

## Renewable Energy Potential Assessment in Indian Perspective

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### Abstract

The present energy scenario in India is not satisfactory, the power supply position prevailing in the country is characterized by persistent shortages and unreliability and also high prices for industrial consumers. We depend to the extent of 70 % on imported oil, and this naturally raises issues about for energy security. The development of Renewable energy resources is necessary for sustainable development of any country. Achieving an efficient configuration of the various forms of energy requires consistency in the policies. This paper reviews all the comprehensive compilation of data related to potential, tariffs and the challenges on critical parameters for all the important sectors of the Indian renewable energy industry.

**Keywords:** Renewable Purchase Obligations, Clean Development Mechanism (CDM), Renewable Energy Certificate (REC), Feed-in-tariffs.

### 1. Introduction

According to Ministry of New and Renewable Energy (MNRE) the vision of Indian renewable energy program is “To develop new and renewable energy technologies, processes, materials, components, sub-systems, products & services at par with international specifications, standards and performance parameters in order to make the country a net foreign exchange earner in the sector and deploy such indigenously developed and/or manufactured products and services in furtherance of the national goal of energy security”.

Since with the increase of population in India about 1.22 billion with a installed capacity of 211.766 GW January 2013[1]. India currently suffering from huge energy shortage because the demand increases at a hectic pace compare to generation. The envisaged growth in the economy can be achieved by enhancing the availability & access to energy. The economic and social prosperity can only be bought by bridging the gap between the demand and supply.

Non renewable power plant constitutes 87.55 percent of the installed capacity and 11.45 percent of renewable capacity [2]. As non renewable energy comes from sources on our planet, they leads to pollution through the by-products they leave behind and mining of non-renewable energy is causing damage to our environment. There is no doubt that fossil fuels contribute to global warming. The result is a system that lacks diversity and security, threatens the health of our citizens, jeopardizes the stability of Earth's climate, and robs future generations of clean air, clean water, and energy independence Hence the role of new and renewable energy has been assuming increasing significance in recent times with the growing concern for the country's energy security.

## **2. Renewable Energy Scenario in India**

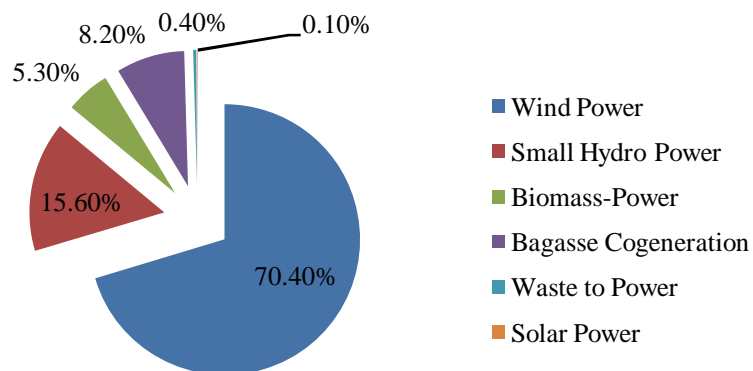
India has over 17 GW of installed renewable power generating capacity. Installed wind capacity is the largest share at over 12 GW, followed by small hydro at 2.8 GW. The remainder is dominated by bio-energy, with solar contributing only 15 MW. The Eleventh Plan calls for grid-connected renewable energy to exceed 25 GW by 2012. *Jawaharlal Nehru National Solar Mission* (JNNSM) targets total capacity of 20 GW grid-connected solar power by 2022. Renewable energy technologies are being deployed at industrial facilities to provide supplemental power from the grid, and over 70% of wind installations are used for this purpose. Biofuels have not yet reached a significant scale in India. India's Ministry of New and Renewable Energy (MNRE) supports the further deployment of renewable technologies through policy actions, capacity building, and oversight of their wind and solar research institutes. The Indian Renewable Energy Development Agency (IREDA) provides financial assistance for renewable projects with funding from the Indian government and international organizations; they are also responsible for implementing many of the Indian government's renewable energy incentive policies. There are several additional Indian government bodies with initiatives that extends into renewable energy, and there have been several major policy actions in the last decade that have increased the viability of increased deployment of renewable technologies in India, ranging from electricity sector reform to rural electrification initiatives. Several incentive schemes are available for the various renewable technologies, and these range from investment-oriented depreciation benefits to generation oriented preferential tariffs. Many states are now establishing Renewable Purchase Obligations (RPOs), which has stimulated development of a tradable Renewable Energy Certificate (REC) program.

As of June 2010, India was one of the world leaders in installed renewable energy capacity, with a total capacity of 17,594 MW (utility and non-utility),[3] which represents approximately 10% of India's total installed electric generating capacity.[4]

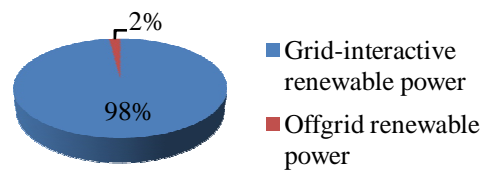
Of that total, 17,174 MW were grid-connected projects, and the remaining 2.4% of installed renewable capacity consisted of off-grid systems.[5] The wind industry has achieved the greatest success in India with an installed capacity of 12,009 MW at the end of June 2010. India has also installed 2,767 MW of small hydro plants (with sizes of less than 25 MW each), 1,412 MW of grid-connected cogeneration from bagasse, and 901 MW of biomass-based power from agro residues. Waste-to-energy projects have an installed capacity of 72 MW. India has off-grid renewable power capacities of 238 MW from biomass cogeneration, 125 MW from biogas, 53 MW from waste-to-energy, 3 MW from solar PV plants, and 1 MW from hybrid systems.[6]

India hopes to develop more of its solar resource potential. As of June 2010, solar PV plants in India had reached a cumulative generation capacity of approximately 15.2 MW. This is approximately 0.07% of JNNSM’s 2022 target of 22 GW.[7] As reported by *CSP Today*, JNNSM’s goal would “make India the producer of almost three-quarters of the world’s total solar energy output.”[8] By the end of the Tenth Plan (2007), India achieved a cumulative installed capacity of 10.161 GW of renewable energy. Additions totaling 15 GW are targeted during the Eleventh Plan to bring the total installed grid-connected renewable generating capacity to over 25 GW. Wind energy is expected to contribute approximately two-thirds of the added capacity in this plan period. If India is able to achieve its renewable energy goals by 2022 (by the end of the Thirteenth Plan), it will reach a total of 74 GW of installed capacity for wind, solar energy, biomass, and small hydropower, with wind and solar expected to account for more than 80% of the installed renewable power.[9]

**Grid-interactive Renewable Power in India**

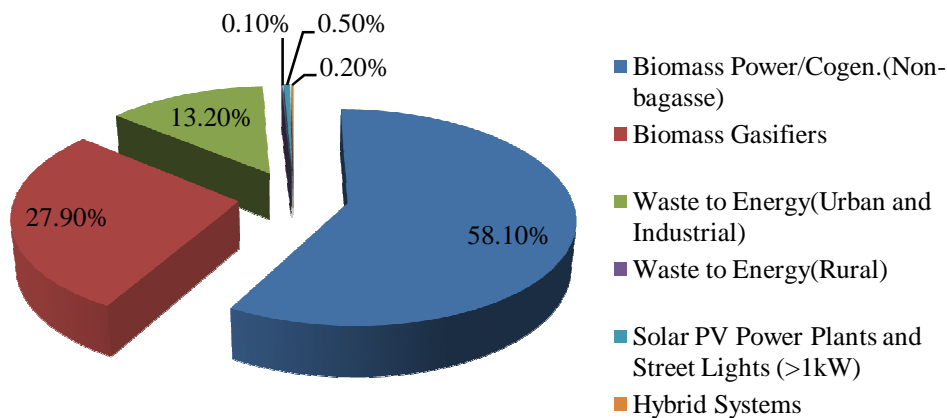


**Renewable Energy in India Total RE installed capacity: approx 19 GW**



Source: MNRE

### Off-grid/Distributed Renewable Power (Including Captive/CHP plants)



Source: MNRE

### 3. Incentives for Renewable Energy by Indian Government

In the early 1980s, the Indian government established the Ministry of New and Renewable Energy (MNRE) to encourage diversification of the country's energy supply and satisfy the increasing energy demand of a rapidly growing economy.[10] The MNRE issued guidelines to all state governments to create an attractive environment for the export, purchase, wheeling and banking of electricity generated by renewable power projects.

Available framework of incentives:

- Feed-in-tariffs
- Up to 80 % accelerated depreciation in renewable energy investments
- Relief in customs duty, excise duty and sales tax
- Exemption from Central Sales Tax, and customs duty concessions on the import of material, components and equipment used in renewable energy projects
- Soft loans
- Government policies covering wheeling, banking, buy-back, and third-party sale of power
- Income tax exemption for any single 10 year period in the first 15 years of a wind farm.

In addition to the above government incentives, most renewable energy projects can increase their monetization through the carbon credits trading under the Clean Development Mechanism (CDM).[11]

Many states in India have introduced renewable purchase obligations (RPO/RPS) for utilities and Renewable Energy Certificates (REC) using which utilities that do not have access to sufficient renewable energy sources could purchase credits from those utilities / companies that generate green power. The RPO acts as the driver for the use of RECs and in turn, RECs provide the support required to implement the RPOs.

## **4. Incentives for Each Renewable Energy Source**

### **4.1 Solar PV, Solar CSP & Thermal**

#### **4.1.1 PV & CSP**

The "National Solar Mission", formally adopted by Prime Minister Manmohan Singh's special panel on climate, envisages the creation of a statutory solar [12] authority that would make it mandatory for states to buy some solar power, according to a draft of the plan. The plan pledges to boost output of solar energy from near zero to 20 GW by 2022.

As part of this plan, in Jun 2010, the MNRE[13] announced the final guidelines for implementing off-grid and small solar PV power plants. In July 2010, similar guidelines for larger, grid connected power plants were released. As of Jun 2011, 500 MW of solar CSP and 200 MW of solar PV grid-connected projects have already been allocated. An additional 300 MW solar PV is expected to be allocated soon.

Incentives vary, depending on whether the project is off-grid or grid connected.

1. *Grid connected solar projects* – These systems are typically supported by high feed in-tariff.

The rates quoted by the winners were in the range Rs 10.912.7/kWh [14-16] for solar PV and 10.49 to 12.24/kWh for CSP.

2. *Off-grid solar projects* – for solar PV projects that are off the grid, incentives have been provided primarily in the form of capital subsidies (30% for non-priority regions and 90% for priority regions), accelerated depreciation and in some cases, access to soft loans (5% interest rate)[17-22]

#### *State Schemes*

Many Indian states are firming up their individual state schemes under the National Solar Mission. Of these, only Gujarat, Rajasthan and Karnataka have so far announced their schemes formally.

#### **4.1.2 Thermal**

Incentives for Solar Thermal for Industrial Purposes [23]

- A subsidy of up to 30% is available from MNRE on solar furnace components
- 80% Accelerated Depreciation is available
- IREDA provides soft loans for solar thermal projects under 2 different schemes
  - Direct User Scheme

- Intermediary Scheme
- For solar water heaters, soft loans at interest rates of 2%, 3% and 5% are provided to domestic, institutional and commercial users respectively.
- SNAs (State Nodal Agencies) can be approached for capital subsidies of Rs. 1900 for domestic, Rs. 1750 for institutional and Rs. 1400 for commercial establishments, per sq. meter of installed solar water heating.

## 4.2 Wind Energy

### Incentives for Wind Energy

- 10 year tax holiday
- Low customs duty on imported components
- Accelerated Depreciation (AD) benefits [24]
- In June 2008, the MNRE announced a national generation based incentive scheme for grid connected wind power projects under 49 MW, providing an incentive of 0.5 rupees per kWh in addition to the existing state incentives.
- A developer can go for either of two benefits - Accelerated Depreciation (AD) or Generation Based Incentive scheme (GBI).
- States such as Maharashtra have recently announced feed-in-tariffs based on wind zones; this tariff structure is more closely aligned with the total amount of electricity production possible. This framework has the potential to significantly increase the returns for wind farm owners in India, making this sector even more attractive than it is presently.

## 4.3 Biomass Power

### 4.3.1 Biomass Power Production

Biomass based power plants in India can avail the following:

- Capital subsidies (30%)
- Accelerated depreciation (80% in first year)
- Exemption from Central Sales Tax and customs duty concessions on the import of material, components and equipment used
- Preferential feed-in-tariff (varies from state to state)

### 4.3.2 Biofuels

India has a Biofuel Policy with an emphasis on biodiesel production from *Jatropha* and ethanol production from sugarcane molasses. In 2004, it was decided, as a first step, to mandate 5% blending of petrol with ethanol. An MOU between the Indian Sugar Mills Association and Indian Oil Corporation is designed to ensure uninterrupted supplies of ethanol for the program. The target was a 20% blend by the year 2011-12, though this target will most likely not be achieved, going by the trends available until Jun 2011.

A National Bio-diesel Board has been created to promote, finance and support organizations that are engaged in the field of oilseed cultivation and oil processing leading to bio-diesel production.

*State incentives for biodiesel*

Incentives are usually provided through the respective state renewable energy development agency. A reduced VAT @ 4% is provided in most states.

- Support price of oil seeds
- Incentives for raising commercial plantations
- Subsidy given for planting material 50% subsidy will be provided on cost of planting material for biofuels crops such as Jatropha.
- Credits and finance resources

#### **4.4 Small Hydro**

- Tax incentives such as enhanced capital allowances IREDA provides low interest rate loans for hydel power stations up to 25 MW
- Incentives for detailed survey and investigation and Detailed Project Report (DPR) preparation
- Interest subsidy for commercial projects
- Financial support for renovation, modernization and capacity up-rating of old SHP stations

### **5. Conclusion**

India has huge potential for producing power from Renewable Energy sources but according to monthly generation report the Percentage share of Renewable energy a source in total generation in the country during 2011-2012 was around 5.5 percent. Realizing the importance of generation from renewable energy sources, ministry of power suggested CEA to adopt many methodologies to enhance the generation from Renewable energy sources. The National electricity aims to accelerated development in RES with many objectives like Reliable power, Quality of power, inexpensive power, commercial viability, power to all. This paper concludes the potential, incentives given by Indian government, challenges faced by the government. Prospects of RES are steadily improving in India towards a great future.

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**Table 1:** Summary of Renewable Energy Sources Growth Potential in India.

Renewable Energy Source	Short Term Growth Potential	Medium Term Growth Potential
<b>High Potential</b>		
Solar PV	high	high
Solar CSP	medium	high
Solar Thermal for Heating/Drying	high	high
Wind	high	high
Biomass Power	high	high
Small Hydro	high	high
<b>Medium Potential</b>		
Large Hydro	medium	medium
Waste to Energy	medium	medium
<b>Low Potential</b>		
Geothermal	low	low
Wave	low	low
Tidal	low	low

Source: EAI India Renewable Energy Advisor

**Table 2**

	Solar PV	Solar CSP	wind	Bio-mas s	Sm all hyd ro	Large Hydro	Geoth - ermal	Tidal energy	Wave energy	Waste to energy
<b>Total available potential</b>	5000 trillion kWh annually	Over 5000 trillion kWh annually	Over 100,000 MW	23.7 GW	10,000 MW	148700 MW	100 MW	Gulf of camby (7000 MW) Gulf of kutch (1200 MW)	40,000 MW	1500 MW

<b>Exploited potential</b>	less than 150 MW	negligible	14157 MW	-	None	38106 MW	none	none	none	70 MW
<b>Projected capacity</b>	2013: 1-2 GW 2017: 4-10 GW 2022: 20 GW		2020 : 50,000 MW	2022 : 10,000 MW	No project yet	15627 MW	No project yet	3.75 MW in Sundarbans	No commercial project	No reliable estimate for projected capacity
<b>Investments</b>	Rs. 84,000 crores until 2022	-	-	-	-	Rs. 28,000 crores	Companies that have started exploring in this field.	Negligible currently.	Negligible, but some effort in gujrat.	Companies that have started exploring in this field.
<b>Cost of power generation</b>	Rs. 10-12/kwh	Rs. 9-11/kwh	Rs. 2.7-3.5/kwh	Rs. 3-4/kwh	6-7 cents/kwh.	Rs. 2.23.25/kwh	6-7 cents/kwh	13-15 cents/kwh	15-17 cents/kwh	Rs. 9-13 crores per MW.