

# Development of Renewable Energy Sector in India and Its Impact on Greenhouse Gasses

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*Abstract: Economic growth, increasing prosperity, a rapid urbanization and raising per capita energy consumption have widened access to energy in India. Renewable energy sources and technologies have the potential to provide solutions to the long-standing energy problems and Green House Gasses emission being faced by the country. Current renewable energy contribution stands at 86 GW(including large hydro power) of the total installed capacity of 305 GW in the country. To meet the energy requirement for such a fast growing economy and cut CO<sub>2</sub> emissions level, India will require an assured supply more energy than the total energy demand. The renewable energy is one and only options to solve the crises. Today, renewable account for about 14% of India's primary energy consumptions. India is increasingly adopting responsible, renewable energy techniques and taking positive steps towards carbon emissions, and ensuring a more sustainable future. In this paper, efforts have been made to summarize the availability, current status, major achievements and future potentials of renewable energy options in India.*

**Keywords: Barriers, CO<sub>2</sub> Emissions, Incentives, Investment, Renewable Energy, Targets.**

## I.INTRODUCTION

Energy is the primary and most universal measure of all kinds of work of human beings and nature. The standard of living and prosperity of a given country can be directly related to per capita energy consumption. The per capita energy consumption of India is 150kWh and 1% of total energy consumed in the world. India uses only 6% of the world's primary energy.

India was the first country in the world to set up a ministry of New and Non-Conventional Energy (MNRE) resources, in early 1980s. As highlighted at the Conference of Paris (COP21) in Paris, the urgent focus of world governments is to limit the rise in the planet's temperature to 2 degree Celsius (3.7°F) by reducing greenhouse gas emissions. The Indian government has set a target of 30% reduction in Greenhouse gases by 2022; this has subsequently given rise to large investments in renewable energies.

India's quest for green energy has crossed a major milestone, with renewable plants like wind, solar, mini hydro and Biomass. The total capacity of renewable energy projects expanded to 44.76 GW on November 2016. However, the country still

depends Primarily on thermal power which produce huge greenhouse gasses. Supply from renewable power depends on sunshine or wind, which is not consistently available but Renewable energy's growth, is propelled by the falling costs of solar and wind energy.

Table:1 Grid connected installed capacity from all sources as of October 31, 2016

Source	Installed Capacity (GW)
RES MNRE	44.78
Large Hydro	42.78
Coal	185.99
Gas	24.51
Diesel	0.92
Nuclear	5.78
Total	305.83

The first figure at the top of the table refers to the fast growing renewable energy sources under the responsibility of the Ministry for New and Renewable Energy and slightly exceeded the installed capacity of large hydro installations. This figure is targeted to reach 175 GW by 2022. Coal power currently represents the largest share of installed capacity at just less than 186 GW. Total installed capacity as of October 31, 2016, for grid connected power in India stood at a little less than 305 GW.

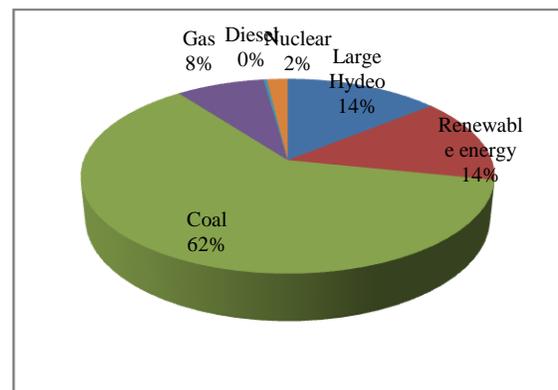


Figure:1 India Energy basket

## II. OVERVIEW AND TARGETS

The role of renewable sources of electricity generation gained a massive boost with the capacity surging ahead of expectation. The main reason for the huge additional capacities is due to the massive price decline in costs of wind and solar energy components.

Table:2 Installed grid connected renewable electricity

Source	installed Capacity (GW)	2022 target (GW)
Wind Power	27.44	60
Solar Power	8.06	100
Biomass Power	4.86	10
Waste-to-Power	0.16	
Small Hydro Power	4.30	5
<b>Total</b>	<b>44.78</b>	<b>175</b>

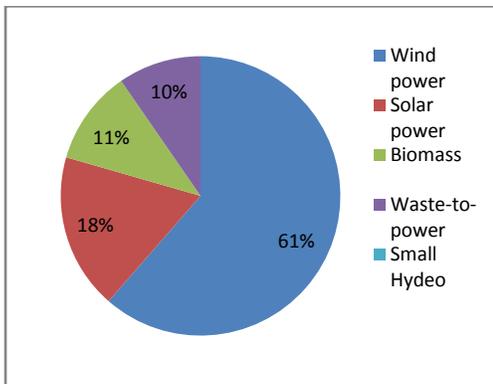


Figure: 2 Installed Grid Interactive Renewable Power Capacity in India as of October 31, 2016

India has the fifth largest power generation portfolio worldwide with a power generation capacity of 305 GW. Economic growth, increasing prosperity, a growing rate of urbanization and rising per capita energy consumption has widened access to energy in the country. Current renewable energy contribution stands at 44.78 GW (excluding Hydro power) of the total installed capacity of 305 GW in the country as on 1.11.2016. Wind energy is the largest and cheapest renewable energy source in India and fourth largest in the world. Wind energy accounts for nearly 70% (23.44 GW) of installed renewable energy capacity. The Government of India has set targets which will take the total renewable capacity to almost 175 GW by the end of 2022. This includes 60 GW of wind power, 100 GW from solar power, 10 GW of biomass power and 5 GW from small hydro power. India requires a cumulative \$2.8 trillion in investment in energy supply in our main scenario, three-quarters of which goes to the power sector, and a further \$0.8 trillion to improve energy efficiency. Coal will continue to

be the main source of power generation in the country for some time and deploy more efficient and low-carbon technologies.

## III. INDIA'S ENERGY CONSUMPTION AND PRODUCTION

Since 1980s, India has encountered a negative balance in overall energy consumption and production. This has resulted in the need to purchase energy from outside the country to supply and fulfill the need of the deserved. Government has more sensitive to renewable energy potential and has started reforms and targets, incentives and legislation in place to convince investors and companies to make the shift.

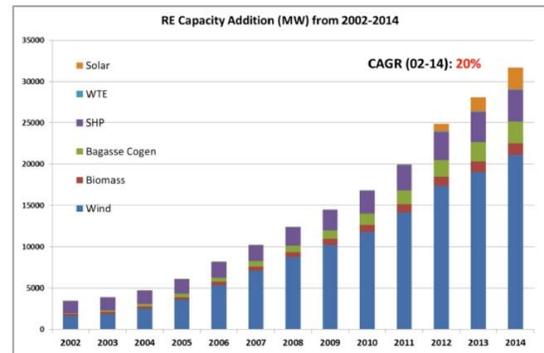


Figure:3 RE capacity addition(MW) from 2002-2014

A 2016 BP Energy Outlook report showed alarming number on India's energy consumption to depend on fossil fuels. This report says that by the year 2035, India's gas import will increase by a staggering 53 percent, oil import by 169 percent and coal import by 85 percent.

## IV. INCENTIVES AND INVESTMENT BY GOVERNMENTS AND INSTITUTIONS

1. Income tax breaks, accelerated depreciation, capital/interest subsidy, custom duty free incentives
2. The government is playing an active role in promoting the adoption of renewable energy resources by offering various incentives, such as generation-based incentives (GBIs), capital and interest subsidies, viability gap funding, concessional finance, fiscal incentives etc.
3. The MNRE is providing central financial assistance to set up small/micro hydro projects both in the private and public sectors
4. Setting up of the solar Energy Corporation of India to boost
5. State electrical regulatory commissions, like AP, Punjab, MP, Mahastra, Rajasthan, Tamilnadu, Gujatat,Haryana,Kerala, Orissa and West Bengal have announced preferred tariff for the purchase of wind power
6. New solar Policy in Telangana, AP, Karnataka and Rajasthan
7. Full exemption on excise duty on pig iron and Ferro-silicon-magnesium for use in the manufacturing of cast components of wind-operated electricity generators and solar power plant components and equipments.

8. Fiscal incentives for Biomass projects and small hydro power projects

### 1. Foreign Direct Investment (FDI) in renewable energy sector

The intensity of use of electrical energy in the Indian economy has shown a steady increase. This trend necessitates a substantial increase in the share of investment. The investment made from government, private sector and foreign investors. The government has created a liberal environment for foreign investment in renewable energy projects. In recent years, India has emerged as one of the leading destinations for investors in developed countries. This attraction is due to the lower cost of manpower, quality products and government incentives. The establishment of a dedicated financial institution – the Indian Renewable Energy Development Agency, makes for renewed impetus to the promotion, development and extension of financial assistance for renewable energy and energy efficiency projects. Foreign Direct Investment (FDI) up to 100% is permitted for renewable energy generates and distribution projects. They are SUZLON from India, ENERCON from Germany, VESTAS from Germany, RRB from India, NEG, Micon(Danish), Applied Materials (USA).100% FDI is positive movement by Indian government. Between April 2000 and March 2016, the industry attracted US\$ 10.48 billion in Foreign Direct Investment (FDI).The initiative would entail an investment of about US\$ 310–350 billion in renewable energy sector.

### V. OBSTACLES TO THE IMPLEMENTATION OF RENEWABLE ENERGY SYSTEMS

Experience with renewable energy projects in India indicates that there are a number of barriers to the effective development and widespread diffusion of these systems. Among these are:

1. Inadequate coordination in renewable energy activities and information on successful and unsuccessful projects
2. Skeptical aptitudes towards renewable energy systems on the part of planners and lack of qualified personnel design, manufacture, market and operating systems
3. Technical and economic uncertainties in many renewable energy systems
4. Weak institutions and policies to finance and commercialize renewable energy system
5. Inadequate documentation and evaluation of past experience
6. The single biggest problem of renewable power is its intermittent nature. The sun does not always shine, and the wind does not always blow.
7. Delay in environmental clearance

#### Advantages of renewable energy

1. The use renewable energy could help foreign exchange reserves
2. Generate local employment
3. We will never run out of this
4. Any negative impact on environment
5. No waste production of CO<sub>2</sub>

6. Reliable energy sources
7. Cheaper and economical
8. Stabilized energy price

#### Comparison between Fossil Fuels and Renewable Energy

Impact	Renewable	Fossil fuel
Availability	Usable as it exists	Limited
Limitation	Inexhaustible resource	Limited
Transportation	Used where it is available	Environmental pollution
Environmental effect	Zero emission	Releasing greenhouse gasses
Geo-political implications	Reduces our reliance on oil	Over-reliance on oil
Cost	Low	High
Capital cost	High	Low
Quantity	Limited	Depend on demand
Reliability	Reliable	Limited

### VI. GREENHOUSE GASES EMISSION

India's CO<sub>2</sub> emissions can be seen through two lenses. Calculated on a per-capita basis, emissions are extremely low, standing at just one-quarter of China's and the European Union's and one-tenth the level in the United States, while India also accounts for only a small share of cumulative historical GHG emissions. On the other hand, India is the third-largest country in volume terms of CO<sub>2</sub> emissions in the world. Heavy dependence on coal for power generation and the use of inefficient subcritical plants to burn it push up the carbon intensity of India's power sector to 791 grams of carbon dioxide per kilowatt-hour (g CO<sub>2</sub>/kWh), compared to a world average of 522 g CO<sub>2</sub>/kWh. Carbon dioxide (CO<sub>2</sub>) concentration in the atmosphere is at a record highest 404.11 parts per million (ppm), driving extreme weather events, including high temperature, storms and droughts, according to some studies. The rainfall over rain-dependent India is becoming increasingly uncertain, unsettling the nation's agriculture, economy due to high greenhouse gas emissions.

India's CO<sub>2</sub> emissions in 2014 continued to increase by 7.8% to about 2.3 Gt CO<sub>2</sub>. This increase, about 170 million tones, made India the largest contributor of global emissions growth in 2014, and fourth largest CO<sub>2</sub> emission country. This high ranking is partly due to the size of its population and economy. Per capita, India's CO<sub>2</sub> emissions are much lower than those of most developed countries. The increase in CO<sub>2</sub> emissions in 2014 was mainly caused by an 11.1% increase in coal consumption, which accounted for 61.4% of India's fossil-fuel primary energy consumption and 56.5% of its primary energy consumption.

The problem is that the rate at which we consume fossil fuels is much faster than the rate at which nature is replenishing them. Based on the present rate of consumption, it is estimated that the world's oil will last for about another 40 years, natural gas for about 60 years and coal for about 200 years. Massive problem with fossil fuel energy generation is the release of CO<sub>2</sub> emission which cause to social, economical and environmental effects.

India has not been responsible for global carbon emissions in the past, and its current emissions are way below the needs of its population.

The problem with these sources is that they are costlier than coal and not as easily available. In many cases, such as renewable energy and nuclear power, the technology isn't freely available to India; much of it must be imported from the West.

#### **Dirty and desirable: The role of coal**

Among the three major fossil fuels, coal is considered the dirtiest. However, it is less than one-fourth the price of either oil or natural gas, and more widely available. This is why coal is more widely used in lower-income countries, such as India. As incomes increase, countries try to move away from coal, as the development trajectories of Western Europe and the USA indicate.

India is also the world's third-largest user of coal. India accounts for just 8.5% of the world's coal usage, while it has 17.5% of the world's people. CO<sub>2</sub> emissions from power generation in India grow nearly two-and-a-half-times over the Outlook period, reaching 2.3 giga tones (Gt) in 2040 (up from just under 1 Gt in 2013). The share of the power sector in the country's total emissions decreases from half today to 45% in 2040. Renewable energy deployment and the use of more efficient coal-fired technologies bring the CO<sub>2</sub> emissions-intensity down by 30%, from 790 grams of carbon dioxide per kilowatt-hour (g CO<sub>2</sub>/kWh) to 560 g CO<sub>2</sub>/kWh.

## **VII. CONCLUSION**

India is an emerging economy increasing GDP is driving the demand for additional electrical energy, as well as transportation fuels. Coal fired generation currently provides two third of the capacity, India is blessed with vast resources of renewable resources like solar, wind, biomass and small hydro. In fact the

technical potential of these exceeds the present installed generating capacity. Accomplishments in these areas is accompanied, by even more rapid deployment of renewable energy, led by wind and solar power, reform in the coal sector that includes a faster transition to high efficiency in the coal-fired power fleet, a concerted push for greater efficiency across end-use sectors and a dedicated effort to tackle emissions of local pollutants and arrest the deterioration in air quality.

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