

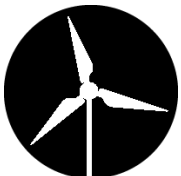
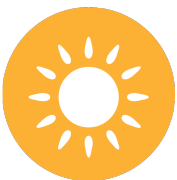


# The Renewable Power Journey in India

For the first time, India's annual electricity generation crossed the one trillion units mark in 2014-15. India has the fifth-largest power generation portfolio worldwide with an installed capacity of **263,665.71 MW** as of February 2015. As a result of strong economic growth, growing rate of urbanization and increasing access to electricity in the country, the demand for electricity is expected to grow three times by 2032. At the same time, India has an energy import bill of approximately \$150 billion, which is expected to double to \$300 billion by 2030.

It is envisaged that a significant share of the increase in demand for electricity has to be met by renewable energy sources. Looking towards renewable energy will help the country reduce its dependence on costly imported fossil fuels and address environmental and health concerns arising out of the production of thermal energy. Renewable energy is now considered crucial in order to meet the country's *current and future energy needs in a sustainable manner*.

According to a 2013 report by Ernst and Young, India ranks **9<sup>th</sup>** overall on Renewable Energy Country Attractiveness Index and **3<sup>rd</sup>** on the solar index. The country has vast untapped resources of renewable energy and according to the India Renewable Energy Status Report 2014, the total renewable energy potential from various sources in India is 2,49,188 MW which implies that only 12.71% of the potential has been achieved. In order to tap this abundant potential, the Government of India has set an aggressive target of *installing 1,75,000 MW of renewable energy by 2022*.

## Renewable and Non-conventional Energy Sources for power generation in India\*

	<p>Wind Power is one of the earliest and most favored choice for capacity addition in India; with several sites having a wind density <i>greater than 200 W/sq. m</i>, India has the potential to generate <b>1,02,788 MW</b> of wind power for grid interaction according to MNRE.</p>		<p>Most parts of the country have about <b>300 sunny days</b> and solar power can be produced even in remote areas, through <i>small off-grid solar plants</i>; average solar radiation incidence over the land in the range of 4-7 kWh/sq. m per day;</p>
	<p>Biomass is widely available, carbon neutral and has been an important energy source for the country; usage of materials like <i>bagasse in sugar mills and rice husk</i> through cogeneration programme and gasifiers is to be promoted for grid power generation.</p>		<p>Micro, Mini and Small Hydro Power i.e. hydropower projects with an installed capacity of <b>up to 25 MW</b> has a lot of potential through river based projects in the Himalayan states and along irrigation canals in other states; total potential of <b>20,000 MW</b> (MNRE)</p>

\*This brief will only consider those sources of renewable energy that come under the Ministry of New and Renewable Energy (MNRE), which implies that large hydropower projects don't come under its ambit.

It is in this context that this brief analyzes the benefits and impact of renewable energy in India and the initiatives and policy measures undertaken by the government, such as specifying renewable purchase obligations in the Electricity Act, 2003 and launching the Jawaharlal Nehru National Solar Mission as part of National Action Plan on Climate Change in order to reduce dependency on coal as well as encouraging state utilities and private players to tap the renewable potential in the country.

## The Benefits of Renewable Energy

Today, renewable energy has evolved from being viewed as an 'alternative energy' source to one that has the potential to address the country's energy security as well as transform the lives of people while mitigating greenhouse gas emissions and reducing the health impact associated with energy generated from fossil fuels.

### Providing Electricity to 'Isolated' Rural Areas

The current power infrastructure in India is not capable of providing sufficient and reliable power supply. Today, *96.7% of villages in India are electrified*, yet **300 million people** have no access to electricity, as the grid does not reach their households. Since poor infrastructure is at the core of this issue, thus decentralized renewable power sources such as wind energy, biomass energy, small hydro power and hybrid can be leveraged to meet the energy requirements of isolated communities and areas which are not likely to be electrified in near future.

### Generating Livelihoods

Renewable energy has the potential to improve livelihood opportunities for rural communities, thereby increasing their incomes and reducing poverty. Empowering rural households by providing them with electricity as well as with renewable energy applications like solar water pumps, mini solar cold storages, solar lanterns etc. can boost the rural economy and help create jobs for millions of people in rural India.

### Reducing Over Dependence on Imported Fossil Fuels

India's electricity generation is **highly dependent on coal** and other fossil fuels such as natural gas and diesel, a substantial portion of which is imported. As a result, electricity generation in India is dependent on imports, which not only raises energy security concerns but also results in high price volatility. Since India has abundant resources of renewable energy, they can help address energy security concerns and reduce volatility.

### Tackling Carbon Emissions

By 2017, greenhouse gas emissions in India will increase to more than 2.4 metric gigatons of CO<sub>2</sub> equivalent per annum. 40% of this emission is caused by the coal-dominated power sector alone. Promoting renewable sources of energy can help cut greenhouse gas emissions and thus improve air quality. Moreover, nearly 43% of the people in rural areas use kerosene for lighting, which is a significant cause of indoor air pollution. Using renewable sources of energy can help reduce this dependence on kerosene resulting in substantial reduction in air pollution as well as in government subsidies.

#### Case Study: *Prepaid Electricity for Rural India – A Gram Power Initiative*

Gram Power, a for-profit company that seeks to provide sustainable electricity to rural India, offers a smart micro-grid system. Gram Power's smart micro-grid system typically includes solar-powered generation, energy distribution infrastructure, smart metering, communications hardware, and battery storage. Using this smart grid, Gram Power supplies locally generated solar power to households in villages.

The micro-grid is funded through government subsidies and private investments from Gram Power or any other corporate organization. It selects and trains a local entrepreneur to whom bulk energy credit is sold and who in turn sells power in prepaid mode to local consumers at a retail price. Electricity is priced so that the revenue generated is sufficient to cover the costs, thus making it a self-sufficient model. A prepaid meter is installed for every consumer, who is then charged on a per hour basis. The local entrepreneur makes 10% on every power sale.

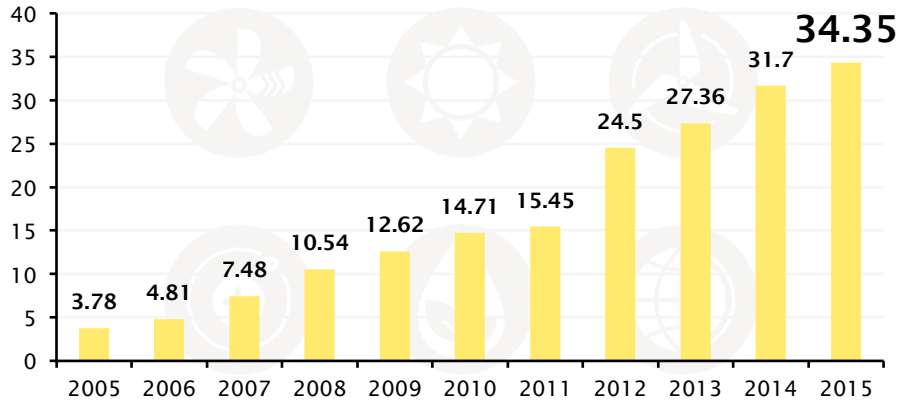
**19 villages** reached and **200,000** lives impacted; 30 more villages in pipeline

## The Current Situation of Renewable Energy in the country

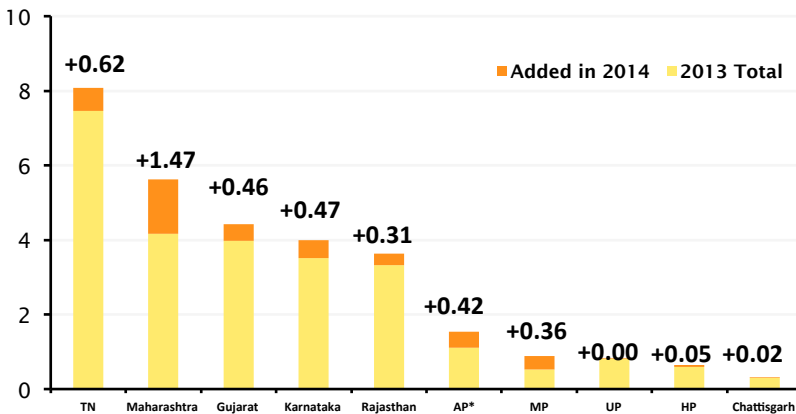
### Total Renewable Energy Installed Capacity, 2005 – 2015\* (in GW)

The installed capacity of renewable energy from non-conventional sources has grown at a Compounded Annual Growth Rate of **24.69%** in this 10-year period

As of 28.02.2015, the share of power generation from renewable energy sources in India's total installed power capacity stands at **13.02%**



### Renewable Energy Capacity and Addition in the Top 10 states (in GW)



Five states, i.e. **Tamil Nadu, Maharashtra, Gujarat, Karnataka and Rajasthan**, together contribute **81.28%** of the total installed capacity of renewable energy in the country.

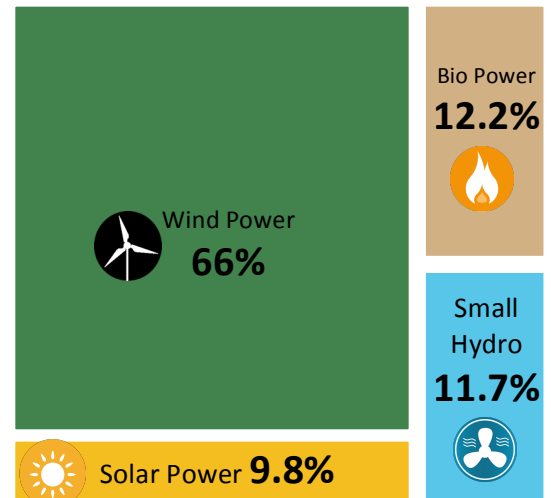
Of these states, the share of renewable energy in the total installed power capacity of the state is highest in case of Tamil Nadu at **38%**

### Composition of different non-conventional sources in the total installed capacity of renewable energy, 2014

Wind power constitutes almost **66%** of the installed capacity of 34,351.39 MW from renewable energy in the country; Tamil Nadu constitutes almost **one-third** of the installed capacity of wind power. Today, India ranks 5<sup>th</sup> in the world in grid connected wind power installations.

**1,142.40 MW** of renewable energy is generated in off-grid/captive power units across the country; Biomass cogeneration and biomass gasifiers are the biggest contributor.

A key driver of the increase in renewable energy capacity has been the rapid decline in cost of solar and wind power. This can be attributed to a mix of *regulatory policies, fiscal incentives, and public financing mechanisms* adopted by the government.



## Summary of key Government Initiatives and Policy Measures to promote RE

India initiated its renewable program in 1981 and was among the world's first countries to have an exclusive ministry for renewable energy development, the Ministry of New and Renewable Energy Sources. In view of the increasing importance of non-conventional and renewable sources of energy, the Government of India as well as the Reserve Bank of India has announced policy measures and key initiatives to provide impetus to this segment. Both the central government and the state governments have recognized the fact that it is essential to diversify the total energy mix of the country and tap the abundant potential of renewable energy in the country.

### Renewable Purchase Obligations (RPOs) – *major driving force to promote the renewable energy sector*

The National Action Plan on Climate Change (NAPCC) prescribes a 15% renewable energy target for the country by 2020. Accordingly, RPOs are the **fixed percentages of the total power, notified by the State Electricity Regulatory Commission** that electricity distribution companies and some large power consumers need to purchase from renewable energy sources. The Government has also introduced the Renewable Energy Certificate (REC) mechanism for aiding the states with low renewable energy potential in meeting their targets. However, a recent study published by the Indian Energy Exchange (IEX) shows that as many as *16 states have a compliance level of less than 70%*. Thus, there is a need to develop an efficient mechanism for monitoring the RPO compliance in different states.

### Remote Village Electrification (RVE) Programme: *delivering electricity to villages through off-grid renewable energy*

The RVE Programme, being implemented by the MNRE provides **financial support for the purpose of basic electrification using renewable energy source** in those remote un-electrified villages and habitations that remained uncovered under the Rajiv Gandhi Gramin Vidyutikaran Yojna. This programme follows from a successful project undertaken by the Chhattisgarh Renewable Energy Development Authority (CREDA), under which about *1500 remote villages were electrified through installation of solar powered micro-grids*. This would help provide electricity to almost 20,000 villages that are not connected to the grid and don't have access to electricity.

### Special Area Demonstration Project (SADP) Scheme: *increasing public awareness*

The SADP Scheme, introduced by the MNRE seeks to **demonstrate application of various Renewable Energy systems** in a project mode at places of National and international importance including world heritage sites, heritage monuments, religious locations and places of public interest to create greater awareness of renewable energy and to supplement the energy requirement at such locations. As part of this scheme, the MNRE also provides Central Finance Assistance for setting up state level Energy Parks (SLEPs). As of 15.01.2015, there are a total of **29 SLEPs** and **128 demonstrations of renewable energy systems at prominent places in the country**. The maximum number of such projects is in Chhattisgarh and Himachal Pradesh. Andhra Pradesh, Goa, Madhya Pradesh, Manipur and Rajasthan are some of the states that still don't have a SLEP sanctioned under this scheme.

### RBI notifies Renewable Energy under Priority Sector Lending – *providing cheaper finance for clean energy projects*

The RBI, in a significant move aimed at addressing financing woes for renewable energy projects, has **accorded priority sector lending (PSL) status for renewable energy**. According to the notification issued by RBI recently, banks can now extend loans up to a limit of Rs.15 crore to borrowers for purposes like renewable energy based power generators, wind mills, micro-hydro plants and for renewable energy base public utilities such as street lighting systems, and remote village electrification. It also announced a loan limit of up to Rs.10 lakh per borrower for individual households. This move is expected to ease the availability of credit from banks in order to undertake small and medium clean energy projects.

### Case Study: Income generation through biomass gasification

**Renewable Energy for Rural Livelihoods (RERL)** program was implemented by the Ministry of New and Renewable Energy in partnership with United Nations Development Programme and Govt. of Germany across 14 villages in Uttarakhand and Rajasthan to demonstrate the *potential of biomass gasification to increase income of farmers*. Sanwara village in Rajasthan, where the primary occupation is agriculture, was covered under the programme.

#### Sanwara Village, Rajasthan

Before the setting up of a biomass gasifier unit, diesel-based pumps were used for irrigation. Due to maintenance and repair costs, and delays in installation of diesel based pumps, the yield of crops was low. Under RERL, a Gasifier of 46 kW, run using biomass collected from households was installed at Sanwara. A number of women SHGs were also mobilized to set up nurseries, which led to *increase in livelihood opportunities for women and ensured steady source of biomass to the gasifier unit*. The gasifier was used to run motor pumps which provided irrigation to over 100 bighas of farm land at lower cost compared to the diesel pumps. Also, there was improvement in the yield of wheat from *3-4 quintals per bigha to 8 quintals per bigha*. The cost saving and income generation is demonstrated below.

Cost of Irrigation (per bigha)- diesel based	Rs 1140
Cost of Irrigation (per bigha)- gasifier based	Rs 660
Total Cost (including maintenance)-diesel based	Rs 1,61,980
Total Cost – gasifier based	Rs 65,912
Cost Savings	<b>Rs 96,068</b>
Total increase in the yield of wheat	188 quintals
Increase in income from higher yield	<b>Rs 1,88,000</b>



The total benefits per household due to the intervention were close to Rs 9000. This demonstrates that biomass gasification is not only a clean form of energy, but also has the potential of creating sustainable economic impact. Such a model, if scaled up, can hugely benefit the rural landscape.

## Conclusion

Renewable energy has emerged as a sustainable solution to the country's energy needs and is now increasingly being viewed as a key component in not just grid-interactive power generation but also as a source of decentralized, off-grid power units in remote areas. Moreover, the cost of electricity generation from major renewable sources like wind and solar now compares favorably with the cost of electricity generation from diesel, natural gas or nuclear energy. Therefore, a shift towards renewable energy is envisaged as a key component of the country's commitment to mitigating greenhouse emissions as well as reduce dependency on fossil fuels.

Furthermore, solar and biomass powered micro-grids are coming up in remote villages and providing decentralized solutions to providing electricity to such villages. This is particularly important since 43.2% of rural households in India are still relying on kerosene and the government plans to replace the kerosene lamps with 20 million solar lighting systems by 2022. Thus, it is important that a comprehensive, integrated and long-term plan of action is drawn to promote renewable energy, encourage investment from private and public entities, and ensure that the energy needs of the country are met in a sustainable and inclusive manner.