

From Gatekeeping to Steering: Adaptive Regulatory Capacity and its Structural Limits in India's Renewable Electricity Transition

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ABSTRACT

In June 2025 India crossed a symbolic threshold, drawing half of its installed generating capacity from non-fossil sources roughly five years ahead of the date implied by its Paris Agreement pledge. The achievement rests on a paradox. The institutions that licensed, priced, balanced and traded the generation behind it were never designed to produce it. The Central Electricity Regulatory Commission (CERC) and the State Electricity Regulatory Commissions (SERCs), constituted under the Electricity Regulatory Commissions Act, 1998 and re-mandated by the Electricity Act, 2003, were built to arbitrate a vertically integrated, coal-dominated, public-utility sector through licensing, cost-plus tariff-setting and dispute adjudication. Renewable generation—variable, capital-front-loaded and market-sensitive—destabilises each of these foundational competencies at once. Drawing on doctrinal analysis of statute, subordinate regulation and apex-court jurisprudence, and on a qualitative reading of regulatory orders and policy instruments from 2003 to 2025, this paper asks whether and how India's electricity regulators are moving from a gatekeeping posture—granting approvals within fixed rules—towards a steering posture that actively designs the institutional conditions of the transition. It traces four adaptive trajectories: procedural reform in licensing and open access; the migration from administered cost-plus tariffs to competitive discovery and the attendant jurisprudence of contractual sanctity, now extended by the Supreme Court's 2025 ruling on cost-reflective tariffs; grid-integration governance through deviation settlement, forecasting, must-run status and storage; and market facilitation through power exchanges, green market segments and tradeable renewable attributes. Read through the 'regulatory state of the South' literature and adaptive-governance theory, the evidence supports a qualified conclusion: Indian regulators display genuine but partial adaptive capacity, bounded by jurisdictional fragmentation, resource inadequacy, political-economy pressure and appellate congestion. The adaptation is real but incomplete, uneven and contested. The paper closes by advancing calibrated reforms to regulatory capacity, coordination and mandate, and by situating the pending Electricity (Amendment) Bill, 2025 as the live vehicle through which several of these questions will be resolved.

Keywords: electricity regulation; renewable energy transition; adaptive governance; regulatory state of the South; CERC and SERCs; competitive tariff discovery; grid integration; energy federalism.

1. Introduction

The decarbonisation of electricity is usually narrated as a problem of technology and finance—of module prices, storage chemistries and the cost of capital. It is at least as much a problem of institutional design. Power systems run on rules, and the rules that governed the fossil-fuel era were written for a world of dispatchable, capital-amortising, monopoly utilities. Whether those rules, and the institutions that administer them, can be re-engineered quickly enough to accommodate a fundamentally different generation fleet is a governance question of the first order. India is an unusually instructive place to pose it.

India is the world's third-largest electricity consumer and, since June 2025, one of a small group of large economies to source more than half of its installed generating capacity from non-fossil sources. As of 30 June 2025 total installed capacity stood at roughly 485 GW, of which non-fossil sources accounted for about 243 GW—50.1 per cent, reached some five years before the date implied by its Nationally Determined Contribution under the Paris Agreement.¹ By late 2025 total capacity had passed 510 GW, of which non-fossil sources supplied close to 263 GW.² The declared ambition—500 GW of non-fossil capacity by 2030³—remains formidable, but the direction of travel is not in doubt. What is examined far less often is the institutional machinery through which this transformation is licensed, priced, balanced and traded.

That machinery was not built for the task. The CERC, established under the Electricity Regulatory Commissions Act, 1998 and subsequently reconstituted by the Electricity Act, 2003 ('EA 2003'),⁴ together with the state-level SERCs, inherited a mandate calibrated to a vertically integrated, predominantly coal-based sector. Its core competencies, which are tariff determination, licensing of generation, transmission and distribution, dispute adjudication and consumer protection, are indispensable but largely retrospective.⁵

The main claim of this paper is that Indian electricity regulators are engaged in a consequential institutional adaptation. This is a movement we characterise as a shift from gatekeeping to steering. Gatekeeping denotes the passive administration of approvals within settled rules, while steering denotes the active design of regulatory environments that enable and direct the energy transition. It marks a change in the regulator's implicit theory of its own role, from neutral arbiter of a market to constitutive actor. That reframing is not original to us. In one of the earliest empirical studies of Indian regulatory practice, Dubash and Rao⁶ argued that the conventional separation of the 'political' and 'economic' content of regulatory decisions was neither feasible nor desirable in a fast-changing sector, and urged instead a bolder regulator with the latitude to steer. The present paper takes that prescription as a hypothesis about what has since occurred and tests it against two decades of the record. The shift is observable across four dimensions: procedural innovation in licensing and open access;

¹ MINISTRY OF POWER (2025), *supra* note 3; GOV'T OF INDIA, INDIA'S UPDATED FIRST NATIONALLY DETERMINED CONTRIBUTION UNDER THE PARIS AGREEMENT (2021-2030) (2022) (India); Paris Agreement art. 4, Dec. 12, 2015, *in* Report of the Conference of the Parties on Its Twenty-First Session, U.N. Doc. FCCC/CP/2015/10/Add.1 (Jan. 29, 2016) (entered into force Nov. 4, 2016).

² MINISTRY OF NEW & RENEWABLE ENERGY, YEAR-END REVIEW AND RENEWABLE ENERGY CAPACITY DATA (2025) (India).

³ MINISTRY OF POWER, 500 GW NON-FOSSIL FUEL TARGET: INITIATIVES FOR INTEGRATION OF RENEWABLE POWER (2023) (India).

⁴See THE ELECTRICITY ACT, 2003, SECTIONS 76, 82, No. 36, ACTS OF PARLIAMENT, 2003 (India); THE ELECTRICITY REGULATORY COMMISSIONS ACT, 1998, No. 14, ACTS OF PARLIAMENT, 1998 (India).

⁵THE ELECTRICITY ACT, 2003, SECTIONS 79, 86.

⁶ Navroz K. Dubash & D. Narasimha Rao, *Regulatory Practice and Politics: Lessons from Independent Regulation in Indian Electricity*, 16 UTILITIES POL'Y 321, 321-331 (2008).

the reconstruction of tariff methodology around competitive discovery; the construction of a grid-integration governance apparatus; and the facilitation of new market architectures for renewable power and its attributes.

The paper advances three contributions. First, it offers an integrated, theoretically framed and longitudinal reading of regulatory adaptation across all four dimensions at once, rather than treating tariff, grid or market questions in isolation, as much of the literature does. Second, it locates Indian regulatory evolution within the 'regulatory state of the South' framework of Dubash and Morgan,⁷ which theorises how independent regulators in developing, federal polities accommodate rather than transcend political pressure. That framing fits India better than the northern-European regulatory-state models on which comparable studies have relied, because it foregrounds the accommodation of political economy that a purely institutional account obscures. Third, it holds the demonstrable evidence of adaptive capacity together with an equally demonstrable set of structural constraints, arguing that the two must be read as one: the ceiling on adaptation is set less by regulatory imagination than by the material and jurisdictional conditions under which regulators work.

Two developments during the drafting of this paper make the argument timely rather than merely retrospective. In August 2025 the Supreme Court, in *BSES Rajdhani Power Ltd v Union of India*,⁸ directed the regulatory commissions to determine cost-reflective tariffs, curtailed the practice of perpetual 'regulatory assets', and instructed the Appellate Tribunal for Electricity (APTEL) to use its supervisory power under section 121 of EA 2003 to enforce compliance nationwide—an unusually direct instance of the judiciary steering the regulators towards their statutory function.⁹ In October 2025 the Ministry of Power released the Draft Electricity (Amendment) Bill, 2025, the first attempted overhaul of EA 2003 in almost two decades, drawing expressly on that judgment.¹⁰ The migration from gatekeeping to steering, in other words, is being negotiated in real time, across courts, ministries and commissions.

The argument proceeds as follows. Sections 2 to 4 set out the research problem, questions and objectives. Section 5 reviews the literature and Section 6 identifies the resulting gap. Section 7 explains the methodology. Section 8 reconstructs the legal and regulatory framework and corrects a common misstatement about the legislative status of recent reforms. Section 9 offers a comparative jurisdictional analysis. Section 10 presents the critical analysis of the four adaptive trajectories and the four structural constraints. Sections 11 to 13 draw findings, advance recommendations and state limitations and directions for further research, before a short conclusion.

2. Research Problem

The research problem arises from a tension between institutional form and institutional function. India has committed to, and is delivering, a renewable deployment programme of exceptional scale. The delivery of that programme depends on regulatory institutions whose statutory design, procedural repertoire and resource base were fixed for a different technological and market order. Where deployment has outrun institutional adaptation, the consequence is concrete rather than abstract: curtailment of clean generation, contractual instability that raises the cost of capital, open-access barriers that suppress corporate procurement, and litigation that delays commissioning. The problem this paper addresses is therefore the adequacy and character of regulatory adaptation—the extent to which India's

⁷ Dubash & Morgan, *supra* note 4; THE RISE OF THE REGULATORY STATE OF THE SOUTH, *supra* note 4.

⁸ *BSES Rajdhani Power Ltd. v. Union of India*, 2025 INSC 937 (India).

⁹ *BSES Rajdhani*, 2025 INSC 937, 67.4, 69.9.

¹⁰ MINISTRY OF POWER (2025), *supra* note 3; PRS LEGISLATIVE RSCH., THE DRAFT ELECTRICITY (AMENDMENT) BILL, 2025 (2025) (India).

electricity commissions have reconstructed their functions to match the transition they are nominally facilitating, and the structural factors that bound that reconstruction.

3. Research Questions

1. How have the functions of the CERC and SERCs changed, in law and in practice, in response to the renewable energy transition between 2003 and 2025?
2. Along which dimensions is regulatory adaptation strongest, and along which is it weakest or most uneven across jurisdictions?
3. What structural constraints—jurisdictional, financial, technical, political and adjudicatory—limit the extent and durability of that adaptation?
4. What can comparative regulatory experience contribute to the design of feasible reforms for the Indian context?

4. Objectives

- To reconstruct, from primary legal and regulatory materials, the trajectory of functional change in India's electricity regulators across the renewable transition.
- To develop and apply an analytical framework—organised around learning, flexibility and coordination capacities—for assessing regulatory adaptation.
- To identify and theorise the structural constraints that bound adaptation, drawing on the 'regulatory state of the South' literature.
- To situate the Indian experience comparatively and to derive calibrated, implementable policy recommendations.

5. Literature Review

5.1 The regulatory state and its 'Southern' variant

The intellectual point of departure for the study of independent economic regulators is the concept of the regulatory state, which describes the reallocation of governance from direct state ownership and command towards arm's-length oversight by specialised, rule-applying agencies.¹¹ A major portion of empirical literature has since examined whether the institutional attributes on which that premise depends, legal independence, financial autonomy and technical competence, which actually deliver superior sectoral outcomes.¹² For the Indian case the is the 'regulatory state of the South' analysis advanced by Dubash and Morgan.¹³ Their main insight is that regulatory agencies in developing, often federal, polities operate under distinctive conditions- redistributive political commitments, weaker administrative capacity, contested legitimacy and pervasive informality. It makes the political pressure, rather than its exclusion, the defining feature of regulatory practice. On this aspect, the question is not whether Southern regulators are 'captured' relative to an idealised independent benchmark, but how they negotiate a durable settlement between technocratic mandate and political reality. That framing reorients the present enquiry away from a

¹¹ Giandomenico Majone, *The Rise of the Regulatory State in Europe*, 17 W. EUR. POL. 77, 77-101 (1994); MICHAEL MORAN, THE BRITISH REGULATORY STATE: HIGH MODERNISM AND HYPER-INNOVATION (2003); David Levi-Faur, *The Global Diffusion of Regulatory Capitalism*, 598 ANNALS AM. ACAD. POL. & SOC. SCI. 12, 12-32 (2005).

¹² JON STERN & JOHN CUBBIN, REGULATORY EFFECTIVENESS: THE IMPACT OF REGULATION AND REGULATORY GOVERNANCE ARRANGEMENTS ON ELECTRICITY INDUSTRY OUTCOMES (World Bank Pol'y Rsch. Working Paper No. 3536, 2005); ANTON EBERHARD, INFRASTRUCTURE REGULATION IN DEVELOPING COUNTRIES: AN EXPLORATION OF HYBRID AND TRANSITIONAL MODELS (Pub.-Priv. Infrastructure Advisory Facility Working Paper, 2007).

¹³ Dubash & Morgan, *supra* note 4; THE RISE OF THE REGULATORY STATE OF THE SOUTH, *supra* note 4.

compliance audit of independence and towards an analysis of how regulators expand their functional repertoire while remaining embedded in political economy.

The reorientation has deep roots in the Indian scholarship itself. Dubash and Rajan¹⁴ showed early that the design of the 1990s reform was itself a political process, driven as much by the fiscal crisis of the state electricity boards and the preferences of external lenders as by any neutral efficiency logic. Dubash and Rao,¹⁵ studying three state regulators in practice, found that Indian commissions routinely exercise discretionary judgement that cannot be reduced to the technical application of expertise, and concluded that regulatory legitimacy would rest as much on the credibility of that discretion—built through public consultation—as on the consolidation of technical competence. Their prescription, that governments give regulators 'the latitude to proactively steer the sector', is the proximate source of the gatekeeping-to-steering distinction developed here, and their empirical method—case reconstruction from orders and interviews—anticipates the doctrinal-institutional approach adopted below. Sen and Jamasb,¹⁶ analysing deregulation across the Indian states, added the crucial finding that ostensibly uniform reform produced highly divergent outcomes, a 'diversity in unity' that any account of regulatory adaptation must explain rather than assume away.

The transitions turn in this literature matters. Where the classical regulatory state was theorised as the arbiter of a settled market, the energy transition demands an agency that helps constitute a market that does not yet exist. Studies of socio-technical transitions argue that such transformations require active institutional steering rather than mere market policing.¹⁷ If that proposition is accepted, it unsettles the neutral-arbiter self-image of the regulatory state and implies a more constitutive, and more contestable, role—precisely the role this paper attributes to CERC and, unevenly, to the SERCs.

5.2 Adaptive governance and regulatory capacity

Adaptive-governance theory supplies the second strand of the framework. Developed initially for the management of complex social-ecological systems, it emphasises the capacity of institutions to revise rules and structures in response to feedback under conditions of uncertainty.¹⁸ Transposed to electricity regulation, the concept directs attention to three distinguishable capacities: a *learning* capacity, evidenced by iterative revision of rules in the light of observed performance; a *flexibility* capacity, evidenced by accommodation of technological and contractual diversity; and a *coordination* capacity, evidenced by the management of multi-jurisdictional and multi-stakeholder interaction. These three axes structure the assessment of adaptation in Section 10.

¹⁴ Navroz K. Dubash & Sudhir Chella Rajan, *Power Politics: Process of Power Sector Reform in India*, 36 ECON. & POL. WKLY. 3367, 3367-3390 (2001).

¹⁵ Dubash & Rao, *supra* note 10.

¹⁶ Anupama Sen & Tooraj Jamasb, *Diversity in Unity: An Empirical Analysis of Electricity Deregulation in Indian States*, 33 ENERGY J. 83, 83-130 (2012).

¹⁷ Frank W. Geels, *Technological Transitions as Evolutionary Reconfiguration Processes: A Multi-Level Perspective and a Case-Study*, 31 RES. POL'Y 1257, 1257-1274 (2002); Jochen Markard, Rob Raven & Bernhard Truffer, *Sustainability Transitions: An Emerging Field of Research and Its Prospects*, 41 RES. POL'Y 955, 955-967 (2012); Matthew Lockwood, Caroline Kuzemko, Catherine Mitchell & Richard Hoggett, *Historical Institutionalism and the Politics of Sustainable Energy Transitions: A Research Agenda*, 35 ENV'T & PLAN. C: POL. & SPACE 312, 312-333 (2017).

¹⁸ Carl Folke, Thomas Hahn, Per Olsson & Jon Norberg, *Adaptive Governance of Social-Ecological Systems*, 30 ANN. REV. ENV'T & RES. 441, 441-473 (2005); Brian C. Chaffin, Hannah Gosnell & Barbara A. Cosens, *A Decade of Adaptive Governance Scholarship: Synthesis and Future Directions*, 19 ECOLOGY & SOC'Y 56 (2014).

The comparative energy-policy literature cautions that adaptation is neither automatic nor costless. Jacobsson and Lauber,¹⁹ analysing the German case, show that regulatory and policy adaptation to renewable energy required deliberate institutional design, sustained political commitment and accumulated technical competence; where any of these was absent, incumbency and path dependence reasserted themselves. Kern and Smith²⁰ similarly emphasise the difficulty of dislodging established socio-technical regimes. The implication for India is that observed adaptation should not be mistaken for a smooth institutional teleology. It is a contingent achievement, reversible where its enabling conditions weaken.

5.3 The India-specific electricity governance literature

Scholarship on Indian electricity governance clusters around three concerns. A first body of work examines the design and performance of the regulatory commissions themselves, consistently identifying resource inadequacy, uneven quasi-judicial quality and jurisdictional fragmentation as recurrent weaknesses; the sustained monitoring undertaken by Prayas (Energy Group) over two decades is representative, and its recent analysis of distribution-utility finances documents the fiscal fragility that shadows every regulatory decision.²¹ A second body addresses tariff policy and procurement, tracing the transformation from administered tariffs towards competitive bidding and its consequences for investment and consumer welfare.²² A third addresses grid integration, balancing, forecasting and deviation settlement.²³ It stresses the technical complexity of managing variable generation within a multi-operator grid. Running through all three is a constant finding that the statute has not kept pace.²⁴ Reviewing fifteen years of the Act, Mukherjee, Dhingra and Sengupta²⁵ found its distribution and open-access provisions the least effective, and Agrawal and Tripathi²⁶ located the principal 'gap' in the same distribution segment, where competition never took hold and financial distress compounded.

The important contribution is Mapping Power,²⁷ which demonstrates through fifteen state narratives that electricity outcomes in India are inseparable from state-level political

¹⁹ Staffan Jacobsson & Volkmar Lauber, *The Politics and Policy of Energy System Transformation—Explaining the German Diffusion of Renewable Energy Technology*, 34 ENERGY POL'Y 256, 256-276 (2006).

²⁰ Florian Kern & Adrian Smith, *Restructuring Energy Systems for Sustainability? Energy Transition Policy in the Netherlands*, 36 ENERGY POL'Y 4093, 4093-4103 (2008).

²¹ PRAYAS (ENERGY GRP.), GRID LINES AND BOTTOM LINES: ANALYSIS OF THE FINANCIAL PERFORMANCE OF ELECTRICITY DISTRIBUTION COMPANIES (2025) (India).

²² S.C. Bhattacharyya, *The Electricity Act 2003: Will It Transform the Indian Power Sector?*, 13 UTILITIES POL'Y 260, 260-272 (2005); Anoop Singh, *Towards a Competitive Market for Electricity and Consumer Choice in the Indian Power Sector*, 38 ENERGY POL'Y 4196, 4196-4208 (2010); Gireesh Shrimali & Sumala Tirumalachetty, *Renewable Energy Certificate Markets in India—A Review*, 26 RENEWABLE & SUSTAINABLE ENERGY REVS. 702, 702-716 (2013).

²³ DAVID PALCHAK ET AL., GREENING THE GRID: PATHWAYS TO INTEGRATE 175 GIGAWATTS OF RENEWABLE ENERGY INTO INDIA'S ELECTRIC GRID, VOL. I—NATIONAL STUDY (Nat'l Renewable Energy Lab'y, Lawrence Berkeley Nat'l Lab'y & Power Sys. Operation Corp. 2017).

²⁴ T. Thakur, S.G. Deshmukh, S.C. Kaushik & M. Kulshrestha, *Impact Assessment of the Electricity Act 2003 on the Indian Power Sector*, 33 ENERGY POL'Y 1187, 1187-1198 (2005); K.L. Joseph, *The Politics of Power: Electricity Reform in India*, 38 ENERGY POL'Y 503, 503-511 (2010).

²⁵ S. Mukherjee, T. Dhingra & A. Sengupta, *Status of the Electricity Act, 2003: A Systematic Review of Literature*, 102 ENERGY POL'Y 237, 237-248 (2017).

²⁶ A. Agrawal & G.C. Tripathi, *Amendments in the Electricity Act 2003: Where the Gap Lies?*, 132 ENERGY POL'Y 797, 797-802 (2019).

²⁷ MAPPING POWER: THE POLITICAL ECONOMY OF ELECTRICITY IN INDIA'S STATES (Navroz K. Dubash, Sunila S. Kale & Ranjit Bharvirkar eds., 2018).

economy, and that attempts to depoliticise the sector are analytically misconceived. This finding is directly associated for the study of regulatory adaptation. It predicts that adaptation will be systematically uneven across states, tracking not regulatory design, which is broadly uniform, but the political economy in which each SERC is operating. The present paper treats that prediction as a hypothesis and finds it substantially borne out.

Two limitations of the existing literature are behind this study. First, most contributions treat a single dimension- tariff, grid or market, in isolation, so that the combined character of regulatory adaptation, and the interactions among dimensions, remain under-theorised. Second, much of the literature predates the decisive developments of the past five years. These are the maturation of competitive procurement, the green-market segments, the storage-procurement frameworks, the reframing of renewable purchase obligations as consumption obligations under the amended Energy Conservation Act, the crossing of the fifty-per-cent non-fossil milestone, and now the 2025 tariff jurisprudence and the draft Bill it prompted.

6. Research Gap

This paper addresses three gaps. No published study provides an empirical integrated analysis of regulatory adaptation across all four functional dimensions through 2025. The experience of regulation in India has not, in theory, been systematically read through the lens of the 'regulatory state of the South', which is better suited to a federal developing nation than the northern regulatory-state models that are typically deployed. The literature often celebrates adaptive achievements or catalogues structural failings, but seldom holds the two in a single frame. It is the interaction between adaptive capacity and structural constraint, however, that determines whether regulatory reform can keep pace with deployment. The paper provides an empirical synthesis, and an analytical re-orientation, linking demonstrated adaptation to demonstrated constraint in a single theoretically grounded account.

7 Methodology

7.1 Research design

The study uses a qualitative interpretive design and three complementary methods. The first is doctrinal legal analysis, the close reading of primary legal materials – constitutional provisions, statutes, subordinate regulations and judicial and appellate decisions – to establish the formal content and evolution of the regulatory mandate. The second is qualitative institutional and content analysis of regulatory orders and policy instruments, used to trace how the formal mandate has been operationalised, revised and contested. The third is comparative legal and institutional analysis, used to situate the Indian experience against selected jurisdictions and to derive transferable lessons. The combination is appropriate because regulatory adaptation is a process—cumulative, context-dependent and only partly captured by any single order or rule—that resists purely quantitative measurement and demands interpretive reconstruction from a corpus of related instruments. The approach follows the case-reconstruction tradition established for Indian regulation by Dubash and Rao,²⁸ extended here from three state commissions to the central-state system as a whole and forward in time to 2025.

7.2 Data sources and periodisation

Primary sources comprise the Constitution of India (Seventh Schedule, List III, Entry 38); the Electricity Regulatory Commissions Act, 1998; the Electricity Act, 2003 and its principal operative provisions (notably sections 42, 61–63, 66, 79, 86, 111, 121, 125, 166 and 178); the Energy Conservation Act, 2001 as amended in 2022; the National Electricity Policy, 2005 and the National Tariff Policy, 2006 (revised 2016); the Green Energy Open Access Rules, 2022; the

²⁸ Dubash & Rao, *supra* note 10.

Draft Electricity (Amendment) Bill, 2025; and the principal CERC regulations on renewable tariff, deviation settlement, forecasting and scheduling, ancillary services, power markets and renewable energy certificates, together with their successive amendments.²⁹ Apex-court and appellate jurisprudence is drawn upon selectively where it has shaped the regulatory framework. Secondary sources include peer-reviewed scholarship and the analytical output of established policy institutions. Official capacity, generation and procurement data are taken from the Ministry of Power, the Ministry of New and Renewable Energy and allied public agencies.

The analysis is periodised into three phases consistent with the policy literature: an *obligation* phase (2003–2010), in which renewable promotion operated principally through purchase obligations and administered tariffs; a *competitive procurement* phase (2010–2018), in which reverse auctions displaced administered pricing; and a *market-development* phase (2018–2025), in which green market segments, storage procurement and open-access reform came to the fore. This periodisation permits comparison of adaptive behaviour across regulatory eras.

7.3 Analytical framework

Regulatory adaptation is operationalised through the four functional dimensions introduced above—licensing and open access; tariff methodology; grid integration; and market facilitation—each assessed along the three capacities drawn from adaptive-governance theory: learning, flexibility and coordination. For each dimension the analysis asks whether rules have been revised in response to observed performance (learning), whether the framework accommodates technological and contractual diversity (flexibility), and whether multi-jurisdictional interaction is effectively managed (coordination). Findings are triangulated across statutory text, regulatory orders and secondary assessment, with weight given to convergent evidence.

7.4 Limitations of method

Three limitations are initially recognised. First, an interpretive reading of a large regulatory corpus involves selection; the analysis foregrounds instruments of framework-setting significance and does not claim exhaustive coverage of every order. Second, quantitative claims about, for example, curtailment rates, appellate pendency or open-access utilisation are taken from official and institutional reporting and are used illustratively rather than as precise measurements; where the underlying figures are contested or not available, the analysis states the direction of the phenomenon rather than asserting a spurious exactness. Third, the comparative material is used to generate hypotheses and lessons, rather than to establish causal equivalence across dissimilar polities.

²⁹ Central Elec. Regulatory Comm'n (Terms and Conditions for Tariff Determination from Renewable Energy Sources) Regulations, 2009, 2012, 2017, 2020 & 2024 (India) (the 2009 Regulations notified Sept. 16, 2009); Central Elec. Regulatory Comm'n (Terms and Conditions for Recognition and Issuance of Renewable Energy Certificate for Renewable Energy Generation) Regulations, 2010 (India), replaced by Central Elec. Regulatory Comm'n (Terms and Conditions for Renewable Energy Certificates for Renewable Energy Generation) Regulations, 2022 (India) (in force Dec. 5, 2022); Central Elec. Regulatory Comm'n (Power Market) Regulations, 2010 & 2021 (India) (the 2021 Regulations notified Feb. 15, 2021); Central Elec. Regulatory Comm'n (Deviation Settlement Mechanism and Related Matters) Regulations, 2014, 2022 & 2024 (India) (the 2014 Regulations notified Jan. 6, 2014, in force Feb. 17, 2014); Central Elec. Regulatory Comm'n (Framework on Forecasting, Scheduling and Imbalance Handling for Variable Renewable Energy Sources (Wind and Solar)) Regulations, 2015 (India); Central Elec. Regulatory Comm'n (Ancillary Services) Regulations, 2022 (India) (notified Jan. 31, 2022); Central Elec. Regulatory Comm'n (Indian Electricity Grid Code) Regulations, 2010 & 2023 (India) (notified Apr. 28, 2010 and May 29, 2023).

8. Legal and Regulatory Framework

8.1 Constitutional concurrency and the architecture of regulation

Electricity in India is a subject in the Concurrent List of the Constitution. It is item 38 in List III (Concurrent List) in Seventh Schedule to the Constitution of India so that both Parliament and State Legislatures can legislate, in case of repugnancy, central law shall prevail.³⁰ This simultaneity is not a technicality, but a structural fact from which much of the coordination difficulty analysed in Section 10 follows. The renewable transition is spatially uneven—resource-rich generation clusters in a handful of states while demand is dispersed nationally—so that efficient deployment repeatedly requires action that straddles the central–state divide, and therefore the CERC–SERC jurisdictional boundary.

EA 2003 is the primary legislative instrument, and it establishes a three-tier regulatory architecture that remains in place: the CERC, with jurisdiction over inter-state transmission, wholesale market design, inter-state generation and national grid governance (section 79); the SERCs, with jurisdiction over intra-state generation, distribution, retail tariff and licensing (section 86); and the Appellate Tribunal for Electricity (APTEL), hearing appeals from both (section 111), with a further appeal to the Supreme Court on questions of law (section 125). Section 86(1)(e) obliged SERCs to promote renewable generation and to specify purchase obligations from renewable sources—the statutory foundation of the Renewable Purchase Obligation (RPO). Sections 61 to 63 govern tariff, distinguishing tariff determination by the commission from the adoption of tariffs discovered through transparent competitive bidding under section 63—a distinction that, as Section 10 shows, became the fulcrum of the shift to competitive procurement. Section 42 mandates open access to the distribution network; section 66 directs the development of a power market; section 121 confers on APTEL a supervisory jurisdiction over the commissions; and section 166 establishes coordination mechanisms, including the Forum of Regulators.

The distribution of powers between the commission's legislative function (making regulations under section 178) and its adjudicatory function (deciding disputes under sections 79 and 86) was authoritatively settled by the Supreme Court in *PTC India Ltd v Central Electricity Regulatory Commission*.³¹ The Constitution Bench held that CERC's regulation-making power is a distinct legislative function of general application, and clarified the relationship between regulations and case-by-case orders. *The significance of the decision for the present argument is that it secured the legal space within which CERC could later use general regulation—rather than piecemeal adjudication—as an instrument of proactive market design, a capacity central to the steering posture.*

8.2 Policy instruments and the reframing of obligations

Policy instruments issued under EA 2003 overprint the statutory scheme. The National Electricity Policy, 2005 and the National Tariff Policy, 2006 (significantly revised in 2016) prescribed the treatment of renewable tariffs and in the 2016 revision, institutionalised competitive bidding for solar and wind beyond certain limits.³² The reframing of the promotion of renewables through the energy-conservation law is a major recent development. The Energy Conservation (Amendment) Act, 2022 introduced a national carbon-credit trading scheme and provided the basis for expressing renewable obligations as consumption

³⁰ INDIA CONST. sched. VII, List III, entry 38; *id.* Arts. 246, 254.

³¹ *PTC India Ltd. v. Cent. Elec. Regulatory Comm'n*, (2010) 4 SCC 603 (India) (Constitution Bench).

³² MINISTRY OF POWER, NATIONAL ELECTRICITY POLICY (2005) (India); MINISTRY OF POWER, TARIFF POLICY (2006, revised 2016) (India).

obligations, which complements the RPO mechanism located in EA 2003.³³ The analytical interest of this migration is that it carries part of the compliance architecture from the electricity statute into an adjacent regime administered by another constellation of institutions. It is an example of adaptation by legislative borrowing rather than by amendment of the parent Act.

8.3 Correcting the legislative record: open access, the lapsed 2022 Bill, and the 2025 draft

A point of factual accuracy warrants emphasis, because it is frequently misstated. The Green Energy Open Access Rules, 2022 were notified by the Ministry of Power under the rule-making power of EA 2003; they were not enacted through any 2022 amendment to the parent statute. The Rules lowered the eligibility threshold for green open access from 1 MW to 100 kW, prescribed time-bound approval, constrained cross-subsidy surcharges and established a national application portal³⁴—using central subordinate legislation to set a floor against which reluctant state frameworks are measured. Separately, the Electricity (Amendment) Bill, 2022 was introduced in the Lok Sabha in August 2022 and referred, the same day, to the Parliamentary Standing Committee on Energy; it was never enacted.³⁵ Commentary that treats an 'Electricity (Amendment) Act, 2022' as operative law—or that attributes the open-access reforms to such an Act—is mistaken.

The distinction is not pedantic, and it has since acquired a sequel. The contested distribution provisions of the 2022 Bill—multiple discoms sharing a network, PPA cost-sharing, floor-and-ceiling tariffs—provoked federalism objections from several states and lapsed with the dissolution of the Lok Sabha. They have now been revived, and expanded, in the Draft Electricity (Amendment) Bill, 2025, which the Ministry of Power placed in the public domain on 9 October 2025 for stakeholder comment.³⁶ Billed as the first comprehensive overhaul of EA 2003 in almost two decades, the 2025 draft would mandate cost-reflective tariffs, empower commissions to determine tariffs *suo motu* to prevent delay,³⁷ introduce statutory grounds (wilful violation and gross negligence) for the removal of commission members, direct a phased reduction of cross-subsidies delivered instead through direct benefit transfer, permit shared use of distribution networks by competing licensees, and align EA 2003 with the Energy Conservation Act, 2001. As of early 2026 the draft remained at the consultation stage, under revision after substantial stakeholder pushback, and unenacted. The analysis that follows accordingly treats the open-access reforms as rule-based exercises of central power under EA 2003, the 2022 Bill as lapsed, and the 2025 draft as a pending—and analytically revealing—reform vehicle whose contested provisions map almost exactly onto the structural constraints identified in Section 10.

Table 1 summarises the principal legislative and policy milestones.

³³ THE ENERGY CONSERVATION ACT, 2001, §§ 14(w), 14(x), 14AA, No. 52, ACTS OF PARLIAMENT, 2001 (India), as amended by THE ENERGY CONSERVATION (AMENDMENT) ACT, 2022, No. 19, ACTS OF PARLIAMENT, 2022 (India).

³⁴ Electricity (Promoting Renewable Energy Through Green Energy Open Access) Rules, 2022 (India) (notified June 6, 2022, as amended in 2023).

³⁵ Electricity (Amendment) Bill, 2022 (India) (introduced in the Lok Sabha in Aug. 2022 and referred to the Standing Committee on Energy; lapsed); PRS LEGISLATIVE RSCH., THE ELECTRICITY (AMENDMENT) BILL, 2022: LEGISLATIVE BRIEF (2022) (India).

³⁶ MINISTRY OF POWER (2025), *supra* note 3; PRS LEGISLATIVE RSCH. (2025), *supra* note 14.

³⁷ MINISTRY OF POWER, DRAFT ELECTRICITY (AMENDMENT) BILL, 2025, cls. amending SECTIONS 61(g), 64 (India) (released for public comments Oct. 9, 2025).

Table 1. Key legislative and policy milestones in India's electricity regulatory framework, 2003–2025.

Year	Instrument / event	Regulatory significance
2003	Electricity Act, 2003	Constituted CERC, SERCs and APTEL; created the RPO mandate (s. 86(1)(e)); enabled competitive bidding and tariff adoption (s. 63)
2005–06	National Electricity Policy; National Tariff Policy	Directed renewable tariff treatment and RPO trajectories; framed transparent procurement
2010	First CERC renewable tariff order; REC Regulations; Power Market Regulations; PTC India (SC)	Benchmark tariff methodology; tradeable renewable attributes; exchange regulation; apex court settles regulation-making power
2014	CERC Deviation Settlement Mechanism Regulations	First dedicated financial instrument for managing schedule deviation of variable generation
2016	National Tariff Policy (revision); competitive bidding guidelines	Entrenched reverse auctions above thresholds; commission role shifts toward PPA adoption under s. 63
2017	Energy Watchdog v CERC (SC)	Restated force majeure and change-in-law; affirmed CERC jurisdiction over composite inter-state schemes; underpinned contractual sanctity
2022	Green Energy Open Access Rules (under EA 2003); Energy Conservation (Amendment) Act	Central floor standards for green open access; carbon-credit scheme and consumption-obligation basis
2022	Electricity (Amendment) Bill introduced; referred to Standing Committee	Contested distribution and federalism provisions; subsequently lapsed, not enacted
2021–25	Green Day-Ahead and Term-Ahead Markets; storage procurement frameworks; 50% non-fossil milestone (June 2025)	Green market segments; storage as an asset class; deployment outruns institutional adaptation
2025	BSES Rajdhani Power Ltd v Union of India (SC); Draft Electricity (Amendment) Bill, 2025	Mandated cost-reflective tariffs and capped regulatory assets; directed APTEL supervision under s. 121; first attempted overhaul of EA 2003 in two decades (pending)

Source: authors' compilation from primary legal instruments and Ministry of Power / MNRE data (2025). The 2022 open-access reforms are rule-based; the Electricity (Amendment) Bill, 2022 lapsed; the Draft Electricity (Amendment) Bill, 2025 remains pending.

9. Comparative Jurisdictional Analysis

There are two reasons for the comparison here: to benchmark the Indian experience against systems that have faced similar integration challenges and to identify lessons that are truly

transferable versus those that depend on institutional endowments that are not replicable. Three comparators are instructive, each for different reasons.

9.1 Germany: capacity and the price of integration

The German Federal Network Agency has overseen the integration of renewables under the *Energiewende* with a highly specialised apparatus, including a developed redispatch regime to manage network congestion as variable generation displaces conventional plant.³⁸ The salient contrast for India is one of resourcing. The German regulator has technical staff in the thousands, an order of magnitude beyond the establishment of most Indian commissions. This differential is not a necessary evil to outcomes, it is a prerequisite for the granular, engineering-heavy rule-making that high-penetration integration demands. The lesson isn't so much about any particular German instrument, but the capacity floor below which sophisticated integration governance cannot be achieved, and below which, several Indian SERCs sit.

9.2 United Kingdom: incentive design and mandate alignment

The UK's Ofgem is a case of regulation through incentive architecture. Its performance-based framework for network companies tied revenue to defined outputs and innovation, embedding transition objectives within the operating incentives of network operators rather than requiring them by fiat.³⁹ What can be transferred is the design philosophy of aligning the commercial interest of the regulated entity with the transition objective so that compliance is no longer adversarial. The non-transferable element is the ownership context. Where, as in much of India, distribution utilities are state-owned and financially distressed, the incentive levers that work on privately owned, financially healthy operators lose much of their force. Incentive design can be borrowed; the conditions that make it bite cannot.

9.3 A Southern federal comparator: Brazil and the limits of central direction

Brazil offers the closest structural analogue among large developing federations: a national regulator (ANEEL) operating within a federal constitutional order, an auction-based procurement tradition and a comparable tension between central coordination and sub-national prerogative.⁴⁰ The Brazilian experience of centralised, technically administered reverse auctions influenced the global diffusion of competitive renewable procurement and demonstrates that a developing federation can operate sophisticated price-discovery mechanisms at scale.⁴¹ It also illustrates, as the 'regulatory state of the South' literature predicts, that formal centralisation does not dissolve political-economy contestation; it relocates it.⁴² The comparative reading cautions against the assumption that India's

³⁸ *Energiewirtschaftsgesetz [EnWG] [Energy Industry Act]*, SECTIONS 13, 13a (Ger.), as amended by the *Netzausbaubeschleunigungsgesetz [NABEG] [Grid Expansion Acceleration Act]*, 2019 (Ger.) (Redispatch 2.0, in force Oct. 1, 2021); BUNDESNETZAGENTUR & BUNDESKARTELLAMT, MONITORING REPORT 2024: DEVELOPMENTS IN THE ELECTRICITY AND GAS MARKETS (2024) (Ger.).

³⁹ OFGEM, RIIIO-2 FINAL DETERMINATIONS FOR TRANSMISSION AND GAS DISTRIBUTION NETWORK COMPANIES AND THE ELECTRICITY SYSTEM OPERATOR: CORE DOCUMENT (rev. 2021) (UK); INDUSTRY AND REGULATORS COMM., THE NET ZERO TRANSFORMATION: DELIVERY, REGULATION AND THE CONSUMER, 2022-23, HL 162 (UK).

⁴⁰ Lei No. 9.427, de 26 de Dezembro de 1996 (Braz.) (instituting the Agência Nacional de Energia Elétrica); Lei No. 10.848, de 15 de Março de 2004 (Braz.) (new electricity industry model; regulated contracting and auctions); Maurício Tiomno Tolmasquim, Tiago de Barros Correia, Natália Addas Porto & Wikus Kruger, *Electricity Market Design and Renewable Energy Auctions: The Case of Brazil*, 158 ENERGY POL'Y 112558 (2021).

⁴¹ GABRIELA ELIZONDO AZUELA, LUIZ BARROSO & GABRIEL CUNHA, PROMOTING RENEWABLE ENERGY THROUGH AUCTIONS: THE CASE OF BRAZIL (World Bank Live Wire Knowledge Note No. 2014/13, 2014); Tolmasquim et al., *supra* note 44.

⁴² OECD, DRIVING PERFORMANCE AT BRAZIL'S ELECTRICITY REGULATORY AGENCY (2021).

coordination problems can be solved by centralisation alone, absent the fiscal and administrative capacity to make central standards effective at the periphery.

Taken together, the comparators suggest three propositions for India: that integration governance has a capacity floor (Germany); that incentive alignment is powerful but ownership-contingent (United Kingdom); and that central coordination is necessary but not sufficient in a Southern federation (Brazil). Each informs the recommendations in Section 12.

10. Critical Analysis: Adaptive Trajectories and Structural Limits

10.1 Licensing and open access: from authorisation to enablement

The EA 2003 licensing regime was built for large conventional plant whose authorisation preceded multi-year, sunk investment. Applied to modular, rapidly deployed solar and wind, it generated friction disproportionate to any public-interest purpose it served. Regulatory adaptation here took the form of progressive de-licensing: the use of exemption powers and the substitution of a lightweight registration procedure for full licensing, reducing compliance cost and approval time.⁴³ This is a clear instance of learning capacity—rules revised once experience revealed the mismatch—and of flexibility capacity, in the creation of differentiated tracks for different project types.

Coordination capacity, however, is weaker in this dimension, and the unevenness is systematic in the manner Mapping Power would predict. High-deploying states developed streamlined single-window and registration systems; low-activity states retained traditional frameworks, sometimes conditioning entry upon distribution-utility consent, in a way that gave incumbents an effective veto over competitors—an outcome squarely at odds with the pro-competitive purpose of EA 2003. This pattern is more pronounced in open access under section 42. The statutory right of third-party supply has been chronically diluted by high cross-subsidy surcharges, long interconnection queues and restrictive banking terms maintained by, or with the acquiescence of, state commissions whose owner-government is also the distribution utility.⁴⁴ The Green Energy Open Access Rules, 2022 are a central effort to defeat this passivity by rule—lowering thresholds, shortening timelines, and capping surcharges—but their real impact is dependent on state implementation, which has been patchy.⁴⁵ Both the lapsed Bill of 2022 and the draft of 2025 repeatedly return to exactly this section which is telling; the persistence of the problem across three attempts at reform itself is evidence that the obstacle is structural rather than a defect of drafting.⁴⁶ The dimension thus shows true adaptation at the level of central rule-making which is repeatedly watered down at the level of state implementation.

10.2 Tariff methodology: competitive discovery and the jurisprudence of stability

The most important adaptation of the period is the reconstruction of the tariff methodology. The first framework – administered, cost-plus determination – assumed known technology costs, and long recovery periods. The early CERC response was a benchmark methodology that set capital-cost and operating norms for solar and wind that were revised annually.⁴⁷ This itself showed strong learning capacity: successive revisions tracked the steep fall in module costs, with benchmark solar tariffs falling from around 17–18 per kWh at the start of the

⁴³THE ELECTRICITY ACT, 2003, SECTIONS 7, 14.

⁴⁴THE ELECTRICITY ACT, 2003, SECTION 42(2), (4).

⁴⁵ INST. FOR ENERGY ECON. & FIN. ANALYSIS, IMPACT OF GREEN ENERGY OPEN ACCESS RULES, 2022 (2024).

⁴⁶ Agrawal & Tripathi, *supra* note 30; Mukherjee, Dhingra & Sengupta, *supra* note 29.

⁴⁷ CERC RE Tariff Regulations, *supra* note 33; CENT. ELEC. REGULATORY COMM'N, SUO MOTU ORDER DETERMINING GENERIC LEVELLISED TARIFF FOR RENEWABLE ENERGY SOURCES FOR FY 2010-11, Petition No. 53/2010 (2010) (India).

decade to the low single digits by the mid-2010s.⁴⁸ But the crucial change was one in structure, not in parameters. With the competitive bidding process taking root, the commission's role changed from setting tariffs under section 62 to adopting tariffs discovered in open auction under section 63. Record low bids through competitive discovery – landmark auctions saw solar tariffs in the region of ₹2.44/kWh in 2017 and less than ₹2/kWh in 2020⁴⁹ – transformed the economics of procurement.

That migration created a new regulatory problem, that of contractual stability. In the former case, the market prices fell below the contract tariffs and financially distressed distribution utilities sought renegotiation or refused to honour power-purchase agreements. In the latter case, post-contract changes in duties and taxes led to a wave of change-in-law claims. By and large, the regulatory and judicial response has been in favour of the sanctity of concluded contracts. This jurisprudence forms the core of the steering account. In *Energy Watchdog v Central Electricity Regulatory Commission*⁵⁰ the Supreme Court narrowly construed force majeure, refused to treat a rise in imported-fuel prices as frustrating a non-escalable tariff, held that a change in foreign law fell outside the change-in-law clause, and—significantly for jurisdiction—held that CERC alone was competent over composite schemes for inter-state generation and sale. In *Uttar Haryana Bijli Vitran Nigam Ltd v Adani Power Ltd*⁵¹ the Court articulated a restitutionary principle, that a party affected by a domestic change in law should be restored to her pre-change economic position through tariff adjustment. The net result was to convert what had been an inconsistent body of decisions into a fairly predictable pass-through principle for material, government-induced cost changes. This is learning capacity at work in the regulator and in the courts: rule-formation updating to govern a class of dispute that did not exist when the framework was designed; It is also a warning – the stability that de-risks investment was won after years of litigation, and the cost of that delay was paid in investment hesitancy.

The jurisprudence didn't end in 2019. In *BSES Rajdhani Power Ltd v Union of India*⁵² decided in August 2025 the Supreme Court dealt with the mirror image of the change-in-law problem: not utilities resisting high contracted tariffs but commissions setting tariffs too low to be cost-reflective, papering over the gap with perpetually accumulating 'regulatory assets'—unrecovered revenue deferred to future consumers, which in Delhi alone had grown to the order of ₹27,000 crore.⁵³ The Court said that in the first principle, tariff has to be cost reflective; that any gap between the approved revenue requirement and the revenue generated by the tariff should arise only in exceptional circumstances; that regulatory assets have to be capped and liquidated within a defined period; and most striking for the present argument, it directed APTEL to invoke its supervisory jurisdiction under section 121 to monitor compliance and issue directions to each and every State Commission so that the judgement is implemented on a time bound basis across the country.⁵⁴ The decision is significant on two counts. Substantively, it extends the logic of the contractual sanctity of the generation contract upstream to the tariff-setting duty itself, closing a loop that had permitted

⁴⁸ CENT. ELEC. REGULATORY COMM'N, Petition No. 53/2010, *supra* note 51; CERC RE Tariff Regulations, *supra* note 33.

⁴⁹ Press Info. Bureau, Gov't of India, *Historic Low Tariff of Rs. 2.44 per Unit Discovered in Bhadla Phase-III Solar Park in Auction by SECI* (May 12, 2017); INST. FOR ENERGY ECON. & FIN. ANALYSIS, *WHY SOLAR POWER TARIFFS IN INDIA REACHED AN HISTORIC LOW* (2020).

⁵⁰ *Energy Watchdog v. Cent. Elec. Regulatory Comm'n*, (2017) 14 SCC 80 (India).

⁵¹ *Uttar Haryana Bijli Vitran Nigam Ltd. v. Adani Power Ltd.*, (2019) 5 SCC 325 (India).

⁵² *BSES Rajdhani*, 2025 INSC 937.

⁵³ *BSES Rajdhani*, 2025 INSC 937, 12, 60.

⁵⁴ *BSES Rajdhani*, 2025 INSC 937, 67.4, 69.9, 71; Electricity (Amendment) Rules, 2024, r. 23 (India) (notified Jan. 10, 2024, inserting rule 23 in the Electricity Rules, 2005).

political economy to repress retail tariffs at the expense of utility solvency. What is driving the regulators institutionally is the judiciary - compelling SERCs to a statutory function they had learnt to evade and activating a dormant supervisory channel to do so. The Draft Electricity (Amendment) Bill, 2025 then sought to convert the same principle into statute⁵⁵ illustrates how, in the Indian setting, courts, commissions and the legislature iterate on one another in constructing the conditions of the transition.

Table 2 sets out the evolution of solar tariff discovery across the period.

Table 2. Evolution of solar tariff discovery and indicative rates, 2010–2025.

Phase	Mechanism	Indicative solar tariff (₹/kWh)	Key regulatory development
2010–13	Administered benchmark (cost-plus)	≈15–18	First CERC renewable tariff order; National Solar Mission Phase I
2013–16	Hybrid: benchmark with early auctions	≈7–10	Annual benchmark revision tracking module-cost decline; viability-gap auctions
2016–20	Competitive reverse auctions (s. 63 adoption)	≈2.4–4.5	Tariff Policy revision mandates bidding; change-in-law jurisprudence matures
2020–25	Auctions with storage / firm-and-dispatchable configurations	≈1.99–3.0	Green open access; storage integration; time-differentiated procurement

Source: authors' synthesis from CERC orders and public procurement records. Figures are indicative benchmarks and auction outcomes, not point estimates; ranges reflect technology, location and configuration.

10.3 Grid integration: governing variability

In the dimension of grid integration, the learning capacity is most evident and the coordination capacity most taxed. Managing system frequency in a narrow band with variable penetration increasing required tools not available in the licensing era toolkit. The main instrument is the Deviation Settlement Mechanism, introduced by CERC regulation in 2014 and revised from time to time thereafter:⁵⁶ this prices deviations from declared schedules, and its design has evolved from a flat charge to a frequency-linked signal that rewards generation during system stress and penalises it during surpluses, with caps that are iteratively adjusted to strike a balance between deterrence and project viability. This is complemented by the forecasting and scheduling framework, which requires wind and solar generators above thresholds to submit and revise schedules in brief blocks, and in so doing calls into being a new regulated intermediary, the renewable forecasting service provider, whose accuracy the commission standardises.⁵⁷ These instruments are revised again and again, a textbook example of adaptive learning.

The must-run status is an example of a coordination limit where renewable output is protected from economic curtailment by mandating its preferential dispatch. The principle has been

⁵⁵ MINISTRY OF POWER (2025), *supra* note 3.

⁵⁶ Deviation Settlement Mechanism Regulations, *supra* note 33.

⁵⁷ Forecasting and Scheduling Regulations, 2015, *supra* note 33; FORUM OF REGULATORS, MODEL REGULATIONS ON FORECASTING, SCHEDULING AND DEVIATION SETTLEMENT OF SOLAR AND WIND GENERATION SOURCES (2015) (India).

defined progressively by CERC with override conditions and compensation.⁵⁸ However enforcement has been largely within the intra-state domain of the State Load Dispatch Centers and SERCs where instruction based curtailment has at times circumvented the obligation.⁵⁹ Curtailment has been modest at the national aggregate level, but has been materially higher in specific high-generation corridors during peak periods.⁶⁰ The pattern is now familiar: a coherent central rule diluted by the jurisdictional geometry of intra-state operation. Ancillary-services regulation and the emergence of battery storage extend the same story of flexibility adaptation—CERC has moved from bilateral provision towards market-based procurement and has begun to constitute storage as a distinct asset class with its own tariff and operational treatment—responding to a technology category the original statute did not contemplate.⁶¹

10.4 Market facilitation: constructing markets for green power

The construction of India's power market is the clearest expression of the steering posture, because here the regulator does not police a market so much as bring one into being. From the licensing of exchanges under the Power Market Regulations, the product suite has expanded through day-ahead, term-ahead and real-time segments to dedicated green segments—the Green Day-Ahead and Green Term-Ahead Markets—that permit price discovery for electricity carrying verified renewable attributes.⁶² The Renewable Energy Certificate mechanism, which separates the environmental attribute from the physical commodity to enable inter-state compliance trading, is a further instance, and its revision in response to oversupply, price collapse and low redemption—through vintage-based pricing and tighter compliance—demonstrates learning from a decade of observed dysfunction.⁶³ Market facilitation scores relatively high on flexibility, given the proliferation of segments and products, and moderately on coordination, given that a national exchange coexists with uneven state-level participation. Its principal limitation is scale: green-market volumes, though growing, remain a small share of total renewable generation, so that the market's signalling function currently outruns its allocative weight.⁶⁴

Table 3 summarises the assessment across the three capacities.

Table 3. Assessment of regulatory adaptation across four dimensions.

Dimension	Learning capacity	Flexibility capacity	Coordination capacity
Licensing & open access	Moderate: exemptions and thresholds progressively revised	High: differentiated tracks for project types and sizes	Low-moderate: persistent SERC divergence; central rules only partly implemented

⁵⁸ Indian Electricity Grid Code, *supra* note 33; Electricity (Promotion of Generation of Electricity from Must-Run Power Plant) Rules, 2021 (India) (notified Oct. 22, 2021).

⁵⁹ FORUM OF REGULATORS, MODEL GUIDELINES FOR MANAGEMENT OF RE CURTAILMENT FOR WIND AND SOLAR GENERATION (2022) (India).

⁶⁰ PALCHAK ET AL., *supra* note 27; FORUM OF REGULATORS, MODEL GUIDELINES (2022), *supra* note 63.

⁶¹ Ancillary Services Regulations, 2022, *supra* note 33; Indian Electricity Grid Code, *supra* note 33; MINISTRY OF POWER, NATIONAL FRAMEWORK FOR PROMOTING ENERGY STORAGE SYSTEMS (2023) (India).

⁶² Power Market Regulations, *supra* note 33; Cent. Elec. Regulatory Comm'n, Order in Petition No. 143/MP/2021 (Oct. 17, 2021) (India) (introducing green day-ahead contracts within the integrated day-ahead market).

⁶³ REC Regulations, *supra* note 33; Shrimali & Tirumalachetty, *supra* note 26.

⁶⁴ CENT. ELEC. REGULATORY COMM'N, ANNUAL REPORT ON THE SHORT-TERM POWER MARKET IN INDIA 2023-24 (2024) (India).

Dimension	Learning capacity	Flexibility capacity	Coordination capacity
Tariff methodology	High: annual benchmarking; competitive discovery; change-in-law and cost-reflective jurisprudence	Moderate: storage and firm-dispatchable configurations emerging	Moderate: national bidding norms with uneven state adoption
Grid integration	High: deviation settlement revised repeatedly; forecasting iterated	Moderate-high: storage asset class; diverse flexibility providers	Low-moderate: intra-state curtailment inconsistencies; CERC-SERC gaps
Market facilitation	Moderate-high: green segments created; certificate mechanism revised	High: multiple segments and products; open-access integration	Moderate: national exchange with uneven state participation

Source: authors' assessment applying the learning–flexibility–coordination framework of Section 7.3.

10.5 Structural constraints

10.5.1 Jurisdictional fragmentation

The concurrency of Entry 38 produces a coordination problem that recurs across every dimension analysed above. The Forum of Regulators, constituted under section 166, provides a venue for harmonisation but issues advice, not binding standards;⁶⁵ compliance is consequently uneven, and states have maintained frameworks at variance with agreed positions where local political economy so dictates. The result is a fragmented national market, where investors in different states face varying surcharges, banking regulations and clearance requirements that add to transaction costs and undermine the intended effect of uniform standards. This is the institutional mirror of the 'accommodation' identified by the regulatory-state-of-the-South literature: fragmentation is not a bug to be engineered away but the institutional expression of a federal settlement in which states retain, and use, real prerogative.⁶⁶

10.5.2 Resource and technical inadequacy

What commissions can actually do limits adaptation. Here the limit is severe. Vacancies of members are common and commissions often work below the sanctioned strength. This affects both throughput and the legitimacy of quasi-judicial orders taken by depleted benches. Technical establishments are thin: many SERCs have only a fraction of the specialist staff commanded by their counterparts in high-penetration jurisdictions. The competence renewable integration demands spans power-systems engineering, financial modelling and contract law simultaneously. The dependence on external consultants does partially plug the gap, but it creates a dependence that can undermine independence, as flagged by Dubash and Rao,⁶⁷ two decades ago, when the intervening expansion of the regulatory task has sharpened rather than relieved. The problem is worsened by financing. Commissions funded from fees, with budgets that are falling behind inflation and have expanded mandates, find it difficult to

⁶⁵THE ELECTRICITY ACT, 2003, SECTION 166(2); FORUM OF REGULATORS, MODEL GUIDELINES (2022), *supra* note 63.

⁶⁶ Sen & Jamasb, *supra* note 20; MAPPING POWER, *supra* note 31.

⁶⁷ Dubash & Rao, *supra* note 10.

attract and retain the expertise needed for sophisticated rule-making. The conclusion is that capacity limits the steering ambition.⁶⁸

10.5.3 Political-economy pressure

Formal independence, fixed tenure, statutory appointment, protection from removal, does not neutralise political economy and the literature would predict that it will not.⁶⁹ The structural conflict is that distribution utilities are largely state owned. This means that the state is both owner of the regulated entity and appointing authority of its regulator. This setup forces exactly the decisions that matter most for the transition—open access surcharges, must-run enforcement, obligation compliance, and, as starkly shown by BSES Rajdhani, the very will to impose cost-reflective retail tariffs—and does so through forums where formal independence does not go. Incumbent interests pushing one way (coal generation and coal-dependent local economies) and large renewable consumers pushing the other. The regulator does not stand outside this contest but administers a settlement within it. This is what makes Indian regulation a regulatory state of the South and not a pale imitation of the northern model.

10.5.4 Appellate congestion and the technical-legal gap

Finally, the adjudicatory system intended to provide certainty has become a source of uncertainty itself. APTEL is facing a large and growing backlog, with several matters pending for several years.⁷⁰ As CERC and SERC orders are frequently appealed, investors are subjected to long periods during which the applicable framework remains unsettled. The cost is exemplified by the change-in-law litigation that followed the imposition of duties on imported solar equipment. Ultimately a pass-through principle was articulated, but the interval before it settled translated into deferred commissioning and elevated risk premia. A competence problem compounds the volume problem, namely the gap between the technical complexity of variable generation disputes and the fact that the benches that decide them are primarily legal. CERC's practice of forming technical expert committees for complex matters is an adaptive response but the effectiveness of this approach remains to be seen. The BSES Rajdhani direction that APTEL exercise its section 121 supervisory power across the country⁷¹ adds a further, untested, burden to an already congested tribunal, which sharpens rather than resolves the question of whether the appellate tier has the capacity to discharge the supervisory role the courts now expect of it. The adjudicatory constraint thus functions in two ways: via delay, and via the risk of technically badly calibrated outcomes.

11. Findings

Four results are obtained. First, regulatory adaptation is real and substantial in places: across all four dimensions the commissions—most notably CERC—have moved beyond incremental procedural adjustment to qualitative changes in function, from tariff determiner to market architect, from licensor to enabler, from arbiter to integrator. Thus, the steering account is vindicated to that extent, and vindicates a prescription made early in the life of regulation in the sector.⁷²

Second, adaptation is uneven in a patterned, not an arbitrary, way. The learning capacity is highest where the challenge is national and technical—tariff methodology and grid instruments revised iteratively by CERC—and lowest where execution is intra-state and politically salient. The unevenness across states is more a matter of political economy than

⁶⁸ Stern & Cubbin, *supra* note 16; Eberhard, *supra* note 16.

⁶⁹ Dubash & Rajan, *supra* note 18; Dubash & Rao, *supra* note 10; Joseph, *supra* note 28.

⁷⁰ PRAYAS (ENERGY GRP.), VACANCIES AT THE APTEL: A PERSISTENT PROBLEM OF DELAYED APPOINTMENTS (2023) (India).

⁷¹ BSES Rajdhani, 2025 INSC 937, 69.9.

⁷² Dubash & Rao, *supra* note 10.

regulatory design, confirming the central prediction of the Mapping Power analysis and the earlier finding of diversity in unity⁷³

Third, adaptation is limited by structure as well as by will. The surface manifestation of jurisdictional fragmentation, resource inadequacy and political-economy pressure acting in concert is the persistent divergence between coherent central rule-making and diluted state-level implementation seen in open access, must-run enforcement and surcharge policy. These material and jurisdictional conditions set the ceiling on steering ambition.

Fourth, adaptation is controversial and reversible. Lengthy litigation ensured contractual stability. In 2025, the apex court had to impose cost-reflective tariff discipline on the reluctant commissions. Open-access reform proceeds amid sustained resistance. The most significant proposed statutory revision is a draft Bill, in its third iteration, mired in the same federalism objections that sank its predecessor. Nothing in the record supports a reading of adaptation as an assured, one-way progression.

12. Policy Recommendations

The following recommendations are meant to be administratively and politically feasible in the near to medium term and each is tied to a particular finding above. This is opportune as the Draft Electricity (Amendment) Bill, 2025 has for the first time in nearly two decades re-opened the statutory settlement and several of these measures could be carried forward on that vehicle.

12.1 *Relieving the capacity constraint*

The ambition of steering is constrained by capacity. So, the first priority is the capacity. A time-limited vacancy-reduction discipline, with legislative or budgetary oversight of unfilled member and senior-staff positions after a specified period, would address the throughput and legitimacy deficits of depleted benches. A dedicated regulatory-capacity fund, financed through a small levy on inter-state transactions and administered collectively, could support specialist recruitment, analytical infrastructure and access to independent technical expertise for resource-poor SERCs, reducing the dependency that reliance on ad hoc consultants creates. A common regulatory academy, built with technical institutions and international regulators, would develop enduring competence in integrating variable generation, market design, storage and emerging areas such as green hydrogen.

12.2 *Firming inter-jurisdictional coordination*

The coordination deficit is structural so soft harmonisation will not be enough. The Forum of Regulators should be empowered by an amendment to section 166 to formulate mandatory minimum standards for a certain and limited number of cross-state issues: open-access processing timelines, obligation-enforcement procedures, curtailment-compensation rules, and flexibility-market participation.⁷⁴ The comparative evidence points to realism: central standards bind only where peripheral capacity allows, so coordination reform must be combined with (not substituted for) the capacity reform above.

12.3 *Embedding transition in the mandate*

Where incumbent interests may challenge transition-oriented decisions as ultra vires or inconsistent with consumer-protection objectives, the transition objective should be explicit in the statutory mandate. We should amend EA 2003 to name energy-transition facilitation – anchored to national capacity and emissions commitments – as a primary objective of the

⁷³ MAPPING POWER, *supra* note 31; Sen & Jamasb, *supra* note 20.

⁷⁴ Cf. THE ELECTRICITY ACT, 2003, SECTION 166(2); FORUM OF REGULATORS, MODEL GUIDELINES (2022), *supra* note 63.

commissions, co-equal with competition, consumer protection and tariff rationalisation.⁷⁵ This would provide a clear mandate to balance transition considerations and to reduce the susceptibility of such decisions to legal challenge. A complementary transparency obligation – annual publication of transition-relevant metrics like capacity facilitated, curtailment, open-access utilisation and storage integration – would create accountability for the facilitative function, and generate the data on which evaluation depends. The 2025 draft Bill provides a natural legislative moment to write such an objective into the parent statute by linking the EA 2003 with the Energy Conservation Act, 2001.

12.4 Reforming the adjudicatory bottleneck

The appellate system is bedevilled with uncertainty due to delay and technical mismatch, but needs to be expanded, ideally with a bench specialised in renewable-energy disputes, and its throughput improved, through mandated pre-filing conciliation for routine commercial matters and statutory timelines for transition-critical cases. It would also address the competence gap left open by pure legal adjudication, making technical assessment institutional – i.e., making the practice of expert committees the standard procedure for complex integration disputes. The supervisory role BSES Rajdhani has now given APTEL makes expansion imperative and not optional: a tribunal that has been asked to police cost-reflective tariff-setting in every state cannot do that out of its present backlog.

Table 4 sets out the recommendations, their instruments and an indicative sequence.

Table 4. Recommendations, instruments and sequencing.

Recommendation	Instrument	Primary responsibility	Horizon
Vacancy-reduction discipline	Legislative/budgetary oversight of unfilled posts	Ministry of Power; legislatures	Short (1–2 yrs)
Regulatory-capacity fund	Levy on inter-state transactions; collective administration	CERC; Forum of Regulators	Medium (2–4 yrs)
Shared regulatory academy	Collaborative institution with technical partners	CERC; MNRE; academia	Medium (3–5 yrs)
Binding coordination standards	Amendment to s. 166; defined standard-setting power	Parliament; Forum of Regulators	Medium (2–4 yrs)
Transition in the mandate	Amendment to EA 2003; annual transition reporting	Parliament; Ministry of Power	Short–medium (2–3 yrs)
Appellate reform	Bench expansion; conciliation; statutory timelines	Ministry of Law; Ministry of Power	Short–medium (1–3 yrs)

Source: authors' formulation. Sequencing reflects dependency: coordination and mandate reforms presuppose capacity reform.

13. Conclusion

India's electricity regulators are undergoing a genuine institutional metamorphosis. In licensing and open access, tariff methodology, grid integration and market facilitation, the

⁷⁵ Cf. THE ELECTRICITY ACT, 2003, PMBL., SECTION 61; INDIA'S UPDATED FIRST NATIONALLY DETERMINED CONTRIBUTION, *supra* note 5.

commissions have evolved from a gatekeeping to a steering posture, iteratively revising rules, constructing markets and, in tandem with the courts, building the contractual and tariff stability on which renewable investment depends. This development is not a partial approximation to some northern ideal but a unique mode of governance that marries technocratic adaptation with political accommodation when viewed from the perspective of the ‘regulatory state of the South’. The commissions demonstrate real adaptive capacity; the achievement of a fifty-per-cent share of non-fossil capacity five years ahead of commitment is, in part, a result. But the transformation is uneven, incomplete, and contested. Its ceiling is determined by jurisdictional fragmentation, resource inadequacy, political-economy pressure and appellate congestion. Together these factors explain the recurrent gap between coherent central rule-making and diluted peripheral execution. That the apex court had to nudge commissions toward cost-reflective tariffs in 2025, and the third successive attempt to overhaul the parent Act is stalled on familiar federalism objections, are reminders that the steering it describes moves against resistance and can stall. As India looks to long-duration storage, offshore wind, green hydrogen and distributed resources – all of which raise integration and market design questions that the current framework only partially addresses – the adaptive capacity of India’s regulators will increasingly determine whether ambition translates into deployed, affordable, secure capacity. The shift is happening from gatekeeping to steering. The open question is whether the institutional constraints on it can be eased quickly enough for it to finish.

14. Limitations

The study is interpretive and qualitative; its conclusions are analytical reconstructions from a large but selectively read corpus, not statistical generalisations. Quantitative indicators are used illustratively and drawn from official and institutional reporting whose precision varies; where figures are contested, the analysis reports direction rather than magnitude, and the headline capacity figures in particular shift month to month as new plant is commissioned. The comparative material generates transferable hypotheses rather than causal equivalences across dissimilar polities. Finally, because the Draft Electricity (Amendment) Bill, 2025 was under active revision as this paper was completed,⁷⁶ the account of its provisions reflects the October 2025 consultation text and should be re-checked against the version ultimately introduced in Parliament.

15. Future Research Directions

- Quantitative measurement of adaptive capacity, constructing validated indices of learning, flexibility and coordination from regulatory-order corpora to permit cross-state and cross-country comparison.
- State-level comparative case studies linking SERC adaptation to the political-economy variables identified in the *Mapping Power* framework, testing the unevenness finding directly.
- Empirical evaluation of the change-in-law and cost-reflective-tariff jurisprudence’s effect on the cost of capital, utility solvency and commissioning timelines, including the early implementation of the *BSES Rajdhani* directions.
- Assessment of the Electricity (Amendment) Bill, 2025—if enacted—as a natural experiment in whether statutory reform can relieve the structural constraints that subordinate legislation and litigation have only partly addressed.

⁷⁶ PRS LEGISLATIVE RSCH. (2025), *supra* note 14.

- Regulatory design for emerging frontiers—long-duration storage, offshore wind, green hydrogen and distributed energy resources—where the existing framework is least developed.
- Evaluation of the technical-committee mechanism in appellate and regulatory adjudication as a response to the competence gap, and of APTEL's capacity to discharge its expanded supervisory role.

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