

The Salience of New and Renewable Energy in Sustainable Development: Opportunities & Challenges in India

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Abstract: *Given the present trends in energy consumption, the global environment is degrading at a fast pace. All the present day world environmental problems like global warming, ozone depletion, greenhouse effect are the consequences of irrational energy usage. The developing world is at a comparative disadvantage in terms of bearing the adverse environmental effects. The sources of energy that are most prominently being used in these third world nations are scarce non-renewable resources. The unabated use of these resources is in contravention to the concept of sustainable development which aims at balancing the needs of present and future generations. There is an urgent need to develop and expand the new and renewable energy sources in place of non-renewables. In the way to adopting these new and renewable energy sources, the developing world faces lots of opportunities and challenges. This paper analyses the current energy status, share of renewable energy, potential for creating capacity in renewables and governmental legislative & institutional framework in this regard in India. It also discusses the key drivers for promoting renewable energy as well as the role of different stakeholders in promoting, developing and adopting new and renewable energy for sustainable development taking a particular case of Indian economy.*

Keywords: *Capacity factor, sustainable development, conventional energy*

I. Introduction

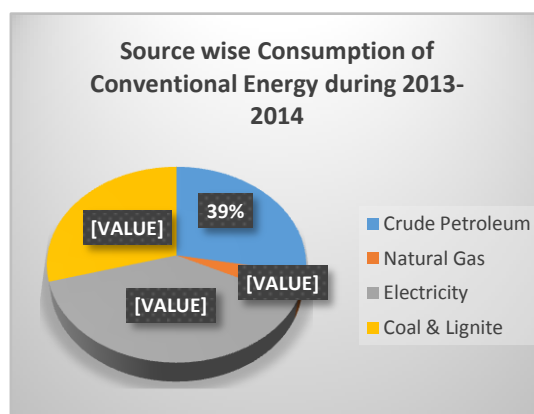
Energy has become a 'strategic commodity' due to its critical role in the socio-economic development and human welfare. India's economic growth is highly conditional upon the availability and sustainability of scarce energy resources. Today the greatest attention in the world is devoted to energy resources because their use is usually irreversible, but the supplies of traditional fossil fuels (oil, natural gas) are running out fast. This is why over the last decades attention is focused on new and renewable energy resources and ways to increase energy efficiency. Holistic planning aims to address the crucial issues of promoting new and renewable energy and minimizing the adverse environmental effects of energy growth. The significance of renewable energy in leading towards sustainable development is undoubting. Brundtland Commission defined sustainable development as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs." This being the guiding notion, expansion of renewable energy will balance the fulfilment of human needs with the protection of the natural environment so that these needs can be met not only in the present, but in the indefinite future. The recent drop in world oil prices to almost 50\$/barrel was in fact one of the consequences of reduced world demand for oil, thereby serving to promote sustainable development.

India is endowed with rich natural resources which can offer huge opportunities for the expansion of renewable energy. Renewable energy in India comes under the purview of the Ministry of New and Renewable Energy. India was the first country in the world to set up a ministry of non-conventional energy resources, in early 1980s. The Ministry aims to bring in energy security; increase the share of clean power; increase energy availability and access; improve energy affordability; and maximise energy equity. India's grid tied renewable energy capacity (excluding large hydro) has reached 33.8 GW, of which 66% comes from wind, while solar PV (photo voltaic) contributed nearly 4.59% along with biomass and small hydro power of the renewable energy installed capacity. This paper discusses how the use of new and renewable energy brings in equity in the distribution of energy thus driving an economy towards sustainable development. It also outlines the current status, potential, need, opportunities, challenges and existing laws in the field of new and renewable energy.

II. Current Energy Status

The energy consumption in India is the fourth largest after China, USA and Russia. The total production of energy from conventional sources (Production of coal, lignite, crude petroleum, natural gas, & electricity) decreased from 13409.47 Peta joules during 2012-13 to 13400.15 Peta joules during 2013-14, showing a decrease of 0.07%.

As far as the consumption of conventional energy is concerned, during 2013-14 total consumption was 47264 Peta Joules. The huge gap between production and consumption was met through imports in global market. The sourcewise consumption of conventional energy is depicted in the pie chart given below. The share of electricity at 54% is the highest followed by coal & lignite at 41%, crude petroleum at 39% and natural gas at a lowly 6%.



Source: Ministry of New & Renewable Resources

About 70% of India's electricity generation capacity is from fossil fuels, with coal accounting for 40% of India's total energy consumption followed by crude oil and natural gas. India is largely dependent on fossil fuel imports to meet its energy demands. India's dependence on energy imports is expected to exceed 53% of the country's total energy consumption by 2030.

The statistics for total installed utility power generation capacity in India reveals that India relies heavily on coal energy to produce electricity. A strong second is hydro power, followed by natural gas. Also, the share of private sector in the built up power capacity at 37% is the highest. It signifies the rising importance of private stakeholders in energy sector.

Total installed Power generation Capacity (end of March 2015)

Source	Utilities Capacity (MW)	%	Captive Power Capacity (MW)	%
Coal	164,635.88	61.51	27,588.00	58.60
Hydroelectricity	41,267.43	15.42	83.00	0.17
Renewable energy source	31,692.14	11.84	Included in Oil	-
Natural Gas	23,062.15	8.61	5,215.00	11.08
Nuclear	5,780.00	2.16	-	-
Oil	1,199.75	0.44	14,196.00	30.17
Total	267,637.35		47,082.00	

Sector	Utility Power Capacity (MW)	Percentage
State Sector	96,963.20	36.23
Central Sector	72,521.16	27.10
Private Sector	98152.99	36.67
Total	267,637.35	

Source: Ministry of New & Renewable Resources

Share of Renewable Energy

India has the world's fifth largest wind power market and plans to add about 100GW of solar power capacity by 2022. India also aims to increase the contribution of nuclear power to overall electricity generation capacity from 4.2% to 9% within 25 years. The vast river basins and exploitable water resources are being seen as an important source for expanding hydro power. The country has five nuclear reactors under construction (third highest in the world) and plans to construct 18 additional nuclear reactors (second highest in the world) by 2025. The wind power surpasses all renewable energy sources in terms of capacity built-up. The table below shows that the vast potential of waste to power is still untapped.

Total Renewable Energy Installed Capacity (31 Dec 2014)

Source	Wind Power	Solar Power (SPV)	Small Hydro Power	Biomass Power	Bagasse Cogeneration	Waste to Power	Total
Total Installed Capacity (MW)	22,465.03	3,062.68	3,990.83	1,365.20	2,800.35	107.58	33,791.74

Source: Ministry of New & Renewable Resources

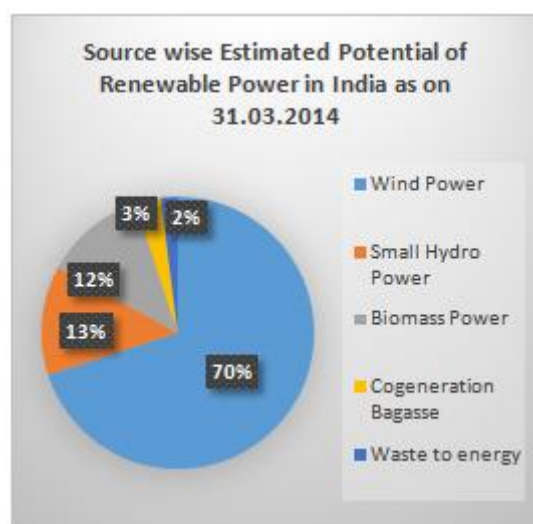
The present state of various renewables in India is:

1. **Wind Power** - The domestic policy support for wind power has led India to become the country with the **fifth largest installed wind power capacity** in the world. The installed capacity of wind power, as on 31 March 2015, was 23444 MW which is higher than the previous year by 10.9%. Wind power accounted for nearly 8.5% of India's total installed power generation capacity and generated 28.314 billion Kwh in the fiscal year 2014-15, which is nearly 2.6% of total electricity generation. Although, the development of wind energy in India started in 1990s, its capacity has increased at a much higher pace than many other countries with huge wind power potential (like Denmark, USA). Wind power is spread across all the coastal regions of India like, Tamil Nadu, Maharashtra, Kerala, Gujarat, Karnataka etc. In its 12th Five Year Plan (2012-2017), the Indian government has set a target of adding 18.5 GW of renewable energy sources to the generation mix out of which 11 GW is wind energy.
2. **Hydro Power**- The hydro power is the most widely used form of renewable energy in India. In terms of exploitable hydro-potential on global scenario, **Indiaranks 5th**. The installed capacity of hydro power, as on 31 March 2015, was 41,267 MW. India's economically exploitable and viable hydro potential has 60% capacity factor. To cater the peak electricity demand and water pumping for irrigation, many sites for pumped storage schemes with an aggregate installed capacity of 94,000 MW have been identified. Pumped storage schemes are a cheap and convenient way for storing surplus electricity to be used at the time of peak load demand. India has already established nearly 6800 MW pumped storage capacity which is part of its installed hydro power plants
3. **Solar Energy** - India is characterised by ideal conditions (high solar insolation) for the generation of solar energy. In our country due to unavailability of electrical grids in major parts, one of the first applications of solar power has been for water pumping, thus replacing India's four to five million diesel powered water pumps, each consuming about 3.5 kilowatts. A 35,000 km² area of the Thar Desert has been set aside for solar power projects, sufficient to generate 700 to 2,100 gigawatts. The government of India launched its Jawaharlal Nehru National Solar Mission under the National Action Plan on Climate Change with plans to generate 1,000 MW of power by 2013 and up to 20,000 MW grid-based solar power, 2,000 MW of off-grid solar power and cover 20 million square metres with collectors by the end of the final phase of the mission in 2020. The Mission aims to achieve grid parity (electricity delivered at the same cost and quality as that delivered on the grid) by 2020. Achieving this target would establish India as a global leader in solar power generation.
4. **Nuclear Power** - India stands ninth in the world in terms of its nuclear capacity. On the basis of its active nuclear power programme, India is expected to have 20 GW of nuclear capacity by 2020. However, the status of India as being a non-signatory to the Nuclear Non-Proliferation Treaty (NNPT) prevents it from obtaining nuclear technology vital to expanding its nuclear industry. For India, United States-India Peaceful Atomic Energy Cooperation Act is supposed to be a way to get access to advanced nuclear technologies.
5. **Waste to Energy** - With the high rate of urbanisation, waste generation in India is expected to increase rapidly in the future. Every year, about 55 million tonnes of municipal solid waste (MSW) and 38 billion litres of sewage are generated in the urban areas of India. In addition, large quantities of solid and liquid wastes are generated by industries. Different types of wastes generated in India are urban waste, industrial

waste, biomass waste and biomedical waste. India is actively involved in anaerobic digestion and biogas technologies and it has established several waste water treatment plants to produce renewable energy from sewage gas. Biomass which includes solid biomass, biogas, liquid biofuels and municipal waste is considered as a direct substitute for fossil fuels and the most effective in decreasing atmospheric CO₂. Bagasse Cogeneration is the highest component in biomass. The Kyoto Protocol also encourages further use of biomass energy.

Potential for Creating Capacity in Renewables

There is high potential in India for generation of renewable energy from various sources like wind, solar, biomass, small hydro and cogeneration bagasse. As on 31.03.14, the total potential for renewable power generation in the country is estimated at 147615 MW. In this total, wind power tops the chart with almost 70% potential. The source wise potential of different sources is depicted in the figure below with the share of wind power at 102772 MW (69.6%), SHP (small-hydro power) at 19749 MW (13.38%), biomass power potential of 17,538 MW (11.88%) and 5000 MW (3.39%) from bagasse-based cogeneration in sugar mills. If we look at state wise potential for renewable power, Gujarat tops the list with 25% share. This is also largely on account of wind power potential.



Source: Energy Statistics 2015

- With the active participation of private sector along with state and centre, the earlier unutilized potential located in the Himalaya mountain ranges including north east of India has started to develop.
- Solar energy is a viable and feasible off grid option to supply electricity in most of the under-developed areas of India. The theoretical potential of about 600 TW per year on account of high solar insolation is considerable and can be effectively utilized once the investment in terms of installation of solar power plants is undertaken. There are vast tracts of land suitable for solar power in all parts of India exceeding 8% of its total area which are unproductive barren and devoid of vegetation. Another important advantage is that there is zero cost of raw material in these solar power plants as these are self-productive. There is unlimited scope for solar electricity to replace all fossil fuel energy requirements (natural gas, coal, lignite and crude oil) if all the marginally productive lands are occupied by solar power plants in future.
- Tidal energy which is harnessed through tides has good potential in Gujarat's Kutch and Sunderbans.
- Nearly 750 million tons of non-edible (by cattle) biomass is available annually in India. Wood gas or syngas which is yielded by gasification of biomass can be converted in to substitute natural gas by Methanation. This converted biomass can be put to higher value addition use and to substitute imported crude oil, coal, LNG, urea fertiliser, nuclear fuels, etc. It is estimated that renewable and carbon neutral biomass resources of India can replace present consumption of all fossil fuels when used productively.

Governmental Legislative & Institutional Framework in India

India is one of those countries in the world which are actively involved in developing the use of renewable energies through its various policy measures including ushering in attractive opportunities for investors in renewables. Policies that relate to the energy sector which aim at raising the use of renewables and promoting sustainable development are:

1. **Energy Conservation Act 2001**, requires large energy consumers to adhere to energy consumption norms and producers of electric appliances to meet energy performance standards and to display energy consumption labels. The Bureau of Energy Efficiency was established to implement the provisions of the Act. Apart from this new building construction are supposed to follow the **Energy Conservation Building Code**.
2. In order to promote energy conservation and energy supply to one and all, in the year 2015, Prime Minister Mr. Modi launched a scheme called **Prakash Path** urging people to use **LED lamps** in place of other lamps to drastically cut down lighting power requirement.
3. The **Indian Renewable Energy Development Agency** which has been set up under Ministry for Non-Conventional Energy Sources (or Ministry for New and Renewable Energy) is a specialized financing agency to promote and finance renewable energy projects. It provides various forms of **subsidies & fiscal incentives** including income tax breaks, accelerated depreciation, custom duty/duty free import concessions, capital/interest subsidy etc.
4. Federal and state governments are encouraging the development of renewable sources of energy by the use of incentives which include the use of nuclear energy (India Nuclear Cooperation Promotion Act), **promoting wind farms** such as Muppandal, and **solar energy** (Ralegaon Siddhi).
5. For electrifying villages, India is using renewable sources of energy like hydel energy, wind energy and solar energy.
6. The Electricity Act 2003, has stated to each state regulatory commission to put the requirement to specify the minimum percentage of electricity that each distribution utility must source from renewable energy sources.
7. In June 2010, the government of India launched the National Mission on Enhanced Energy Efficiency (NMEEE) with an outlay of 2.35 billion INR, which aimed at saving nearly 23 million tons oil-equivalent of fuel in coal, gas and petroleum products in 5 years.
8. The Indian Government announced **Perform Achieve Trade (PAT)** scheme in 2008 which is an innovative, market-based trading scheme under its National Mission on Enhanced Energy Efficiency (NMEEE) in National Action Plan on Climate Change (NAPCC). It aims to improve energy efficiency in industries by **trading in energy efficiency certificates** in energy-intensive sectors.

Key Drivers of Renewable Energy in India

- **Strengthening energy security:** India ranks fourth and sixth globally as the largest importer of oil, and of petroleum products and LNG, respectively. The increased use of indigenous renewable resources is expected to reduce India's dependence on expensive imported fossil fuels thereby strengthening its energy status.
- **Climate change and sustainable development:** A genuine concern for environment calls for the need of green energy revolution in India. One such initiative in terms of "National Solar Mission" aims to promote the development and use of solar energy for power generation and other uses, with the ultimate objective of making solar energy compete with fossil-based energy options. Also, the use of alternative energy reduces deforestation and minimize the carbon dioxide emissions and various forms of pollution, as well as pressure on forests.
- **The demand-supply gap:** As the population is rising continuously so will be the demand for energy, the gap between demand and supply of energy can be met using abundant renewable energy sources.
- **International protocols:** Being a signatory to international climate change protocol, the government has to play an active role in promoting the adoption of renewable energy resources by offering various incentives, such as GBIs, tax holidays, etc.
- **Cost competitiveness of renewable energy technology:** Renewable energy is becoming increasingly cost competitive compared to fossil fuel-based generation. This is because these resources get free supply of raw materials which run them. For example, solar energy, tides, water from rivers, etc.
- **Offering viable off grid options:** Renewable energy is a distributed and scalable resource, making it well suited to meet the need for power in remote areas, which lack grid and road infrastructure.
- **Large untapped potential:** India has abundant untapped renewable energy resources. For example, India has significant potential to produce energy from biomass derived from agricultural and forestry residues.

- **Social welfare dimension:** Access to basic social services, such as education and health care can be raised through (lighting/heating/cooling of schools and health centres) using solar panels and increased access to water in rural areas (through solar PV pumping systems). The use of solar home systems also prevent health issues related to indoor use of firewood and improve household safety by decreasing domestic accidents caused by candles and kerosene lamps.

The Role of Different Stakeholders in Promoting New and Renewable Energy

Private Sector

Presently the government of India is offering various tax incentives for all those investors who are investing in green technologies or are using renewables in their production. This is because every project of renewable energy, whether grid related or off-grid, helps the environment because it creates clean energy and also helps avoid use of fossil fuels. Also, grid generation by wind, solar, hydro and biomass sectors offers large investment opportunities to the private sector not only in generation of power, but also in manufacturing. Thus, it is in the interest of private sector to promote renewable energy.

NGOs

Non-governmental organizations (NGOs), through public information and the promotion of individual or collective equipment, are primarily involved in experimental activities and the promotion and dissemination of renewable energy installations as part of community development efforts. These organisations are working at regional and sub-regional levels to promote green energy and spreading the awareness about sustainable and efficient energy use.

Development Partners

Development partners have an important role to play in promoting and disseminating renewable energy technologies.

1. Multilateral development institutions like the World Bank Group, United Nations Development Program and United Nations Environment Program, Asian Development Bank are important stakeholders in the sustainable development of all developing and developed world. So, they can provide, promote and disseminate renewable energy techniques in the developing world.
2. Bilateral development partners operating within the framework of bilateral cooperation for financing projects and programs through public or private institutions have an equal stake in developing sustainable energy. This is because the sustainable development in the countries of bilateral trade partners have positive externality effect.
3. There are many different organizations that work directly with beneficiary populations and seek funding for renewable energy projects and programs from development partners.

Opportunities in the way to Develop Renewables in India

1. The government of India, through its legislative policies, has created **favourable tax and customs regime** for investment and development of renewable energy. The major advantages of green energy investments are tax benefits and subsidies which are as high as 100% in case of some investments.
2. There is abundant existence and **availability of significant renewable energy potential**, especially solar, hydro and biomass/biofuels in India which can be usefully applied to do away with the energy scarcity problem confronting the nation.
3. India can **consolidate its balance of trade position** by exporting raw materials or components or finished renewable energy supply products (e.g. solar panels, wind turbines, and hydrogen fuel cells).
4. The share of India in the deployment of renewable energy in the world (given in the table below) shows that **India's share in wind and biogas plants are quite high**. This reflects that the environment is quite amenable for the production and installation of renewable energy.

Deployment of Renewable Capacity

Wind installation (global)	60,000 MW (cumulative)
India's share (and position)	6270 MW (fourth in the world)
SPV cell production (global)	1,700 MW (in 2005)
India's share (and position)	37 MW (seventh in the world)
Biogas plants (global)	16 million units (cumulative)
India's share (and position)	3.9 million family size units (second in the world)
Solar Thermal (global)	110 million sq.m (cumulative)
India's share (and position)	1.65 million sq.m (ninth in the world)

Source: Ministry of New & Renewable Resources

Challenges in Switching to Renewables

1. **Lack of awareness:** People need to be introduced and made aware about the significance of renewable energy in the present scenario. It is generally seen that lack of information greatly raises people's distrust in new technologies and creates a phenomenon of rejection.
2. **Destabilisation of existing commercial activities:** The introduction of new technologies or new techniques always makes people dependant for their living on old techniques vulnerable. Development of renewables may destabilize certain commercial activities (i.e., kerosene) and certain sectors (e.g., firewood) that bring subsistence incomes to part of the population (i.e., the producers and sellers of improved stoves, woodcutters, charcoal sellers, wholesale carriers and truck owners, etc.).
3. **High installation cost:** Whenever something new is created, it demands substantial initial investment. The relatively high cost of installing renewable energy equipment may hamper the adoption of these new technologies.
4. **Weak institutional and political framework:** Renewable energy programme is a significant global level programme that needs support of various stakeholders at different levels of its implementation. The main weakness is related to the large number of institutional actors, as well as inadequate material, along with financial and human resource constraints.
5. **Regulatory barriers:** Misalignment of state targets with national objectives and inconsistent implementation of state and centre capacities is hampering the development of renewable energy in India.
6. **Lack of significant transmission capacities:** The required infrastructure in terms of electricity storage and transmission is a major technical difficulty.

III. Conclusion

As the Indian economy is expanding and growing, its energy needs are also rising. The pressure on conventional sources like coal, oil, and other fossil fuels is quite high, and thus indicative of developing alternative sources. The persistent use of these non-renewable sources is against the requisites of the concept of sustainable development, which calls for efficient and equitable distribution of energy sources amongst the present and future generations. For this purpose, a separate Ministry of New and Renewable Energy has been developed. India is blessed with immense resources of renewable energy in the form of solar, wind, biomass and small hydro. The data sources indicate that the technical potential of these renewables exceeds the present installed generation capacity. It says that renewable energy remains a small fraction of installed capacity, yet India is blessed with over 150,000MW of exploitable renewables. The government of India has enacted several legislative and regulatory mechanism in order to promote renewables and to facilitate the access of energy even in the remotest of the country's villages. The need for renewables is arising due to growing demand of the energy hungry economy and constrained supply. The fossil fuel strategy will surely bring price volatility from dwindling supplies and added pollution from carbon combustion. Thus, switching fuels through new and renewable energy system makes sense for the cause of sustainable development of the economy. There is an important role and interest of all stakeholders in expanding renewables. Tapping India's wind, solar, biomass, and hydro could bring high quality jobs from domestic resources. Extending the energy co-operation between all states, and ultimately between neighbour nations will expand international trade and environmental peace on the subcontinent. There are many opportunities and challenges in the way of adopting and expanding sustainable energy sources. The potential needs to be harnessed appropriately and channelled in the right direction and all challenges need to be addressed by united efforts of all the stakeholders including government, business organisations, individuals and the whole world. Therefore, it is sensible that all efforts and investment consider accelerating these sustainable energy resources before committing to the same fossil fuel path as western nations did in their way to become developed.

References

- [1]. <http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/RE%20Mali%20exec%20summary%20final.pdf>
- [2]. <http://unep.org/greeneconomy/Portals/88/GETReport/pdf/Chapitre%206%20Renewable%20Energy.pdf>
- [3]. https://en.wikipedia.org/wiki/Energy_policy_of_India
- [4]. https://en.wikipedia.org/wiki/Renewable_energy_in_India
- [5]. Shankar, Pushkar. , Renewable energy in India: Status and Future Prospects
- [6]. https://en.wikipedia.org/wiki/Ministry_of_New_and_Renewable_Energy
- [7]. http://www.indiaenvironmentportal.org.in/files/file/Energy_stats_2015_0.pdf
- [8]. <http://www.ev.com/IN/en/Industries/Power---Utilities/Renewable-energy-in-India-status-and-growth-2013>
- [9]. <http://www.geni.org/globalenergy/library/energytrends/currentusage/renewable/Renewable-Energy-Potential-for-India.pdf>