# Reactive Power, BESS and Dynamic Compensation for RE Grid Connectivity in India 2026

By Sudarshan Karweer · 25 August 2026 · growthifye.com

*How reactive power planning, BESS and dynamic compensation shape RE evacuation, compliance and bankability in India in 2026.*

India's renewable pipeline is no longer constrained only by land, modules or turbines; increasingly, it is constrained by grid behaviour. In 2026, many solar, wind and hybrid projects are discovering that connectivity is available on paper but evacuation is fragile in practice unless reactive power, voltage control and dynamic compensation are planned correctly from day one. For C&I consumers signing open-access PPAs, developers bidding into utility tenders, lenders underwriting cash flows, and utilities managing weaker nodes, the central technical question is simple: can the project inject power without causing voltage instability, poor power factor, tripping, curtailment or repeated non-compliance?

This is where transmission engineering becomes commercially decisive. Reactive power compensation, STATCOM/SVC sizing, inverter capability, BESS control modes, harmonic filtering and power system studies now sit at the heart of project viability. The old approach of treating substation and evacuation design as a late-stage engineering package is no longer adequate. In many states and ISTS-connected schemes, these decisions now influence not only capex but also achievable CUF, scheduling performance, commissioning timelines and lender confidence.

This article explains how India's 2026 transmission environment is changing, what developers and power buyers should look for, and how reactive power and dynamic compensation should be integrated into project design for better bankability and grid acceptance.

## Why reactive power planning has become a first-order project risk

A decade ago, many developers viewed grid evacuation mainly as a line-routing and bay-allocation problem. That view is outdated. With rising renewable penetration, lower system inertia, greater inverter-based generation and long radial evacuation paths, voltage management has become as important as MW injection.

Several practical factors are driving this shift in India in 2026:

- Solar parks are often far from strong pooling stations, increasing electrical distance to the grid.
- Wind-rich corridors face fluctuating reactive power demand due to changing generation and line loading.
- Hybrid projects combine multiple inverter and transformer blocks whose aggregate grid behaviour must be coordinated.
- Many substations face tight voltage bands, especially during low-load, high-generation periods.
- Grid operators increasingly scrutinise fault ride-through, dynamic voltage response and post-disturbance recovery.

For project owners, the consequences are measurable. If reactive power is not available at the right point and at the right time, a project may face:

- Reduced active power export during high-voltage conditions
- Grid-code non-compliance notices
- Repeated inverter clipping or tripping
- Additional compensation equipment capex after detailed studies
- Delay in connectivity approval or charging permission
- Higher curtailment risk at weak nodes

In financial terms, even a 1.5% to 3.0% loss in annual net export due to avoidable reactive-power-related restrictions can materially affect DSCR in tightly priced projects. For a 250 MW solar project selling at Rs 2.55-3.10/kWh, the revenue impact can easily run into several crore rupees annually, depending on CUF and curtailment profile.

## The 2026 Indian context: ISTS, state networks and hybrid evacuation challenges

India's transmission build-out continues through interstate expansion, renewable energy zone development, Green Energy Corridor phases, and state-level strengthening works. Yet the pace of generation addition in solar, wind and storage means that connectivity studies are becoming more granular and less standardised.

By 2026, most serious utility-scale projects are encountering one or more of the following conditions:

- Long 220 kV or 400 kV evacuation stretches before reaching a strong grid node
- Shared pooling stations with uncertain generation coincidence factors
- Hybrid plants with solar, wind and storage injecting through common ICTs and switchyards
- Grid-code obligations requiring dynamic support beyond fixed capacitor banks
- Seasonal voltage variation due to changing agricultural, urban and industrial load patterns

For C&I open-access structures, the issue is just as relevant. Captive and group-captive projects connected at 132 kV or 220 kV often assume that evacuation is simpler than central procurement projects. In reality, state transmission utilities are increasingly applying rigorous load-flow, short-circuit and stability review standards, especially in states with high RE saturation. Maharashtra, Gujarat, [redacted], Karnataka, Tamil Nadu, Andhra Pradesh and Rajasthan renewable corridors all present situations where weak-grid behaviour can materially alter design choices.

The practical implication is that developers must stop asking only, "What is the approved evacuation voltage level?" and start asking, "What reactive power envelope, voltage control philosophy and dynamic support requirement will the node demand across operating scenarios?"

## What power system studies should decide before EPC freeze

Many project teams still commission core electrical studies too late, often after major equipment assumptions are already embedded in contracts. That sequencing is risky. In 2026, transmission engineering should influence procurement decisions well before EPC freeze and financing close.

At minimum, developers should require an integrated study package covering:

- Steady-state load flow under peak generation and low-load conditions
- Reactive power balance at plant boundary and interconnection point
- Short-circuit contribution and breaker duty check

- Dynamic voltage response for disturbances and fault recovery
- Transient stability where required by utility or CTU/STU
- Harmonic analysis for inverter-rich systems and compensation equipment interaction
- Insulation coordination and overvoltage review, especially for long EHV lines or GIS interfaces

These studies should not be treated as a compliance formality. They should answer commercially relevant design questions such as:

- Can the plant meet power factor obligations without excessive active power derating?
- Are fixed capacitor banks sufficient, or is a STATCOM/SVC necessary?
- Will BESS inverters be configured to provide reactive support during idle or charging states?
- What transformer tap strategy is needed across seasonal voltage ranges?
- Will line charging at low export periods push the node into overvoltage?
- Are harmonic filters needed to avoid resonance between capacitors, transformers and inverter controls?

For example, a 300 MW solar project evacuating through a 40-60 km 220 kV line may find that line charging significantly elevates voltage during dawn and low-load periods. If the design assumes only fixed compensation, the plant may struggle to keep voltage within limits without curtailing output or switching frequently. In such a case, a STATCOM or suitably controlled inverter-based dynamic VAR support may be economically justified even if initial capex appears higher.

Typical indicative 2026 market ranges seen in India for major compensation-related elements, subject to OEM, rating, control complexity and substation scope, are:

- 220 kV fixed/reactor-capacitor compensation packages: roughly Rs 0.4-1.2 crore per MVAr equivalent depending on scope
- Utility-grade STATCOM installations: often around Rs 0.9-1.8 crore per MVAr equivalent at project level, with site-specific civil and integration costs
- Harmonic filtering additions: highly variable, often 5% to 15% of the reactive compensation package cost where required
- Advanced plant controller and SCADA-grid integration upgrades: often Rs 1-4 crore for larger hybrid or pooled projects

These are not budgeting substitutes, but they show why early study-led optimisation matters. A poorly sequenced design can add tens of crores later through change orders, redesign and commissioning delays.

## BESS as a grid-support asset, not only an energy-shifting asset

Battery energy storage systems are commonly discussed in India in terms of peak shifting, ancillary services and firm renewable supply. But in transmission engineering, BESS should also be evaluated as a grid-support resource.

A properly specified BESS inverter can provide:

- Dynamic reactive power support
- Fast voltage regulation
- Ramp-rate control for hybrid export profiles
- Frequency response support where applicable
- Improved plant-level dispatch smoothness

- Better utilisation of common evacuation infrastructure

This does not mean every renewable project should add storage merely for connectivity. The economics depend on tariff structure, curtailment expectations, market access, charging strategy and control flexibility. However, in some weak-grid or hybrid cases, BESS can reduce the need for separate dynamic compensation equipment or at least improve total system performance.

Consider two stylised cases:

- A solar-plus-storage project with a common 220/33 kV pooling substation may use BESS inverters to support voltage during rapid irradiance changes, reducing the stress on plant controllers and lowering the need for oversized standalone reactive devices.
- A wind-solar hybrid connected at 400 kV may deploy coordinated control between WTGs, solar inverters and BESS PCS to maintain a tighter reactive power schedule at the interconnection point, improving dispatch reliability and grid acceptance.

The key is control philosophy. Lenders and utilities should ask whether the BESS is specified only for MWh dispatch or also for reactive capability across operating states. A battery that can only support reactive power in limited modes may offer less real grid value than assumed in the financial model.

In 2026 bid and merchant environments, this distinction matters. If a developer is counting on storage to improve evacuation performance, the EPC scope, OEM guarantees, EMS/PMS logic and interconnection studies must explicitly reflect that role.

## Commercial impact on C&I buyers, lenders and utilities

Transmission engineering choices are often seen as a developer-side issue, but they affect every stakeholder in the value chain.

For C&I consumers:

- Weak evacuation or poor voltage control can increase curtailment and reduce contracted renewable supply.
- Open-access power delivered from unstable nodes may show higher variability in actual schedules.
- Projects with robust reactive planning are generally more reliable counterparties for long-tenor supply arrangements.

For lenders and investors:

- Grid-related underperformance is now a bankability issue, not just an O&M issue.
- Sensitivity analysis should include export restrictions, commissioning delay due to study revisions, and capex additions for compensation equipment.
- Independent engineer reviews should check whether reactive support assumptions are proven through credible simulations.

For utilities and policymakers:

- Standardised study templates and pre-defined reactive support expectations at identified nodes can reduce approval friction.
- Better coordination between generation approvals and transmission planning can limit late-stage redesign.
- Compensation obligations should be transparent enough to avoid speculative bidding based on incomplete grid assumptions.

For developers, the business case is straightforward. Spending more on early-stage transmission engineering can reduce both schedule risk and energy-loss risk. In a market where tariffs remain tight and debt sizing is sensitive, that trade-off is usually favourable.

## Practical design strategies for 2026 renewable evacuation packages

The best-performing projects in today's market are not necessarily those with the lowest initial electrical BoQ. They are the ones that align generation profile, evacuation design, compensation strategy and compliance evidence from the outset.

A practical 2026 approach should include the following:

- Screen multiple interconnection nodes, not just the first available node, using electrical strength and voltage behaviour as selection criteria.
- Model seasonal and low-load scenarios explicitly; overvoltage at low system demand is often underestimated.
- Optimise inverter reactive capability before defaulting to large external compensation packages.
- Evaluate fixed and dynamic compensation combinations rather than choosing one technology in isolation.
- Test BESS reactive support roles where storage is already part of the project concept.
- Align protection, plant controller logic and utility SCADA expectations early in the design phase.
- Validate whether the common pooling substation can support future expansion without major retrofit.

Developers should also maintain discipline on data quality. Study results are only as good as the assumptions behind them. Common failure points include outdated upstream network models, inconsistent transformer impedance data, unrealistic generation coincidence assumptions in pooled parks, and omission of nearby planned projects that will alter node behaviour by the time commissioning occurs.

A robust owner's engineer or advisory process should therefore cover:

- Utility and CTU/STU coordination
- Review of connectivity conditions and technical minutes
- Independent study validation
- Compensation and substation concept optimisation
- Interface management between developer, EPC, OEMs and utility
- Commissioning support and compliance documentation

## What decision-makers should do before financial close

Before financial close or final EPC award, project sponsors should ensure that transmission engineering is advanced enough to answer five questions clearly.

- What is the committed reactive power requirement at the interconnection point across the operating range?
- Which equipment will meet that requirement: inverter capability, capacitor/reactor banks, STATCOM/SVC, BESS PCS, or a combination?
- Have dynamic and harmonic interactions been checked for the final plant architecture?
- Is the capex and schedule contingency for grid-related design change still material?

- Can the project maintain export reliability without hidden derating under realistic grid conditions?

If these questions remain open, the project is not truly de-risked, regardless of land status or module pricing.

India's renewable scale-up in 2026 requires a more mature view of evacuation engineering. The winners will be developers and power buyers who treat grid behaviour as a commercial design input, not a late-stage approval hurdle. Reactive power planning, dynamic compensation and storage-integrated voltage control are now central to reliable project delivery across ISTS, state networks, green energy corridors and C&I open-access structures.

For sponsors, utilities and lenders alike, the message is clear: bankable renewable projects are no longer defined only by tariff and resource quality, but by the quality of their transmission engineering decisions.

If your project needs support on ISTS/state connectivity, power system studies, reactive compensation strategy, substation design or evacuation bankability review, contact Growthifye's advisory desk for a technical and commercial assessment.

ABOUT THE AUTHOR

**Sudarshan Karweer — Chief Executive Officer, Growthifye**

Over 23 years in management consulting — concept to scale — building and scaling new-age digital and energy businesses. An EY alumnus, Sudarshan leads Growthifye's renewable energy & storage advisory, EPC, transmission engineering and green-financing practices for developers, utilities and C&I consumers across India.
Contact: info@growthifye.com · +91 84510 99371 · growthifye.com