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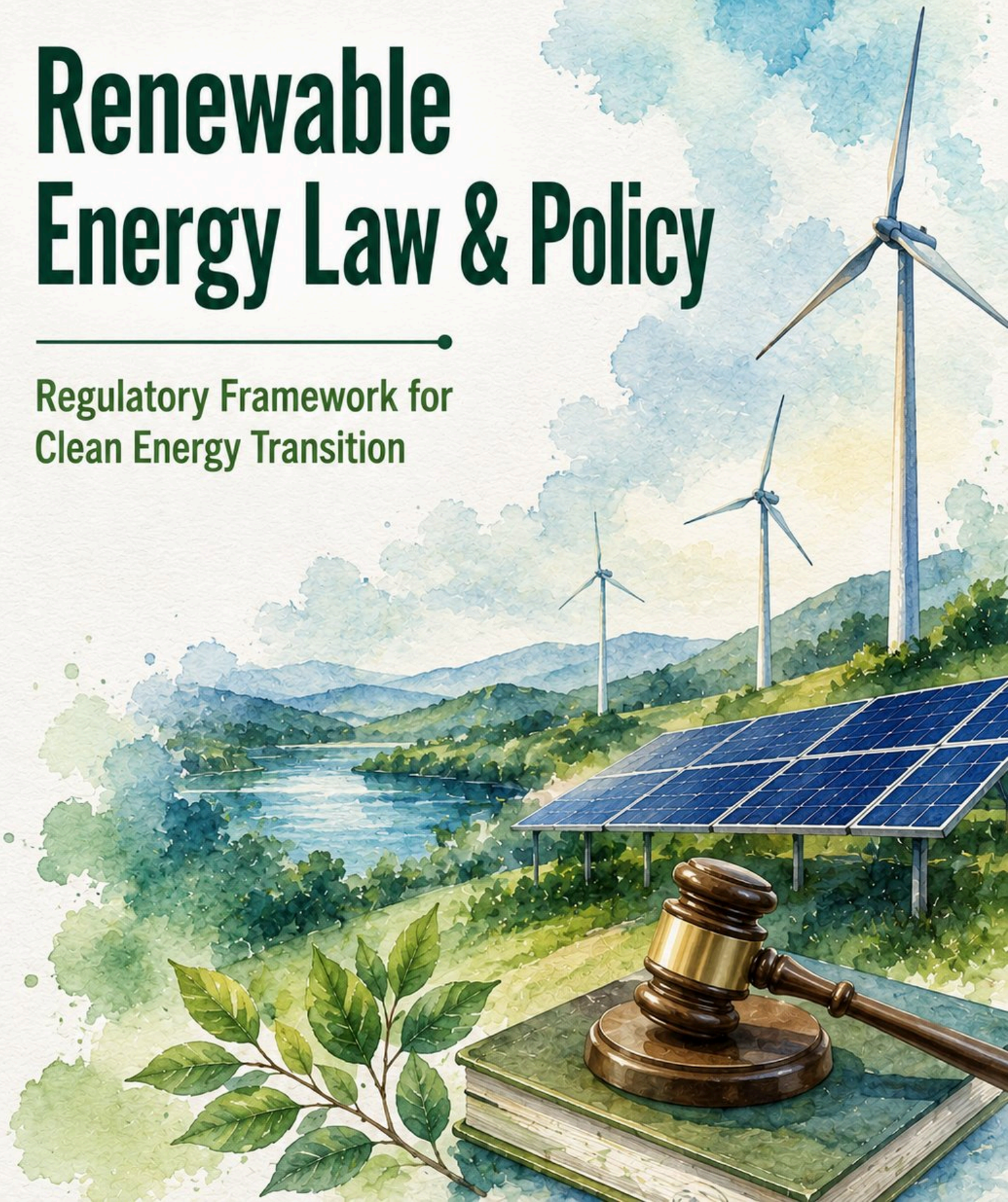
Renewable Energy Law & Policy

Regulatory Framework for Clean Energy Transition



BHATT & JOSHI ASSOCIATES — INDIAN POWER SECTOR LEGAL SERIES

Renewable Energy

Legal & Regulatory Architecture

Booklet III of VI

Bhatt & Joshi Associates, Advocates & Legal Consultants

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CHAPTER ONE

History and Policy Architecture of Renewable Energy in India

From Pilot Programmes to 500 GW: Legislative and Policy Evolution

India's renewable energy sector has undergone a transformation of extraordinary speed and scale, driven by declining technology costs, ambitious national targets, and a progressive legal and regulatory framework. This chapter traces the evolution of renewable energy law and policy from the early state-level programmes to the current national architecture.

1.1 Early Renewable Energy Policy: The MNES Era

India's renewable energy programme began in earnest in the 1980s and 1990s under the Ministry of Non-Conventional Energy Sources (MNES), established in 1982 as the first dedicated government ministry for renewable and alternative energy in the developing world. MNES administered demonstration and incentive programmes for wind energy, small hydro, biomass, solar water heating, and solar photovoltaic systems, primarily through state nodal agencies. The Wind Power Programme, launched in 1992–93 with the assistance of development financing from the World Bank and bilateral donors, produced India's first significant wind capacity installations in Tamil Nadu, Rajasthan, Gujarat, and Karnataka, laying the groundwork for what would

become one of India's most important new industries.

The financial instruments used in this early period included accelerated depreciation (allowing investors to claim 100 per cent depreciation on wind energy assets in the first year of operation, significantly improving the post-tax economics of wind investment), generation-based incentives (per-unit payments from the Ministry of New and Renewable Energy budget for each unit of electricity generated from eligible renewable sources), and concessional financing from the Indian Renewable Energy Development Agency (IREDA), established in 1987 as a dedicated financial institution for renewable energy projects. These early instruments, while imperfect in design and modest in scale, attracted the initial private sector investment in renewable energy and built the project development, financing, and O&M capabilities that would be essential for the larger expansion that followed.

1.2 The Electricity Act, 2003 and Renewable Energy Integration

The Electricity Act, 2003 provided the statutory framework for integrating renewable energy into the mainstream of India's electricity sector regulation, replacing the fragmented state-level programmes of the MNES era with a national regulatory architecture grounded in the Act's core provisions. The critical provisions of the Act for renewable energy are: Section 3(1) (requiring the National Electricity Policy to promote electricity from renewable sources); Section 61(h) (guiding regulatory commissions to promote co-generation and renewable generation in determining tariffs); Section 86(1)(e) (requiring State Electricity Regulatory Commissions to specify Renewable Purchase Obligations and promote connectivity for renewable generators); Section 42(2) read with Section 38 (requiring non-discriminatory open access to the grid for all generators including renewable generators); and Section 63 (enabling competitive procurement of renewable energy through tariff-based competitive bidding).

These provisions collectively established the legal basis for: the Renewable Purchase Obligation (RPO) framework, which creates a mandatory minimum demand for renewable electricity; the open access framework, which ensures that renewable generators can connect to the grid on non-discriminatory terms; the tariff-based competitive bidding framework, which enables cost-effective procurement of renewable energy; and the policy guidance from the Central Government (through the National Electricity Policy and Tariff Policy) on the promotion of renewable energy by the regulatory commissions. The Act's framework was supplemented by the National Solar Mission (2010), the National Wind Mission (2015), and the National Green Hydrogen Mission (2023), each providing the sectoral policy architecture for a specific renewable energy technology.

1.3 Jawaharlal Nehru National Solar Mission

The Jawaharlal Nehru National Solar Mission (JNNSM), announced in January 2010 as one of eight missions under the National Action Plan on Climate Change, set India's first serious national target for solar energy: 20 GW of solar power by 2022, subsequently revised upward to 100 GW and then to 175 GW. The Mission provided the policy architecture, institutional framework, and initial procurement mechanisms that catalysed India's solar revolution. It introduced the competitive bidding framework for solar power procurement (through NTPC Vidyut Vyapar Nigam as the central procurement agency), established the Domestic Content Requirement (DCR) policy for solar cells and modules, and created the Solar Energy Corporation of India (SECI) in 2011 as the dedicated central agency for solar procurement and development.

The JNNSM's most lasting contribution was the competitive procurement framework, which drove solar tariffs from Rs. 10.95

per kWh in Batch I (2010) to below Rs. 2.50 per kWh by 2021 — a reduction of nearly 80 per cent in real terms that transformed solar from a premium niche technology to the cheapest new electricity source in India. This tariff discovery mechanism, codified in the Central Government's competitive bidding guidelines and adopted by CERC under Section 63, created the commercially viable and investor-friendly framework for large-scale solar deployment.

1.4 State-Level Renewable Energy Policies

While the Central Government's framework provided the overarching policy architecture, the implementation of renewable energy development has primarily occurred at the state level, reflecting the federal character of electricity sector governance under the Constitution. Each major renewable energy state — Rajasthan, Gujarat, Tamil Nadu, Andhra Pradesh, Karnataka, Telangana, and Madhya Pradesh for solar; Tamil Nadu, Gujarat, Rajasthan, Andhra Pradesh, and Karnataka for wind — has developed its own state-level renewable energy policy providing land facilitation, connectivity incentives, single-window clearances, and state-specific incentives for renewable developers.

The state renewable energy policies address matters including: the designation of renewable energy development zones with pre-assessed resource potential and streamlined approvals; the provision of government land at concessional rates or on long-term lease for solar and wind parks; the development of park infrastructure (internal roads, water supply, common evacuation infrastructure) by state government agencies to reduce individual project development costs; and the specification of local content and employment requirements for projects developed within state-sponsored parks. The regulatory implementation of state renewable energy policies by the SERCs — including the specification of the applicable open access framework, the wheeling charges for renewable energy, and the RPO targets that create the mandatory demand for state-level renewable procurement — has been critical for translating state policy commitments into actual investment flows.

1.5 India's NDC and the 500 GW Target

India's Nationally Determined Contribution (NDC) under the Paris Agreement, submitted to the UNFCCC and updated in 2022, commits India to achieving 500 GW of installed capacity from non-fossil fuel sources by 2030 and to reducing the emissions intensity of its GDP by 45 per cent from 2005 levels by 2030. These commitments, which represent India's contribution to the global effort to limit climate change to 1.5°C above pre-industrial levels, have been translated into national targets for renewable energy capacity addition, green hydrogen production, and energy efficiency improvement that shape the entire electricity sector policy and regulatory framework. The 500 GW target by 2030 implies annual renewable energy capacity additions of 45–50 GW per year, roughly double the rate achieved in recent years and requiring massive parallel investment in generation, transmission, storage, and grid management infrastructure.

CHAPTER TWO

Renewable Purchase Obligation: Legal Framework and Enforcement

Statutory Basis, RPO Specifications, REC Mechanism, and Compliance Architecture

The Renewable Purchase Obligation is the foundational regulatory demand instrument for renewable energy in India, creating a mandatory minimum consumption requirement for renewable electricity across the supply chain. This chapter examines its legal framework, implementation, and enforcement.

2.1 Statutory Basis: Section 86(1)(e)

Section 86(1)(e) of the Electricity Act, 2003 is the statutory foundation for the RPO, vesting the State Electricity Regulatory Commission with the function of specifying "for purchase of electricity from renewable sources of energy, a percentage of the total consumption of electricity in the area of a distribution licensee." This provision creates both a mandate (the Commission must specify an RPO percentage) and a floor (the specified percentage constitutes a minimum obligation on the distribution licensee). The Section 86(1)(e) obligation is complemented by Section 61(h), which requires the Commission to be guided by the principle of promoting co-generation and generation from renewable sources.

The Central Government has issued the RPO trajectory specification under the Electricity (Amendment) Act framework, specifying minimum RPO percentages that all SERCs must mandatorily specify for their distribution licensees. The current RPO trajectory requires: a wind RPO of 1.5 per cent, a solar RPO rising to 6.94 per cent and increasing annually, and a non-solar RPO covering biomass, small hydro, and other non-solar non-wind sources. The total RPO for distribution licensees is required to reach approximately 43 per cent by 2030, consistent with India's NDC targets. These centrally specified minimum RPO percentages constrain the SERCs' discretion in setting lower RPOs, though SERCs retain the discretion to specify higher RPOs in their states.

2.2 RPO-Obligated Entities

While distribution licensees are the primary RPO-obligated entities under Section 86(1)(e), the RPO framework has been extended by CERC and most SERCs to cover open access consumers and captive power plant owners. These entities consume electricity that does not flow through the distribution licensee's supply and therefore does not attract the licensee's RPO obligation; if they were exempt from RPO, the migration of large consumers to open access or captive supply would reduce the total volume of electricity subject to RPO, undermining the policy objective of maximising renewable energy consumption. The extension of RPO to open access consumers and captive users creates a parallel obligation structure in which: the distribution licensee's RPO is computed on the basis of the total electricity supplied to consumers (net of electricity supplied through licensed means); and the open access consumer's and captive user's RPO is computed on the basis of their own electricity consumption.

The RPO can be fulfilled through: procurement of electricity from renewable energy generating stations under long-term or short-term PPAs; procurement of Renewable Energy Certificates (RECs) through the power exchanges; direct investment in

renewable energy generating capacity (captive renewable generation); and procurement of renewable electricity through the open access framework. The diversity of fulfilment options reflects the policy objective of maximising flexibility for obligated entities in meeting their RPO while ensuring that the aggregate renewable energy procurement meets the specified percentage of total consumption.

2.3 Renewable Energy Certificates: Mechanism and Market

The Renewable Energy Certificate (REC) mechanism, established through CERC's REC Regulations and implemented through the power exchanges, creates a national market for the environmental attribute of renewable electricity generation, separate from the commodity electricity market. An REC represents the generation of one megawatt-hour of electricity from an eligible renewable energy source, certified by the state nodal agency and registered in the Central Agency's registry. Obligated entities who cannot procure sufficient renewable electricity directly (because, for instance, they are located in states with limited renewable resources) can fulfil their RPO by purchasing RECs from renewable generators in other states.

The REC market has undergone significant evolution since its launch in 2011. The market's performance has been affected by: the high floor prices and forbearance prices initially specified by CERC, which constrained market liquidity by limiting the price range within which RECs could trade; the inconsistent enforcement of RPO compliance by SERCs, which reduced the mandatory demand for RECs; and the competition from the Green Day-Ahead Market (G-DAM) and Green Term-Ahead Market (G-TAM), which allow buyers to procure renewable electricity with attribute in a single transaction. CERC has revised the REC framework multiple times to address these issues, progressively reducing the floor and forbearance prices to market-reflective levels and strengthening the enforcement framework. The REC market's effectiveness as a compliance mechanism depends critically on consistent and rigorous enforcement of RPO obligations by the SERCs, which has been uneven in practice.

2.4 RPO Enforcement: Regulatory and Judicial Practice

The enforcement of RPO compliance by SERCs has been one of the most challenging aspects of the renewable energy regulatory framework. Most distribution utilities and many open access consumers have failed to consistently meet their RPO targets, but the regulatory consequences have generally been modest: SERCs have issued directions to non-compliant entities to develop compliance plans and procure RECs to make up the shortfall, but have rarely imposed the financial penalties available under their RPO regulations. This inconsistent enforcement has significantly weakened the effective demand for renewable electricity and RECs, contributing to periods of REC market illiquidity and below-floor-price REC prices.

APTEL has addressed RPO enforcement in several decisions, consistently holding that RPO is a mandatory obligation that the SERC must enforce through appropriate regulatory proceedings. APTEL has directed SERCs to: specify clear RPO targets for each year; require obligated entities to file annual RPO compliance reports; scrutinise compliance reports and identify non-compliant entities; issue show-cause notices to non-compliant entities; and impose penalties for continued non-compliance after adequate opportunities for rectification. The Supreme Court has also addressed RPO enforcement, confirming APTEL's position that RPO is a statutory obligation and directing SERCs to ensure effective enforcement of the obligation across all categories of obligated entities.

CHAPTER THREE

Grid Connectivity and Transmission for Renewable Energy

GNA Regulations 2022, ISTS Waiver, Green Energy Corridors, and Must-Run Dispatch

The physical integration of renewable energy into India's electricity grid requires a robust legal and regulatory framework for grid connectivity, transmission access, and system operation. This chapter examines the connectivity and transmission framework specifically relevant to renewable energy generators.

3.1 CERC Connectivity Regulations 2022: A New Architecture

The CERC (Connectivity and General Network Access to the Inter-State Transmission System) Regulations, 2022, replaced the earlier Long-Term Access, Medium-Term Open Access, and Short-Term Open Access frameworks with a unified General Network Access (GNA) framework. The GNA framework represents a fundamental redesign of the transmission access regime, intended to better accommodate the large volumes of variable renewable energy flowing through the ISTS and the rapidly changing commercial arrangements for renewable energy procurement. Under the GNA framework, all entities with contracted generation or load capacity can apply for GNA — the right to inject into or withdraw from the ISTS — without being tied to a specific long-term bilateral contract arrangement.

The GNA concept decouples the physical transmission access right from the specific commercial arrangement (PPA or otherwise) under which power is being traded. A renewable generator holding GNA approval can inject power into the ISTS under any commercial arrangement — whether a long-term PPA, a medium-term bilateral contract, a power exchange transaction, or an open access arrangement — without requiring a separate CERC approval for each commercial arrangement. This flexibility is particularly valuable for renewable energy generators, whose commercial arrangements may change frequently (for instance, as they participate in both long-term PPAs and short-term power exchange transactions), and for storage-linked projects whose charging and discharging arrangements may vary based on market conditions.

3.2 ISTS Waiver for Renewable Energy: Policy and Legal Dimensions

The waiver of inter-state transmission system (ISTS) charges and losses for renewable energy generators — under which solar, wind, and specified other renewable energy generators are exempt from paying the annual ISTS transmission charge for a specified period — is one of the most significant policy instruments for reducing the delivered cost of renewable electricity to distribution utility procurers. The legal basis for the ISTS waiver is the Ministry of Power's notification under the Electricity Act, 2003 authorising CERC to grant the waiver for eligible renewable energy projects, and CERC's implementation of the waiver through its Sharing of ISTS Charges and Losses Regulations.

The ISTS waiver has progressively reduced the delivered cost of renewable electricity by eliminating a cost component (transmission charges) that can be Rs. 0.30–0.60 per kWh for electricity transmitted over long distances through the national transmission network. For renewable energy projects in resource-rich states (Rajasthan, Gujarat) supplying load centres in other states (Maharashtra, Delhi, Uttar Pradesh), the ISTS transmission distance can be 1,000–2,000 km, and the waiver represents a

significant financial benefit to the renewable energy developer and the procuring distribution utility. CERC has periodically extended the waiver period in response to policy direction from the Ministry of Power, reflecting the Central Government's continuing support for renewable energy deployment through network cost reduction.

3.3 Must-Run Status and Curtailment Management

The must-run status of renewable energy generators under the Indian Electricity Grid Code (IEGC) creates a regulatory obligation on the load despatch centres to despatch renewable generation ahead of conventional generators in the merit order dispatch queue, subject to grid safety constraints. Must-run status reflects the zero marginal cost of renewable generation and the policy imperative to maximise renewable energy utilisation. However, the implementation of must-run dispatch in a grid with rapidly growing renewable penetration and limited intra-state transmission capacity has been challenging, with significant renewable curtailment occurring in states with high renewable concentration.

CERC's curtailment management framework requires the Regional Load Despatch Centre (RLDC) to: schedule all must-run renewable generation in the day-ahead schedule to the maximum extent consistent with grid security; document and justify any curtailment of must-run generation, specifying the specific grid security reason; and report curtailment statistics regularly to CERC and the affected generators. Where CERC finds that curtailment is occurring for commercial or merit-order reasons rather than genuine grid security reasons, it has the authority to direct the RLDC to revise its scheduling practices and to impose penalties on the entity responsible for the improper curtailment. The curtailment compensation framework — still under development by CERC — will provide financial protection to renewable generators against revenue loss due to curtailment, strengthening the financial bankability of renewable energy projects in curtailment-affected states.

3.4 Green Energy Corridors: Infrastructure for Integration

The Green Energy Corridor (GEC) programme represents India's largest dedicated investment in transmission infrastructure for renewable energy integration. GEC Phase I (2013–2020) involved the construction of approximately 9,700 circuit kilometres of new transmission lines and 19 GW of substation capacity in eight renewable-energy-rich states, with funding from the Ministry of New and Renewable Energy, the states, and KfW (Germany) with European Investment Bank support. GEC Phase II, covering additional states and higher renewable targets, is under implementation. The GEC investments have been essential for enabling the evacuation of the renewable energy capacity commissioned in the target states, and their regulatory treatment under CERC's ISTS tariff framework ensures that the cost of the infrastructure is recovered from ISTS users.

The planning and approval of GEC transmission assets involves coordination among multiple agencies: PGCIL (the CTU) prepares the transmission investment plan in consultation with the CEA and the relevant state transmission utilities; CERC approves the tariffs for the GEC transmission assets under its cost-of-service framework; the state transmission utilities develop and operate the intra-state transmission elements of the GEC; and the Ministry of New and Renewable Energy provides the policy direction and facilitates inter-ministerial coordination for the GEC programme. This multi-agency governance structure requires effective coordination mechanisms to avoid delays in the development of the transmission infrastructure needed to enable renewable energy project commissioning.

CHAPTER FOUR

Competitive Procurement: RfS, PPA Framework, and Tariff Adoption

Bidding Guidelines, Standard PPAs, SECI Mechanism, and CERC Section 63 Practice

Competitive procurement under Section 63 has been the engine of India's renewable energy revolution, discovering tariffs that have made renewable electricity the cheapest source of new generation. This chapter examines the legal and procedural framework for competitive renewable energy procurement.

4.1 Central Government Bidding Guidelines

The Central Government's Guidelines for Tariff-Based Competitive Bidding for Grid-Connected Solar PV Power Projects (and equivalent guidelines for wind, hybrid, RTC, and storage projects) provide the legal and procedural framework for competitive renewable energy procurement under Section 63 of the Electricity Act, 2003. These guidelines specify: the conditions for conduct of competitive procurement (including the requirement for open, transparent, and non-discriminatory bidding); the standard terms of the Request for Selection (RfS) document; the model Power Purchase Agreement to be used; the qualification criteria for bidders; the evaluation methodology (L1 tariff selection); the post-bid opening process; and the conditions for CERC/SERC tariff adoption. Compliance with the guidelines is a condition for CERC/SERC adoption of the competitively discovered tariff under Section 63.

The guidelines have been progressively refined through successive versions, incorporating lessons from the implementation of earlier procurement rounds, legal challenges before CERC and APTEL, and feedback from industry stakeholders. Key refinements have included: clarification of the definition of a "Change-in-Law" event to explicitly include changes in domestic law (but not changes in foreign law); improvement of the payment security provisions following payment defaults by several state distribution utilities to renewable generators; introduction of liquidity penalties for project completion delays to strengthen the developer's commitment to timely commissioning; and the development of technology-specific provisions for hybrid, RTC, and storage projects that go beyond the original solar-only framework.

4.2 SECI's Role in Central Procurement

SECI (Solar Energy Corporation of India Limited) has emerged as the dominant central procurement agency for renewable energy in India, procuring solar, wind, hybrid, RTC, and storage capacity on behalf of distribution utilities across the country. SECI's model involves: conducting competitive tenders for specified renewable energy capacity; entering into long-term PPAs with the successful bidders (as the "intermediary procurer"); and entering into back-to-back Power Sale Agreements (PSAs) with distribution utilities in various states that allocate the procured capacity and associated tariff obligations. CERC adopts the SECI PPA tariff under Section 63 (as an inter-state trading transaction under SECI's trading licence), and the state's SERC separately approves the distribution utility's procurement from SECI as consistent with applicable Tariff Policy principles and the state's RPO obligations.

SECI's model offers several advantages over state-level competitive procurement: larger tender sizes (typically 500 MW to 5,000 MW per tender) create the competitive pressure and economies of scale needed for the lowest tariff discovery; national procurement aggregates demand from multiple states, enabling efficient pooling of diverse resource zones; and SECI's stronger credit quality (backed by Central Government ownership) supports lower financing costs for developers compared to PPAs with financially weaker state distribution utilities. SECI's growing dominance in renewable energy procurement has, however, raised questions about the adequacy of state-level procurement and the risk concentration from multiple states depending on a single intermediary procurer.

4.3 Standard PPA for Renewable Energy: Key Provisions

The standard PPA for competitive renewable energy projects incorporates several key provisions that define the commercial relationship between the generator (developer) and the procurer (SECI or distribution utility) over the 25-year contract period. The scheduled commercial operation date (SCOD) provisions specify the target commissioning date for the project and the penalties (delay charges) applicable if commissioning is delayed beyond the SCOD by more than specified grace periods. The CUF/PLF guarantee provisions specify the minimum annual generation that the developer must achieve; if actual annual generation falls below the guaranteed level, the developer must pay compensation to the procurer at the specified rate per unit of shortfall.

The force majeure provisions define the categories of events that excuse performance and the procedure for claiming force majeure relief, including the notification requirements (typically within 7–14 days of the FM event), the obligation to mitigate FM impact to the extent practicable, and the consequences of prolonged FM (including potential PPA termination if FM continues beyond a specified period with specified buyout provisions). The change-in-law provisions, as discussed in Chapter H of this booklet, define the mechanism for adjusting the tariff or compensating the developer for regulatory or legislative changes that materially affect project economics after the base date. The refinancing provisions allow the developer to refinance its project debt after commissioning, with a specified sharing of refinancing gains between the developer and the procurer.

4.4 CERC Section 63 Adoption: Practice and Principles

CERC's tariff adoption proceedings under Section 63 follow a well-established procedure for verifying that the competitive bidding process was conducted in compliance with the applicable guidelines and adopting the tariff in the successfully executed PPA. CERC's review in these proceedings is not a de novo evaluation of the project economics or the tariff level, but a procedural verification that: the bidding process was open, transparent, and non-discriminatory; the RfS document and model PPA used were consistent with the applicable guidelines; the qualification criteria were applied consistently to all bidders; the L1 tariff was correctly identified and the successful bidder was selected on this basis; the executed PPA reflects the terms committed in the bid; and there are no regulatory impediments to the adoption of the tariff.

CERC will decline to adopt a tariff, or adopt it conditionally, where: the bidding process was not conducted in accordance with the guidelines; there are allegations of bid rigging, collusion, or conflict of interest that have not been satisfactorily addressed; the executed PPA deviates materially from the model PPA in ways that prejudice the interests of consumers or future procurers; or the tariff adoption would be inconsistent with CERC's regulatory mandate or applicable Tariff Policy provisions. Consumer groups and state distribution utilities that object to the tariff adoption have an opportunity to be heard before CERC, providing a

mechanism for independent scrutiny of specific procurement decisions.

CHAPTER FIVE

Offshore Wind, Hybrid, and Round-the-Clock RE: Emerging Frameworks

Offshore Wind Regulation, Hybrid Project Design, RTC Procurement, and Storage Integration

India's renewable energy sector is moving beyond conventional onshore solar and wind to more sophisticated project structures that address intermittency and expand resource diversity. This chapter examines the regulatory frameworks for these emerging categories.

5.1 Offshore Wind: Policy and Regulatory Framework

India's offshore wind energy potential, estimated at 127 GW within 200 nautical miles of the Indian coast, represents a vast untapped resource that can complement the increasingly saturated onshore wind resource zones. The Ministry of New and Renewable Energy's National Offshore Wind Energy Policy (2015) and the Offshore Wind Energy Lease Rules (2023) establish the legal framework for the development of offshore wind projects in India's Exclusive Economic Zone (EEZ) and the continental shelf. The legal complexity of offshore wind governance arises from the involvement of multiple regulatory bodies: MNRE (overall policy and offshore wind zone designation), Ministry of Earth Sciences (offshore data and meteorological support), Ministry of Shipping (maritime navigation safety), Ministry of Defence (military clearances), environmental authorities (CRZ and EIA clearances), and CERC/SERC (electricity tariff and connectivity regulation).

India's first offshore wind competitive tender, for 1 GW off the Gujarat coast, was issued by SECI in late 2023 with a tariff ceiling of Rs. 6.00 per kWh, supported by viability gap funding (VGF) to bridge the gap between the competitive tariff and the higher cost of offshore wind generation at India's current stage of offshore wind development. The VGF requirement — estimated at Rs. 6,000–8,000 crore per GW — reflects the cost premium of offshore wind over onshore renewable alternatives and requires the Central Government's budgetary support for the first generation of offshore wind projects until the technology cost curve for Indian offshore wind descends to a competitive level.

5.2 Wind-Solar Hybrid Projects

Wind-solar hybrid projects, which co-locate wind turbines and solar PV panels at the same grid connection point, take advantage of the complementary generation profiles of wind (which peaks at night and during cloudy periods in many Indian resource zones) and solar (which generates during daylight hours). By combining the two technologies at a single grid connection with a common transformer and evacuation infrastructure, hybrid projects reduce the effective per-unit cost of the shared infrastructure, achieve higher capacity utilisation of the grid connection (since the wind generation fills in during solar generation gaps), and produce a more predictable and less variable aggregate output than either technology alone.

CERC's regulatory framework for hybrid projects addresses: the determination of the "project capacity" for connectivity purposes (based on the AC capacity at the grid connection point rather than the aggregate DC capacity of the wind and solar components, since the grid connection is sized for the maximum AC output); the competitive tariff adoption under Section 63 (based on the per-unit tariff for the total energy delivered to the grid over the contract term, without distinguishing the source); and the

performance guarantee framework (based on the aggregate CUF for the hybrid project, with specific provisions for the wind and solar components). CERC has adopted tariffs for numerous hybrid projects procured by SECI under MNRE's hybrid tender programmes, establishing a growing body of regulatory precedent for this technology category.

5.3 Round-the-Clock Renewable Energy: Legal Framework

Round-the-Clock (RTC) renewable energy projects — which commit to supply a contracted quantum of renewable electricity on a continuous 24×7 basis, meeting a specified minimum supply level in every hour of every day throughout the year — represent the most commercially ambitious category of renewable energy procurement in India. The RTC obligation requires the developer to design and operate a portfolio of wind, solar, and battery/pumped storage capacity that collectively provides near-continuous supply regardless of the variability of individual renewable resources. Achieving the RTC obligation requires: sufficient wind and solar capacity to generate the contracted quantum on average; sufficient storage capacity to bridge the gaps between renewable generation and contracted supply; and sophisticated energy management systems to optimise the dispatch of the combined wind-solar-storage portfolio.

The legal and commercial structure of an RTC PPA differs from a conventional renewable energy PPA in several important respects. The contracted quantum is specified as a firm supply obligation (typically expressed in MW of contracted power or GWh per year), and the developer bears a commercial obligation to deliver this supply or pay penalty for shortfall. The tariff for the RTC PPA reflects the higher cost of the combined wind-solar-storage portfolio relative to a simple solar or wind project, and is specified per unit of the contracted supply rather than per unit of total generation. The force majeure and change-in-law provisions must be calibrated to the specific risks of RTC projects, including the risk of regulatory changes affecting storage technology costs and the risk of battery degradation reducing the storage component's reliability over the contract term.

5.4 Storage Integration: Legal and Regulatory Framework

The integration of battery energy storage systems (BESS) into India's electricity sector is creating a new regulatory frontier that requires simultaneous adaptation of the tariff framework (to enable cost-effective competitive procurement of storage services), the grid code (to accommodate the unique technical characteristics of battery inverter-based resources), the ancillary services market (to value storage's rapid response capabilities), and the distribution network framework (to enable distributed storage and vehicle-to-grid applications). CERC has been progressively developing each of these regulatory dimensions through consultation papers, draft regulations, and specific tariff adoption orders for storage projects procured by SECI and distribution utilities.

The competitive procurement of standalone BESS under CERC's Section 63 framework has established important precedents. The tariff structure adopted by CERC for storage projects typically involves a capacity charge (per MW of power capacity) covering the capital cost recovery and a variable charge (per MWh of energy discharged) covering operating costs. The competitive bidding for storage capacity has discovered tariffs declining from approximately Rs. 8–10 crore per MWh of energy capacity in early procurements (2019–20) to below Rs. 6 crore per MWh in more recent tenders, reflecting the dramatic global decline in lithium-ion battery costs and the increasing competition among storage developers in Indian tenders.

CHAPTER SIX

Green Hydrogen, Carbon Markets, and the Renewable Energy Future

NGHM, Carbon Credit Trading Scheme, International Climate Law, and India's Energy Transition

India's renewable energy sector is at the forefront of a transformative energy transition with global implications. This chapter examines the emerging legal frameworks for green hydrogen, carbon markets, and the international climate law dimension of India's renewable energy programme.

6.1 National Green Hydrogen Mission: Legal Architecture

The National Green Hydrogen Mission (NGHM), launched in January 2023 with an initial outlay of Rs. 19,744 crore, establishes the policy framework for India to become a leading producer and exporter of green hydrogen. The NGHM targets the production of at least 5 million metric tonnes (MMT) of green hydrogen per year by 2030, requiring an estimated 125 GW of dedicated renewable energy capacity and significant investment in electrolyser manufacturing, distribution infrastructure, and end-use applications. The legal architecture of the NGHM spans multiple regulatory domains: the Electricity Act, 2003 (for the renewable electricity that powers electrolysers); the Energy Conservation Act, 2001 (for the energy efficiency standards for electrolysers); the Petroleum Act and Gas Cylinder Rules (for hydrogen storage and transportation safety); and the Environment Protection Act, 1986 (for the environmental clearances required for large green hydrogen production facilities).

MNRE has issued Guidelines for Green Hydrogen/Green Ammonia Policy specifying: the renewable energy procurement options for green hydrogen producers (dedicated renewable capacity, open access procurement from the grid, or a combination); the ISTS transmission charge exemption for renewable electricity used in hydrogen production; the banking arrangements for surplus renewable energy; and the RPO treatment of electricity consumed in electrolysis. These guidelines address the key regulatory barriers to green hydrogen economics, reducing the delivered cost of renewable electricity to electrolysers and providing the regulatory framework within which bankable green hydrogen project investments can be structured.

6.2 Energy Conservation (Amendment) Act 2022: Carbon Markets

The Energy Conservation (Amendment) Act, 2022 amended the Energy Conservation Act, 2001 to introduce the Carbon Credit Trading Scheme (CCTS) as India's first domestic carbon market. The CCTS creates a legal framework for: the designation of "obligated entities" (large energy-consuming industries and electricity generators above specified thresholds) whose greenhouse gas emissions are subject to the scheme; the specification of sector-specific "intensity targets" (baseline emissions intensity levels against which actual performance is measured); the issuance of "carbon credit certificates" to entities whose emissions intensity is below the baseline (reflecting a net reduction in emissions); and the trading of carbon credit certificates on designated trading platforms (initially the Power Exchanges). Entities whose emissions intensity exceeds the baseline must purchase carbon credits to cover their excess emissions.

The CCTS's intersection with the electricity tariff regulatory framework is significant. Thermal power generators who operate more efficiently than their sector baseline will earn carbon credits, providing an additional revenue stream on top of their tariff

income. Inefficient thermal generators whose emissions exceed the baseline will bear additional costs from purchasing carbon credits, increasing their effective fuel cost and potentially reducing their competitiveness in the energy market merit order. Renewable energy generators, which have zero direct greenhouse gas emissions, can earn carbon credits in proportion to the fossil fuel generation they displace (on a methodology specified by the Bureau of Energy Efficiency). Over time, the CCTS will create progressive financial incentives for the decarbonisation of the electricity sector, complementing the tariff regulatory incentives for renewable energy deployment.

6.3 International Climate Law and India's Electricity Sector

India's commitments under international climate law — particularly the Paris Agreement's framework of Nationally Determined Contributions (NDCs) and the net zero emissions goal by 2070 announced at COP26 — have profound implications for the electricity sector's long-term development trajectory. The Paris Agreement's Article 6, which creates a framework for international trading of greenhouse gas emission reductions (the successor to the Kyoto Protocol's Clean Development Mechanism), potentially allows India to generate internationally tradeable emission reduction units from its renewable energy projects and sell them to countries with more ambitious emission reduction commitments. The development of a credible CCTS and the integration of Indian renewable energy projects into Article 6 mechanisms could generate significant additional revenue for Indian renewable developers and contribute to making India a global leader in the emerging carbon credit market.

The legal framework for India's participation in Article 6 transactions is being developed by the Ministry of Environment, Forest and Climate Change and the Bureau of Energy Efficiency, in consultation with the Ministry of Power and the Ministry of Finance. Key issues include: the accounting for Article 6 transactions in India's NDC (ensuring that emission reductions sold internationally are not also counted in India's domestic NDC progress); the selection and verification methodology for emission reductions from renewable energy projects; the authorisation process for Article 6 transactions; and the revenue sharing between the Indian government and the project developers whose emission reductions are sold internationally. The resolution of these issues will determine the commercial value of Article 6 participation for India's renewable energy sector.

6.4 Rooftop Solar and Prosumer Regulation

The PM Surya Ghar Muft Bijli Yojana (PMSGMBY), launched in February 2024, targets the installation of rooftop solar systems in 1 crore (10 million) residential households, with government subsidies of Rs. 30,000–78,000 per installation depending on system size. This programme is expected to significantly increase the population of electricity prosumers in India, creating a large and dispersed distributed energy resource that the distribution network must accommodate through appropriate net metering frameworks, reactive power management, and distribution network management protocols.

The regulatory framework for rooftop solar and prosumer management has been developed by SERCs through their net metering regulations, which specify: the eligible consumer categories and maximum system size for net metering (typically up to the sanctioned load of the domestic consumer); the settlement period for net metering credits (monthly or annually); the applicable credit rate for surplus generation exported to the grid; the technical requirements for the grid-interactive solar inverter and the bidirectional meter; and the interconnection standards for rooftop solar installations of different sizes. The development of a comprehensive and commercially attractive net metering framework — including a fair credit rate for exported generation and streamlined application processes — is a critical enabler for the PMSGMBY's ambitious installation targets.

6.5 Regulatory Outlook: India's Renewable Energy at Scale

India's renewable energy sector faces a set of regulatory challenges commensurate with the extraordinary scale of the expansion underway. The regulatory framework must simultaneously: enable the rapid competitive procurement of the 45–50 GW of new renewable capacity needed annually to meet the 2030 target; manage the integration of this growing renewable capacity into the electricity grid without compromising supply reliability; develop the storage, flexibility, and smart grid infrastructure needed for a high-renewable electricity system; ensure the financial sustainability of distribution utilities as they absorb large volumes of competitively priced renewable electricity; and create the emerging regulatory frameworks for green hydrogen, carbon markets, and offshore wind that will shape the next phase of India's energy transition. The quality and adaptability of the legal and regulatory framework — the Electricity Act, 2003, the CERC and SERC regulatory architecture, and the policy direction of the Central Government — will be decisive in determining whether India can achieve its ambitious renewable energy and climate goals while maintaining affordable and reliable electricity for its 1.4 billion people.

> **Booklet III Key Takeaways:** India's renewable energy legal framework rests on the Electricity Act, 2003's provisions for RPO, competitive procurement (Section 63), and grid access, implemented through CERC regulations, Central Government bidding guidelines, and SECI's procurement architecture. The 500 GW target by 2030 requires not only continued cost reduction in solar and wind but the development of new frameworks for offshore wind, hybrid and RTC projects, storage, green hydrogen, and carbon markets. Practitioners must navigate a complex, rapidly evolving multi-level framework spanning electricity regulation, environmental law, carbon markets, and international climate commitments.

EXTENDED ANALYSIS

Renewable Energy Law: Deep Dives and Emerging Issues

Wind Policy, Land Acquisition, IREDA, PPAs, Environmental Law, and Cross-Border Trade

A.1 Wind Energy Policy: From State Feed-in Tariffs to National Competitive Procurement

India's wind energy sector preceded solar in scale and regulatory development, with significant capacity additions beginning in Tamil Nadu in the early 1990s under state government incentive programmes. The Tamil Nadu Electricity Board (now Tamil Nadu Generation and Distribution Corporation, TANGEDCO) and the Tamil Nadu Wind Energy Corporation facilitated the development of wind farms in Muppandal, Kayathar, and other windy districts of Tamil Nadu, creating the first substantial commercial wind energy portfolio in India. Karnataka and Andhra Pradesh followed with their own wind development programmes, and Gujarat emerged as the second major wind state in the mid-2000s with the development of the Kutch and Saurashtra wind resource zones.

The state-level feed-in tariff (FiT) system, under which SERC-determined cost-based tariffs were paid to wind generators for electricity sold to the state distribution utility, was the dominant procurement mechanism for wind energy until the introduction of competitive bidding in 2017. The FiT system provided the revenue certainty needed to attract private investment in wind development but suffered from several structural weaknesses: FiT levels were often set without rigorous cost benchmarking, resulting in either insufficient FiTs that discouraged investment in unfavourable resource zones or excessive FiTs that provided windfall profits to generators in premium resource locations; the FiT was a per-unit payment with no capacity availability obligation, creating no incentive for generating companies to maximise their plant availability; and the FiT system provided no competitive pressure for cost reduction, in contrast to the dramatic tariff reduction achieved through competitive bidding after 2017.

The transition from FiTs to competitive bidding for wind energy was enabled by the growing maturity of the wind technology market in India (with a well-established domestic wind turbine manufacturing industry led by Suzlon, Inox Wind, and the Indian subsidiaries of Vestas, GE, Siemens Gamesa, and Envision) and by the Central Government's decision to use SECI as the competitive procurement vehicle for wind energy on a national scale. SECI's Wind Tranche-I tender in 2017, which procured 1,000 MW at tariffs of Rs. 3.46 per kWh, marked the beginning of the competitive procurement era for Indian wind energy. The subsequent wind procurement tranches by SECI and state renewable energy agencies have progressively driven wind tariffs towards Rs. 2.80–3.20 per kWh, significantly below the cost-based FiTs of the pre-2017 period.

A.2 Land Acquisition for Renewable Energy: Legal Framework and Challenges

Land acquisition for large-scale renewable energy projects — utility-scale solar parks (typically requiring 5 acres per MW, or approximately 5,000 acres for a 1,000 MW solar park) and wind farm development (requiring 20–25 acres per MW for the turbine pads, internal roads, and exclusion zones, though the land between turbines can often continue to be used for agriculture or grazing) — is one of the most legally complex and practically challenging aspects of renewable energy development in India. The legal framework for land acquisition spans multiple statutes: the Right to Fair Compensation and Transparency in Land

Acquisition, Rehabilitation and Resettlement Act, 2013 (LARR Act, for compulsory acquisition of private land for public purposes); state land revenue laws (for the assignment of government wasteland to solar and wind projects); the Forest Conservation Act, 1980 (for the use of forest land for renewable energy projects); and the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (for the use of tribal lands for renewable energy development).

The LARR Act, 2013, which replaced the colonial-era Land Acquisition Act, 1894, significantly increased the cost and timeline for compulsory land acquisition by: requiring a Social Impact Assessment (SIA) before the issuance of a land acquisition notification; introducing enhanced compensation standards (including a multiplier of up to two times the market value for rural land and replacement value principles for urban land); specifying mandatory rehabilitation and resettlement provisions for displaced families; and requiring consent of 70–80 per cent of affected families for acquisition in certain categories of projects. These enhanced requirements have made compulsory land acquisition significantly more expensive and time-consuming than under the predecessor legislation, prompting renewable energy developers to rely predominantly on voluntary land purchase or long-term lease arrangements rather than compulsory acquisition.

State government facilitation of land for solar and wind projects has been a critical enabler of large-scale renewable development. The Rajasthan government's Solar Park Policy, the Gujarat government's Solar Park Guidelines, the Andhra Pradesh Solar Policy, and similar state frameworks have designated large areas of government wasteland (revenue land with low agricultural productivity) for solar park development, making land available to developers at specified lease rates and removing the need for individual developers to navigate complex land acquisition processes. The success of these state land facilitation frameworks in enabling the rapid development of India's largest solar parks — including the Bhadla Solar Park in Rajasthan (2,245 MW), the Pavagada Solar Park in Karnataka (2,050 MW), and the Charanka Solar Park in Gujarat (590 MW) — demonstrates the value of government land facilitation in overcoming the land constraint on renewable energy development at scale.

A.3 Indian Renewable Energy Development Agency (IREDA): Financing Architecture

The Indian Renewable Energy Development Agency Limited (IREDA), established in 1987 as a Non-Banking Financial Company (NBFC) under the Ministry of New and Renewable Energy, provides specialised long-term debt financing for renewable energy and energy efficiency projects. IREDA's mandate as a "dedicated" financial institution for the sector gives it deeper technical expertise in renewable project assessment, greater risk appetite for newer technologies (such as offshore wind and green hydrogen), and longer loan tenors (up to 20–25 years, compared to the typical 12–15 year tenors offered by commercial banks) that better match the long-term cashflow profile of renewable energy infrastructure. IREDA's initial public offering (IPO) in November 2023, which listed IREDA's shares on the BSE and NSE, significantly improved its capital base and its ability to raise funds from the capital market for on-lending to renewable energy projects.

IREDA's principal lending products include: project finance term loans for solar, wind, biomass, small hydro, and storage projects; refinancing facilities for renewable energy loans originated by commercial banks and NBFCs; direct lending for rooftop solar installations to residential, commercial, and industrial consumers; and viability gap funding (VGF) administration for specific government-supported programmes including the PMSGMBY and offshore wind development. IREDA's lending operations complement those of PFC and REC (which focus primarily on large central and state sector projects) by providing tailored financing to smaller private sector renewable developers and to technology categories where mainstream commercial bank financing may be constrained by risk appetite limitations.

A.4 Environmental Law Interface with Renewable Energy

The development of large-scale renewable energy projects in India requires compliance with a comprehensive framework of environmental and forest clearances under the Environment (Protection) Act, 1986 (EPA) and the Forest Conservation Act, 1980 (FCA). The Environmental Impact Assessment (EIA) process, governed by the EIA Notification 2006 under the EPA, requires large renewable energy projects (above specified capacity thresholds) to undergo a rigorous environmental assessment process including: preparation of an Environment Impact Assessment report by an accredited consultant; public consultation with local communities in the project area; appraisal by the Expert Appraisal Committee (EAC) of the Ministry of Environment, Forest and Climate Change; and issuance of an Environmental Clearance (EC) from the relevant authority (MoEFCC for large projects, SEIAA for smaller projects).

Solar energy projects, which were initially exempted from mandatory EIA requirements on the basis that they have minimal environmental impact, have progressively been brought within the EIA framework as the scale of individual projects has grown and the cumulative environmental impact of large solar parks has become a matter of regulatory concern. Large solar parks above 500 MW capacity are now required to undergo EIA, addressing issues including: the impact on biodiversity (particularly for projects in or near wildlife habitats and biodiversity hotspots); the impact on local hydrology and land use (particularly for projects that involve large-scale land clearance and grading); the impact on local communities (including the displacement of grazing lands, the disruption of traditional land use patterns, and the visual impact of large solar arrays); and the management of solar panel waste at end-of-life (a growing concern given the large volumes of solar panels that will reach end-of-life in the 2035–2045 period).

The Forest Conservation Act (FCA), 1980 regulates the diversion of forest land for non-forest purposes, including renewable energy projects. Transmission lines for renewable energy evacuation frequently cross forest areas, requiring Stage I (in-principle) and Stage II (final) forest clearances from the Ministry of Environment, Forest and Climate Change or the State Forest Department, depending on the size of the forest area to be diverted. The Compensatory Afforestation Fund Act, 2016 (CAMPA) requires that forest area diverted for development projects be compensated by planting of an equivalent area of forest elsewhere, with the developer required to deposit the full cost of compensatory afforestation in the CAMPA fund before forest diversion can be approved. The cost and delay associated with forest clearances for transmission infrastructure is a significant constraint on the timely commissioning of renewable energy projects in forest-rich states and has been identified as a priority area for regulatory streamlining in the Ministry of Power's renewable energy facilitation initiatives.

A.5 Biomass and Small Hydro: Regulatory Framework

Biomass and small hydroelectric generation — two of the original non-solar, non-wind renewable energy categories that have been part of India's renewable energy programme from its inception — have distinct regulatory characteristics and challenges that differ significantly from the solar and wind frameworks that now dominate public and regulatory attention.

Biomass electricity generation uses agricultural residues, wood chips, municipal solid waste, or purpose-grown energy crops as fuel in dedicated boilers or gasifiers that produce steam or syngas for electricity generation. Biomass projects are regulated under CERC's Terms and Conditions of Tariff Regulations for Renewable Energy Generating Stations (under Section 62) or through competitive bidding under Section 63, depending on the procurement mechanism used. The key regulatory parameters for biomass tariff determination include: the normative capital cost (which varies with the biomass feedstock and technology used);

the normative plant load factor (PLF, typically 80–85 per cent for biomass projects); the applicable fuel cost (biomass fuel prices are determined by local market conditions and vary significantly across feedstock types and geographies); and the O&M expense norms. The fuel supply risk is the primary commercial challenge for biomass projects: biomass fuel prices are volatile, dependent on agricultural commodity markets, and subject to seasonal and geographical availability constraints that can significantly affect project economics.

Small hydroelectric projects (up to 25 MW installed capacity) are classified as renewable energy under India's regulatory framework (large hydro above 25 MW is not classified as renewable for RPO purposes, though it generates clean electricity). The development of small hydro projects in Himachal Pradesh, Uttarakhand, Jammu & Kashmir, and the northeastern states is facilitated by MNRE's Hydro Power Development Policy and by state government policies that designate eligible rivers and streams for small hydro development. The regulatory framework for small hydro tariff determination involves CERC (for inter-state projects above 25 MW) or the relevant SERC (for intra-state projects), applying cost-based tariff principles similar to those for large hydro but with specific small hydro normative parameters. Small hydro projects face distinctive development challenges including: seasonal flow variability (limiting generation to the monsoon and post-monsoon period for run-of-river schemes); environmental flow requirements (which may reduce the water available for power generation); the complexity of water rights and inter-state water sharing agreements in multi-state river basins; and geological risks in Himalayan hydroelectric sites.

A.6 Cross-Border Renewable Energy Trade

India's growing renewable energy capacity, combined with the development of the South Asian regional power market, is creating opportunities for cross-border renewable energy trade that could benefit both India and its neighbours. Bhutan's large hydroelectric potential (over 30 GW of developable capacity, of which approximately 2.3 GW is currently operational and several thousand MW are under development) has been the primary source of cross-border renewable energy flows, with India importing firm hydroelectric power from Bhutan under long-term bilateral agreements that have been in place since the 1980s.

The regulatory framework for cross-border renewable energy trade in the South Asian context involves: CERC's Guidelines for Cross-Border Trade of Electricity, which specify the commercial and settlement framework for bilateral electricity trade between India and its neighbours; bilateral power trade agreements between India and specific neighbouring countries (Bhutan, Nepal, Bangladesh), which establish the commercial terms for electricity trade and the institutional arrangements for cross-border power transmission; and the emerging multilateral framework under SAARC and BIMSTEC for regional energy cooperation, which aims to create a South Asian regional power market with common technical standards and commercial arrangements. The development of cross-border renewable energy trade is constrained by the political complexity of bilateral energy relationships (particularly with Pakistan, which has significant renewable energy potential but with whom energy trade is currently very limited), the technical challenges of interconnecting national grids with different standards and operating practices, and the regulatory complexity of cross-border electricity trade involving multiple national regulatory jurisdictions.

The SAARC Framework Agreement for Energy Cooperation (Electricity), signed in 2014, provides the political framework for expanding cross-border electricity trade in South Asia. India's CERC has been the primary technical anchor for developing the regulatory framework for cross-border trade, and CERC's cross-border guidelines are the authoritative domestic regulatory instrument for the commercial and settlement aspects of India's international electricity trade. As the renewable energy surplus in Nepal (seasonal hydropower) and the demand for clean energy in Bangladesh grows, the volume and commercial sophistication of

cross-border renewable energy trade is expected to increase significantly in the coming years, requiring progressive strengthening of the regulatory framework to support larger and more commercially complex transactions.

A.7 Renewable Energy Certificates: Market Evolution and Regulatory Reforms

The Renewable Energy Certificate (REC) market has undergone substantial evolution since its inception in 2011, reflecting the progressive development of India's renewable energy sector, the changing policy context for RPO enforcement, and CERC's periodic revisions to the REC framework to address market design deficiencies. The REC market's performance can be assessed along three dimensions: price efficiency (whether REC prices reflect the supply and demand fundamentals of the renewable energy attribute market); liquidity (whether there is sufficient trading volume and market participation to enable efficient price discovery and position management by obligated entities and renewable generators); and compliance effectiveness (whether the REC mechanism is successfully driving RPO compliance among obligated entities).

Price efficiency in the REC market has been constrained by the floor and forbearance price framework that CERC specified in the initial REC Regulations, which set REC prices within a regulated band rather than allowing them to be determined purely by supply and demand. The initial floor prices (Rs. 1.50 per unit for non-solar RECs, Rs. 9.30 per unit for solar RECs) and forbearance prices (Rs. 3.39 per unit for non-solar, Rs. 17.00 per unit for solar in the early period) were set at levels that did not reflect market conditions, resulting in periods of price discontinuity (when market clearing prices hit the floor or forbearance price) that distorted the REC market's informational efficiency. CERC has progressively reduced and rationalised the price band, and the Green Market segments introduced in 2021 provide an alternative price discovery mechanism for renewable energy attributes that is more directly market-based.

Liquidity in the REC market has been affected by the uncertainty about RPO enforcement, which is the primary source of demand for RECs. When obligated entities are uncertain whether the SERC will enforce their RPO or penalise non-compliance, they have less incentive to proactively procure RECs to meet their targets, reducing the demand side of the REC market. The strengthening of RPO enforcement — through the FoR's common framework, APTEL's enforcement orders, and the Ministry of Power's periodic monitoring of DISCOM RPO compliance — is expected to improve REC market liquidity as obligated entities face credible regulatory consequences for non-compliance.

A.8 Renewable Energy and Consumer Choice: Green Tariff Options

The growing demand from commercial and industrial consumers for green electricity — electricity demonstrably sourced from renewable energy — is creating a new market dimension for renewable energy regulation. Corporate sustainability commitments, including Science-Based Targets (SBTi), RE100 pledges, and environmental, social, and governance (ESG) reporting requirements, are driving large industrial and commercial consumers to seek renewable electricity procurement as a demonstration of environmental responsibility. The regulatory framework must accommodate this consumer demand for green electricity while ensuring that the underlying renewable energy attributes are not double-counted (claimed by both the consumer and the national RPO compliance framework).

CERC and the SERCs have developed green tariff options for eligible consumers through several mechanisms: the Green Day-Ahead Market and Green Term-Ahead Market on the power exchanges, which allow consumers to purchase electricity with a

green attribute in a single market transaction; the open access framework, which enables large consumers to procure green electricity directly from renewable generators under bilateral contracts; the group captive framework, which allows multiple consumers to jointly invest in renewable generation capacity and consume the output under captive arrangements; and the net metering framework for smaller consumers with rooftop solar installations. The regulatory challenge is to ensure that each unit of green electricity consumed by a corporate purchaser is supported by a unique renewable energy attribute claim that is not also used to satisfy a distribution utility's RPO obligation, maintaining the environmental integrity of the green electricity market.

A.9 Renewable Energy and Power System Security

The large-scale integration of variable renewable energy — solar and wind — into India's electricity grid creates challenges for power system security that require both technical and regulatory responses. Power system security concerns arising from high renewable penetration include: frequency stability (the risk that rapid changes in renewable output cause frequency deviations beyond the acceptable range of 49.90–50.05 Hz specified in the Grid Code); voltage stability (the risk that reactive power requirements for voltage support cannot be met in network areas with high concentration of inverter-based renewable resources); inertia reduction (the replacement of conventional synchronous generators with inverter-based resources reduces the system's kinetic energy reserve, making frequency deviations larger and faster after a generation trip); and ramping challenges (the steep "duck curve" in the net load after subtracting solar generation from total demand requires the remaining conventional and flexible generation to ramp up rapidly in the evening hours as solar generation falls).

CERC's response to these power system security challenges has involved: revisions to the Grid Code specifying requirements for inverter-based resources to provide synthetic inertia, fast frequency response, and reactive power support; development of the ancillary services market to procure and compensate flexibility services from generators, storage, and demand response; and investment in the operational capabilities of POSOCO (the National Load Despatch Centre) for managing a high-renewable grid including advanced forecasting tools for wind and solar generation, improved scheduling and despatch processes, and enhanced monitoring of grid frequency and voltage.

A.10 Future of Renewable Energy Regulation: 2030 and Beyond

India's renewable energy regulatory framework will need to continue evolving rapidly as the country approaches and surpasses the 500 GW target. The key regulatory priorities for the 2025–2030 period include: completing the development and implementation of the comprehensive storage procurement and market participation framework; finalising the regulatory framework for offshore wind, including the offshore transmission infrastructure, the environmental monitoring requirements, and the environmental remediation obligations; developing the regulatory architecture for green hydrogen production, distribution, and export; implementing the Carbon Credit Trading Scheme and integrating it with the electricity sector's renewable energy framework; and strengthening the RPO enforcement framework to ensure effective mandatory demand for renewable energy across all obligated entities.

Beyond 2030, as India moves towards its 2070 net zero commitment, the electricity sector will need to achieve near-complete decarbonisation, requiring: the near-total replacement of coal-based generation with renewable energy and storage; the development of advanced nuclear energy (including small modular reactors) for firm low-carbon baseload supply; the large-scale development of green hydrogen for industrial and transport decarbonisation; and the electrification of most thermal energy uses

(space heating, process heat, and transportation) that are currently met by fossil fuels. The legal and regulatory framework for this deep decarbonisation will need to address energy access and affordability in the context of the massive infrastructure transition, the financial implications for stranded fossil fuel assets and their owners, the just transition for workers and communities dependent on the fossil fuel sector, and the international cooperation needed to share the technology and finance required for a global energy transition.

India's renewable energy regulatory framework has demonstrated remarkable adaptability since the enactment of the Electricity Act, 2003, evolving from a framework primarily designed for cost-based regulation of conventional electricity infrastructure to one that enables competitive, market-based procurement of renewable energy at global scale. The institutional architecture of CERC, the SERCs, SECI, IREDA, and the Forum of Regulators provides the governance framework within which this continued evolution must occur. Practitioners who understand this framework — its legal foundations, regulatory instruments, institutional actors, and jurisprudential principles — are well-positioned to advise the generators, procurers, investors, and policymakers who are building India's clean energy future.

EXTENDED ANALYSIS II

Renewable Energy Law: Case Studies, Disputes, and Advanced Topics

Landmark Decisions, Project Finance, Interconnection Standards, and Policy Implementation

B.1 Section 86(1)(e) RPO: Constitutional Validity and Scope

The constitutional validity of Section 86(1)(e)'s RPO mandate was challenged before several High Courts on the grounds that it imposed an unreasonable restriction on the distribution licensee's freedom to procure electricity from the least-cost source (Article 19(1)(g)) and constituted an unconstitutional delegation of legislative power by requiring the SERC to specify RPO percentages without adequate legislative guidance. Courts uniformly upheld the constitutional validity of the RPO mandate, holding that: the promotion of renewable energy is a legitimate regulatory objective serving the public interest in energy security, environmental protection, and the promotion of clean technology; the restriction on least-cost procurement is a reasonable restriction under Article 19(6) given the overriding public interest in transitioning to clean energy; and the legislative guidance for RPO specification is adequately provided by the Act's objectives and the National Electricity Policy, making the delegation to the SERC constitutionally valid under the established test for legislative delegation.

The scope of RPO obligations has been progressively expanded through SERC regulations to cover: distribution licensees (the primary obligated entities under Section 86(1)(e)); open access consumers above a specified load threshold; captive power plant owners (who consume electricity from their own generating capacity rather than from the distribution licensee); and most recently, through the Ministry of Power's RPO trajectory notification, all obligated entities are required to fulfil a specific minimum RPO in each year up to 2030. The inclusion of open access consumers and captive users in the RPO framework is legally grounded in the SERCs' general regulatory authority under Section 86 to specify conditions for the development of electricity within the state, though it has been challenged by some consumer groups on the grounds that Section 86(1)(e) specifically refers to "distribution licensees" as the RPO-obligated entity.

B.2 Competitive Bidding: Dispute Resolution and Remedies

The competitive bidding process for renewable energy procurement has been the subject of numerous regulatory and legal disputes, reflecting both the high commercial stakes of individual tender outcomes and the novelty of the legal questions arising in an evolving procurement framework. Major categories of disputes in competitive bidding proceedings include: qualification disputes (challenging the procurer's decision to reject a bidder on qualification grounds); tariff computation disputes (challenging the calculation of the levelised tariff for bids with escalating or non-uniform tariff structures); evaluation disputes (challenging the process by which bids were evaluated and ranked); procurement contract disputes (challenging the terms of the PPA offered to the successful bidder); and adoption disputes (challenging CERC's decision to adopt or conditionally adopt the competitively discovered tariff).

CERC has developed a consistent approach to resolving procurement disputes in its Section 63 adoption proceedings: it focuses on whether the procurement process was conducted in substantial compliance with the applicable guidelines, rather than

substituting its own judgment for that of the procurer on detailed evaluation questions. Where the procurement process has been conducted in substantial compliance with guidelines and there is no evidence of discrimination or bad faith, CERC will adopt the tariff even if the process had minor procedural imperfections. CERC will decline to adopt, or will refer for re-procurement, only where material violations of the guidelines are established — including demonstrated collusion, conflict of interest, or systematic discrimination in the evaluation process.

B.3 Renewable Energy Project Finance: Key Legal Issues

The project financing of renewable energy projects involves a set of legal structures and instruments that have become progressively standardised as the industry has matured. The typical legal structure for a large utility-scale solar or wind project involves: a Special Purpose Vehicle (SPV) incorporated to own and develop the project; equity contributed by the developer and, in some cases, by infrastructure funds, multilateral development bank equity windows, and strategic investors; project debt from a consortium of banks or from IREDA, PFC, or REC as development finance institution lenders; and the PPA with SECI or the state distribution utility as the primary off-take revenue security. The SPV structure isolates the project's assets and revenues from the developer's other activities, providing lenders with a cleaner security package and enabling more efficient project finance documentation.

The primary security for renewable energy project finance comprises: a first charge on the SPV's fixed assets (land, solar panels, mounting structures, invertors, transformers, evacuation line, and substation); assignment of the PPA and all project contracts (including EPC contracts, O&M agreements, and insurance policies) in favour of the lenders; pledge of the developer's shares in the SPV; a DSRA (Debt Service Reserve Account) funded with 3-6 months' debt service equivalent; and an Escrow Agreement governing the application of PPA revenues, including the waterfall priority under which PPA revenues are applied first to O&M costs, then to debt service, then to the DSRA top-up, and only then released to the developer as equity return. Lenders typically also seek a state government guarantee or LC from the distribution utility procurer to backstop the PPA payment obligation, supplemented by a tripartite agreement in the case of central sector projects.

B.4 Renewable Energy and Insolvency: Emerging Issues

Several renewable energy projects — particularly from the first and second generation of Indian solar and wind development (2010–2015) — have encountered financial distress as a result of: development-era construction cost overruns; higher-than-anticipated interest costs arising from refinancing of development-period bridge loans into more expensive term debt; operation-era CUF shortfalls that reduced actual generation below the guaranteed level; and (in some cases) payment disputes with distribution utility procurers that caused revenue shortfalls. Some of these distressed projects have been referred to the IBC resolution process, creating the renewable-energy-specific insolvency issues discussed in Booklet II's analysis of the electricity sector-IBC interface.

The key renewable-energy-specific insolvency issues include: the treatment of the long-term PPA as a critical contract that the resolution applicant (new investor) intends to continue (requiring CERC's consent for the transfer of generation licence to the new owner through the resolution process); the valuation of the project assets and the PPA for resolution plan purposes (which requires assessing the NPV of the PPA's remaining tariff payments, the condition of the project equipment, and the cost of any required capital expenditure to restore the project to full functionality); and the treatment of any accrued but unpaid PPA

receivables as part of the resolution plan's debt structure. NCLT and the National Company Law Appellate Tribunal (NCLAT) have developed an evolving jurisprudence on these issues, and the Supreme Court's decisions on electricity sector insolvency provide the overarching legal framework.

B.5 Grid-Interactive Solar: From Utility-Scale to Distributed

The legal and regulatory framework for solar energy covers a spectrum from the very large (500 MW+ utility-scale solar parks connected to the ISTS) to the very small (1–10 kW rooftop solar installations on residential buildings). This spectrum requires a correspondingly diverse set of regulatory instruments: the ISTS connectivity and GNA framework for large projects; the state transmission utility's connectivity framework for medium-scale projects connected to the intra-state transmission system; the distribution network connectivity regulations for smaller projects; and the net metering framework for residential rooftop solar. Each layer of this connectivity framework must be technically and commercially consistent with the others, ensuring that solar generators of all sizes can access the grid efficiently and that the commercial settlement of their electricity sales or self-consumption is clear and enforceable.

The PM Surya Ghar Muft Bijli Yojana (PMSGMBY) targets 1 crore residential rooftop solar installations, representing potentially 10,000–30,000 MW of distributed solar capacity, with direct government subsidies of Rs. 30,000–78,000 per installation. The regulatory implementation of PMSGMBY requires each SERC to: specify net metering regulations consistent with the Ministry of Power's framework (including a minimum credit rate for exported generation, streamlined approval and connection processes, and consumer protection standards for billing disputes); update their distribution licensee performance standards to include targets for rooftop solar connection processing; and develop regulatory accounting guidelines for the treatment of rooftop solar imports in the distribution utility's energy accounts and tariff proceedings.

B.6 International Regulatory Comparisons: Lessons for India

India's renewable energy regulatory framework has developed largely in parallel with, rather than in direct emulation of, the renewable energy regulatory experience of other major economies. However, several international regulatory models offer lessons that may be relevant for the continuing evolution of India's framework.

Germany's Energiewende (energy transition) programme, which has achieved 50+ per cent renewable electricity penetration through a combination of feed-in tariffs (for earlier projects), competitive auctions (for more recent projects), and a comprehensive grid expansion and balancing programme, provides lessons on: the management of the political economy of energy transition (including the impact of rising electricity tariffs on industrial competitiveness and household affordability); the design of auction mechanisms that maintain competition while providing sufficient revenue certainty for project finance; the importance of grid infrastructure investment keeping pace with renewable capacity addition; and the need for flexible balancing mechanisms (including demand response, interconnection with neighbouring countries, and increasingly, battery storage) to manage the variability of a high-renewable electricity system.

China's renewable energy regulatory experience — which has produced the world's largest solar (700+ GW) and wind (400+ GW) capacity additions through a combination of feed-in tariffs, competitive auctions, RPO requirements, and massive manufacturing subsidies — demonstrates that the scale economies achievable in manufacturing and project development can drive cost

reductions faster than even the most ambitious regulatory projections, and that price discovery through competitive markets is a powerful driver of cost efficiency when applied consistently and at scale. China's experience also illustrates the risks of overshooting: the rapid pace of renewable capacity addition has produced periods of high curtailment (particularly in northern China) where the transmission infrastructure and grid flexibility mechanisms have not kept pace with generation growth, resulting in significant wasted renewable energy.

Booklet III: Comprehensive Coverage Summary

This booklet has examined India's renewable energy legal and regulatory framework in depth, covering: the historical evolution from the MNES era to the current 500 GW programme; the RPO mandate and REC mechanism; grid connectivity and transmission architecture including the GNA Regulations 2022 and ISTS waiver; the competitive procurement framework under Section 63 and the SECI model; emerging categories including offshore wind, hybrid, RTC, and storage; and the frontier issues of green hydrogen, carbon markets, and climate law. Extended analyses have addressed wind policy evolution, land acquisition challenges, IREDA financing, environmental law, biomass and small hydro, cross-border trade, REC market reform, green tariff options, power system security, and international comparisons. Together these analyses provide a comprehensive reference for practitioners advising on all aspects of India's renewable energy law and regulation.