

# India's Renewable Energy Future

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## Foreword

India is one of the few countries in the world blessed with different kinds of renewable energy sources. Of the total installed power generation capacity in India, varied renewable energy sources contribute to around 13.5 percent. However, the energy produced through renewable energy accounts for around 5–6 percent of total energy generated.

The price volatility of fossil fuels (which are the main source of power in the country), depleting fossil fuel reserves along with the challenges associated with mining fossil fuels and environmental degradation due to usage of fossil fuels, creates a space for renewable energy to compliment conventional power plants (which use fossil fuels) to address the country's energy needs in a sustainable manner.

Recognizing this potential, the Government is promoting renewable energy in an aggressive way and has planned an extremely ambitious target. Such an ambitious renewable energy target has associated risks, which need mitigation for success. How to mitigate this risk is very crucial to ensure that aggressively set renewable targets are met.

If we are able to mitigate the risks associated, we can ensure that the country becomes/has:

- One of the prominent countries in the world to engage in renewable energy.
- A self-sustaining manufacturing, engineering, procurement and construction (EPC), and operation and maintenance (O&M) ecosystem that caters not only to the country's need but also meets demand from South Asian, Middle Eastern, and North African countries.
- Huge employment opportunities which can be generated in manufacturing to EPC to O&M sector.
- Self-sustained in terms of energy requirements/security.
- Provider of better quality of life to the citizens of the country.

Along with the tangible benefits, growth of renewable energy will also bring huge intangible benefits to the society and the country. The whitepaper dwells on the overall renewable energy landscape and ways to mitigate the risk in a sustainable way, and what lies ahead of us once the plans become successful.

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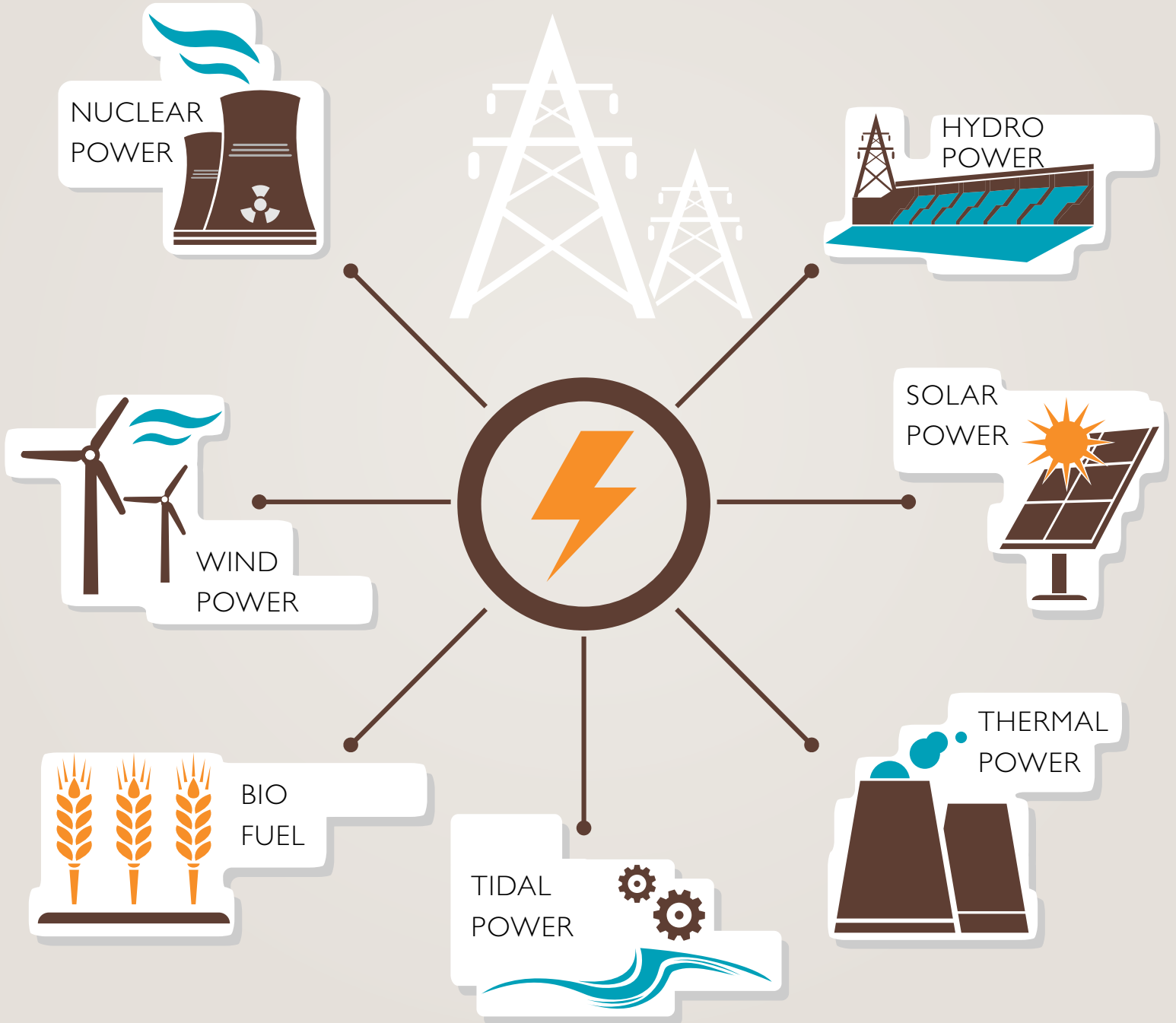
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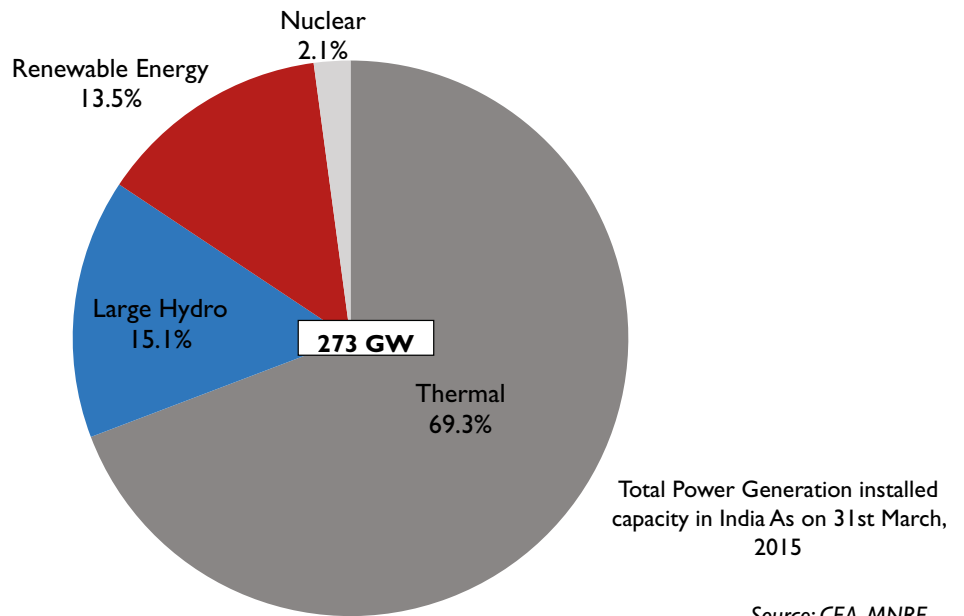
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# Energy Sector Overview in India



Thermal power is the backbone of the Indian power sector; and it is close to 70 percent of the total installed capacity. Thermal power includes power produced from fossil fuels such as coal, gas, diesel or nuclear energy. A closer look shows that coal, currently, is the predominant fuel type in the sector. Coal based power plants account for nearly 60 percent of the total installed capacity.

**Exhibit I: Installed Power Generation Capacity**



Large hydro power plants are second in terms of installed power capacity. Renewable energy is next with 13.5 percent, while nuclear energy forms a minimal 2.1 percent. However, with the Government of India's massive expansion plan for renewables, renewable energy would overtake large hydro in the next 1-2 years, in terms of installed power generation capacity.

The breakup is quite different if we consider the actual energy generation. Out of total energy generated (approximately 1.1 Trillion units), thermal energy contributes to around 80 percent of total energy generated in India, while large hydro and renewable energy contribute around 12 percent and 5-6 percent, respectively.

Going forward, renewable energy is expected to record the fastest growth in India. The Government has ambitious plans of achieving cumulative installed capacity of 175,000 MW by 2022. Not just installed capacity, renewable energy is also expected to contribute 15 percent of the country's energy demand, which would reach 2 Trillion units by then.

Now, let us see what are the constituents of renewable energy.

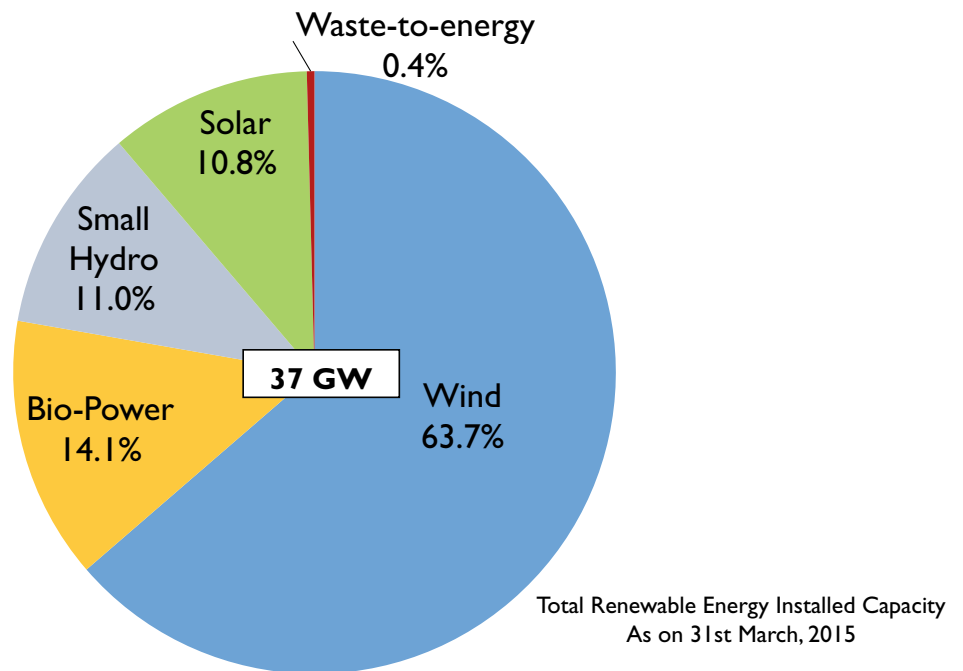
Renewable Energy comprises of:

- Wind Energy
- Biopower/Biomass
- Waste To Energy
- Geothermal Energy (Not very prominent in India)
- Solar Energy
- Small Hydro
- Tidal Energy (Not very prominent in India)

In India, currently, wind energy dominates the space with a staggering 64 percent approximately of the total installed capacity. Wind has been the mainstay of the Indian renewable energy industry from the 1990s and India is one of the top 5 countries, in terms of installed capacity for wind energy.

However, over the last 3 years, it has been India's progress in the solar sector that has captured the world's imagination. Over the next decade, India is expected to emerge as one of the leading countries globally, in terms of solar installations.

**Exhibit 2: Installed Renewable Energy Capacity**



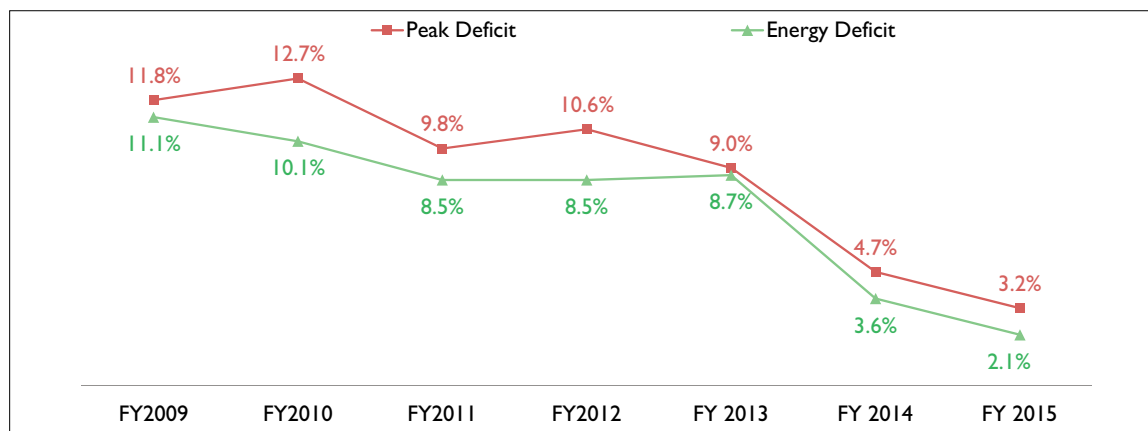
Source: MNRE

# Renewable in the Indian Scenario



Historically, the performance of the Indian power sector has never been satisfactory. Power generation capacity addition almost never met targets. Investment in transmission and distribution sector has been inadequate. Currently, only 70 percent of Indian households have access to electricity; the percentage of households actually having access to quality electrical power round-the-clock is far less. On top of low penetration, the energy demand-supply gap still exists in the country (even though it has improved over the years).

**Exhibit 3: Peak Deficit and Energy Deficit Over the Years**



Source: CEA

Per capita energy consumption in India is around 900 units, which is lowest amongst the BRIC nations, and is about 1/3<sup>rd</sup> of the global average. Given the Government's focus on manufacturing sector and initiatives like "power for all", the energy requirement would grow multifold over the next decade.

Thermal power, which is the backbone of the Indian power sector, is beset with challenges. Some of the major ones are:

- Availability of fuels, especially good quality coal, at competitive rates. The country has ample reserves of coal. Unfortunately, over the last decade, primarily due to environmental concerns, we have not been able to mine our reserves of coal, though things have improved in the last few months. We had to depend on imported coal for meeting the requirement of some of our power plants. International prices of coal fluctuate like any other commodity, which makes it challenging for power plant operators to maintain margins.
- Environmental concerns - Coal fired power plants cause pollution. They, along with polluting industries and vehicular emissions, are the major sources of air pollution.
- Disposal of wastes like fly ash, etc.



Apart from the above mentioned points, the cost of power generation through fossil fuel fired plants is not expected to reduce in future; in fact there is a growing chance of it increasing due to increase in clean energy cess, increase in cost of imported coal (though price of coal in international markets is currently low, the prices may rise again), increase in cost of power plant equipment, etc.

It would be very challenging for India to have energy security as well as provide power to all its citizens if we rely on thermal power with limited growth of renewables.

Cost of power generation through renewable energy sources, particularly solar, will not increase substantially as equipment costs are largely not expected to move up. Hence, with zero fuel cost and very low maintenance cost, renewable energy sources can arrest energy prices in the long term and help the country to be self-sufficient in energy and lower its current account deficit.

# Opportunities and Challenges Associated with Renewable Energy



**Challenges**

**Opportunities**

Renewable energy offers reasonable solutions to some of the problems plaguing the Indian power sector. India is well endowed with renewable energy sources, particularly solar and wind. As per current estimates, India has commercially exploitable renewable energy potential of about 895 GW, of which about 750 GW is solar.

**Exhibit 4: Potential of Renewable Energy**

| Technology   | Potential (MW)  |
|--|---|
| Wind   | 102,800 (80 m hub height)   |
| Small Hydro (up to 25 MW)  | 19,700  |
| Biomass including Bagasse Cogeneration (including waste-to-energy) | 22,500  |
| Solar  | 750,000 (assuming 3 percent of wasteland in India is made available for solar at 50 MWp / km <sup>2</sup> ) |

Source: MNRE

Apart from these, solar energy can be utilized in various stand-alone applications, including water heating, home lighting systems, and defense applications. Needless to say, if properly utilized, renewable energy can help India in its quest for 'energy for all' in a sustainable way.

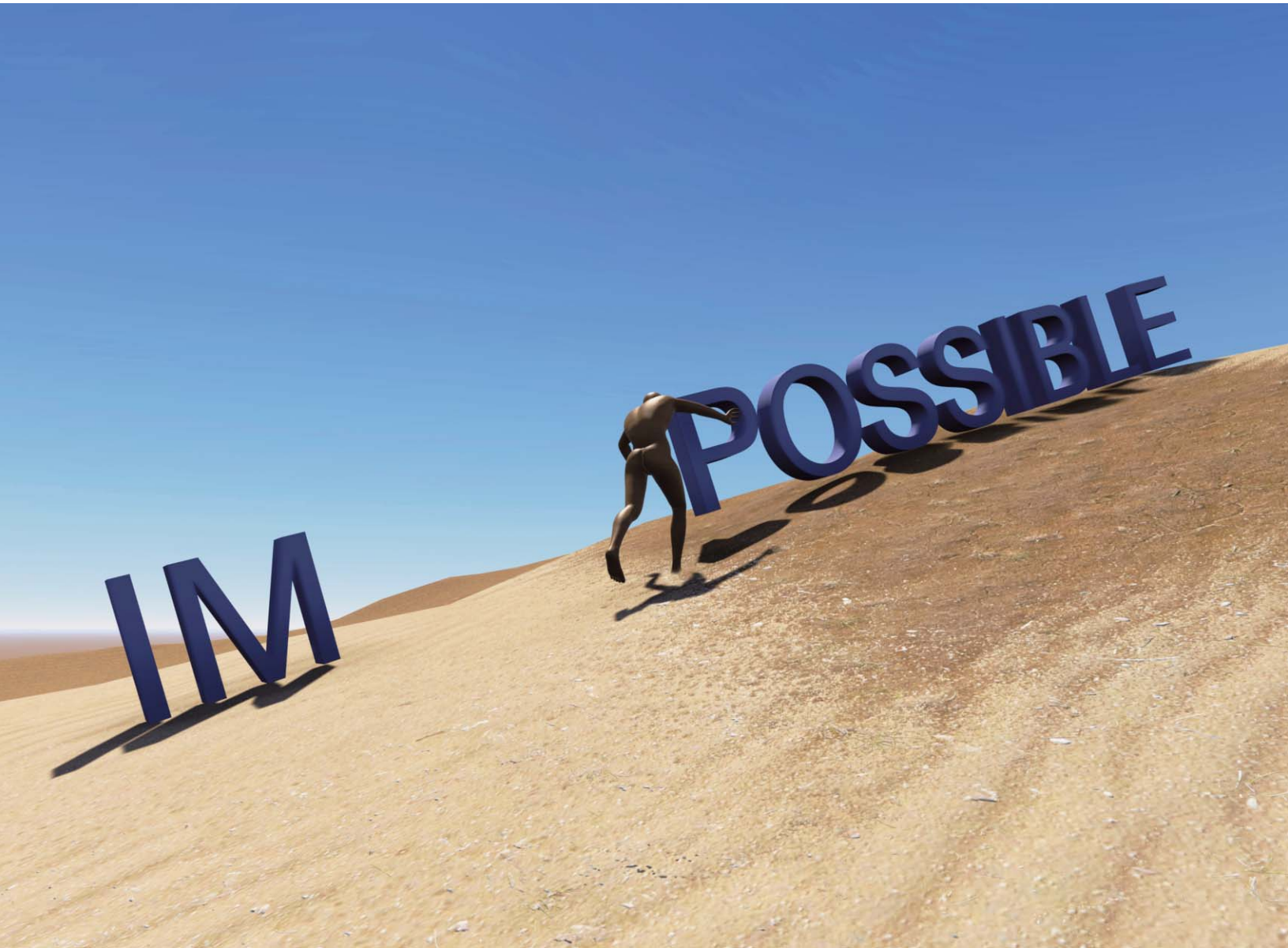
Historically, the renewable energy industry had been dominated by wind energy. Wind energy already has an established ecosystem in India; most incumbents have established manufacturing / assembling units in India. In terms of cumulative installed capacity, India is one of top five countries globally, with an estimated installed base of little above 23 GW. By 2022, the target installed base for wind is expected to be 60 GW. This is expected to be achieved through new capacity addition, repowering, and off-shore wind installations. One of the key advantages of wind is that the cost of energy is almost comparable to conventional / thermal energy prices. The cost of solar power had been prohibitive till about 2010. Since then, with falling equipment prices, low gestation period, and low entry barriers, solar PV installations have increased rapidly. However, the biggest advantage of solar PV lies in varied scale and applications where it can be utilized. Starting from solar lanterns, solar home lighting systems, rooftop systems to utility scale solar installations – the scale and application range of solar is indeed very wide and has the potential to touch and transform the lives of the poor / marginalized community in a significant way. Utility-scale solar thermal is still expensive in the Indian scenario, along with a longer gestation period. On the other hand, solar water heater is used for both residential and commercial applications across India.

While there is huge potential for renewable energy in India, the tariffs are generally higher compared to conventional energy. However, the same is fast approaching grid parity and increasingly becoming an economically viable answer to India's energy needs. India also aspires to become a leader in solar energy sector by forming an association of (mostly developing) countries having high solar potential and helping them exploit that potential.

However, along with the opportunities, there are some challenges apart from the higher cost. One of the biggest drivers for renewable energy in India should be Renewable Purchase Obligation (RPO), wherein obliged entities are required to use renewable energy to meet a mandated percentage of their requirement. Unfortunately, RPO is yet to be strictly enforced in most of the states in India.

Another challenge for renewable energy would be predictable availability. Unlike thermal energy, we have less control on input of renewable energy; hence the output is less stable. Solar is not available in the evenings or night. Similarly, wind energy generation is most effective in the summer months – this unpredictability has the potential to make India's already creaking transmission and distribution (T&D) infrastructure even more vulnerable. Since the current contribution of renewable energy in total energy consumption is very less, grid stability is not affected. However, going forward, as the contribution of renewable energy will increase; we will need energy storage mechanisms to provide stability to the grid, thereby effectively pushing the price upwards.

# Encashing the Opportunities and Mitigating Associated Risks



As mentioned earlier, there are tremendous opportunities in the renewable sector up for grabs but we need to seize the opportunity in a very responsible and sustainable way.

One of the main challenges currently for the renewable energy sector is availability of funds at low interest rates and longer repayment schedules. Alternative sources of funds such as pension funds, provident funds and insurance funds, which have significant corpuses but are bound by Government regulations, can be some of the needed sources of funds to cover this shortfall. The role of Development Finance Institutions such as IREDA, IFCI, SIDBI, which has somewhat reduced in the last few years, also have to be strengthened. The recently announced National Investment and Infrastructure Fund (NIIF) with a corpus of INR 20,000 crore is a welcome decision to create new sources of funds.

In spite of all the above, foreign investments in renewable energy are key to achieving these ambitious plans. Foreign investor's confidence needs to be reinforced. Issues such as red tapism, right of way/land issues, inadequate policy support specially from the various State Governments (enforcement of RPO obligations, etc), inadequate T&D network (an area of huge concern), unavailability of skilled and unskilled labor, etc. will be overcome.

The current T&D network and especially distribution network is an area of concern. The increase in usage of renewables has a direct relation with the T&D network, which should be robust and "smart" enough to withstand energy fluctuations associated with renewable energy power. The T&D network in the country needs massive investment to sustain itself. With renewables increasing its share in the total energy mix, the T&D network needs to be strengthened.

To maintain stability of the grid it is also important to have suitable distributed storage options like batteries. Currently, the cost of distributed storage is high, which will make non grid connected renewables less attractive. India should jointly work with the other countries to bring down the cost of distributed storage.

Lastly, a manufacturing ecosystem encompassing feedstock to finished products is very important for the success of the ambitious plan. Currently, the country doesn't have a viable manufacturing ecosystem, adequate and low-cost finances, whole hearted buy in from various State Governments, and adequate T&D network to support the aggressive renewable plan.

The plan will not achieve success if we are not able to plug the gaps. The Government has already planned/announced several policy level reforms which will be the key to its ambitious plans.

# Benefits of an Aggressive Renewable Energy Plan



India is an energy deficit country and imports bulk of its crude oil and natural gas requirements. This is a grave threat to our energy security, considering the global political environment in which we live in.

With threat to energy security, rising fuel prices, unavailability of power to all citizens of the country, and the impacts of climate change, renewable energy offers a “viable solution” to tackle the mentioned challenges to some extent.

An ambitious and aggressive renewable energy plan will help us to:

- Be less reliant on imported crude oil and natural gas. This will help us to be an energy sufficient country apart from the huge savings of precious foreign exchange. This will also improve our balance of payment situation.
- Avoid to some extent, the effect of increase in prices of conventional fuel and the uncertainties associated with conventional fuel. The prices of commonly used conventional fuel like coal have been increasing and will increase in the future apart from the various uncertainties associated with mining of coals. So is the case with nuclear energy.
- Make power available to every nook and corner of the country. Basic power needs are not being met. Conventional grid connected distribution may not be the ideal and economical choice to make power available to each and every citizen of the country. Thus, renewable energy offers various choices which can be more economical as well as technically practical.
- Make power available to remote and inaccessible locations through a micro grid which will also help in increasing the standard of living of people residing in those locations. Small solar devices such as solar lanterns and home lighting systems have already improved the quality of life of people using them. Covering the other uncovered areas and making the products more robust and more need based are good improvement points. Adding more products like solar water pumps, solar cold storages, solar charging stations will be helpful for the economy.
- Reduce the effect of climate change. These effects are plain to see and increased usage of renewable energy will help to reduce effect of climate change.

Apart from the above mentioned benefits, growth of renewable energy will create a raw material - manufacturing - installation and commissioning - operation and maintenance ecosystem which will not only generate huge employment opportunities, but would also be a game changer, globally. This can help the country become a forerunner in the renewable energy market and share its expertise and knowledge with other countries. The expertise we gain in renewable energy project management and delivering quality services at a very competitive rate can be our gift to other countries planning their renewable energy foray. Needless to say, this would also be a big commercial opportunity.



According to the Natural Resources Defense Council (NRDC) and Council on Energy, Environment, and Water (CEEW), if India achieves its new target of 100 GW of installed solar energy by 2022; as many as 1 Million Full Time Employment (FTE) jobs (excluding manufacturing) could be created. Approximately 183,500 FTE jobs would be generated if India were to reach its target of installing 60 GW of wind energy capacity by 2022.

# What can we expect for different Stakeholders?



**Social Changes**

- Access to power in the remote and inaccessible locations across the country. With access to power, quality of life increases apart from the economic development it creates in the region.
- Availability of employment in own location. With increase in off-grid renewables, employment opportunities increase in the area of installation.
- Reduced effect of climate change for all citizens of the country.

**Non-Social Changes**

- Growth of the manufacturing ecosystem - High growth in the manufacturing value chain starting from wafers to modules for solar, advancement in gasifier's technology for biomass, various components for small hydro, various balance of system components, etc. This growth will not only generate huge employment opportunities but will also help the country become an export base and earn precious foreign exchange.
- Growth in the EPC and O&M market - High growth of the renewable sector will open ample opportunities in the EPC and O&M space. Opportunity in the renewable EPC and O&M space (which is not very technologically dependent) is vendor/technology agnostic. This has more to do with managing projects in a better and competitive manner which we have done in other sectors such as telecom, etc.

The complexity of constructing solar off grid and small grid connected power plants is less, hence, small and mid-sized companies can execute projects. This will create a pool of companies near the project location and help in generating employment opportunities locally. The same EPC companies can also take on O&M jobs and help in sustainable employment.

- Financial institutions focused on renewable energy financing - Though things have improved, one of the bottlenecks for a financial institution to shy away from renewable finance, especially solar, is still to some extent, lack of essential and reliable information.

Growth of the sector will help the financing bodies not only to increase their loan portfolio but also be an expert in renewable energy financing. India is one of the few countries in the world which has a renewable energy portfolio of all types of renewables in different geographies/locations. Solar projects are in cold deserts like Ladakh and hot deserts like Rajasthan, elevated regions like Karnataka to semi-arid places like Andhra Pradesh.

Few countries have so much variety both in terms of renewable energy types or geography. The learnings of this mammoth exercise can be leveraged by financial institutions and they can be in a better position when similar opportunities arise in different geographies across the globe.

- Increase in other allied industries - The growth of the renewable energy industry will not only boost industries (various balance of system products like solar inverters, etc) directly related to renewable energy but also industries (various power electronic products like UPS, etc.) which are not directly related to renewable energy. The reason for the growth of the non related industries is the manufacturing ecosystem which is expected to be created.
- More renewable sources added will ensure the dream of smart grid in its truest sense will become a reality very soon. This will provide a boost to smart metering infrastructure companies, cabling companies and IT companies. A new market for ancillary services will be created.

# Change in the Energy Landscape with more Renewable Energy and the Positive Changes to the Society



The Indian power generation sector has not changed much in the last few decades or so except for addition of new conventional fuels like natural gas, nuclear fuel, etc. With the addition of massive renewable energy, it is expected that the energy landscape will witness a change.

Smart grids and distributed generation will be integral in the country's energy landscape. As mentioned earlier, distributed generation will help to improve the quality of life of people in remote and inaccessible areas. Adding more renewables will also speed up the adoption of smart grids in the country. The country will be less dependent on imported crude and natural gas and the country will have a lesser number of "unpowered" people.

We can expect a much "cleaner" society wherein the local population is the stakeholder in their social and economic empowerment not only through employment but by also having a respectable quality of life.

## Conclusion

India is an energy deficit country and is expected to remain so considering the pace of the growth of the Indian economy and the population growth rate. The country has to have a balanced energy portfolio to meet the energy and socio political environmental challenges of the future.

The country currently doesn't have a viable manufacturing ecosystem, adequate and cheap finances, whole hearted buy in from various State Governments, and adequate T&D network to support renewables.

Scaling up the existing manufacturing ecosystem and making it end-to-end is possible, considering the scale at which renewables is expected to grow. The country also has a very strong banking system. With changed Government regulations in the banking sector, inflow of funds for renewable sector will increase. Majority of the state distribution utilities are reeling under massive debts. The only feasible option to put them back to shape is the Central Government bailing them out after putting checks and mechanisms so that they are not in debt again. Strict enforcement of RPOs at the state level can be one of the conditions for the bail out.

The renewable energy plans announced by the previous Government and scaled up by the current Government has a moderate chance of becoming successful with some proactive steps as mentioned above, along with course correction measures, wherever deemed important, to be done by taking the feedback of stakeholders. There is an opportunity for both conventional and renewable sources of energy to co-exist and contribute towards the country's growth.

In its quest for achieving the ambitious renewable energy target, the Government should focus not only on big grid connected system, but also on distributed generation which is one of the biggest advantages of going renewable. At no point in time should distributed generation (with solar, wind, biomass, small hydro plants) be left out or ignored in the overall scheme of things.

Lastly, fossil fuel based power plants are the backbone of the Indian power sector and it is expected to remain the backbone of the power sector. Renewable based power plants will compliment the fossil fuel based power plants, for the country to have a balanced energy portfolio and to achieve the goal of energy security.

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