?
- Does the battery warranty align with the dispatch strategy assumed in the base case?
- Are augmentation reserves included, and who bears technology replacement risk?
- What happens if auxiliary consumption or round-trip losses are higher than modelled?
- Is the O&M strategy able to sustain high dispatch availability across three technologies instead of one?

For equity investors, the main issue is often not whether the asset can technically deliver, but whether it can do so without consuming hidden lifecycle costs. A tariff that appears competitive at financial close can become thin if augmentation, PCS replacement, and balancing purchases are underestimated.

This is where independent modelling, dispatch simulation, and contract-risk review are essential. FDRE is not a standard solar project with a battery attached. It is a complex supply product.

How developers and offtakers should evaluate FDRE opportunities now

For developers, three disciplines matter most in 2026:

- Build the sizing case from delivery obligations, not from capex comfort zones
- Use downside-year dispatch simulations with realistic curtailment and degradation assumptions
- Align battery warranties, augmentation schedules and financing structure with actual cycling needs

For utilities and C&I buyers, the evaluation should go beyond quoted tariff:

- Check monthly and seasonal firmness, not only annual delivery claims
- Test whether the project can withstand low-resource windows without excessive market purchases
- Review interconnection strength, scheduling approach and loss allocation
- Understand whether surplus energy has value or simply masks an inefficient design

For policymakers, the next improvement area is standardisation. Clearer templates for firmness definitions, deviation treatment, curtailment compensation, and balancing-energy rules would reduce avoidable pricing noise and support healthier competition.

India’s FDRE market is strategically important because it can bridge the gap between variable renewable buildout and the system’s growing need for predictable clean power. But that value will only be realised if projects are sized and contracted around real operating conditions rather than idealized annual averages.

The winning FDRE projects in 2026 will not necessarily be the cheapest on headline tariff. They will be the ones that combine realistic renewable complementarity, prudent storage sizing, robust evacuation planning, and contract structures that remain resilient under weak-resource and high-curtailment conditions.

If you are evaluating an FDRE bid, hybrid portfolio, or financing case, contact Growthifye’s advisory desk for project-specific support on sizing, delivery modelling, bankability review, and commercial risk assessment.

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