

# Adapting Green Technology for Optimal Deployment of Renewable Energy Resources and to Generate Power for Future Sustainability

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## Abstract

This paper also focuses on renewable energy management for meeting present energy demand and future need for power generation. The main objective is to evaluate whether India can meet its energy demand with growing technology and development in renewable energy sector.

**Keywords:** Green Technology, Power Generation, Renewable Energy Management, Renewable Energy Sources

## 1. Introduction

The term Green Technology is about combining ecological science and technology for the improvement and implement techniques to conserve the natural resources and atmosphere in addition to diminish or alleviate the harmful result on surroundings due to human activities. The area of green technology includes a continuous development of ecologically affable ideas and methods in order to generate power from non-conventional resources of energy such as wind power, solar power, ocean energy that would also assist in reducing the carbon foot print in atmosphere. The advancement of renewable energy over the period of time has outshined all anticipations. The installed capacity and production of energy from non-conventional resources has elevated globally with sustainable policies build up by countries all over the world. The various power predicament during 1970s and followed by consequent financial recession emphasized the position of energy for both nationwide and financially viable precautions. During this critical time, few countries such as Germany, Denmark, Spain and the United States have started promoting the utilization of renewable, which led to advancement in technology and economies of scale. Emerging prominence on extenuating environment transformation and acclimatize to its

effect has added to the impetus. There has been significant contribution of renewable energy for mitigating global heat, demand for power and transport sector has also augmented progressively. While the percentage contribution of power generated from renewable energy resources has been reasonable due to increase in population and worldwide demand for power. But there has been by most remarkable development in renewable energy market and application of green technology in developing countries and emerging economy. Even though during the last decade incredible progress in the power segment has been observed, the renewable heating and cooling sector has lagged behind. This is regardless of the noticeable development since 2004 in the application of geothermal, solar thermal and biomass heating technologies for water and space heating, process heat and cooling. The application of renewable energy is also in transport sector such as use of bio fuels.

## 2. Benefit of Producing Renewable Energy from Non-Conventional Resources

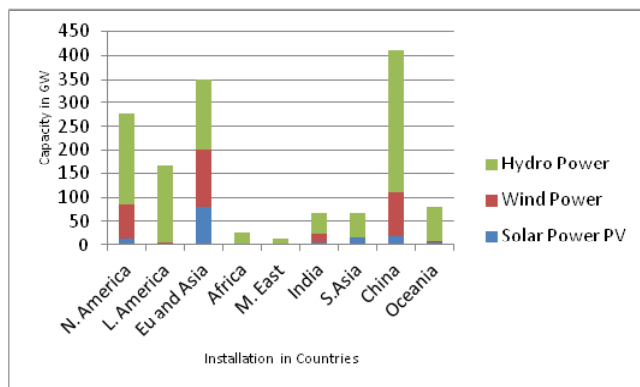
Ecological and financial payback of totting up renewable energy compared with power portfolio of state can be:

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- Renewable energy can diminish our dependency on conventional sources and power imported from foreign countries. Resources such as wind, solar, running water, can invariably supply energy.
- The ecological advantage of power produced from renewable energy resources is it reduces harmful pollutant released into the environment.
- It also creates financial progress and employment opportunity in industries, installation and more.
- Switching to non-conventional energy sources also means stabilizing cost on energy<sup>1</sup>.

### 3. A Worldwide Outlook for Implementing Green Technology and Renewable Energy

Presently the usage of renewable energy technologies has spread worldwide for providing electricity, industrial application such as heating, cooling and in the field of transportation. The research and development in application of green technology has also increased during the last decade. Nevertheless, the renewable energy sector has to overcome frequent challenge. The financial support provided for supply of fossil fuels, nuclear power and persists to overshadow fiscal inducements for renewable sector<sup>1,2</sup>. During the period 2004 till 2014 it has been observed that the worldwide demand for renewable energy has risen. There has been over all increase of 30% for supply of energy from renewable sources from 2004 to 2013. By 2013, renewable contributed roughly 19% of the world's ultimate power expenditure, a slight less than the biomass energy. Heat energy from contemporary non-conventional sources raised from less than 1% in 2004 to 10%



**Figure 1.** Worldwide renewable power capacity additions (Power in GW).

of overall ultimate power exploited in 2014; hydropower grew in sluggish manner at 3.8% in 2014 compared with total energy from other renewable sources. All other form of renewable sources used for power generation has increased its share from 0.5% to 3.5% during the last decade. During the year 2013 around 2.3% of fuel demand for transportation was met by bio fuels. The total capacity addition till 2014 in different form of renewable energy sources such as wind, solar and hydro energy is depicted in Figure 1.

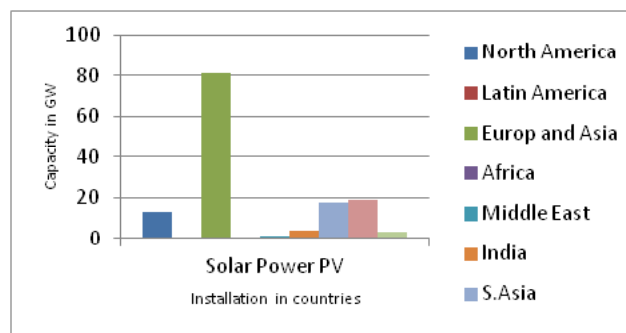
## 4. Global Development in Renewable Energy Resources

### 4.1 Solar PV

The overall worldwide effective capability of solar PV during the year 2012 has achieved a landmark of about 100GW that grew to attain a capacity addition of about 139GW during 2013 as represented in Figure 2. During the last decade considerable addition of solar PV has been observed in Europe and China market that is estimated to be around 70% of total installation. The annual installed capacity of solar PV in China has reached 13GW by the end of 2013. The installed capacity of Japan is 6.9GW, United States is 4.8GW and followed by UK contributing 1.5GW. The capacity addition of Solar PV is motivated by declining cost.

### 4.2 Wind Energy

In this sector of wind power the cumulative addition of worldwide wind capacity addition has reached 319GW, with a significant increase of 271GW since 2004. However in year 2013 the steady growth of wind market declined due to downturn in the financial market globally. The total installation in US market dropped from 13GW in 2012. The



**Figure 2.** Solar power capacity (Power in GW).

wind energy sector began to rise again in 2014; during this period China took the leading market. The concept of wind power business started in Denmark, Germany and the United States, 2004 saw the wind market widen. The wind power installation in China reached from 0.5GW in 2004 to 16GW in 2013. The development in wind market in countries like Europe, China and the United States, Canada, Brazil and India have grown to be vital markets along with Mexico and South Africa rising swiftly. The total wind power capacity in the world till 2014 is depicted in Figure 3.

### 4.3 Hydro Power

The worldwide progress in hydro power sector increased from 285GW in 2004 to 715GW by the end of 2013. With increase power demand in all sector, power generated from installation of hydro power plants is approximately 16% of the global power supply. The total global capacity for hydro power projects have achieved a milestone of 1000GW by 2014 as portrayed in Figure 4. The countries where majority of installation have materialized are China, Turkey, Brazil, Vietnam and Russia. In order to mitigate the demand for power projects of higher capacity building up is required, therefore joint-venture business models which comprises of partnership between local and international parties are escalating<sup>2,3</sup>.

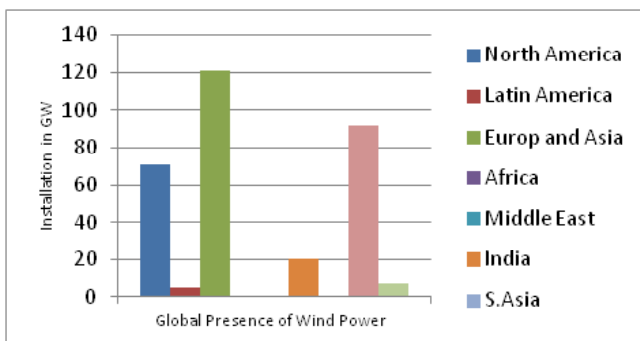


Figure 3. Wind power capacity (Power in GW).

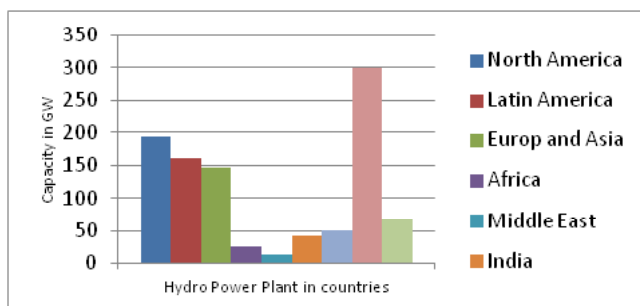


Figure 4. Hydro power capacity (Power in GW).

### 4.4 Ocean Energy

Development in this form of energy is less as compared with other sources of renewable energy. Ocean energy relics as a wild card in the renewable power generation portfolio. Industrial ocean energy capacity was roughly 527 MW by the end of 2013<sup>4,5</sup>. Few form of power generated by utilizing ocean energy is mentioned below:

#### 4.4.1 Oil

It is the major source of energy and oil is the world's largest primary energy source and approximately 1650 billion barrels of oil reserves are there.

#### 4.4.2 Natural Gas

Natural gas is also generated from ocean similar to that of crude oil. It is a combination of hydrocarbons and comprise mostly of methane (CH<sub>4</sub>).

#### 4.4.3 Ocean Hydro Power

The offshore hydropower is focused on tidal and wave technology. A 254MW Tidal power project in South Korea and a small wave power plant of 300 kW in Spain has been setup.

#### 4.4.4 Wind Power

Power of wind is utilized as prime mover in electricity generation, domestic utility, small scale industries, in farm houses, flourmills etc. since ancient time. Offshore wind turbines are more efficient due to availability of stronger and more consistent sea breezes wind velocity increases on going away from the shore, but it also imposes difficulty in construction of structures and foundations as well as offshore grid connections. Floating foundations have resolved the issue to some extent. For capturing maximum power of the high wind speeds and altitude; higher hub heights and larger rotor diameters are recommended. Annual growth of around 25% recorded over the past decade. In 2012 global share of wind power in power generation was 2.3%, by record addition of 44 GW accounted to 282 GW in the year.

#### 4.4.5 Wave and Tidal Energy

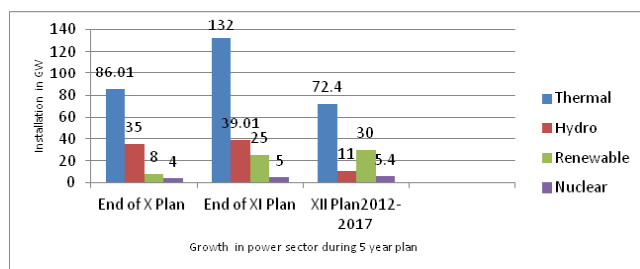
The ocean wave and tides are generated due to gravitational forces amongst the sun, earth and moon. Although enormous energy is available in ocean waves, but slow motion waves and least concentrated energy are the associated limitations.

## 5. An Overview of Development in Renewable Energy and Green Technology in India

India is considered to be the fifth-largest country energy producing portfolio globally. The accepted resource of power that accounts majority share is Coal around 58%. The installed power capacity is growing to achieve 223GW by the end of 2013 which was 98GW during 1998. During the period 2000 to 2001 India was considered to be the seventh-largest power consumer. With financial escalation and growing affluence, joined with reasons such as emerging rate of urbanization, growing per capita power utilization and industrialization in the country are expected to thrust energy requirement additionally in the country. The regulatory policies in energy sector are favorable for its growth and enhancement of energy sector. In order to augment the development of energy sector, government has allowed investment of 100% FDI with no further prerequisite of obtaining permit to set up a power plant. On the other hand, demand for energy persists to surpass supply of power and peak demand scarcity over the last 10 years normally about 8% and 12%, respectively. The progress in power sector in India during five year plan is shown in Figure 5. The overall installed capacity of thermal power plant is around 67% the total installed capacity in the country<sup>5-7</sup>.

## 6. Predicament in Indian Energy Sector

As per the 12<sup>th</sup> 5 year plan set by Government of India renewable energy capacity to add is 29.8GW, taking the total renewable energy capacity to 55GW by the end of 2015. In order to achieve this target we need to identify the issue prevalent in this sector. Renewable Energy Country Attractiveness Index (RECAI), Ernst and Young LLP and August 2013<sup>7,8</sup>.



**Figure 5.** India installed generation capacity (GW).

- Limitation in usage of conventional sources of energy such coal which is required primarily for production of power in thermal power plants. With increase demand the percentage use of coal will increase significantly for mitigating demand on power.
- Equipment shortage in Hydro power plants and thermal power plants factors also needs to taken for achieving our target of power addition annually.
- Land acquirement and Environment permission create an ever more moment to us dispute in the Indian Power sector. The setting up of power plants and utilities face foremost restriction and hindrance in accessibility of land and other clearances cause problem for execution of project.
- Transmission and Distribution Losses are amongst the major worrisome setback in the Indian energy segment India's cumulative technical and commercial fatalities average around 32% of electricity which is extremely high as contrast to other developing countries.
- Aged and incompetent power plants and transmission lines required to be substituted or modernize to accomplish the power production and meet the demand.
- Inconsistent rainfall in India is also responsible for irregular operation of hydro plants during whole year. Many times, the exhaustion of the water reservoir source a deficiency in production from the hydro plants.
- India is lavishly gifted with diversity of renewable energy resources. However the renewable resources are not utilized, having only approximate 10% of total energy generation.

## 7. Prospect Viewpoint for Altering Indian Power Sector

There is to be changed in condition of Indian Transmission, Generation and Distribution by adapting new, innovative strategies.

- Modernization and renovation is required to be carried out in existing power plants. This would enhance the performance for generating power. At present the fuel conversion efficiency of existing thermal power plants is around 31 percent which should be at least 38%.
- Development of National Grid is vital for increasing the transmitting and distribution of power. As per 12th plan period it is visualized to put in new inter-regional capacities of 20700 MW at 220 kV. This

would enhance the total inter-regional transmission competency of national power grid.

- Implementing modern technique such as Demand and Supply Management (DSM) for conserving energy. DSM is the setting up, realization and scrutinizing of utility activities designed to persuade buyer usage of energy which can produce preferred alteration in the load, shape of the utility. The successful implementation of the method would reduce operating costs, save fuel and enhanced plants life.

## 8. Conclusion

Energy is the vital requirement in each sector. With globalization and increase in industrialization demand for power has increased. Till date major portion of electricity is produced from conventional sources as compared to energy generated from renewable resources. The research development in the field of green technology is coming up with new devices for generating electricity from solar, wind, hydro and ocean energy. At present the current power development in India is not adequate. The power supply position prevailing in the country is considered by importunate scarcity and irregularity and also high cost for manufacturing customers. There is also apprehension about the situation concerning petroleum products electricity is produced domestically but its supply depends upon the availability of coal, exploitation of hydro power sources and the scope for expanding nuclear power and there are constraints affecting each source. Vibrant performing society wants energy as its lifeline and the quantum of its use indicate the quality of life being experienced by its members. There is a great inconsistency in the energy use amongst diverse regions of the world and

even for countries like India where the rural areas are not getting the benefits of energy and where obtaining food and shelter is a daily challenge. India needs to bridge this divide as soon as possible and this is of paramount importance for any growth which should include all sections of society. Therefore is vital to improvise green technology for increasing its usability to obtain renewable energy.

## 9. References

1. Bisoyi B, Das B. Necessitate green environment for sustainable computing. International Conference on Computer and Communication Technologies (IC3T 2015). (Springer); 2015. p. 515–24.
2. Kumar V, Shrivastava RL, Untawale SP. Solar energy: Review of potential green and clean energy for coastal and offshore applications. International Conference on Water Resources, Coastal and Ocean Engineering, (ICWRCOE 2015). Science direct; 2015. p. 473–80.
3. Pinson P, Giebel G, Clausen NE. Renewable energy resources – Onshore/offshore wind energy. Reference Module in Earth Systems and Environmental Sciences; 2013. p. 53–64.
4. Esteban DM, Javier JD, Jose SL, Vicente N. Vulnerability of energy to climate. Why offshore wind energy? Renewable Energy. 2011; 36(2).
5. Renewable Energy Country Attractiveness Index (RECAI), Ernst and Young LLP; 2013 Aug.
6. Garg P. Energy scenario and vision 2020 in India. Journal of Sustainable Energy and Environment. 2012; 3:7–17.
7. Omer A, Ghosh S, Kaushik R. Indian power system: Issues and opportunities, international. Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering. 2013 Mar; 2(3).
8. Samad T, Annaswamy AM (Editors). The impact of control technology; 2011.