

Power – Renewable Energy

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Overview

The renewable energy sector in India represents future growth and change in the power generation sector in India. Renewable energy offers India unique value proposition i.e. bridging the gap in country's energy requirement to power its entire population 24x7 and at the same time cutting on emission due to combustion of fossil fuels for energy. The push to develop and harness power through renewable energy resources is the Government's attempt to rebalance the energy mix in favor of cleaner energy generation.

Renewable Energy constitutes 17.5% of the total electricity generation capacity operational in the country. The two main kind of renewable energy sources which have found the widest application are wind energy and solar energy. India with 3,200 km of coastline and tropic of cancer passing through the center of the country, there is ample opportunity for more solar and wind farms to be set up.

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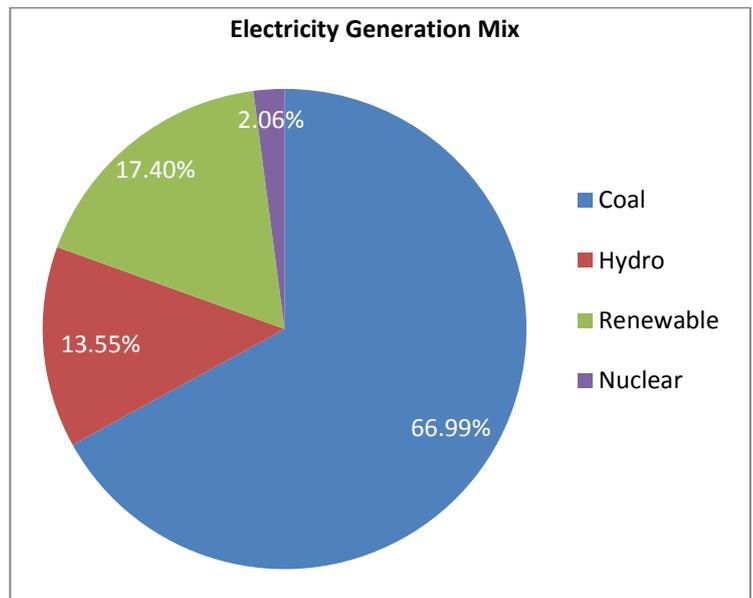
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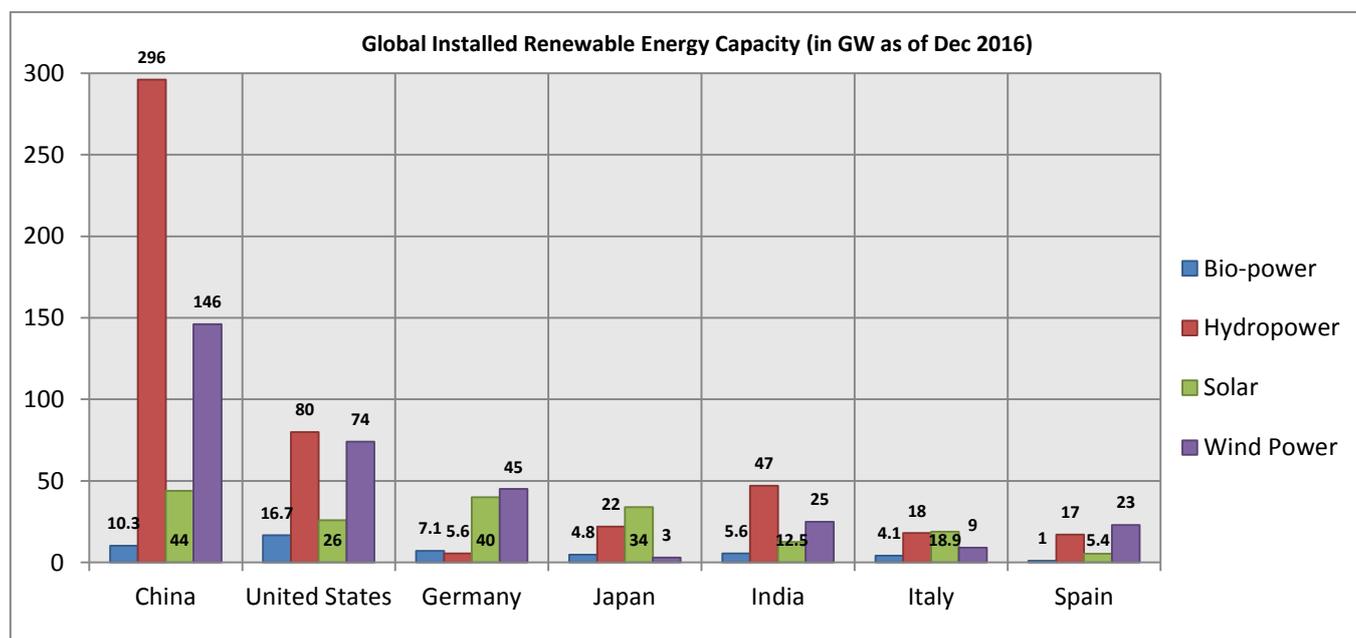
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Renewable energy would lead the next phase of growth in power capacity addition, as the government would be keen to gradually cut on import of fuel for generation of electricity. The magnitude of success and achieving set targets would solely depend on Government's timely intervention and provision of incentives.

❖ **Renewable Energy: Global perspective**



Renewable Energy resources, also called clean energy resources are no-environment impact sources of energy. Environment and its degradation being a major concern in today’s rapidly developing world, a transformation in the energy generation mix in order to fulfill rapidly growing energy demand in developing nations. They also have climatic and environmental impact.

Renewable energy technologies are getting cheaper through technological change and benefits of mass production. Cost reductions in critical technologies such as wind and solar are expected to continue. Cost reduction in the recent past in solar equipment has been an outcome of excess production capacity which has been set up in China. With Chinese solar renewable market slowing down, the manufacturers had to explore overseas markets and compete with global manufacturers. The massive scale of production made it easier for Chinese manufacturers to reduce their prices. This has benefited developing markets as it has reduced the overall cost of procurement of equipment for setting up solar farms. This has also led to investors taking a keen interest in investing in developing markets and funding renewable energy projects.

Globally, hydro-electricity and geothermal electricity produced at favorable sites are now the cheapest way to generate electricity. Renewable energy is also the most economical solution for new grid-connected capacity in areas with good resources. As the cost of renewable power falls, the scope of economically viable applications increases.

The graph above shows the top-7 countries with respect to installed renewable energy capacity. China and USA lead by a huge margin, whereas newer entrant India has rapidly inched upwards in the ranking with higher addition of renewable energy resources post 2014.

❖ **India: The Energy Story Renewed**

Rapid deployment of renewable energy, energy efficiency and technological diversification of energy sources would result in significant energy security along with economic benefits.

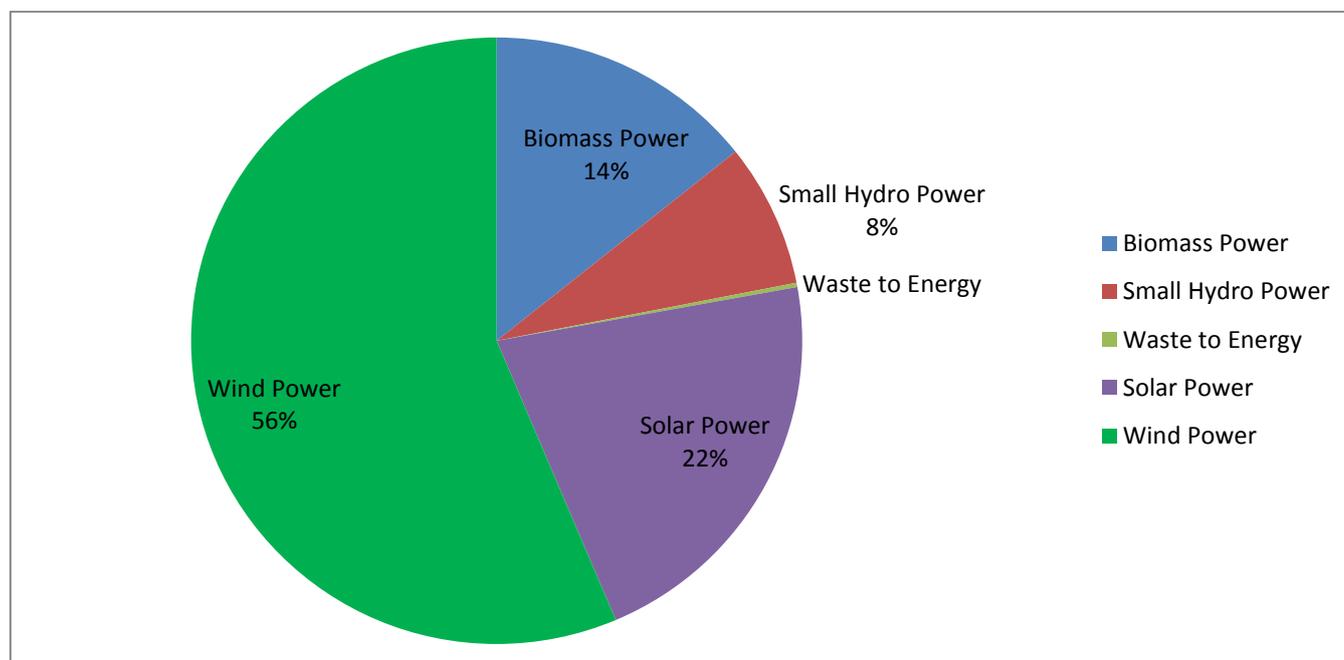
The Union Government scaled-up the target of renewable energy capacity over 5 times to 175 GW by 2022. This includes 100 GW from solar energy, 60 GW from wind energy, 10 GW from bio-power and 5 GW from small hydro-power.

Grid connected renewable energy has seen a growth of 91% with a capacity addition of 22.6 GW during the three year period between 2014-17. This is almost twice compared to the capacity added i.e. 11.7 GW between 2011-14. The total installed capacity of grid renewable power stands at 57.26 GW, which accounts for 17.5% of

grid power from all renewable resources. This 57.26 GW grid renewable power installed capacity includes 32.3 GW from Wind power, 12.5 GW from Solar power, 4.38 GW from Small Hydro Power and 8.31 GW from Bio-Power.

Renewable energy as a primary source of generating electricity: One of the major reasons for thrust on adoption of renewable energy as a primary source of generating electricity has been the ease of installation and commissioning compared with other conventional electricity generation. Typically, setting up a thermal power plant or a nuclear power plant takes between 4-6 years which includes land acquisition, taking requisite permissions, building infrastructure around the plant and construction and commissioning of the plant followed by integrating it with the grid. In case of wind or solar energy, due to its nature of not having any kind of effect on the environment or ecology, it is easier for agencies to install commission and integrate these plants. But it is not just the convenience and cost of installation, but also the savings due to zero escalation of cost of electricity generated through solar or wind against an inflation escalation every year from fossil fuel based electricity. This means that for long term PPAs, the tariff remains the same across the life cycle of renewable sources whereas in case of thermal power plants, inflation based hikes to account for increasing price of coal and its handling and transportation is applicable.

Renewable Energy Source-Wise Breakup (As on 31st March 2017)



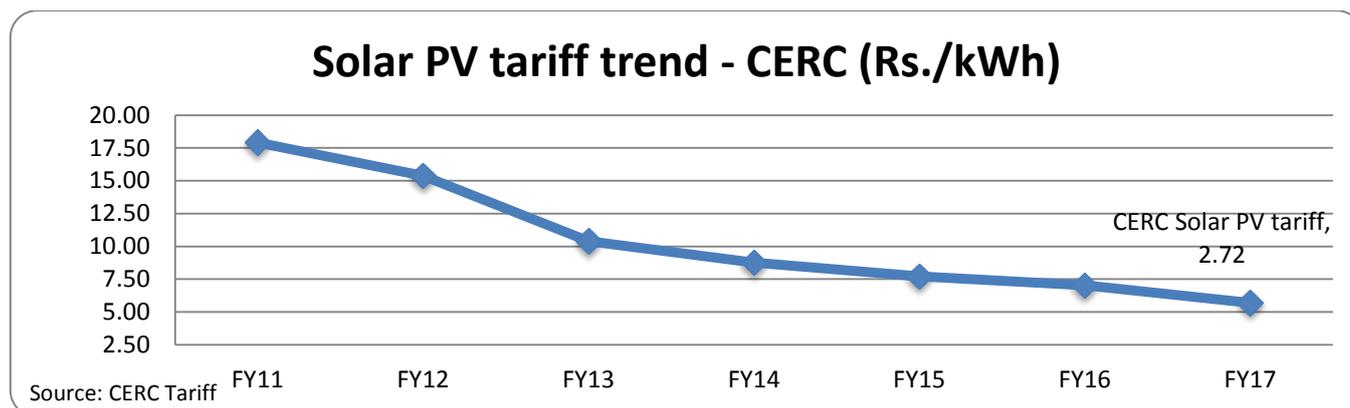
- ❖ **National Tariff Policy 2016** The amended tariff policy focuses on renewable energy, especially solar. It proposes to increase the renewable purchase obligation (RPO) from solar to 8% of electricity consumption (3% earlier). This increase could potentially support 80GW solar capacity, assuming sustained 8% annual demand growth in FY16-22. The increase in RPO was necessary to complement the government’s ambitious 100GW solar capacity addition target. However, with Discoms under UDAY scheme having weak finances, implementation of renewable projects could be impacted.

So what are RPO’s: Renewable Purchase Obligation (RPO) refers to the obligation imposed by law on some entities to either buy electricity generated by specified ‘green’ sources (Solar, small hydro, wind etc), or buy, in lieu of that, ‘renewable energy certificates (RECs)’ from the market. The ‘obligated entities’ are mostly electricity distribution companies and large consumers of power. RECs are issued to companies that produce green power, who opt not to sell it at a preferable tariff to distribution companies.

Lowered transmission charges and bundling of renewable to reduce cost will aid offtake. Apart from exempting solar and wind power from inter-state transmission charges and losses, the policy has proposed bundling renewable power with power from plants where PPAs have expired or completed their useful life. It has also proposed RGOs (Renewable Generation Obligations) – which require that new coal/lignite-based thermal plants should establish/procure/purchase renewable capacity after a specified date. However, implementation of RGOs will require an amendment to the Electricity Act. Nevertheless, these measures will go a long way in reducing costs and ensuring offtake of renewable power.

Types of Renewable energy:

Solar Energy



Solar energy has been the frontrunner among renewable energy resources and it is expected that the tariff of solar generated electricity would be at par with thermal and other conventional energy resources.

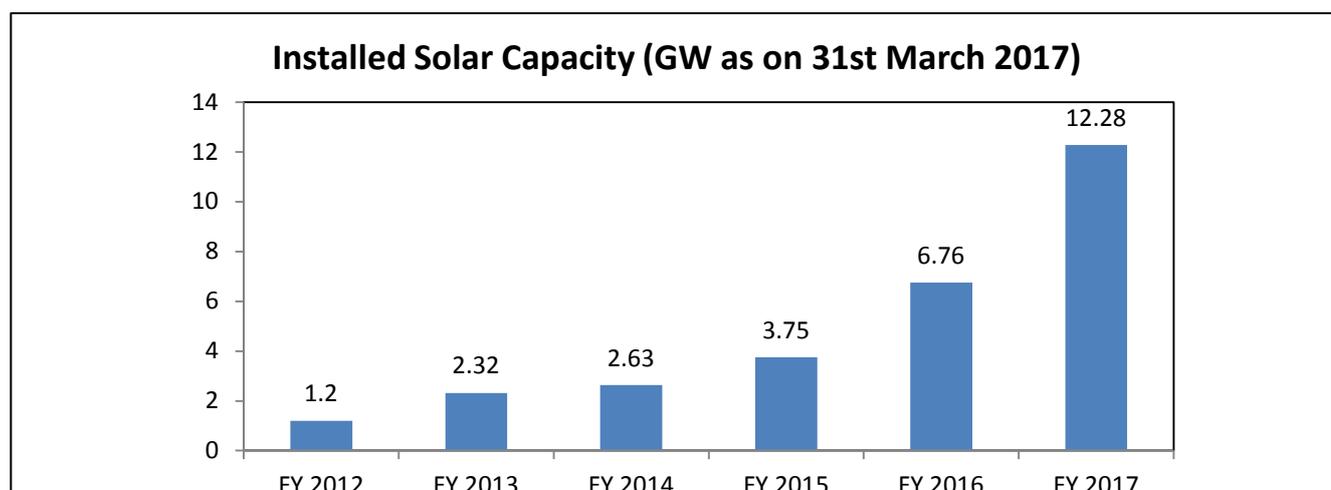
India is endowed with vast solar energy potential. About 5,000 trillion kWh per year energy is incident over India's land area with most parts receiving 4-7 kWh per sq. m per day. Hence both technology routes for conversion of solar radiation into heat and electricity, namely, solar thermal and solar photovoltaics, can effectively be harnessed providing substantial scalability for solar in India. Solar also provides the ability to generate power on a distributed basis and enables rapid capacity addition with short lead times. Off-grid decentralized and low-temperature applications will be advantageous from a rural electrification perspective and meeting other energy needs for power and heating and cooling in both rural and urban areas. From an energy security perspective, solar is the most secure of all sources since it is abundantly available. Theoretically, a small fraction of the total incident solar energy (if captured effectively) can meet the entire country's power requirements. It is also clear that given the large proportion of poor and energy un-served population in the country, every effort needs to be made to exploit the relatively abundant sources of energy available to the country. While, today, domestic coal based power generation is the cheapest electricity source, future scenarios suggest that this could well change.

Solar Power contributes approximately 12.5GW out of the total installed renewable energy capacity of 51.36 GW in the country. By 2022, this capacity target has been set, to achieve 100 GW of solar installations.

Incentives offered by Government for the development of the Solar Energy sector include: (Source: MNRE)

- Solar components are exempt from excise duties and concession on import duties required to set up a solar plant.
- A 10-year tax holiday for solar power projects.
- Wheeling, banking and third party sales, buyback facility by states.
- Guaranteed market through solar power purchase obligation for states.
- Reduced wheeling charges as compared to those for conventional energy.
- Special incentives for exports from India in renewable energy technology under renewable sector-specific SEZ.
- A payment security mechanism to cover the risk of default by state utilities/discoms.
- A subsidy of 30% of the project cost for off-grid Photovoltaics (PV) and solar thermal projects.

- Loans at concessional rates for off-grid applications.



Small Hydro Power

Small Hydro Power (SHP) Programme is one of the thrust areas of power generation from renewable as per the Ministry of New and Renewable Energy. It has been recognized that small hydropower projects can play a critical role in improving the overall energy scenario in for remote and inaccessible areas. The Ministry has been encouraging the development of small hydro projects across public and private sector.

An estimated potential of about 20,000 MW of small hydro power projects exists in India. As per Ministry of New and Renewable Energy, there are 6,474 potential sites with an aggregate capacity of 19,749.44 MW for projects up to 25 MW capacity which have been identified.

In order to promote and implement SHP Programme, Central Financial Assistance is provided for:

- Resource Assessment and Support for Identification of new sites
- Setting up new SHP Projects in the private / co-operative / Joint sector etc.
- Setting up new SHP Projects in the Government sector
- Renovation and modernization of existing SHP projects in the Government sector
- Development/upgradation of Water Mills (mechanical/electrical output) and setting up Micro Hydel Projects (up to 100 KW capacity)

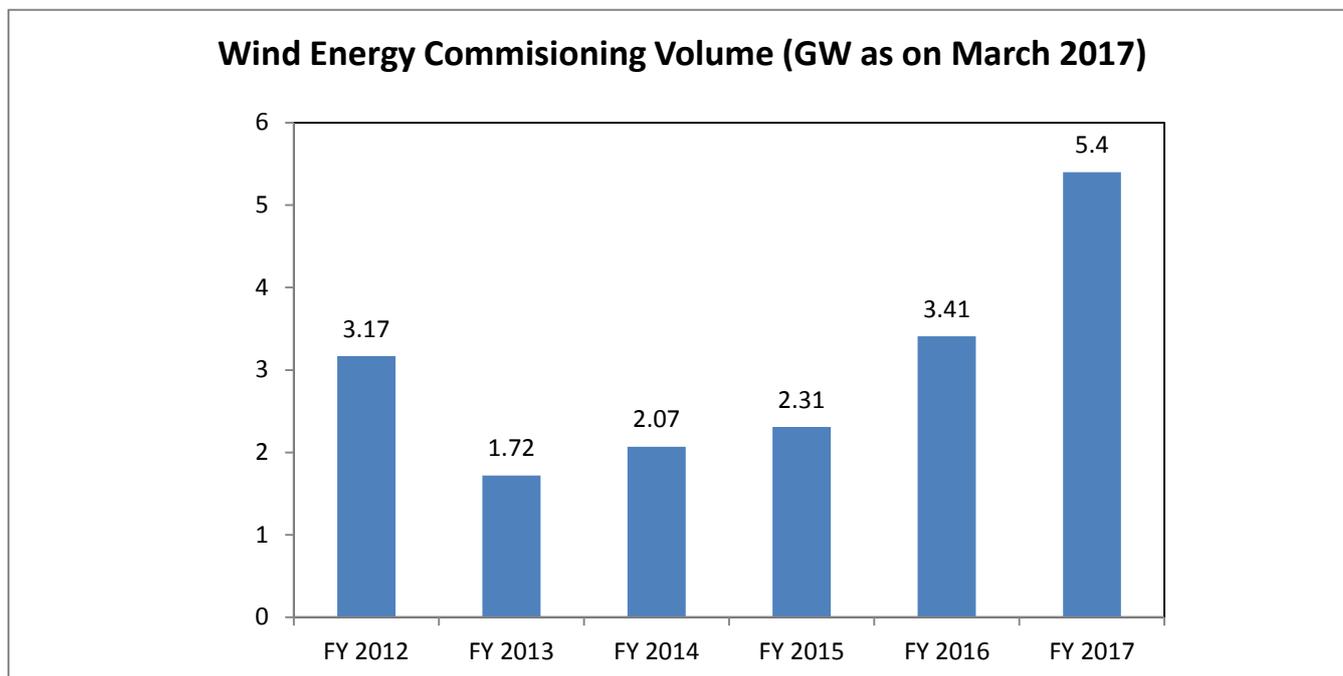
As on 31st March 2017, 4.3 GW of Small Hydro Power projects are installed and operational as per data from Ministry of New and Renewable Energy.

Wind Energy

Wind Energy, like solar is a free energy resource but is more intermittent than solar. Wind speeds may vary within minutes and affect the power generation and in cases of high speeds- may result in overloading of generator. Energy from the wind is tapped using turbines.

Irrespective of the type or location of setting up a turbine, Wind Resource Data has to be determined in the area of the proposed site. The Wind Resource data provides an estimate of average and peak wind speeds at a location based on various parameters. Once this data is compiled, it is also important to determine the access to power transmission lines which would connect this generated electricity to the grid. It is also necessary to study the impact of putting up wind turbines on the community and wildlife in the locality. If sufficient wind resources are found, the developer will secure land leases from property owners, obtain the necessary permits and financing; purchase and install wind turbines. The completed facility is often sold to an independent operator called an independent power producer (IPP) who generates electricity to sell to the local utility, although some utilities own and operate wind farms directly. Wind mills can be set up ranging scales of:

- On-shore grid connected Wind Turbine systems
- Off-shore Wind turbine systems
- Small Wind and Hybrid Energy Decentralized systems (Floating)



The potential for wind power generation for grid interaction in India has been estimated at about 1,02,788 MW taking sites having wind power density greater than 200 W/sq. m at 80 m hub-height with 2% land availability in potential areas for setting up wind farms @ 9 MW/sq. km.

As on 31st March 2017, 32.3 GW, out of the total installed renewable energy capacity of 51.36 GW in the country is contributed by wind energy and it the single biggest contributor among renewable energy sources. The 2022 renewable energy target of 175GW includes 60 GW though wind energy of which over 50% has already been attained. Globally, India is at the fourth position after China, the US and Germany, in terms of wind capacity installation. Even though, Solar is cheaper than wind energy, the advantage of wind is that the equipment for generating it is entirely made in India. Wind power tariff has dropped to a record low of Rs 3.46 per unit in an auction of 1,000 MW capacity conducted by Solar Energy Corporation of India (SECI) in early 2017.

Biomass

Biomass is a carbon neutral fuel source for the generation of electricity. Apart from providing the much needed relief from power shortages biomass power projects have the potential to generate employment in rural as well as urban areas.

About 32% of the total primary energy use in the country is derived from biomass and more than 70% of the country's population depends upon it for their energy needs. The Ministry of New and Renewable Energy (MNRE), Government of India has initiated a number of programmes for the promotion of efficient biomass conversion technologies which can be used in various sectors of the economy. India has over 5,940 MW biomass based power plants comprising 8.18 GW of grid connected and off-grid power plants. Out of the total grid connected capacity, major share is from bagasse cogeneration and approximately 130 MW is from waste to energy power plants. Waste to energy is still in its formative days with a little over 130 MW of installed capacity. But the same has huge scope considering the fact that it would address one of the biggest issues which large cities in our country are facing- **waste disposal and management**. For waste to energy projects to be successful, Municipalities and Corporations need to come out with definitive plans and work towards implementing them, with fiscal and monetary support from the Union Government. With cities being administered and governed by local bodies, these local bodies need to chalk out a strategy to dispose-off the waste by converting it into electricity.

Challenges and barriers in Biomass

Biomass is relatively more reliable source of renewable energy free of fluctuation and does not need storage. But it is not the preferred renewable energy source compared to solar or wind mainly due to the challenges involved in ensuring reliable biomass supply. This is because of the wide range in its physical properties and fluctuation in availability round the year depending on cropping patterns. Biomass from agriculture is available only for a short period after its harvesting, which can stretch only for 2-3 months in a year. So there is a need to have robust institutional and market mechanism for efficient procurement of the required quantity of biomass, within this stipulated short time, and safe storage till it is finally used.

State wise biomass power and cogeneration projects

State	Capacity (MW)
Andhra Pradesh*	389.75
Bihar	43.42
Chhattisgarh	264.90
Gujarat	55.90
Haryana	52.30
Karnataka	737.28
Madhya Pradesh	36.00
Maharashtra	1,112.78
Odisha	20.00
Punjab	140.50
Rajasthan	111.30
Tamil Nadu	662.30
Uttarakhand	30.00
Uttar Pradesh	936.70
West Bengal	26.00
Total	4,761.00

Some of the major barriers faced in faster realization of available biomass power potential for a variety of end use applications are

- inadequate information on biomass availability,
- absence of organized formal biomass markets,
- problems associated with management of biomass collection, transportation, processing and storage; problems associated with setting up large size biomass plants,
- non-availability of cost effective sub megawatt systems for conversion of biomass to energy in a decentralized manner, and
- Lack of capability to generate bankable projects on account of financial and liquidity problems, etc.

The major challenges in ensuring sustained biomass supply at reasonable prices are:

- Increasing competing usage of biomass resources, leading to higher opportunity costs;
- unorganized nature of biomass market, which is characterized by lack of mechanization in agriculture sector, defragmented land holdings, and vast number of small or marginal farmers
- Cost of biomass storage and transportation to power plants, which is consistently rising with time.

Cost-Tariff Parity-efficiency study of different sources of energy

Source type	Capital/MW installation*	Tariff/unit Charges)#	(Exc.	Power Factor(PLF)@	Loading
Hydel power	Rs. 5.5-7.0 crore	Rs. 3.37- 5.00		30-40%	
Solar	Rs. 6.5-8.00 crore	Rs. 2.42-5.41		20-25%	
Thermal	Rs. 3.2-5.00 crore	Rs. 2.30-4.25		55-60%	
Wind	Rs. 7.25-12.5 crore	Rs. 3.41-5.50		25-30%	
Nuclear	Rs. 20-30 crore	Rs. 6.00- 9.00		80-90%	

@-Power loading factor has been taken from global averages and may vary for renewable energy sources in India.

#-Tariff per unit has been taken as an average of lowest and highest power tariff from different sources.

*-Capital/MW has been a rough estimate based on project cost of setting up specific projects.

❖ Challenges in the renewable energy sector

Even though renewable energy as industry offers a viable and clean alternative to conventional energy sources, the sector still faces its own set of challenges, owing to the nature of the industry. Energy being a utility, Government regulates it. This limits the ability of producers and investors to churn out the required returns while conducting their business.

Few of the challenges have been listed below:

Long Term Financing has been a challenge when it comes to renewable energy especially for new entrants. Bankers would not lend to entities where there are no promoter or parent company guarantee. But with conventional power projects amongst others being severely hit by economic slowdown, banks and financial institutions are seeing renewable energy as a viable opportunity. The Renewable energy companies are looking for long term funds i.e. 25 years. Since banks cannot lend for a term of 25 years, corporate loan restructuring schemes like 5:25 which has been allowed by the RBI could well help these new entrants to fund their projects. With periodic refinancing and a bullet payment at the end of every 5 years by the borrower, new firms would gradually find viable financing terms from bankers going forward.

The budgetary allocation made during the Union Budget seems to be quite inadequate if one were to look at the targets set under various schemes for renewable energy infrastructure development. Union budget has allocated an amount of approximately Rs. 3.9 lakh crore on the infrastructure sector, but the allocation for renewable energy has been Rs. 5,473 crore which is inadequate.

Poor financial condition of state discoms has been a major issue. These state discoms have been hit by distribution losses due to power theft or other technical causes, reduction in collection efficiency, dependence on government subsidy due to farm waivers and sharp increase in debt due to increasing arrears etc. Even though the government tried to revive these discoms by introducing UDAY scheme in 2015, the scheme did improve the condition for few discoms most of them are still being challenged.

Inadequate and under-penetrated transmission networks: The limitation of connecting renewable electricity to the grid becomes major concern barrier. Even though there are vast tracts of lands with high potential which can be used to set up solar farms or wind farms, the unavailability of transmission lines and connectivity to the grid, makes it technically unviable.

India ranks one of the highest in terms of **loss of electricity produced** which roughly translates to 27-30% based on different estimates. Electricity in states is distributed through state electricity distribution companies. Loss of electricity could be because of theft/pilferage, technical and transmission loss, substantial energy sold at low voltage or subsidized prices. For renewable energy particularly, transmission has been a challenge, given the low capacity factors[#] (defined as the ratio of output over a period of time to the maximum installed output) and high congestion on the existing transmission lines.

Tariffs of renewables have been falling consistently given the falling prices of power modules, raw materials and competitive dynamic bidding. And in spite of drastic fall of over 100% in tariffs of renewable energy, they are still expensive compared with conventional energy sources. Therefore, State discoms with their stressed finances are still reluctant to buy energy in large scale from renewable energy producers. This has led to some producers still not finding enough long term takers for their electricity produced except for some central agencies in particular regions.

Poor finances of state discoms has also led to states not being able to meet their Renewable purchase obligation (RPO) which refers to the mandate imposed by law on some entities, mainly power distribution companies, to procure a certain part of their power requirement from renewable sources. What further deepens this problem is lenient view taken by regulators and absence of any penalty or action in case of not meeting obligations.

❖ **Growth prospects:**

Push for clean energy on the part of the Government and introducing policy initiatives and implementing achievable targets would make renewable energy viable and meaningful.

❖ **State Wise RPO Obligation 2016-17**

State	RPO Obligation 2016-17	
	Solar	Non Solar
Gujarat	1.75%	8.25%
Maharashtra	1.00%	10.00%
Uttarakhand	2.75%	8.75%
Jammu & Kashmir	1.00%	6.50%
Jharkhand	1.50%	3.50%
Himachal Pradesh	2.75%	8.75%
Assam	1.00%	3.00%
Kerala	2.75%	8.75%
Bihar	1.50%	5.00%
Orissa	2.75%	8.75%
Goa & Union Territories	1.65%	3.20%
Madhya Pradesh	2.75%	8.75%
Haryana	0.50%	3.00%
Rajasthan	2.50%	8.90%
Tamil Nadu	2.50%	9.00%
Punjab	1.30%	4.10%
Delhi	0.35%	8.65%
Andhra Pradesh	0.25%	4.75%
Karnataka (BESCOM)	0.50%	12.00%
Karnataka (MESCOM)	0.75%	14.50%
Karnataka (CESC)	0.50%	12.00%
Karnataka (HESCOM)	0.50%	7.50%
Karnataka (GESCOM)	0.50%	5.50%
Karnataka (HRECS)	0.50%	7.50%
Karnataka (Deemed Licenses)	0.50%	5.50%
Chhattisgarh	2.00%	7.75%

- **Green Corridor:** The government has announced an ambitious project to handle 55GW of renewable energy in two phases of development of 33GW and 22GW respectively. Interestingly, the renewable energy development is spread across the country and hence this corridor would transverse through all prominent renewable energy producing states. The corridor would act as control and management

center apart from transmission wherein it would integrate, monitor and manage the large-scale renewable energy.

- **Budgetary allocation:** The allocation to the Ministry of New and Renewable Energy stands at Rs5,473 crore in Union Budget 2017 compared to Rs. 5,036 crore last year. Out of this, 74% of the outlay is directed to grid-interactive renewables, specifically mentioning the second phase of solar park development for 20 GW of capacity. The total budget is further split between Rs3,361 crore for solar and only Rs408 crore for wind, a clear indication that the government will continue to prioritize solar. Additionally, the budget extends support to power 2,000 railway stations through solar, under the Indian Railways 1GW solar mission. Smaller sums of Rs135 crore and Rs76 crore have been earmarked for small hydro and bio-power, respectively. Despite recent suggestions large hydro remains outside the purview of renewable energy.
- **Ease of doing business:** Renewable energy has been re-classified as 'white category'. Previously, this sector was under 'green category' and the re-classification will enable ease of doing business as setting up of solar and wind power plants will be exempt from seeking environmental clearances from Ministry and consent from State Pollution Control Boards.
- **UDAY, or Ujjwal Discom Assurance Yojana**, the financial resurgence scheme for ailing discoms was introduced to revive the state electricity distribution companies. It comprises of three parts;
 - (i) financial re-engineering of debt to the tune of Rs 4.5 lakh crore approximately;
 - (ii) provisioning of cheap power through the higher availability of coal/swapping of coal, etc, and higher funding towards rural electrification schemes,
 - (iii) Operational improvement by discoms for sustainability.

The scheme envisaged that 75% of the debt shall be taken over by the state, out of which 50% will be in the first year itself and the remaining in the following years. Although the scheme has improved discom balance sheets and has lowered interest rates while ensuring cheaper power and higher availability, the operational improvement of these discoms still has a long way to go.

- Electricity for all and higher electrification/penetration in rural India under **Deen Dayal Upadhyay Gram Jyoti Yojana** (DDUGJY) and similar schemes by the Union Government has set an ambitious target of electrifying all villages by 2018. Even though given the vast geography and the infrastructure like transmission lines still missing in vast regions, they would certainly be a major boost for energy generating companies as a large part of the demand would come from these newly covered geographies.
- **Growth in per capita electricity consumption** would see its next major growth as uninterrupted electricity is supplied to the users.
- For renewable energy to come at par with conventional energy sources, Manufacturers with **advanced technology in the renewable space** need to be provided an open market so that they could invest in the Indian markets. For the entire renewable energy ecosystem to develop, it is very important that the Government ensures a free market for highly competitive and advanced technologies to enter the market which in turn would lead to more cost effective and efficient power systems being manufactured and installed in the country.

❖ Outlook

- The Government is focused on providing universal access and 24x7 supply of electricity to the users. Even though India is amongst the top-5 electricity producers we still face energy deficit. The major reasons could be attributed to lack of transmission network, loss and wastage of power and obsolete power generation methods with very low loading factor.
- Introduction of GST has seen Solar Devices being taxed under 5% slab which was previously not taxed. With solar rooftop schemes yet to pick up pace, and have been off the target widely, this adverse taxation would hamper chances of taking of anytime soon. Solar rooftops targets have been set at an ambitious 40GW out of the total 100GW allocated for Solar Energy. This would certainly have an impact on the tariff of solar energy which has otherwise been falling consistently. **At the same time, wind equipment for which the tax-rates have**

been slashed from 8.5% to 5% may see the tariff coming down further and closing the gap between wind and solar based electricity.

- **We expect more financiers and sponsors especially private equity funds and pension funds to invest in completed renewable energy projects which would provide exit to developers.** Financial institutions, especially banks would fall short of contributing towards funding the huge renewable energy target, i.e. \$ 600 billion in the next 10 years, with mounting NPA's and bail-out of discoms being given higher priority. The renewable segment would have to access innovative ways like green bonds, climate bonds etc. for their capital requirements.
- Foreign Direct Investment (FDI) up to 100% is permitted under the automatic route for renewable energy generation and distribution projects subject to provisions of The Electricity Act, 2003. Total FDI equity inflow in the non-conventional energy sector during April 2014 to December 2016 was USD 2.05 billion. **We see FDI increasing further during FY 17-18 as more projects in solar and wind near completion. Apart from Solar and Wind energy, we don't see major addition of capacity in other renewable energy sources given the lack of clarity and prospect in terms of viability and return on investment.**

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