



Legal Framework for the Promotion of Solar Energy in India

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Article Info

Article History:

Published: 22 Oct 2026

Publication Issue:

Volume 03, Issue 10
October 2026

Page Number:

406-421

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Abstract:

Solar energy has emerged as a significant component of India's clean energy transition, yet its expansion depends on a clear and effective legal framework addressing renewable energy obligations, land use, grid integration, investment, and environmental concerns. (Background of the Study) Solar energy has become an important component of India's renewable energy sector and its transition towards sustainable energy. The promotion and development of solar energy are governed by various laws, policies, regulations, and government schemes relating to renewable energy generation, electricity distribution, grid connectivity, environmental protection, and investment. However, the growth of the solar energy sector involves several legal and regulatory challenges, including land acquisition and use, power purchase arrangements, grid integration, transmission, regulatory approvals, and coordination between central and state authorities. The existing legal framework plays an important role in facilitating solar energy development while addressing these challenges. (Hypothesis) The existing legal and regulatory framework in India provides a basis for promoting solar energy but requires further legal and policy reforms to address emerging challenges and support its sustainable development. (Objectives of the Study) (i) To examine the legal framework governing the promotion and development of solar energy in India (ii) To analyse the role of relevant energy laws, policies, and regulations in promoting solar power generation (iii) To identify legal and regulatory challenges relating to land, grid integration, transmission, and investment (iv) To examine the role of central and state authorities in regulating solar energy development (v) To suggest possible legal and policy measures for strengthening the promotion of solar energy in India. (Research Focus) The research examines the legal and regulatory framework governing solar energy development in India, with particular focus on renewable energy obligations, electricity regulation, grid connectivity, land use, power purchase arrangements, investment, and environmental requirements. It further examines the interaction between central and state regulatory mechanisms and evaluates whether the existing framework adequately addresses the emerging requirements of India's expanding solar energy sector. (Significance of the Study) This study evaluates the existing legal framework for promoting solar energy in India and identifies the major legal and regulatory challenges affecting its development. It seeks to examine areas requiring greater regulatory clarity and consistency and considers possible legal and policy reforms to facilitate investment, improve regulatory efficiency, support grid integration, and promote sustainable growth of solar energy in India.

Keywords: solar energy, renewable energy, energy law, electricity regulation, renewable energy obligations, grid integration , sustainable development , environmental regulation.

1. INTRODUCTION

India's energy sector is undergoing a significant transformation due to the increasing need for clean, reliable and sustainable sources of energy. Among renewable energy sources, solar energy has acquired particular importance because of India's geographical conditions, technological developments and increasing demand for electricity.

The promotion of solar energy is not solely a matter of government policy. It involves a complex legal framework covering electricity generation, transmission, distribution, tariffs, renewable energy obligations, land, environmental regulation, taxation, investment and contractual arrangements.

The Electricity Act, 2003 constitutes the principal statutory framework governing the electricity sector in India. It establishes institutions such as the Central Electricity Regulatory Commission (CERC), State Electricity Regulatory Commissions (SERCs), the Central Electricity Authority and the Appellate Tribunal for Electricity.

The statutory framework has been supplemented by national renewable-energy policies and regulations intended to increase the share of renewable electricity in India's energy mix.

One of the important regulatory mechanisms is the Renewable Energy Purchase Obligation (RPO), under which specified entities are required to procure electricity from renewable energy sources in accordance with the applicable regulatory framework.

Solar energy projects, however, involve multiple stages and legal requirements. A developer may need to secure land, establish generation facilities, obtain connectivity, arrange transmission, enter into power purchase arrangements and comply with environmental and local regulatory requirements.

Consequently, the effectiveness of solar-energy promotion depends not only upon the availability of financial incentives but also upon the predictability and coordination of the legal framework.

This paper therefore examines the legal framework governing solar energy in India and identifies the principal legal and regulatory challenges affecting its development.

2. DEVELOPMENT OF SOLAR ENERGY IN INDIA

2.1 Meaning and Importance of Solar Energy

Solar energy refers to energy derived from the radiation of the sun and may be converted into electricity through photovoltaic technology or concentrated solar power systems.

Solar photovoltaic projects have become particularly significant because of declining technology costs and the ability to deploy projects at different scales, ranging from rooftop installations to large utility-scale solar parks.

From a legal perspective, solar energy is important because it involves the interaction of energy law, environmental law, land law, contract law and regulatory law.

2.2 Evolution of Solar Energy Policy in India

India's solar-energy policy has developed through various stages.

The Jawaharlal Nehru National Solar Mission was launched as a major policy initiative for promoting solar energy. It subsequently became an important component of India's broader renewable-energy strategy.

The policy framework has progressively expanded to cover:

- utility-scale solar projects;
- rooftop solar;
- solar parks;
- distributed generation;
- solar manufacturing;
- renewable-energy procurement;
- grid-connected projects; and
- renewable-energy certificates.

The development of solar energy has therefore moved from a predominantly policy-driven sector towards a more mature regulated electricity market.

2.3 National Solar Mission

The National Solar Mission was established with the objective of promoting sustainable growth of solar energy in India.

The Mission sought to create an enabling policy framework, encourage investment, promote technological development and reduce the cost of solar power.

Its development demonstrates the importance of government policy during the early stages of renewable-energy markets.

3. LEGAL FRAMEWORK GOVERNING SOLAR ENERGY IN INDIA

3.1 Electricity Act, 2003

The Electricity Act, 2003 is the principal legislation governing the electricity sector in India.

The Act provides the legal framework for:

- generation;
- transmission;
- distribution;
- trading;
- electricity supply;
- regulatory commissions;
- open access; and
- tariff regulation.

An important feature of the Act is the liberalisation of electricity generation, subject to applicable legal and regulatory requirements.

For solar projects, the Act is relevant because electricity generated by a solar plant must ultimately be integrated into the electricity system or supplied to consumers through legally recognised arrangements.

3.2 Renewable Energy Purchase Obligations

Renewable Energy Purchase Obligations constitute an important mechanism for creating demand for renewable electricity.

RPO requirements require specified electricity distribution licensees, open-access consumers and other designated entities to procure a specified proportion of their electricity consumption from renewable sources, subject to the applicable regulations.

The framework has increasingly distinguished between different categories of renewable energy, including solar and non-solar sources.

RPOs therefore perform two important functions:

1. creating a regulatory market for renewable electricity; and
2. encouraging electricity consumers and distribution entities to increase renewable-energy procurement.

However, effective enforcement is necessary for the mechanism to create predictable demand.

3.3 Role of Central Electricity Regulatory Commission

CERC plays an important role in regulating inter-State electricity transmission and other matters falling within its statutory jurisdiction.

Its functions are particularly relevant to large solar projects supplying electricity across State boundaries.

CERC regulations may address matters relating to:

- inter-State transmission;
- open access;
- tariffs;
- renewable-energy certificates;
- connectivity; and
- market mechanisms.

3.4 Role of State Electricity Regulatory Commissions

State Electricity Regulatory Commissions play an important role in the regulation of electricity within individual States.

Solar developers may therefore encounter different regulatory requirements depending upon the State in which a project is located.

State-level regulation may affect:

- tariffs;
- distribution arrangements;
- open access;
- RPO compliance;

- banking;
- transmission charges;
- wheeling charges; and
- approval of power purchase agreements.

The existence of State-level regulation is constitutionally and institutionally significant, but variations between States may also create uncertainty for developers operating across multiple jurisdictions.

4. RENEWABLE ENERGY OBLIGATIONS AND SOLAR PROMOTION

4.1 Importance of Renewable Energy Obligations

Renewable Energy Purchase Obligations are among the principal legal mechanisms used to create demand for renewable electricity.

Without sufficient demand, generation capacity alone may not result in commercially viable projects.

RPOs therefore connect electricity regulation with renewable-energy policy.

4.2 Renewable Energy Certificates

Renewable Energy Certificates (RECs) provide another mechanism through which renewable-energy attributes can be recognised and traded.

The REC mechanism can allow obligated entities to meet renewable-energy requirements through the purchase of certificates subject to the applicable regulatory framework.

This creates a market-based mechanism alongside physical electricity procurement.

4.3 Legal Challenges Relating to RPO Compliance

Several issues may arise concerning:

- determination of the obligated entity;
- calculation of renewable-energy consumption;
- treatment of captive generation;
- applicability to open-access consumers;
- compliance monitoring; and
- consequences of non-compliance.

The effectiveness of the RPO framework therefore depends upon consistent implementation and enforcement.

5. LAND AND SOLAR ENERGY PROJECTS

5.1 Importance of Land

Utility-scale solar projects require significant areas of land.

Land-related issues can therefore substantially affect project development.

A solar project may require land through:

- private purchase;
- lease;
- government allotment;
- land pooling; or
- acquisition under applicable law.

5.2 Land Acquisition

Where compulsory acquisition is involved, the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 may become relevant, depending upon the nature and legal structure of the project.

Land acquisition can raise questions concerning:

- compensation;
- rehabilitation;
- resettlement;
- agricultural land;
- livelihood;
- common resources; and
- local communities.

5.3 Land-Use Conflicts

Large solar parks may create conflicts between renewable-energy development and existing land uses.

Potential conflicts may arise concerning:

- agricultural land;
- grazing areas;
- forest areas;
- wildlife habitats;
- common land; and
- community resources.

Solar-energy policy should therefore incorporate appropriate land-use planning rather than treating land merely as an economic input.

6. GRID CONNECTIVITY AND TRANSMISSION

6.1 Importance of Grid Integration

Solar energy is inherently dependent upon solar availability and therefore differs from conventional dispatchable generation.

As the share of solar electricity increases, grid management becomes increasingly important.

Grid integration involves:

- connectivity;
- transmission;
- scheduling;
- forecasting;
- balancing;
- storage; and
- curtailment management.

6.2 Transmission Infrastructure

Solar resources are not always located close to major centres of electricity consumption.

This creates a need for substantial transmission infrastructure.

The Green Energy Corridor and associated transmission infrastructure have been developed to facilitate renewable-energy integration.

However, delays in transmission development can affect project commissioning and generation.

6.3 Curtailment

Curtailment occurs when a generating plant is prevented from supplying electricity to the grid despite having generation capability.

For solar developers, unexplained or prolonged curtailment can have significant commercial consequences.

Power Purchase Agreements should therefore clearly address:

- curtailment;
- deemed generation;
- compensation;
- grid failure;
- force majeure; and
- payment obligations.

7. POWER PURCHASE AGREEMENTS AND CONTRACTUAL ISSUES

7.1 Importance of Power Purchase Agreements

A Power Purchase Agreement (PPA) is one of the most important contractual documents for a solar project.

It generally establishes:

- tariff;
- project capacity;
- commissioning date;
- supply obligations;
- payment terms;
- performance standards;
- default;
- termination; and
- dispute resolution.

7.2 Tariff Uncertainty

Solar projects often require significant upfront investment.

Therefore, tariff certainty is important for determining project viability.

Changes in law, regulatory interventions or delays in approval may affect the economics of the project.

7.3 Renegotiation and Termination

Disputes may arise when one party seeks to renegotiate a tariff or terminate the PPA.

The contractual framework should therefore clearly address:

- change in law;
- force majeure;
- termination payments;
- delay;
- default;
- regulatory changes; and
- dispute resolution.

A stable contractual environment is essential for attracting long-term investment.

8. ENVIRONMENTAL REGULATION AND SOLAR PROJECTS

8.1 Environment (Protection) Act, 1986

The Environment (Protection) Act, 1986 provides the central statutory framework for environmental protection in India

Although solar energy is a clean source of electricity, solar projects may still create environmental impacts through land conversion, construction, waste generation, transmission infrastructure and associated development.

Therefore, renewable energy should not automatically be equated with zero environmental impact.

8.2 Environmental Approvals

Depending upon the nature and location of a project, various environmental permissions and statutory requirements may apply.

The regulatory challenge is to maintain environmental safeguards while ensuring that clean-energy projects are not subjected to unnecessary procedural duplication.

8.3 Solar Panel Waste

Solar photovoltaic panels have a limited operational life and eventually generate waste.

The increasing deployment of solar projects creates a future requirement for effective recycling and waste-management systems.

Legal regulation should therefore address:

- collection;
- recycling;
- producer responsibility;
- disposal; and
- recovery of valuable materials.

This issue is becoming increasingly important as India's installed solar capacity expands.

9. INVESTMENT AND FINANCIAL REGULATION

9.1 Importance of Investment

Solar projects are capital-intensive and require substantial investment in land, equipment, transmission and infrastructure.

Investment certainty is therefore directly linked to the stability of the legal framework.

9.2 Government Incentives

Government policies have supported solar energy through various mechanisms, including:

- subsidies;
- viability-gap support;
- competitive bidding;
- tax measures;
- concessional financing;
- solar parks; and
- manufacturing incentives.

However, the availability and structure of incentives may change over time.

9.3 Regulatory Certainty

Investors generally require clarity regarding:

- tariffs;
- taxation;
- import duties;
- renewable-energy obligations;
- grid charges;
- land requirements;
- environmental approvals; and
- dispute resolution.

Frequent policy changes may affect the financial assumptions on which projects were originally established.

10. CENTRAL AND STATE REGULATORY COORDINATION

Solar energy regulation involves both Central and State institutions.

At the Central level, important institutions include:

- Ministry of New and Renewable Energy;
- Ministry of Power;
- Central Electricity Regulatory Commission;
- Central Electricity Authority; and
- other relevant ministries and authorities.

At the State level, the relevant institutions may include:

- State Electricity Regulatory Commissions;
- State renewable-energy agencies;
- State transmission utilities;
- distribution companies;
- revenue authorities; and
- local authorities.

The involvement of multiple authorities creates a need for effective coordination.

A developer may obtain approval from one authority but still be unable to commence operations because another approval remains pending.

A coordinated single-window approach can therefore reduce regulatory delays.

11. MAJOR LEGAL AND REGULATORY CHALLENGES

The major challenges affecting solar-energy development in India may be summarised as follows:

11.1 Regulatory Fragmentation

There is no single comprehensive solar-energy statute covering the entire project life cycle.

11.2 Land Acquisition and Land Use

Availability of suitable land and disputes concerning compensation and land use can delay projects.

11.3 Grid Connectivity

Obtaining timely grid connectivity and transmission capacity can affect project commissioning.

11.4 Curtailment

Uncertainty concerning curtailment and compensation can affect project revenues.

11.5 PPA Disputes

Tariff disputes, delayed payments and contractual renegotiation can affect investor confidence.

11.6 State-Level Variations

Different State-level regulations may create inconsistent requirements for developers.

11.7 Environmental Concerns

Large solar projects may have local environmental and land-use impacts even though solar electricity itself is a low-carbon source.

11.8 Waste Management

The future volume of discarded photovoltaic modules creates a growing regulatory challenge.

11.9 Investment Uncertainty

Changes in incentives, taxation, tariffs and regulatory requirements can affect project economics.

11.10 Lack of Coordinated Approvals

Multiple regulatory authorities may create overlapping or sequential approval requirements.

12. ROLE OF JUDICIARY IN SOLAR ENERGY REGULATION

The judiciary and electricity-regulatory tribunals have an important role in resolving disputes relating to renewable-energy projects.

Disputes may involve:

- tariff determination;
- PPAs;
- regulatory changes;
- renewable-energy obligations;
- transmission;
- payment defaults; and
- contractual performance.

Judicial decisions concerning electricity regulation have also contributed to the interpretation of regulatory powers and contractual obligations.

The Appellate Tribunal for Electricity (APTEL) plays an important role in resolving appeals from electricity regulatory commissions.

A predictable dispute-resolution system is particularly important because solar projects involve long-term contractual and financial commitments.

13. INTERNATIONAL AND POLICY DIMENSION

India's solar-energy development is also connected with its broader international climate and energy commitments.

The expansion of solar energy contributes to reducing dependence on fossil fuels and supports India's clean-energy transition.

International investment may also play an important role in financing solar infrastructure.

Consequently, domestic legal rules concerning foreign investment, taxation, contracts, dispute resolution and intellectual property may influence the development of the solar sector.

India must therefore maintain a regulatory environment capable of supporting domestic development while remaining attractive to international investors.

14. HYPOTHESIS AND FINDINGS

The hypothesis of this study is that India's existing legal and regulatory framework provides a basis for promoting solar energy but requires further reforms to address emerging challenges.

The study broadly supports this hypothesis.

India has established a substantial legal and institutional framework through the Electricity Act, renewable-energy regulations, government schemes, tariff mechanisms and regulatory commissions.

However, several practical challenges remain.

The most important findings are:

1. The legal framework is fragmented across multiple statutes and regulatory authorities.
2. Land availability and land-use conflicts may delay large-scale solar projects.
3. Grid connectivity and transmission infrastructure are essential for effective utilisation of solar generation.

4. PPA disputes can affect the financial stability of solar projects.
5. Differences between Central and State regulatory frameworks can increase compliance costs.
6. Environmental considerations must be incorporated into renewable-energy planning.
7. Solar-panel waste requires stronger long-term regulatory attention.
8. Investment depends substantially upon regulatory and contractual certainty.
9. Renewable-energy obligations require consistent implementation and enforcement.
10. Greater coordination between Central and State authorities is necessary for efficient project development.

15. SUGGESTED LEGAL AND POLICY REFORMS

15.1 Integrated Solar Energy Regulatory Framework

India may consider developing an integrated regulatory framework covering major aspects of solar-energy projects.

This need not necessarily take the form of an entirely new statute. Existing legislation could initially be supported by coordinated rules and guidelines.

15.2 Single-Window Approval Mechanism

A centralized digital approval mechanism should coordinate:

- land;
- electricity;
- transmission;
- environmental;
- local;
- construction; and
- other project approvals.

15.3 Clear Rules on Curtailment

PPAs and regulatory frameworks should clearly establish:

- circumstances permitting curtailment;
- priority of renewable generation;
- compensation;
- deemed generation; and
- dispute-resolution mechanisms.

15.4 Strengthening RPO Enforcement

Renewable-energy obligations should be supported by transparent monitoring and effective enforcement.

The consequences of non-compliance should be clear and consistently applied.

15.5 Land-Use Planning

Solar parks should be developed through appropriate land-use planning that considers:

- agricultural interests;
- ecological sensitivity;
- local communities;
- infrastructure;
- transmission availability; and
- water resources.

15.6 Strengthening Solar-Waste Regulation

India should develop a comprehensive lifecycle approach for photovoltaic modules covering:

- manufacturing;
- installation;
- use;
- collection;
- recycling; and
- disposal.

15.7 Standardised Power Purchase Agreements

Model PPAs can reduce contractual uncertainty and provide clarity regarding:

- tariff;
- payment;
- default;
- curtailment;
- change in law;
- force majeure;
- termination; and
- dispute resolution.

15.8 Central-State Coordination

A permanent coordination mechanism involving Central and State authorities can reduce regulatory inconsistency.

15.9 Regulatory Stability

Policy changes should provide reasonable transition periods for existing projects.

This is particularly important for projects involving long-term financing.

15.10 Strengthening Dispute Resolution

Specialised and time-bound dispute-resolution mechanisms can improve investor confidence and reduce project delays.

16. CONCLUSION

Solar energy has become a central component of India's renewable-energy strategy. The country has developed a substantial legal and institutional framework to facilitate solar-energy generation through electricity legislation, renewable-energy obligations, regulatory commissions, government policies, financial mechanisms and grid-development initiatives.

Nevertheless, the rapid expansion of solar energy has created new legal and regulatory challenges.

The principal difficulties relate to land acquisition and use, grid connectivity, transmission, curtailment, power purchase agreements, renewable-energy obligations, environmental requirements, solar-waste management and coordination between Central and State authorities.

The existing legal framework provides a strong foundation but must continue to evolve with technological and market developments.

The objective of legal reform should not merely be to introduce additional regulation. Instead, the focus should be on clarity, coordination, predictability and effective enforcement.

A well-coordinated regulatory framework can reduce delays, encourage investment, protect environmental and community interests and improve the integration of solar electricity into India's power system.

The future development of solar energy in India will therefore depend not only on increasing installed capacity but also on creating a stable legal environment capable of supporting long-term investment while ensuring sustainable and responsible development.

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