SECTOR OVERVIEW

A. The Energy Sector in India

1. India remains in chronic need of additional power generation capacity. Although, the electrification rate of households in India has increased from 43% in 2000[1] to 75% in 2010,[2] the quality and reliability of service remain suboptimal and rural areas in particular remain underserved. The Eleventh Five-Year Plan (2007–2012) targeted additional capacity of 79 gigawatts (GW); however, only 55 GW was realized. The Twelfth Five-Year Plan (2012–2017) targets an additional 88 GW, including 30 GW of renewable energy capacity.[3] Although the 12th plan sets ambitious targets to connect all villages to the electricity network, reliability will likely remain an issue. Because of continued demand growth, power supply is expected to continue to fall 10%–12% short of demand every year during the 12th plan (footnote 3).

2. India also needs to preserve its energy mix, not only to combat climate change but also to ensure the country's energy security. The availability of indigenous conventional fuels is diminishing and India has to import increasing quantities of coal and liquefied natural gas. Increasing scarcity of water is putting pressure on coal-based power plants during the pre-monsoon season drought. Investing in renewable power mitigates import dependency and the impact of potential imported fuel price increases. The share of renewable power, including hydro power, in total installed capacity has declined from 44% in 1970 to 31% in 2011. The government intends to stop this decline and has set a goal of maintaining the proportion of renewable power at its current level (31%) until 2023.[4]

3. The Indian energy sector has recently seen some favorable developments that are targeted to increase further investments in the sector, and particularly in renewable power generation. The Jawaharlal Nehru National Solar Mission (JNNSM) was launched in 2010, setting the target for 20 GW of grid-connected solar power capacity by 2020. In addition to capacity developed under the JNNSM with central government off-take, the different states have announced targets for capacity that will benefit from state utilities' off-take. Under these programs, solar developers benefit from attractive tariffs, although most tariffs are determined as a result of bids and solar tariffs are expected to decrease and reach "grid parity" over the medium term.[5] In the wind subsector, the seven states with the highest wind potential increased their wind feed-in tariffs in 2012–2013, and the central government announced the reinstatement of the generation-based incentive for wind projects in 2013.[6] In September 2012, the central government approved a large financial restructuring plan for state electricity boards. Several state electricity boards are in bad financial health, and the plan aims to strengthen their balance sheet to encourage investments across the energy sector.[7] In September 2013, Rajasthan and Tamil Nadu issued bonds under this program, while Haryana, Himachal Pradesh, and Uttar Pradesh are expected to follow soon.[8]

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[1] International Energy Agency (IEA). 2002. *World Energy Outlook – 2002*. Paris: Chapter 13.
[2] IEA. 2011. *World Energy Outlook – 2011*. Paris: Chapter 12.
[3] Planning Commission. 2013. *Twelfth Five-Year Plan*. New Delhi: Government of India.
[4] Central Electricity Authority (CEA). 2012. *National Electricity Plan*. Delhi: Government of India.
[5] HSBC Global Research. 2013*. India Renewables*. Bangalore. HSBC forecasts grid parity for solar over 2016–2018.
[6] The generation-based incentive provides an incentive of Rs0.5 per kilowatt-hour generated by wind projects under the scheme up to a maximum of Rs10 million per project, while a total of Rs8 billion will be made available.
[7] The plan allows half of the short-term liabilities to be taken over by state government while the remaining debt will be restructured with commercial banks. In turn, the utilities commit to implement annual tariff increases.
[8] http://www.business-standard.com/article/companies/two-discoms-issue-bonds-of-over-rs-16-000-cr-under-centre-s-restructuring-plan-113091100825_1.html; accessed on 19 September 2013.

4. The government's energy sector strategy is based on three pillars: (i) reforming the sector's policy and regulatory framework, (ii) promoting energy efficiency, and (iii) promoting renewable energy. The 12th plan calls for continued emphasis on renewable resources. Table 1 shows that India has large unrealized renewable energy potential.

Table 1: India's Grid-Connected Renewable Power Potential and Capacity
(MW)

Item	Potential	Installed Capacity (November 2012)	Unrealized Potential
Large hydro power (larger than 25 MW)	148,701	39,324	109,377
Small hydro power (up to 25 MW)	15,000	3,465	11,535
Wind power (onshore)	49,130	18,321	30,809
Wind power (offshore)	20,000	0	20,000
Bio-power (agro-residues)	18,000	1,243	16,757
Cogeneration (bagasse)	5,000	2,199	2,801
Waste to energy	2,700	94	2,606
Solar power	20,000	1,047	18,953
Geothermal power	10,000	0	10,000
Total	**288,531**	**65,693**	**222,838**

MW = megawatt.
Note: Since resource is not the limiting factor for solar power, the number used as "potential" in this table is the JNNSM's target for grid-connected power.
Sources: Ministry of New and Renewable Energy, Central Electricity Authority, and International Energy Agency.

B. Solar Power in India

5. The year 2012 was a historic year for the solar photovoltaic industry as cumulative global installed solar photovoltaic capacity crossed the 100 GW mark with additional solar photovoltaic installation in 2012 itself estimated to be 30 GW. India, however, represents only 1% of the global installed capacity, despite stronger potential than most countries.

6. India is endowed with rich solar resources given its location on the equatorial sunbelt. The daily average solar energy incidence over India varies from 4 kilowatt-hours per square meter (kWh/m^2) to 7 kWh/m^2 with about 2,300–3,200 sunshine hours per year, depending upon the location. This rate of insolation is among the highest in the world, comparing favorably with Australia (4.7 kWh/m^2/day), the People's Republic of China (3.4 kWh/m^2/day), and western Europe (2.9 kWh/m^2/day). Effective unlocking of this huge potential would enable power generation on a distributed basis and rapid capacity addition with relatively short lead times.

7. The JNNSM is an initiative of the central government aimed at deploying of 20 GW of grid-connected solar projects and 2 GW of off-grid solar projects by 2022. As of May 2013, more than 1,759 MW of grid-connected solar power projects have been commissioned in India.[9] The JNNSM has adopted a three-phase approach, the first phase of which has been completed with installation of 745 MW in 2012–2013.[10] In December 2012, the Ministry of New and Renewable Energy (MNRE) released a draft policy document for phase 2 of the JNNSM, targeting 10 GW of solar installations by 2017, which will include 4 GW of capacity under the central government program and another 6 GW from the state programs.[11] States have indeed set targets or launched bids for at least 6.2 GW of capacity by 2017—Rajasthan (at least 1.0 GW, although

[9] *Times of India*. 2013. Over 1,759 MW of projects commissioned under National Solar Mission. 28 July.
[10] Government of The United Progressive Alliance. Report to the People 2012–2013. New Delhi.
[11] MNRE. 2012. *Jawaharlal Nehru National Solar Mission. Phase II – Policy Document (draft).* New Delhi.

the official target is 10.0–12.0 GW in 10–12 years); Gujarat (at least 1.0 GW, although no target was set); Tamil Nadu (at least 1.0 GW, although the official target is 3.0 GW); Andhra Pradesh, Chhattisgarh, Kerala, and Uttar Pradesh (0.5 GW each); Maharashtra (0.4 GW); Madhya Pradesh (0.3 GW); Karnataka (0.2 GW); and Bihar, Odisha, and West Bengal (0.1 GW each).

C. Wind Power in India

8. Official estimates state that approximately 60GW[12] of wind power potential remains untapped, while other sources believe that the potential could be much higher. India currently has the fifth-largest installed wind capacity globally, behind the People's Republic of China, the United States, Germany, and Spain. The states of Tamil Nadu, Karnataka, Maharashtra, Gujarat, and Rajasthan together account for over 96% of the total installed capacity, which increased from 17.3 GW in February 2011 to 18.3 GW in November 2012. Table 3 summarizes India's onshore wind potential and installed capacity by state.

Table 3: Onshore Wind Potential and Capacity by State
(MW)

State	Potential	Installed Capacity (February 2011)	Unrealized Potential
Andhra Pradesh	5,394	245	5,149
Gujarat	10,609	2,966	7,643
Karnataka	8,591	1,934	6,657
Kerala	790	35	755
Madhya Pradesh	920	376	544
Maharashtra	5,439	2,733	2,706
Rajasthan	5,005	2,071	2,934
Tamil Nadu	5,374	6,988	0[a]
Others	7,008	3	7,005
Total	**49,130**	**17,351**	**33,393**

MW = megawatt.
[a] According to the IEA, onshore wind power potential could be up to 60,000 MW, which means that unrealized potential still exists in Tamil Nadu as well.
Source: Ministry of New and Renewable Energy, New Delhi.

9. Commercial wind power projects have been promoted through many fiscal and promotional incentives. The main driving force for development of the wind subsector has been the attractive feed-in tariffs set by the different states and increased from time to time to reflect changes in economics. Between August 2012 and October 2013, the electricity regulatory commissions of Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, and Tamil Nadu increased wind feed-in tariffs by an average of 18% (as of November 2013, tariffs in these states are in the range of Rs3.5–Rs5.9 per kilowatt-hour).

10. The other driving force for development of the wind subsector has been the provision of 80% accelerated depreciation. However, since about 2010, the energy sector in India has witnessed a qualitative change with the entry of independent power producers and a good possibility of foreign direct investment. The independent power producers and foreign direct investment investors, in general, cannot benefit from the accelerated depreciation benefits. So, to enhance the investor base in the wind subsector, the government introduced a generation-based incentive in December 2009 (para. 19).

[12] IEA. 2011. *Technology Development Prospects for the Indian Power Sector*. Paris.

11. As a result of lower labor and production costs and a strong local equipment manufacturing base, wind power equipment costs in India are considerably lower than in other countries around the world. In the first half of 2010, the installed cost for a wind power project in India averaged Rs53.7 million per MW. The current annual production capacity of wind turbines manufactured in India is about 3,000–3,500 MW (footnote 12).

D. Impact of Climate Change on Renewable Energy Resources

12. Notwithstanding the above expectations in terms of solar and wind potential in India, global climate change may alter the geographic distribution and the variability of solar and wind resources, the quality of these resources, and the prevalence of extreme weather events (such as typhoons and floods) that may impact the operation of the projects. Research on this is nascent and overall suggests that these impacts, although real, are unlikely to be of a magnitude that will greatly impact the amount of electricity generated by solar and wind projects being developed today or the potential for further development of renewable energy in India.[13]

E. Government Policy for Renewable Energy

13. The energy sector in India is regulated through a complex multi-ministerial structure that involves, amongst others, the Union Ministry of Power, the Ministry of Coal, the Ministry of Petroleum and Natural Gas, the MNRE, the Department of Atomic Energy, the Central Electricity Regulatory Commission (CERC), and the Planning Commission. In addition, most states have a state ministry of power as well as state electricity regulatory commissions (SERCs). Renewable energy policies are currently embedded in the existing framework of the Electricity Act, 2003; the National Electricity Policy, 2005; and the National Tariff Policy, 2006 (and as amended in December 2010).

14. **Electricity Act**. The Electricity Act, 2003 is the legislative cornerstone for India's power industry, providing a legal framework for efficient development and competition. The act's primary concerns are the unbundling of state electricity boards, open access, and competition. Under Part VII Section 61(h) of the act, the promotion of cogeneration and electricity generation from renewable sources is identified as a consideration in the establishment of tariff regulations, allowing the CERC to establish a preferential tariff for renewable energy. Further, the open access provision allows licensed renewable energy power generators access to transmission lines and distribution systems and only requires that the generators pay a wheeling charge for the use of the transmission lines and a fee to the load dispatch center.

15. **National Electricity Policy**. The National Electricity Policy, 2005, stipulates the need to increase the share of electricity from nonconventional sources and allows for the SERCs to establish a preferential tariff for electricity generated from renewable sources to enable them to be cost competitive. Section 5.12.3 of the policy encourages the development of cogeneration facilities and allows SERCs to promote arrangements between cogenerators and distribution companies interested in purchasing excess electricity through a competitive bidding process.

16. **National Tariff Policy**. The National Tariff Policy, January 2006, mandates competitive bidding for power procurement by distribution utilities. It also mandates that each SERC specify a renewable purchase obligation (RPO) with distribution companies in a time-bound manner.

[13] Intergovernmental Panel on Climate Change. 2011. *Renewable Energy Sources and Climate Change Mitigation*. Special Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA .

The objective of this policy is to enable renewable energy technologies to compete with conventional sources. Section 6.4 of the policy calls for the establishment of preferential tariffs with distribution companies for the purchase of electricity from nonconventional technologies. As of March 2012, 25 states had established RPOs or had draft regulations under consideration, with RPO requirements ranging from 1% to 15% of total electricity generation.

17. **Tradable renewable energy credits**. In January 2010, the CERC announced the terms and conditions for a tradable renewable energy credits (RECs) program. Under this program, renewable energy generators will have two options—either sell the renewable energy at a preferential tariff fixed by the SERC concerned; or sell the electricity generated, and the environmental attributes associated with the generation, separately.[14] On choosing the second option, the environmental attributes can be exchanged in the form of an REC. The price of the electricity component would be equivalent to the weighted average purchase cost to the distribution company, including short-term power purchase but excluding renewable power purchase cost. The RECs will be issued by the CERC and the value of one REC will be equivalent to 1 megawatt-hour of electricity delivered to the grid from renewable energy sources. The RECs can be traded only on power exchanges approved by the CERC within the band of a floor price and a ceiling price to be determined by the CERC from time to time.

18. **Accelerated depreciation benefits under the Income Tax Act**. The accelerated depreciation scheme was a fiscal incentive given by the government to wind power generators where 80% depreciation was allowed in the first year after construction and the rest was spread over the life of the project. The scheme was intended to assist early project development and it successfully helped the wind industry to achieve scale in India. In 2009, the Government of India withdrew these benefits for wind farms commencing operations after 31 March 2012. However, the accelerated depreciation benefit is still available to certain solar projects.[15]

19. **Generation-based incentive**. The MNRE announced this scheme in December 2009 as a more effective substitute to the accelerated depreciation. The generation-based incentive (GBI) is implemented through the Indian Renewable Energy Development Agency, a central government agency. GBI was initially available for wind turbines commissioned on or before 31 March 2012. However, only 1.3 GW were registered under the scheme, while the government had set a target of 4.0 GW. On 1 August 2013 the union cabinet of ministers approved the reinstatement of the GBI for wind projects. The GBI will provide an incentive of Rs0.5 per kWh of electricity generated by wind projects eligible under the scheme up to a maximum of Rs10 million per project, while a total of Rs8 billion will be made available for this purpose up to 2017.[16]

[14] CERC. 2010. CERC Announces Renewable Energy Certificate (REC) Regulation—A Step Forward for Green Energy Promotion. CERC Press Release. 18 January.

[15] E.g., grid-connected solar power plants having power purchase agreements where this clause is especially mentioned as in the case of the Gujarat Solar Policy, solar systems used for captive consumption, and solar off-grid systems with battery back-up.

[16] www.thehindubusinessline.com.industry-and-economy/cabinet-clears-generationbased-incentive-for-wind-power-projects/article5019072.ece accessed on 19 September 2013.