Grid Synchronisation Studies for RE Evacuation in India 2026: ISTS, Costs, Timelines

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A practical 2026 guide to grid synchronisation studies for RE evacuation in India: ISTS approvals, modelling, costs, timelines and lender risks.

India's renewable build-out is no longer constrained only by module prices, turbine availability or land. In 2026, one of the most underestimated schedule risks sits inside the transmission workstream: grid synchronisation studies for inverter-based renewable generation connecting to STU and ISTS networks.

For solar, wind, hybrid and co-located BESS projects, synchronisation is not a clerical milestone. It is the point where plant design assumptions meet the real behaviour of the grid. Weak-grid conditions, interaction between multiple inverter-based resources, protection coordination gaps, harmonic distortion, voltage excursions and switching transients can all delay charging, commissioning and commercial operation.

For Indian RE developers, C&I consumers sourcing open-access power, lenders evaluating completion risk, and utilities responsible for secure grid operation, synchronisation studies have become a critical due-diligence item. They now sit alongside connectivity approval, bay readiness, SCADA integration, and compliance with the Indian Electricity Grid Code, CEA technical standards, and system operator requirements.

This article explains what grid synchronisation studies mean in the Indian 2026 context, where they fit in the ISTS and STU process, what they cost, how long they take, and what developers should do differently to avoid expensive delays.

Why synchronisation studies matter more in India in 2026

India's transmission system is connecting a far larger share of inverter-based generation than it was designed for a decade ago. Rajasthan, Gujarat, Karnataka, Tamil Nadu, Andhra Pradesh and inter-state pooling corridors are seeing clusters of solar, wind and hybrid projects evacuating through 220 kV, 400 kV and 765 kV systems into increasingly dynamic networks.

Three trends are driving the importance of synchronisation studies:

- Higher renewable concentration at pooling substations and in green energy corridors
- More grid-forming and grid-following inverter interactions across solar, BESS and wind assets
- Tighter operator scrutiny on dynamic performance before charging and synchronisation

In practice, this means a project can have land, modules, inverters, transmission line, and even bay construction substantially complete, but still face delay if the utility, CTU, STU or SLDC/RLDC identifies unresolved issues in modelling, settings, fault ride-through response, reactive support, harmonics or communication interfaces.

For lenders, this has become a bankability issue. A 30 to 90 day delay in synchronisation can affect first generation, cash-flow start date, DSRA planning, IDC, and PPA supply obligations. For open-access C&I projects, delayed synchronisation can also push back contracted supply to commercial consumers, forcing procurement from exchange markets or incumbent discom supply at higher tariffs.

What exactly is covered in a grid synchronisation study

In Indian project practice, synchronisation is not one single study. It is a package of technical checks, model validation tasks, site tests and coordination reviews that together establish whether the generating station can safely energise, sync and operate without creating unacceptable grid risk.

Depending on the technology and voltage level, the package usually includes:

- Load-flow validation at the point of interconnection
- Dynamic stability assessment under normal and contingency conditions
- Voltage and reactive power performance review
- Fault ride-through and post-fault recovery verification
- Harmonic assessment and filter adequacy review
- Protection coordination and relay settings validation
- Switching transient and energisation checks for transformers, lines and reactors
- SCADA, telemetry and communication interface readiness
- Verification of generator/inverter control models submitted to utility or system operator
- Black start or restoration-related operating logic where applicable for BESS or hybrid systems

For inverter-based resources, model quality is now a major issue. Generic OEM models often do not capture site-specific controller behaviour, plant-level reactive control, PPC response or interactions with external STATCOM/SVC equipment. When a utility simulation does not match actual field behaviour, synchronisation approval can get held up until revised models and tests are submitted.

This is why serious developers increasingly integrate [Power system studies](/coreservices/transmissionengineering/powersystemstudies) with pre-commissioning planning rather than treating synchronisation as a final-week activity.

Indian regulatory and utility context developers must track

In 2026, synchronisation readiness sits within a broader regulatory framework rather than a single standalone approval. Depending on project type and location, developers need to align with:

- Indian Electricity Grid Code requirements
- CEA technical standards for connectivity to the grid
- CEA standards for construction, operation and safety of electrical plants and lines
- CTU connectivity procedures for ISTS-linked projects
- STU and state transmission utility connectivity conditions for intrastate evacuation
- RLDC/SLDC scheduling, telemetry and data acquisition requirements
- Utility-specific protection, metering and communication protocols

For ISTS-connected projects, the process usually becomes stricter where renewable energy parks, pooling stations, 400 kV substations and shared evacuation corridors are involved. RLDCs and transmission utilities increasingly ask for validated dynamic models, detailed inverter capability curves, PPC settings philosophy, and evidence that plant response under low short-circuit strength conditions is acceptable.

This is especially relevant in renewable-heavy pockets where system strength can vary by season, time of day, and outage condition. A project that appears compliant in a normal load-flow base case may perform poorly during a nearby line outage, transformer outage, low-demand high-generation scenario, or energisation sequence.

Developers should also remember that synchronisation risk often emerges at interfaces:

- Generator transformer to pooling substation
- Pooling substation to transmission line
- Project SCADA to substation gateway and load despatch centre
- Plant controller to inverter and reactive compensation systems
- Protection coordination between project and utility relays

These interfaces are where documentation gaps and design responsibility disputes commonly arise.

Typical workflow, timelines and cost ranges in 2026

A well-run synchronisation workstream starts 6 to 9 months before planned charging, not 2 weeks before. In 2026, realistic timelines for Indian projects are as follows:

- Base data collection and utility interface: 2 to 4 weeks
- Network model build or review: 2 to 3 weeks
- Load-flow, short-circuit, dynamic and harmonic studies: 3 to 6 weeks
- Utility comments, revisions and resubmission: 2 to 6 weeks
- Site readiness checks for protection, SCADA and metering: 2 to 4 weeks
- Pre-charging and synchronisation test planning: 1 to 2 weeks
- Final charging/synchronisation approvals and execution window: 1 to 3 weeks

In a straightforward intrastate solar project with a mature STU process, the end-to-end study and approval cycle may close in 6 to 10 weeks if data quality is good and the bay is ready. For larger ISTS-connected hybrid or wind-solar-BESS projects, 10 to 18 weeks is more realistic, and longer if multiple agencies are involved or if revised OEM models are required.

Typical 2026 cost ranges in India vary by voltage level, project complexity and whether field support is included:

- Standalone synchronisation study package for a 50 to 100 MW solar project: Rs 8 lakh to Rs 20 lakh
- Detailed dynamic and harmonic package for a 100 to 300 MW hybrid project: Rs 18 lakh to Rs 45 lakh
- Multi-scenario weak-grid assessment with OEM model validation and utility support: Rs 35 lakh to Rs 75 lakh
- On-site testing, relay coordination support and commissioning interface adders: Rs 5 lakh to Rs 25 lakh

These costs are small relative to delay losses. For example:

- A 100 MW solar project delayed by 30 days at a 24% CUF loses roughly 17.3 million units of generation opportunity annually prorated to one month at commissioning impact level
- At a realised tariff of Rs 2.8 to Rs 3.4 per kWh, revenue deferral can be around Rs 4.8 crore to Rs 5.9 crore for that period, excluding IDC and liquidated exposure
- For C&I open-access structures where delivered tariffs may be in the Rs 4.2 to Rs 6.5 per kWh range depending on state, the commercial impact can be even sharper if replacement power is procured elsewhere

That is why synchronisation studies should be treated as schedule insurance, not just engineering overhead.

Common failure points seen on Indian RE projects

Most synchronisation delays do not arise because the grid is fundamentally unavailable. They arise because project teams discover integration issues too late. The recurring failure points in India in 2026 include:

- Incomplete or inconsistent OEM dynamic models for inverters, PPC, STATCOM or BESS converters
- Mismatch between approved single-line diagram and as-built protection philosophy
- Poor coordination between EPC, transmission contractor, utility and SCADA vendor
- Reactive power capability shortfall at the interconnection point under low-voltage conditions
- Harmonic levels exceeding utility thresholds after combining multiple inverter blocks
- Telemetry tags, time synchronisation or communication redundancy not matching RLDC/SLDC requirements
- Bay or line readiness being achieved before relay setting approval and end-to-end testing
- Energisation sequence not validated for transformer inrush, line charging or reactor switching

Hybrid plants face additional complexity. A solar-wind-BESS project may behave differently across resource combinations: solar-only, wind-only, BESS charge mode, BESS discharge mode, or simultaneous operation. If the submitted studies assess only one dispatch state, utility reviewers often ask for additional scenarios.

Developers also underestimate the importance of substation design choices. Robust [HV/EHV substation design](/coreservices/transmissionengineering/hvehvsubstationdesign) and early review of bus arrangement, transformer sizing, reactor placement, earthing, CT/PT specification and auxiliary supply philosophy can materially reduce synchronisation risk later.

What lenders, utilities and C&I buyers should ask before COD

A lot of market participants still treat synchronisation as the developer’s internal issue. That is a mistake. Different stakeholders should ask pointed questions before assuming commercial readiness.

For lenders:

- Have all required grid models been submitted and accepted by the relevant utility/operator?
- Is there any outstanding comment related to dynamic response, harmonics, protection or telemetry?
- Is the planned synchronisation date dependent on third-party bay, line or communication readiness?
- What is the contingency if utility-directed model revisions take 4 to 6 additional weeks?

For C&I offtakers under open access:

- Has the project obtained all practical approvals required for charging and synchronisation, not just connectivity grant?
- Are there risks of restricted injection due to interim operating limits at the evacuation node?
- If synchronisation slips, what is the replacement power strategy and tariff consequence?

For utilities and policymakers:

- Are model submission templates standardised enough to avoid repetitive clarification cycles?
- Can testing protocols for inverter-based plants be harmonised across states and ISTS-linked nodes?
- Are there enough trained reviewers for dynamic studies, harmonics and controller validation?

The answer in many cases is no. As India pushes toward much higher RE penetration, the synchronisation bottleneck is as much an institutional capacity issue as an engineering issue.

Practical developer checklist for faster synchronisation

Developers aiming for 2026 commissioning should build the following into project execution from day one:

- Freeze interconnection philosophy early, including voltage level, line length, transformer ratings and reactive support concept
- Obtain utility base-case data and modelling requirements as early as possible
- Contract OEMs with explicit obligations to provide validated RMS/EMT-compatible models where required
- Run internal studies on weak-grid, outage and seasonal high-generation scenarios, not just normal case snapshots
- Integrate [Protection, control & SCADA](/coreservices/transmissionengineering/protectioncontrolandscada) scope with the study package instead of treating it as a separate commissioning task
- Conduct pre-utility review of relay settings, telemetry mapping, PPC logic and metering architecture
- Build 30 to 60 days of schedule buffer between mechanical completion and target synchronisation date
- Ensure clear responsibility allocation between plant EPC, line EPC, substation package and utility interface team

For projects connecting into crowded renewable corridors, developers should also consider whether the interconnection strategy itself is creating avoidable risk. In some cases, a marginally higher capex option with better system strength, shorter line length, or cleaner utility interface can reduce time-to-COD and improve long-term generation reliability.

This is where an independent advisor adds value beyond drawing preparation. The best outcomes usually come when transmission planning, utility engagement, design review and commissioning support are coordinated under one technical strategy rather than fragmented across vendors.

The 2026 takeaway for Indian RE evacuation

Grid synchronisation studies have moved from being a back-end compliance task to a front-end bankability issue. In India's 2026 market, where renewable clusters are denser, inverter penetration is higher and grid behaviour is more complex, developers cannot rely on generic study reports or last-minute utility follow-up.

The winning approach is simple: treat synchronisation as a structured engineering and approval program beginning months before energisation. Budget for high-quality studies, validate OEM models early, coordinate design and communications interfaces, and plan for realistic utility review cycles.

For RE developers, this protects COD. For C&I consumers, it improves supply certainty. For lenders, it reduces completion risk. For utilities, it supports safer integration of large-scale renewable capacity into STU and ISTS networks.

If your project is approaching connectivity, bay readiness or commissioning, contact Growthifye's advisory desk for practical support on transmission planning, utility interfaces and synchronisation readiness.

Explore Growthifye's related capabilities

This analysis connects directly to our advisory practice: [Power system studies](/coreservices/transmissionengineering/powersystemstudies) · [HV/EHV substation design](/coreservices/transmissionengineering/hvehvsubstationdesign) · [Transmission line engineering](/coreservices/transmissionengineering/transmissionlineengineering) · [Protection, control &

SCADA](/coreservices/transmissionengineering/protectioncontrolandscada).

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