

India's Solar Energy Future

Policy and Institutions

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*A Report of the CSIS Wadhvani Chair in U.S.-India
Policy Studies*

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Introduction

Renewable energy is gaining traction as an important area of focus for governments worldwide. It is increasingly essential to a country's energy portfolio, not only to combat climate change but also to diversify sources and protect against external shocks. As governments must do more with fewer resources, renewable energy is also increasingly part of an economic sustainability calculation. A clean energy future demands greater investment in renewables, which in addition to environmental benefits could provide attractive dividends such as job creation, economic growth, energy security, and greater insulation from oil price volatility.

The International Energy Agency (IEA) notes that India will become the single-largest source of global oil demand after 2020.¹ Crude oil imports are the biggest contributor to India's bloated current account deficit. The outlook for India's energy production seems stark as it is estimated the country will face a shortage of 6.7 percent in 2013–2014.² Southern India, consisting Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, and Puducherry, showed a combined economic growth rate of 7.85 percent in 2013. However, this trajectory would be negatively affected owing to a projected 20 percent shortage in electricity.³ The primary reason for the electricity shortage is an over-reliance on thermal energy from coal and gas. Further, 100,000 out of nearly 600,000⁴ villages in India do not have access to electricity.⁵ Against this backdrop, renewable energy presents a more sustainable and financially sound option for the long term.

The United States and India are uniquely positioned to collaborate in the renewable energy sector, given their burgeoning strategic partnership, converging energy interests, technological prowess and myriad bilateral dialogue mechanisms that allow for close consultation and policy coordination.

Both countries can leverage their technical knowhow to drive innovation and investment in affordable and efficient renewable energy technologies. American private- and public-sector investment has an opportunity to expand their foothold in India in solar energy. India allows up to 100 percent Foreign Direct Investment (FDI)

¹ PTI, "India will be largest source of oil demand growth after 2020: International Energy Agency," *Economic Times*, December 4, 2013, http://articles.economictimes.indiatimes.com/2013-12-04/news/44757431_1_oil-demand-growth-ia-world-energy-outlook.

² Lok Sabha, Unstarred Q. No. 866—Shortfall in electricity supply, August 13, 2013.

³ *Ibid.*

⁴ Lok Sabha, Unstarred Q. No. 3399—Village Electrification, December 13, 2012.

⁵ Gevorg Sargsyan et al., *Unleashing the Potential of Renewable Energy in India* (Washington, DC: World Bank, 2011), http://www.esmap.org/sites/esmap.org/files/India-Study_WEB_Final.pdf.

in renewable energy generation and distribution. It also has favorable geographic conditions for solar power, annually averaging 300 to 330 sunny days.⁶

This paper will analyze and clarify the regulatory and institutional frameworks put in place by the Indian government to promote investment in India's solar energy sector. To date, a lack of clarity and comprehension has inhibited investment in India's opening economy in sectors ranging from defense technology to retail. This paper aims to articulate India's institutional structures in solar energy.

Public institutions have played a crucial role in India's economic growth.⁷ After India gained independence, former prime minister Jawaharlal Nehru laid out the first five-year plan (FYP) in 1950. The FYPs are highly integrated, designed along the lines of Soviet-era centralized economic plans. It devised the role of the Indian government in major economic sectors such as energy, telecommunications, banking, and agriculture, while retaining a high degree of control on private-sector investment over the next four decades.

Beginning in 1991, India began to liberalize its economy, as part of the structural reforms required by an IMF bailout package. Since then, foreign and domestic private companies have played a larger role in the economy. Regulatory bodies such as the Securities and Exchange Board of India (SEBI) have played a crucial role in attracting private investment by ensuring a viable regulatory environment. SEBI was a statutory body set up in 1992 to safeguard the interest of investors in securities and to promote and regulate the securities market. SEBI has also enabled foreign institutional investors to invest up to 10 percent in equities of any one company. However, it is still tedious for private institutions to obtain licenses to start new businesses—just one example being the difficulty in acquiring land and obtaining environmental clearance.

In this context, it is critical to understand the regulations and reforms that India has taken to promote private domestic and foreign investment in infrastructure and energy. Measures and reforms have been continually passed to keep up with India's rapid growth.

Both the United States and India are leaders and partners in renewable energy and in taking measures to combat climate change. They have jointly collaborated in research and renewable energy generation. Included here is a detailed picture of the different institutions involved in policy formulation, distribution, and administration of solar energy in India.

⁶ Ministry of New and Renewable Energy, "Solar," <http://www.mnre.gov.in/related-links/grid-connected/solar/>.

⁷ Arvind Subramanian, "The Evolution of Institutions in India and Its Relationship with Economic Growth," *Oxford Review of Economic Policy* 23, no. 2 (2007), <http://www.iie.com/publications/papers/subramanian0407b.pdf>.

U.S.-India Energy Relations: An Overview

Globally, there has been an upward trend in renewable energy investment, currently worth \$244 billion.⁸ Developing countries alone accounted for 45 percent of investment in 2012, up 19 percent from the previous year. As the world moves toward greater renewable energy production, the United States and India have emerged as leaders in renewable energy investment. With investment worth \$40.5 billion in 2012, together the two countries account for 16.5 percent of global investment in renewable energy. In 2011, Ernst and Young rated India as the world's third-best investment destination in the renewable energy sector, behind China and the United States.⁹

The United States has taken advantage of this favorable climate. Nearly 40 percent of India's first 1,000 MW of installed solar power capacity was financed by a partnership between the Overseas Private Investment Corporation (OPIC), Export-Import Bank of the United States, U.S. Agency for International Development (USAID), U.S. Department of Commerce, and U.S. Trade and Development Agency.

Figure 1 shows the trend of global and domestic investment in India's clean energy. The chart shows that in 2011, there was a significant increase in investment. The decline in investment in 2012 may reflect an overall decline worldwide, and may not be specific to India. *The Global Trends in Renewable Energy 2013*,¹⁰ a report by the United Nations, attributed this global decline to policy uncertainty. Investment in solar energy in India is expected to increase steadily with the execution of the second phase of the Jawaharlal Nehru National Solar Mission (JNNSM), which lasts from 2012–2017.

India and the United States collaborate on renewable energy projects through different instruments such as memorandums of understanding (MoU), joint working groups, and multilateral forums.

In 2009, the two countries agreed on a comprehensive MoU to enhance cooperation on energy security, energy efficiency, clean energy, and climate change. Both countries have launched joint efforts in renewable energy research. Under the U.S.-India Partnership to Advance Clean Energy (PACE) research, the two countries established a \$125 million Joint Clean Energy Research and Development Center, which supports innovation in solar energy and building efficiency by convening a public-private consortium. Some notable achievements of PACE include reduced CO₂ per kilowatt hour of electricity generated by coal through efficient coal conversion and establishment of India's first Energy Conservation Building Code.¹¹

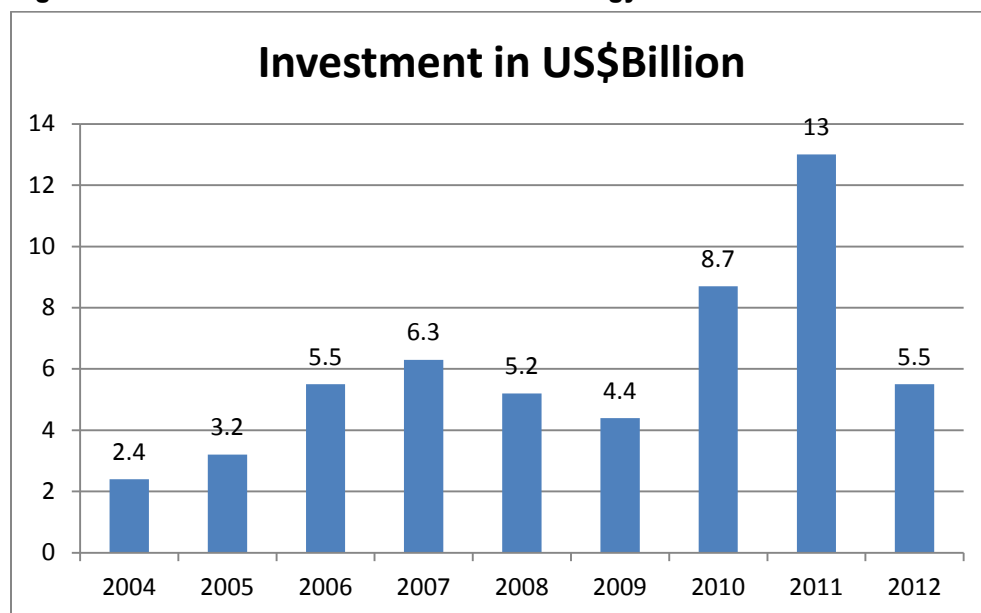
⁸ Angus McCrone et al., *Global Trends in Renewable Energy Investment 2013* (Frankfurt: UNEP Collaborating Centre, 2013), <http://www.unep.org/pdf/GTR-UNEP-FS-BNEF2.pdf>.

⁹ Ernst & Young, "Renewable energy country attractiveness indices," May 2011, [http://www.ey.com/Publication/vwLUAssets/Renewable_energy_country_attractiveness_indices_Issue_29/\\$FILE/EY_RECAI_issue_29.pdf](http://www.ey.com/Publication/vwLUAssets/Renewable_energy_country_attractiveness_indices_Issue_29/$FILE/EY_RECAI_issue_29.pdf).

¹⁰ McCrone et al., *Global Trends in Renewable Energy Investment 2013*.

¹¹ "U.S.-India Partnership to Advance Clean Energy (PACE)," Solar Energy Research Institute for India and the United States, June 2013, http://www.seriius.org/pdfs/062013_indo_us_pace_report.pdf.

Figure 1: Investment in India's Renewable Energy in US\$ Billion¹²



Cooperation in renewable energy has also been institutionalized via a Joint Working Group on New Technologies & Renewable Energy set up under the U.S.-India Energy Dialogue in May 2005.¹³ To engage constructively in multilateral forums such as the annual United Nations Framework Convention on Climate Change (UNFCCC) meetings, the U.S.-India Climate Change Dialogue was set up. A new joint working group has also been established by India's Planning Commission and USAID to enhance the capacity of both countries in long-term planning to achieve low-carbon, inclusive growth. This institutional framework and cooperation encourages and enhances communication between the two countries at a working level, and the routine meetings are action-causing events that often spur further initiatives.

Jawaharlal Nehru National Solar Mission (JNNSM/Solar Mission)

India's energy policy has been shaped by its need to ensure energy security and by a larger goal of attaining energy self-sufficiency. South and East Asian countries have emerged as major energy consumers, which has led India into a position of competition with other emerging economies for sources of energy worldwide. In 2003, former president Abdul Kalam explained the country's energy policy, saying, "Maximum self-reliance is the cornerstone of our energy security strategy."¹⁴ In recent years, a rising middle class and increased industrial activity have resulted in a sharp upsurge in demand for power, making Kalam's policy of diversity for self-reliance and security even more pressing.

¹² Ibid.

¹³ Lok Sabha, Unstarred Q. No. 5068—Foreign Investment in Solar Energy, April 26, 2013.

¹⁴ Lok Sabha, President's Address to the Parliament, February 17, 2013.

Currently the gap between India’s energy supply and demand is projected to be 6.7 percent.¹⁵ Of this estimate, southern states are projected to have a shortage of 19 percent.¹⁶ This shortfall has caused frequent blackouts for both industries and homes, crippling states without power for sustained periods of time. The primary reason for the electricity shortage is an over-reliance on thermal energy from coal and gas (shown in Figure 2). Currently, only 12 percent of India’s energy is supplied by renewable energy, and solar power constitutes only 4 percent of the renewable energy mix (shown in Figure 3).

Figure 2: Total Installed Capacity¹⁷

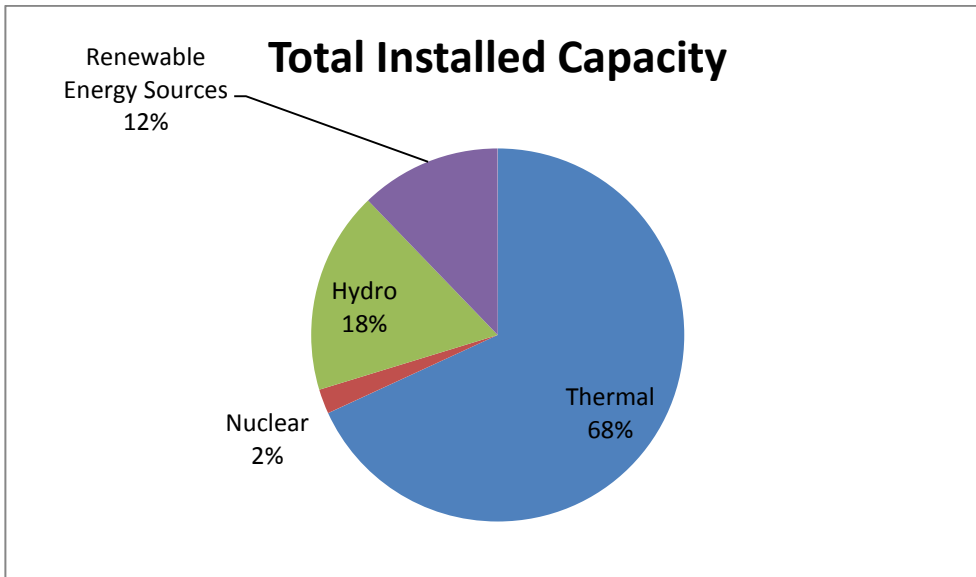
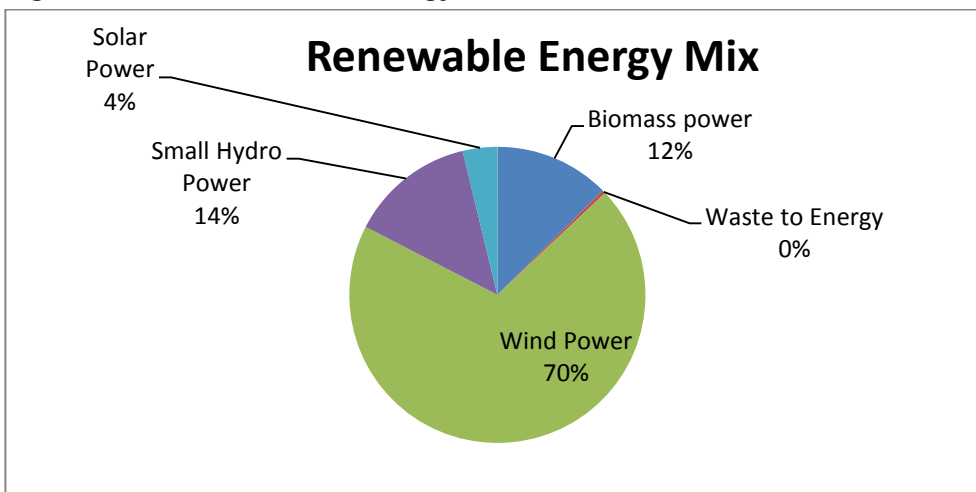


Figure 3: India’s Renewable Energy Mix¹⁸



¹⁵ Lok Sabha, Unstarred Q. No. 866—Shortfall in electricity supply, August 8, 2013.

¹⁶ Ibid.

¹⁷ Central Electricity Authority, “Installed Capacity (in MW) of Power Utilities in the States/UTS Located in Northern Region Including Allocated Shares in Joint & Center Sector Utilities,” July 31, 2013, http://www.cea.nic.in/reports/monthly/inst_capacity/jul13.pdf.

¹⁸ Ministry of Statistics and Programme Implementation, “Energy Statistics 2013,” http://mospi.nic.in/mospi_new/upload/Energy_Statistics_2013.pdf?status=1&menu_id=216.

In order to diversify its energy supply to achieve greater self-reliance and meet growing energy demands, the government has embarked on a concerted effort to explore potential sources of domestic renewable energy. JNNSM is one of several initiatives under the National Action Plan on Climate Change. The mission envisions a gradual shift from dependence on conventional sources of energy to renewable ones.

The objective of the JNNSM is to harvest solar energy on a large scale in India. The mission has three phases (Table 1), spanning 15 years that coincide with India’s five-year plans (developed by the Planning Commission). The short-term objective is to ensure an enabling framework for investment in solar energy, with the ultimate goal of adding 20,000 MW of grid capacity and 2,000 MW of off-grid capacity by 2022. It is estimated that the current operational solar power capacity is approximately 2,000 MW.¹⁹

Table 1: Three Phases of JNNSM

Phase	Time Period	Grid-Connected Power	Off-Grid Solar Applications	Solar Collectors
Phase 1	2007 to 2012	11,000 MW	200 MW	7 million sq mt
Phase 2	2012 to 2017	10,000 MW	1,000 MW	15 million sq mt
Phase 3	2017 to 2022	20,000 MW	2,000 MW	20 million sq mt

Source: “Jawaharlal Nehru National Solar Mission Phase II—Policy Document,” Ministry of New and Renewable Energy, December 2012, <http://mnre.gov.in/file-manager/UserFiles/draft-jnnsmpd-2.pdf>.

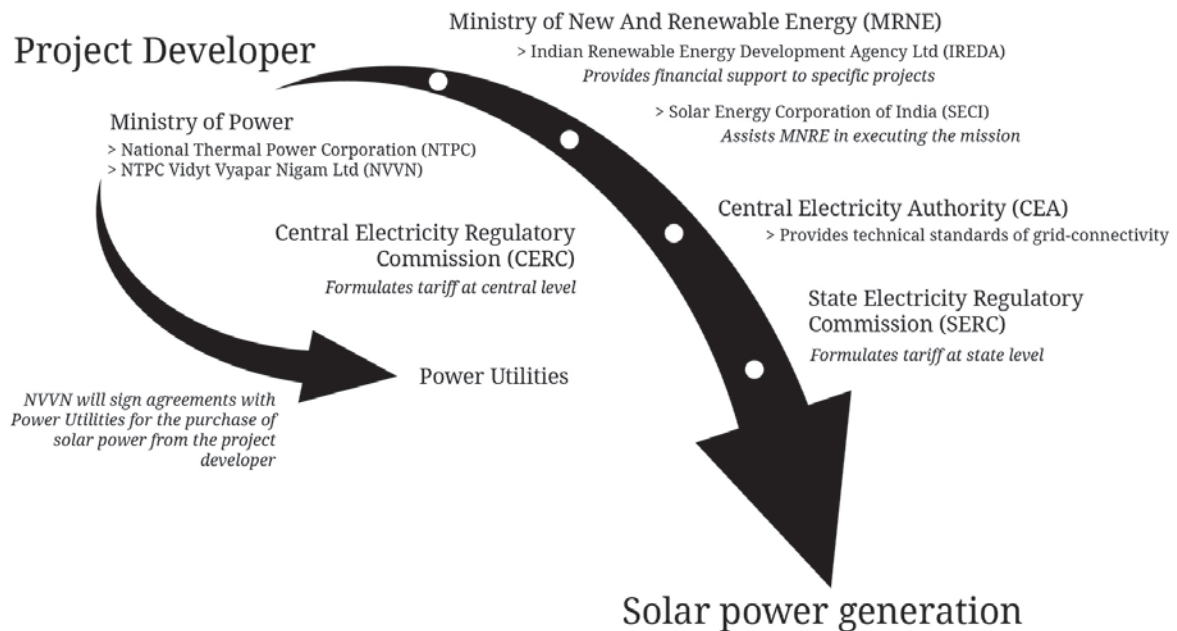
Institutional Framework for JNNSM

India’s constitution outlines which laws and regulations are the responsibility of the central and state governments. Electricity is a “concurrent” subject in the constitution, which means responsibility is shared between the central and state governments. The central government is a facilitator with various central government schemes.²⁰ State governments are responsible for subtransmission and distribution. (Figure 4 shows the institutional framework for solar power.)

¹⁹ PTI, “Achieving 20K MW solar power capacity by 2022 won’t be easy,” *Economic Times*, December 1, 2013, http://articles.economictimes.indiatimes.com/2013-12-01/news/44619588_1_transmission-network-power-capacity-power-distribution.

²⁰ Lok Sabha, Unstarred Q. No.2082—Funds for Power Supply, August 29, 2013.

Figure 4: Institutional Framework for the Solar Mission



Ministry of New and Renewable Energy (MNRE)

- MNRE is a scientific cabinet-level ministry in charge of production, development, and applications of solar energy, including solar photovoltaic devices.²¹
- Deploys strategy for indigenously developed and manufactured new and renewable energy products and services.
- Responsible for research and development of other nonconventional/renewable sources of energy and programs.
- Assists industry in achieving standards, specifications, and performance parameters.
- Aligns the costs of new and renewable energy products and services with international standards and facilitates the industry in attaining the same.

Indian Renewable Energy Development Agency Ltd (IREDA)

- Under the oversight of the Ministry of New and Renewable Energy.
- Provides financial support to specific projects to generate electricity through renewable energy.

²¹ Cabinet Secretariat, “Business Rules: First Schedule,” http://cabsec.nic.in/showpdf.php?type=allocation_first_shedule_abr21&special.

- The solar mission would provide an annual tranche to be utilized for refinance operations for renewable-energy projects.
- Small and medium enterprises that manufacture solar system components are supported by the refinance operations of IREDA.

Solar Energy Corporation of India (SECI)

- SECI was established in 2011 and is administered by the Ministry of New and Renewable Energy.
- The mandate of SECI is to pursue developmental, commercial, and implementation of the solar mission.

Some initiatives taken by SECI are:

- To set up solar thermal demonstration units that utilize domestic R&D resources.
- Deploy solar lights for promotion of cottage industry in villages.²²

*Ministry of Power (MoP)*²³

- Cabinet-level ministry in charge of policy in the electric power sector. It works in tandem with MNRE and maintains oversight of the National Thermal Power Corporation (NTPC) and NTPC Vidyut Vyapar Nigam Ltd (NVVN).
- Responsible for administration of *The Electricity Act, 2003*.
- Formulates and administers central government schemes relating to power supply/development and distributed generation in the states and union territories.
- Oversees energy conservation and efficiency in the power sector.

National Thermal Power Corporation (NTPC)

- NTPC is a state-owned enterprise. The government of India owns a 75 percent share of the company and has the power to appoint directors. It is the country's largest power producer, contributing more than 27 percent of total electricity generated.

NTPC Vidyut Vyapar Nigam Ltd (NVVN)

- The chairman of NTPC also heads NVVN. It is only supported by NTPC through financial, managerial, and technical support. Its core business is to facilitate power trading, through which NVVN aims to achieve optimum power utilization. States with surplus power are able to trade with those states with a

²² "Chairman's statement," *SECI Annual Report 2011-12*, <http://203.110.84.87/seci/upload/uploadfiles/files/From%20the%20Chairman%20Desk.pdf>.

²³ Cabinet Secretariat, "Business Rules: First Schedule."

power deficit. For example, during a favorable monsoon in Kerala in 2013, the Kerala State Electricity Board (KSEB) signed an agreement with NVVN to trade surplus power to Tamil Nadu, which was facing an acute power shortage.²⁴

Central Electricity Regulatory Commission (CERC)

CERC was established to promote competition and investment and to advise the government on institutional barriers to increasing electricity supply. Its chairman and members are appointed by the Indian government. State and Central Electricity Regulatory Commissions (SERCs) were established through *The Electricity Act, 2003* to set tariffs at the state level. Some key functions of the regulatory commissions are:²⁵

- Regulate tariff of central government-owned generation companies, interstate transmission of electricity;
- Issue licenses for transmission and trading electricity interstate;
- Regulate electricity purchase and procurement of distribution licenses;
- Advise the government in formulation of national electricity policy and tariff policy;
- Specify or enforce standards with respect to quality, continuity, and reliability of service by licensees.

Central Electricity Authority (CEA)

- Established by *The Electricity Act, 2003*, the CEA counsels the government on national electricity policy.
- Cannot consist of more than 14 members. Eight of the 14 members are appointed by the government.
- Advises the government and commissions on technical matters relating to the generation, transmission, trading, distribution, and utilization of electricity.
- Directs the state government or companies on electricity system maintenance.

Project Developer

- Project developers are both state-owned and private companies.
- Project developers are selected through a competitive tariff-based reverse bidding process for large capacity projects (5 MW and above) by NVVN. Some examples of

²⁴ B.S. Anilkumar, "KSEB hits jackpot deal, inks pact to sell surplus power," *Times of India*, October 1, 2013, http://articles.timesofindia.indiatimes.com/2013-10-01/thiruvananthapuram/42573512_1_kerala-state-electricity-board-kseb-acute-power-shortage.

²⁵ Central Electricity Regulatory Commission, "Mandatory Functions," <http://www.cercind.gov.in/Function.html>.

project developers are GAIL (India) Limited, Karnataka Power Corporation Limited, and EMC Limited.²⁶

- Project developers are awarded for small-capacity projects (up to 2 MW) through a fixed-tariff/generation-based incentive (GBI) scheme.

State Nodal Agency (SNA)

- State nodal agencies implement MNRE programs at the subnational level.
- The objectives of SNAs such as Gujarat Energy Development Agency (GEDA) and Maharashtra Energy Development Agency (MEDA) are:
 - Provide technical and financial assistance to those projects that implement renewable energy.
 - Undertake and also assist other agencies in renewable energy R&D.

State Utilities/Power Utilities

Power distribution utilities are mostly state-owned such as State Electricity Boards (SEBs). However, with reforms and disinvestment in state utilities, private companies such as Tata Power and Bombay Suburban Electricity Supply (BSES) opened in Delhi, Mumbai, and Odisha.

Framework of JNNSM

Since the government's short-term objective is to create an enabling framework for solar investment in India, there has not yet been an overhaul of India's overarching power-generation structure. Many private-sector energy leaders have called for a streamlining of the energy bureaucracy, as multiple layers and confusing policy caveats act as a drag on the country's economic potential.

The framework specified by *The Electricity Act, 2003* remains in phase 1 and 2 of the solar mission. Accordingly, the MoP is responsible for the execution of power in India. It administers *The Electricity Act, 2003*. While MNRE is responsible for solar power in India, MoP is still responsible for the execution of the solar mission.

NTPC's subsidiary NVVN is responsible for entering into power-purchasing agreements (PPA) with project developers. With this PPA, developers are authorized to sell power.²⁷

The price at which this power can be sold by the project developers is decided by the respective state regulatory commissions. The tariff rate is outlined in the National Tariff Policy 2006. This tariff policy is regulated by commissions at the national and state level.

²⁶ NVVN, "Details of Project Developers with Existing Power Purchase Agreements," <http://nvvn.co.in/DetailsofProjectDevelopersunderJNNSMPhaseIwithexistingPPA.pdf>.

²⁷ "Section 14, The Electricity Act 2003," *Gazette of India*, June 2, 2003, http://powermin.nic.in/acts_notification/electricity_act2003/pdf/The%20Electricity%20Act_2003.pdf.

NVVN signs agreements with power distribution utilities for the purchase of solar power from project developer.²⁸ These utilities then distribute power to households and industries.

State governments provide massive subsidies to different categories of consumers such as agriculture, industry, and railways. State utilities face huge losses due to low tariffs and unpaid bills for subsidies. In 2011, only state utilities in Delhi, Gujarat, Karnataka, Kerala, Gujarat, Puducherry, and Andhra Pradesh generated profits. On the other hand, state utilities in Tamil Nadu made losses amounting to \$1.34 billion.²⁹ Uncertainty in nonpayment from loss-making power utilities and low tariffs discourage project developers.

The Indian government provides subsidies in order to provide an incentive to spur private-sector investment in solar power; the following approaches were followed in the mission:

1. *The bundling scheme*: The central government has a discretionary 15 percent quota in (thermal) power, which can be distributed to states. In this scheme, the central government purchases power from project developers at the market price. It then bundles power from the discretionary quota along with the power purchased from the project developers and sells it at a subsidized price.

Companies view this as an incentive to sell power at a higher cost. They do not bear the brunt of the impact of the low tariff pricing because of the high cost of setting up solar power plants. The government finances this subsidized price.

Discretionary quota, however, has been used by the central government for a wide range of purposes, including supplying power to neighboring Bangladesh.³⁰ In order to get a share of the discretionary quota, state governments have to petition the central government. There have been instances of states such as Karnataka, Tamil Nadu, and Bihar petitioning the central government either during a poor monsoon season or for the agriculture sector during harvest.³¹

2. *Generation-based incentive (GBI)*: GBI is a price-based incentive provided to support small grid solar power projects (100 kW to 2 MW) connected to the state utilities. The incentive provided is the difference between the fixed CERC price and the estimated market price. Projects are selected on a first-come-first-serve basis.
3. *Viability gap funding (VGF)*: The government provides funds to support infrastructure projects that are not anticipated to have a high financial return.

²⁸ NVVN, "Guidelines for solar grid power projects," <http://www.nvvn.co.in/NVVN%20Presentation.pdf>.

²⁹ Lok Sabha, Unstarred Q. No.5901—Losses of Power Distribution Companies, February 2, 2013.

³⁰ ENS, "India-Bangladesh power transmission link open," *Indian Express*, October 6, 2013, <http://www.indianexpress.com/news/indiabangladesh-power-transmission-link-open/1178942/>.

³¹ Sujay Mehdudia, "Centre to consider State's demand," *Hindu*, July 24, 2008, <http://www.thehindu.com/todays-paper/tp-national/tp-newdelhi/centre-to-consider-states-demand/article1300558.ece>.

Solar power projects (750 MW grid connected) are selected through an open competitive bidding process and provided up to 20 percent of capital costs.³²

National Tariff Policy (NTP)

The tariff policy in India is guided in tandem by the *National Tariff Policy* and *National Electricity Policy*. The tariff policy's objective is to attract investment to the sector by fixing an adequate tariff for electricity. At the same time, a high priority is to provide electricity to the Indian public at an affordable price. Through this policy, and with the establishment of different institutional actors in *The Electricity Act, 2003*, the government has attempted to ensure regulatory consistency. The policy also tries to achieve greater transparency in procurement. The central government issues guidelines through the electricity policy for distribution licenses on tariff-based bidding processes for procurement of electricity.

SERCs determine the tariff for the generation, supply, and transmission of electricity. They also regulate the procurement price of distribution licenses for electricity and have the right to impose duties and taxes on the sale and consumption of electricity. The SERCs are responsible for the roadmap to achieve tariffs that are within ± 20 percent of the average cost of supply.

Renewable Energy Certificate (REC) Mechanism

According to *The Electricity Act, 2003*, state and central regulatory bodies are mandated to promote renewable energy. To do this, regulatory bodies have taken a number of measures, including the adoption of the Renewable Purchase Obligation (RPO).

Distribution companies have to purchase a portion of their electricity from renewable energy sources.³³ The renewable energy sources are classified as *solar* and *non-solar*. This portion differs for each state according to the level of renewable energy development and is specified by respective SERCs. For example, in Tamil Nadu, the total electricity to be generated from solar power ranges between 0.1 to 1 percent.

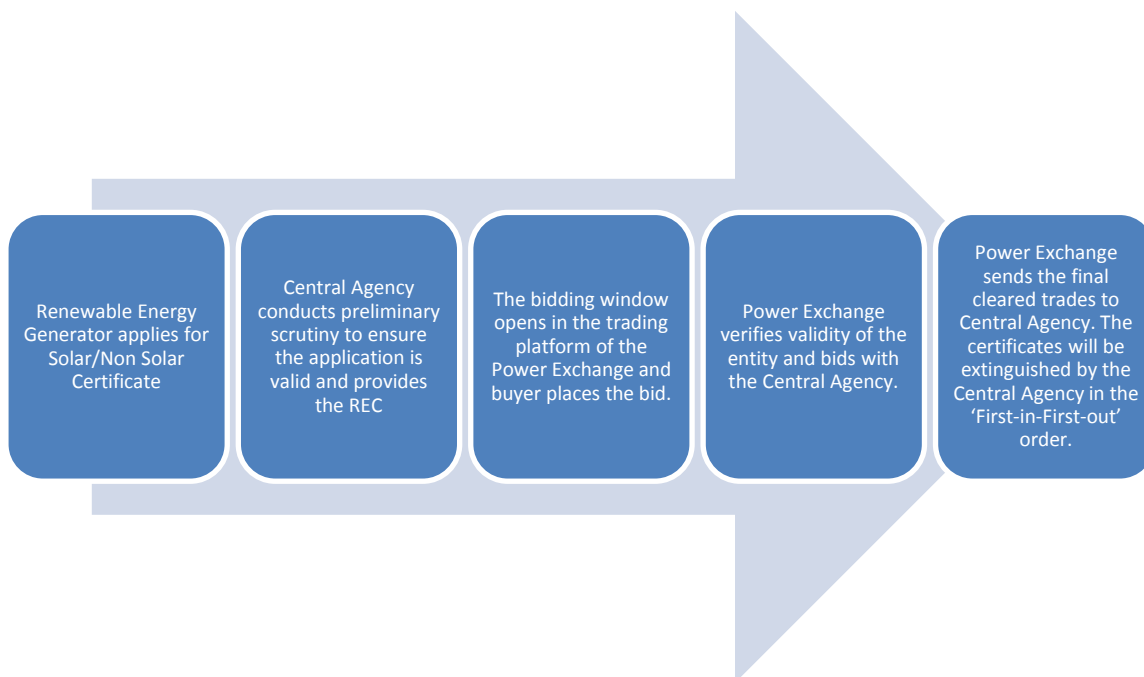
Not all states have the capacity to meet this mandated obligation. In order to meet the mandated RPO, the Renewable Energy Certificate (REC) mechanism was introduced.

A single REC is issued to project developers for 1 MWh of electricity generated into the grid from renewable energy sources. This REC can be purchased by distribution companies through the procedure described in Figure 5. Through this certificate mechanism, demand for solar energy is increased.

³² Press Information Bureau, Government of India, "Setting up of 750 MW of Grid connected Solar PV Power projects under Batch-1 of Phase-II of Jawaharlal Nehru National Solar Mission with Viability Gap funding support from National Clean Energy Fund," October 3, 2013, <http://pib.nic.in/newsite/PrintRelease.aspx?relid=99837>.

³³ Press Information Bureau, Government of India, "CERC announces Renewable Energy Certificate (REC) Regulation—a step forward for green energy promotion," January 18, 2010, <http://pib.nic.in/newsite/erelease.aspx?relid=57007>.

Figure 5: Renewable Energy Certificate Mechanism



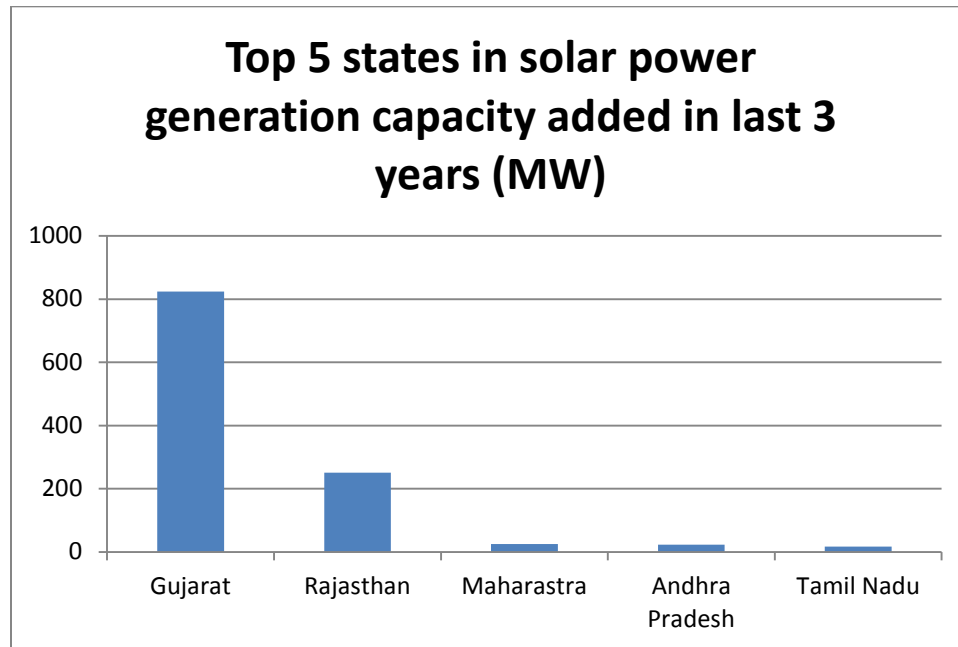
Solar Power Generation across States

India is blessed with the potential for a significant amount of solar energy generation. At 300 to 330 days of sun per year, the country plans to establish mega solar power plants to capitalize on this important domestic resource. As in many other sectors, India's states seek to drive change and attract investment in solar power, too (the top five states in solar power generation added in the last three years are shown in Figure 6). MNRE has finalized plans to set up the world's largest solar power project in Rajasthan, with a capacity of 4,000 MW. The first phase of the project is anticipated to be complete by 2016.³⁴ Land has already been allocated for a project in Gujarat. The government also plans to set up mega projects in Kargil and Ladakh with capacities of 2,000 MW and 5,000 MW, respectively.³⁵

³⁴ Press Information Bureau, Government of India, "Largest Solar Power Project in the World to Be Set Up in Rajasthan 1st Phase to Be Completed in 3 Years—Praful Patel," September 20, 2013, <http://pib.nic.in/newsite/erelease.aspx?relid=99512>.

³⁵ "More ultra mega solar plants on anvil," *The Hindu*, November 11, 2013, <http://www.thehindu.com/business/Industry/more-ultra-mega-solar-plants-on-anvil/article5339822.ece>.

Figure 6: Top Five States in Solar Power Generation Capacity Added in Last Three Years (MW)³⁶



The Power Grid Corporation of India Ltd. (PGCIL) has identified eight “renewable-energy-rich” states (not in any order):

1. Andhra Pradesh
2. Gujarat
3. Himachal Pradesh
4. Karnataka
5. Maharashtra
6. Tamil Nadu
7. Jammu & Kashmir
8. Rajasthan

Conclusion

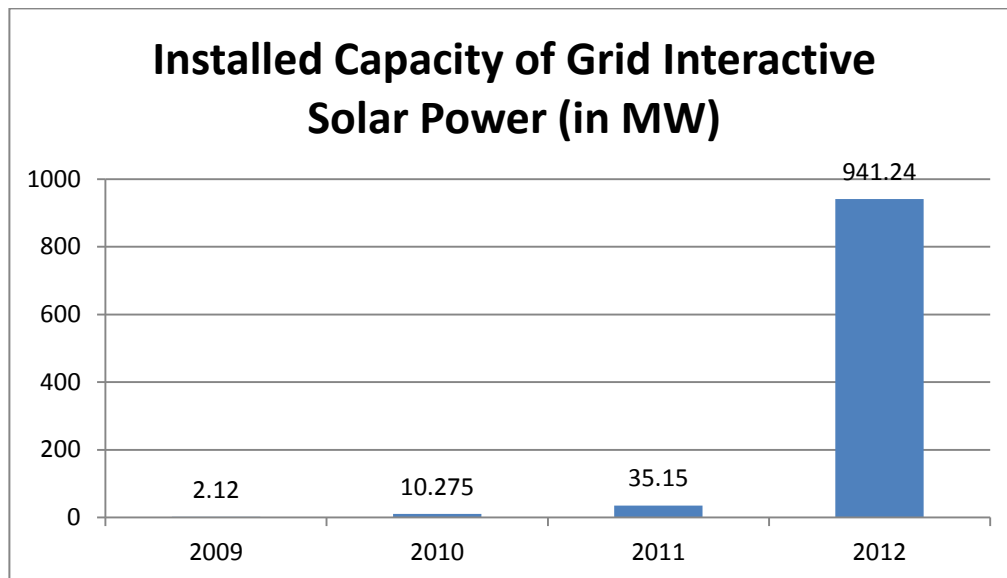
Due to India’s continued acute energy shortage, and the vital role it plays in India’s economic development, India has taken many important measures to promote solar energy development. As Kalam said, a policy of diversity in energy is crucial to India’s growth. In order to diversify its energy supply to achieve greater self-reliance and

³⁶ Lok Sabha, Unstarred Q. No.1968—Investment in Renewable Energy Sector, August 3, 2013.

meet growing energy demands, the government has embarked on a concerted effort to explore potential sources of domestic renewable energy. The economic and institutional reforms and investment made by the Indian government clearly reinforce its commitment to emerge as a leader in solar energy. Through the national tariff policy and *The Electricity Act, 2003*, the government attempted to ensure regulatory consistency in the power sector.

India's enabling framework has assisted private companies to generate nearly 87 percent of India's renewable energy. After the JNNSM was implemented, the installed capacity of grid interactive solar power increased from virtually nothing to 941.24 MW in 2012 (as shown in Figure 7). This indicates a robust implementation of the solar mission and the regulatory framework. India allowed up to 100 percent FDI in renewable energy generation and distribution.

Figure 7: Installed Capacity of Grid Interactive Solar Power (in MW)³⁷



Cooperation in renewable energy was institutionalized via a Joint Working Group on New Technologies & Renewable Energy between India and the United States. This institutional framework and cooperation in U.S.-India energy dialogue encourages and enhances communication between the two countries at a working level, and the routine meetings are action-causing events that often spur further initiatives. It presents an opportunity for government and global companies to invest in India's renewable sector and promote its measures for sustainability.

³⁷ Ministry of Statistics and Programme Implementation, "Energy Statistics 2011–2013," http://mospi.nic.in/mospi_new/upload/energy_stats_2011.pdf, http://mospi.nic.in/mospi_new/upload/Energy_Statistics_2012_28mar.pdf, http://mospi.nic.in/mospi_new/upload/Energy_Statistics_2013.pdf.

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