

# India: Towards New and Renewable Energy Sources for Growing Energy Demand

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## Abstract

*In developing countries like India, availability of electricity in the rural areas is still a distant dream. Energy plays crucial role in attaining productivity and prosperity for a nation. Per-capita energy indicates the standard of living of the people, energy access to the people and specifies the growth of the nation. Renewable energy thus plays an important role in mitigating this gap by providing quality energy access to the people. An increase in the production of renewable energy has been observed since 6th (1980–1985) to 12th plan (2012–2017).*

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## INTRODUCTION

In countries with a fast emerging economy such as India, large energy generation capacities are needed to achieve the developmental goals. In India, most of the energy requirements are fulfilled through oil, gas and coal. Rapid growth and global competition to acquire access to fossil resources along with environmental concerns regarding extensive usage of fossil fuel for energy, has pushed India to explore other energy options.<sup>[1–3]</sup>

As per the present energy scenario, there are only limited fossil fuel reserves. The demand for energy is growing at an alarming rate, rising from 82.2 to 86.7 million barrels/day across the world. According to recent statistics, it is believed that the rate at which energy is being consumed; we will be running out of petroleum in next 50 years, natural gas within 65 years and coal in about 200 years.<sup>[4]</sup>

Former Prime Minister Dr. Manmohan Singh while launching India's National Action Plan on Climate Change once said, *"Our vision is to make India's economic development energy-efficient. Over a period of time, we must pioneer a graduated shift from economic activity based on fossil fuels to one based on non-fossil fuels and from reliance on non-renewable and depleting sources of energy to renewable sources of energy. In this strategy, the sun occupies centre-stage, as it should, being literally the original source of all energy"*.

In India, wind power development got initiated during the 1990s. Since then, it has significantly increased in the past few years. Although a newcomer to the wind industry in comparison to Denmark and US, domestic policy support for wind power has led India to have the fourth largest installed wind power capacity in the world (World Wind Energy Report 2008).



**Fig. 1.** Solar Resource Map of India (Wikipedia, the Free Encyclopedia).

India being densely populated with high solar insolation, makes an ideal combination for using solar power in this country. Major proportion of India does not have an electrical grid, so one of the first applications of solar power would be for water pumping. This will help to replace India's 4-5 million diesel-powered water pumps, each of which consumes nearly 3.5 kilowatts and off-grid lighting. New solar power projects have been proposed, and approximately 35,000 km<sup>2</sup> area of the Thar Desert has been set aside for these projects, sufficient to generate 700–2100 gigawatts (Wikipedia, the free encyclopedia).

India was ranked third among the top producers of coal with 8% production share in the world, in 2010. In India, the largest coal belt is located at Jharia, where initially there were forests inhabited by tribes.<sup>[5–9]</sup>

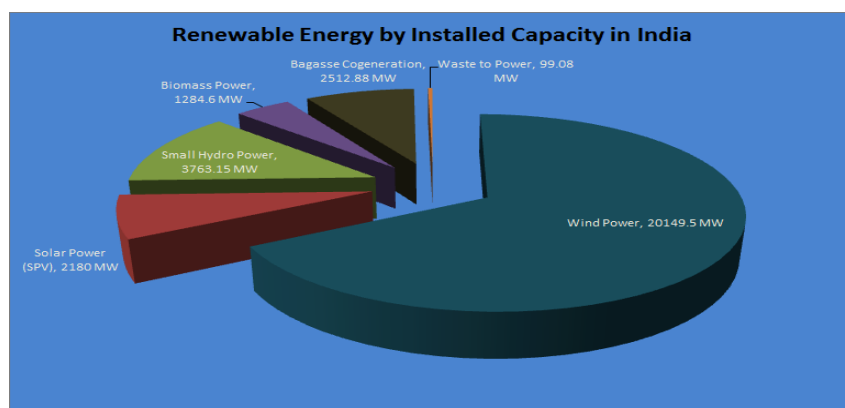
In India, it is needed for the commercial and primary energy supplies to grow at a pace of 6% and 5% per annum, respectively. In India, the annual coal production as reported for the year 2006–2007 was nearly 400 million tons. Here,  $\geq 90\%$  of coal produced is of non-coking type, out of which, above 80% is consumed by the India Power Sector.<sup>[10]</sup>

Since ages, mankind is utilizing solar energy for drying, wind energy for sailing boats and/or grinding of grains, biomass for cooking/heating and water stream for grinding through water mills. The systematic beginning of renewable energy development in India may be dated back to 1981.<sup>[5]</sup>

Till date, electricity produced from solar, wind, biomass, and other biological matter such as algae, *Jatropha* seed, etc., and hydro resources has reached the stage of grid parity.

## METHODOLOGY

There are many renewable energy sources available in India. These are solar energy, wind energy, biomass, hydroelectric plants and fuel cells.



**Fig. 2.** Sources of Renewable Energy in India (December 2013, MNRE India).

- (1) Solar energy: ‘Solar’, a Latin word meaning ‘Sun’, is the source of all energy on earth.

Solar technologies are broadly described as active or passive depending on the way they receive, convert and distribute sunrays. Active solar technology makes use of photovoltaic panels, pumps and fans to transform sunlight into a useful output. In contrast, passive solar technology is

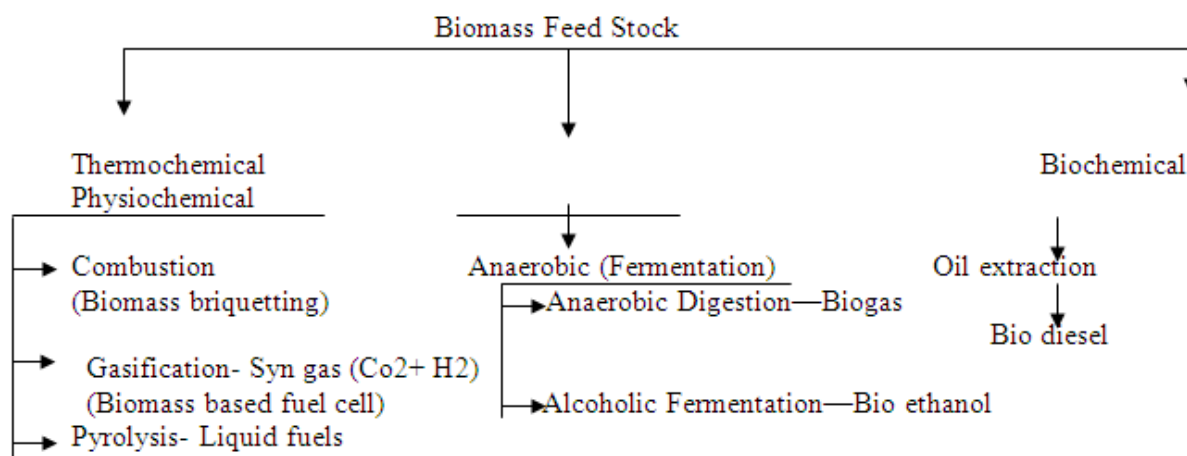
based on selecting materials with favourable thermal properties, designing spaces that circulate air and referencing the position of a building towards the Sun.

- (2) Wind energy: Wind energy harnessing by active and/or passive way, involves the use of wind mill for water-lifting, grain-milling etc. and other aero-generators, wind-turbine for electric generation.

**Table 1.** Some Largest Wind Farms of India (Wind Farm List 2014).

Wind farm	Producer	State	Current capacity (MW)	Notes
Muppandal windfarm	Muppandal Wind	Tamil Nadu	1500	[11]
Jaisalmer Wind Park	Suzlon Energy	Rajasthan	1275	[12]
Brahmanvel windfarm	Parakh Agro Industries	Maharashtra	528	[13]
Dhalgaon windfarm	Gadre Marine Exports	Maharashtra	278	[14]
Chakala windfarm	Suzlon Energy	Maharashtra	217	[15]
Vankusawade Wind Park	Suzlon Energy	Maharashtra	189	[16]
Vaspet Windfarm	ReNew Power	Maharashtra	144	[17]

- (2) Biomass generation:



**Fig. 3.** Biomass to Energy Conversion Technology.

- (4) Hydroelectric plants: Alternate Hydro Energy Centre (AHEC), established in Indian Institute of Technology, Roorkee, promotes power generation through the development of small hydropower project in hilly areas.
- (5) Fuel cells: Alkaline fuel cells, phosphoric acid fuel cell, polymer electrolyte membrane fuel cell, direct methanol fuel cell, methane carbonate fuel cell & solid oxide fuel cell<sup>[6]</sup>

## RESULT AND DISCUSSION

### Progressive Trend in Financial Expenditure in Renewable Energy Sector

The financial allocation for renewable energy sector vis-à-vis the total allocation remains in the range of 0.1, 0.45, and 0.76% during the 6th, 11<sup>th</sup>, and 12th plan, respectively (Table 2).

**Table 2.** Allocation is Renewable Energy over Conventional Energy Source.

Five plan period	Total plan outlay (Rs. in crore)	Energy sector outlay (Rs. to crore % of total)	% Share in the total plan allocation			
			Power	Oil/Gas	Coal	Renewable
Sixth (1980–1985)	109.290	30.751 (28.1)	16.7	7.8	3.5	0.1
Seventh (1985–1990)	220–220	61.689 (28.2)	17.4	7.3	3.2	0.3
Eighth (1992–97)	434.100	115.561(26.5)	18.4	5.5	2.4	0.2
Ninth (1997–2002)	859.200	219.915 (25.6)	14.5	8.6	2.04	0.44
Tenth (2002–07)	893.187	286.592 (32.1)	16.05	11.60	3.18	0.80
Eleventh (2007–2012)	3156.571	823.788 (28)	14.16	14.16	2.92	0.45
Twelfth (2012–2017)	4333.739	1028.460 (23.7)	10.17	10.17	10.19	0.76

**Table 3.** Estimated Potential and Plan Capacity Addition in Grid Interactive Renewable Power in India (in MW).

Resource	Estimated potential	Up to IXth plan as on 31-03-2002	X plan achievement 01-4-02-31.3 2007	XIth plan Achievement 1-4-207 To 31-3-2012	XIIth plan 01-4-12 To 31-5-13	Cumulative achievement 31-5-2013
Wind power	102.500	1.628	5.464	10,260	1965	19,317
Small hydro power	19.750	1.434	542	1419	276	3671
*Biomass power	23.700	389	795	2021	467	3672
**Solar power	20–30 MW/Sq. km	2	1	938	828	1769
Waste energy	2700	-	15	7.4	0.7	96
Total	168,950	3453	6802	14,712	3403	28,525

\*Including Biogases Cogeneration, Urban and Industrial Waste to Energy.

\*\*Taxing 20,000 MW Solar Power Target Till 2022 Under JNNSM.

**Table 4.** Showing the Global Status Trend of Different Technology of RE.

	2009	2010	2011
Global new investment in NRE (Annual, in billion USD)	161	220	257
Renewable power capacity (Total not include hydro in GW)	250	315	390
Renewable power capacity (Total include hydro in GW)	1170	1260	1360
Hydro power capacity (Total figures in GW)	915	945	970
Wind power capacity (Total in GW)	159	198	238
Solar PV capacity (Total in GW)	23	40	70
Concentrating solar thermal power total in GW	0.7	1.3	1.8
Solar hot water capacity total in GW	153	182	232
Ethanol production (Annual in billion litres)	73.1	86.5	86.1
Biodiesel production (Annual in billion litres)	17.8	18.5	21.4

## CONCLUSION

There has been a consistent increase towards the development of renewable energy with an annual growth rate of 23%, rising from approximately 3900 MW in 2002–2003 to 31,702 MW and 137 MW in August 2014. Wind energy continues to dominate India's renewable energy industries, comprising 70% of installed

capacity of 21,192 MW; followed by hydropower, biomass power, solar power and waste of energy. In terms of electricity generation, with normative capacity utilization factors, the renewable power installed capacity is generating around 50 BU per year corresponding to about 6.5% total electricity and 12.5% of total capacity, as reported during 2013–2014.

**REFERENCES**

1. [www.mnre.gov.in](http://www.mnre.gov.in).
2. Raghubansi A.S., Singh R.P., Sharma B. Biomass to energy, *Renew Energy*. 2013; 6(4): 13–5p.
3. Tiwari S.K. Solar energy utilization through network, *Renew Energy*. 2012; 6(1): 18–20p.
4. Das D. Biomass to biohydrogen a successful path, *Renew Energy*. 2014; 7(6): 28–31p.
5. Tripathi A.K. Three decades of renewable energy, *Renew Energy*. 2013; 6(5 & 6): 10–7p.
6. Nouni M.R. Fuel cells, *Renew Energy*. 2013; 6(5 & 6): 56–8p.
7. World Wind Energy Report 2008.
8. Wind farm list. Retrieved 2 February 2014.
9. Ministry of New and Renewable Energy. (December 2013) *Renewable Energy in India*. The True Cost of Coal Greenpeace; 2008, 24–9p.
10. Shahi R.V. *India's Strategy towards Energy Development and Energy Security*. Board of International Energy Agency; 2006, 1–21p.