# TECHNOLOGICAL ADVANCEMENTS IN THE FIELD OF ENERGY PRODUCTION

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**Abstract**

Renewable energy has been the need of 21st century and it has prominent role in the life of human being. Renewable energy is called the energy that is unruffled from renewable resources such as sunlight, wind, rain, waves, tides and geothermal heat. Renewable energy closely linked with hydro and biomass energy resources. It is considered as environmentally clean energy and reasonably priced. It is considerable fact that renewable energy significantly provides energy in many important areas such as electricity, space heating and cooling, geothermal heat pumps, bio-fuels, ocean energy, hydrogen and fuel cells and green power. Most of the renewable power generation is acquired from fossil fuel, air and water. The energy requirement in India is being met by both conventional and non conventional means. Renewable energy has to be utilized to greater extent so as to India achieve the Millennium Development Goals and can counter the emerging challenge of global warming. Our priority is to provide a more secure energy supply to reduce greenhouse emission and to supply sustainable and healthier energy. More renewable energy resources produce little effect on global warming emission. Although, the green houses emissions have to be reduced. Some policies have to be created to facilitate the usage of renewable energy. The purpose of this paper is to demonstrate the feasibility of renewable energy to policy makers, political establishment and the public. The study is tried to explore integration of enhanced electrical capacity of renewable energy resources. The present study shows that the solar, wind and biomass energy generation systems emerged as the most suitable renewable energy resources. The aim of this study is to contribute to the development of the widespread use of renewable energy resources.

**Keywords:** Biomass, Development, Greenhouse, Renewable energy, Resources.

## I. Introduction

Energy is an essential element of our everyday life. Energy is required to carry out all sorts of activities in household, industry and agriculture. Nearly 40% of total population of India depends on different energy sources for cooking, water heating and lighting etc. in household. India is heavily dependent on fossil fuels for its energy needs. Most of the power generation is carried out by coal and mineral oil-based power plants which contribute heavily to greenhouse gases emission. Solar Power a clean renewable resource with zero emission has got tremendous potential of energy which can be harnessed using a variety of devices.

India's quest for green energy has crossed a major milestone, with renewable plants, mainly wind and solar, surpassing the capacity of large hydroelectricity projects, which were once the country's biggest source of electricity and regarded as "temples of modern India". In the country's renewable mix, wind power accounted for 56.2 percent with as much as 32.3 GW, followed by solar which took the share of 21.8 percent with 12.5 GW. In April 2017, solar reached 3.8 percent of total installed capacity up from 2.23 percent in April 2016. The country has an installed capacity of 62,053 MW of grid-connected renewable power as of 31 November, 2017. Wind power capacity is at 32,746 MW, making India the fourth-largest wind power producer in the world.

In order to achieve the renewable energy target of 175 GW by the year 2022, 60GW from wind power, 10 GW from biomass power and 5GW from small hydro power. The bidding process for the further additional 115 GW or thereabouts to meet these targets of installed capacity from January 2018 levels will be completed by the end of 2019-20. Newer renewable electricity sources are projected to grow massively by nearer term 2022 targets, including a more than doubling of India's large wind power capacity. India set a target of producing 40% of its total energy needs through renewable sources by 2030. The total capacity of renewable energy projects expanded to 42,850 megawatts, overtaking hydropower that stood at 42,783MW.

The major programmes on implementation of Solar Park, Solar Defence Scheme, Solar scheme for CPUs, Solar PV power plants on Canal Bank and Canal Tops, Solar Pumps, Solar Rooftop etc have been launched during the last two years. Although, India is facing an acute energy scarcity which is hampering its industrial growth and economic progress. Setting up of new power plants is inevitably dependent on import of highly volatile fossil fuels. Thus, it is essential to tackle the energy crisis through judicious utilization of renewable energy resources such as Biomass Energy, solar Energy, Wind Energy and Geothermal Energy.

Renewable energy sources and technologies have potential to provide solutions to the longstanding energy problems being faced by the developing countries like India. Solar energy can be an important part of India's plan not only to add new capacity but also to increase energy security, address environmental concerns, and lead the massive market for renewable energy. However, greater concern for environment has brought many issues with use of fuel. There is now a national thinking and drive going on to conserve known sources such as firewood, agricultural waste, dung, kerosene, oil and biogas products etc.

The government is playing an active role in promoting the adoption of renewable energy resources by offering various incentives, such as generation-based incentives, capital and interest subsidies, viability gap funding, concessional finance and fiscal incentives etc. The objective of the National Solar Mission is to reduce the cost of solar power generation in the country through long-term policy, large scale deployment goals and the domestic production of critical raw materials, components and products. Renewable energy is becoming increasingly cost-competitive as compared to fossil fuel-based generation.

## II. Solar Energy in India:

Solar power in India is a fast developing industry. As of 31 January 2018 the country's solar power had 20 GW total capacity. India expanded its solar-generation capacity 8 times from 2,650 MW on 26 May 2014 to over 20 GW as on 31 January 2018. The 20 GW capacity was initially targeted for 2022

The country added 3 GW of solar capacity in 2015-2016 and over 5 GW in 2016-2017, the highest of any year, with the average current price of solar electricity dropping to 18% below the average price of its coal-fired counterpart. With about 300 clear and sunny days in a year, the calculated solar energy incidence on India's land area is about 5000 trillion kilowatt-hours per year. The solar energy available in a single year exceeds the possible energy output of all of the fossil fuel energy reserves in India. The daily average solar-power-plant generation capacity in India is 0.20 kWh per $m^2$ of used land area, equivalent to 1400–1800 peak (rated) capacity operating hours in a year with available.

| Annual solar-power generation | |
|---|---|
| **Year** | **Solar power generation (billion kwh)** |
| 2013-14 | 3.35 |
| 2014-15 | 4.60 |
| 2015-16 | 7.45 |
| 2016-17 | 12.09 |

## III. Solar Thermal Power:

The installed capacity of commercial solar thermal power plants in India is 227.5 MW with 50 MW in Andhra Pradesh and 177.5 MW in Rajasthan. It can cater the load demand perfectly and work as base load power plants

**Fig.1: Solar penal for generation of electricity.**

when the extracted solar energy is found excess in a day. Solar power, generated mainly during the daytime in the non-monsoon period, complement wind which generate power during the monsoon months in India. Solar panels can be located in the space between the towers of wind-power plants. It also complements hydroelectricity, generated primarily during India's monsoon months.

**Fig.2: Solar power plant for energy production.**

Solar-power plants can be installed near existing hydropower. When solar thermal storage plant is forced to idle due to lack of sunlight locally during cloudy days in monsoon season, it is also possible to consume the cheap excess infirm power from solar PV, wind and hydro power plants by heating the hot molten salt to higher temperature for converting stored thermal energy in to electricity during the peak demand hours when the electricity sale price is profitable.

## IV. Solar Thermal Energy:

Generating hot water or air or steam using concentrated solar reflectors, is increasing rapidly. Presently concentrated solar thermal installation base for heating applications is about 20 MW in India and expected to grow rapidly. Cogeneration of steam and power round the clock is also feasible with solar thermal CHP plants

**Fig.3: Solar thermal power plant.**

## V. Nanocrystalline Solar Cells:

The dye-sensitized solar cells provide a technically and economically credible alternative concept to present day *p*–*n* junction photovoltaic devices. In contrast to the conventional systems, where the semiconductor assumes both the task of light absorption and charge carrier transport, the two functions are separated here. Light is absorbed by a sensitizer which is anchored to the surface of a wide band gap semiconductor. Charge separation takes place at the interface via photo-induced electron injection from the dye into the conduction band of the solid. Carriers are transported in the conduction band of the semiconductor to the charge collector. The use of transition metal complexes having a broad absorption band in conjunction with oxide films of nanocrystalline [1] morphology permits the harvesting of a large fraction of sunlight. Near-quantitative conversion of incident photons into electric current is achieved over a large spectral range extending over the whole visible region. Overall solar to electric conversion efficiencies over 10% have been reached.

Energy storage is one of the key technologies for energy conservation and therefore is of great practical importance. One of its main advantages is that it is best suited for solar thermal applications. This study deals with a comprehensive discussion of the evaluation and the selection of sensible and latent heat storage technologies, systems and applications in the field of solar energy. Several issues relating to energy storage [2] are examined from the current perspective.

## VI. Powering the planet:

Global energy consumption is projected to increase, even in the face of substantial declines in energy intensity,at least 2-fold by midcentury relative to the present because of population and economic growth [3]. This demand could be met, in principle, from fossil energy resources, particularly coal. Among renewable energy resources, solar energy is by far the largest exploitable resource, providing more energy in 1 hour to the earth than all of the energy consumed by humans in an entire year. An especially attractive approach is to store solar-converted energy in the form of chemical bonds in a photosynthetic process. Scientific challenges involved with this process include schemes to capture and convert solar energy and then store the energy in the form of chemical bonds.

## VII. Different types of renewable energy sources

### VII.1 Wind Energy:

Other forms of clean energy include wind and biomass. Windmills were used extensively in Northwestern Europe to grind flour as early as the 12th century, and were used for water pumping in early American farming and ranching. Today's windmills or wind turbines harvest the power of wind to create renewable energy. Most wind power is produced at wind farms, facilities that are carefully placed in windy locations. As a renewable energy, wind is non-polluting and produces no emissions or chemical waste.

### VII.2 Biomass Energy:

Biomass is a renewable energy that is produced from burning organic matter such as wood, paper, tree trimmings and waste from mills. Once these products are burned, the heat produced turns a steam turbine, which moves a generator to produce electricity.

### VII.3 Biogas Energy:

Biogas is created when microorganisms cause organic waste, such as food wastes and paper, to decompose in landfills. When organic matter decomposes landfill gas is produced. In biogas energy projects, landfill gas is burned in boilers, reciprocating engines, and combustion turbines to produce electricity. Large-scale biogas use produces electricity, heat and steam, chemical production, and vehicle fuel.

### VII.4 A Renewable Energy Scenario for Geothermal Heat, Wind Power and Biomass:

With biomass resources being finite, the two marginal energy resources are geothermal heat and wind power. If geothermal heat is utilized more, wind power may be limited and vice versa. The analyses show that it is possible to cover energy needs through the use of locally available sources in combination with significant electricity savings, heat savings, reductions in industrial fuel use and savings and fuel-substitutions in the transport sector. The costs of the scenario [4] are at a comparable level with the reference situation, but with significantly higher needs for investments and lower fuel costs. Implementation of the scenario would therefore have a positive socio-economic impact as investments are more local labour-intensive than fuel supply.

### VII.5 wind energy systems using biomass-based energy storage:

A completely renewable electricity generation system is proposed by combining wind energy, compressed air energy storage, and biomass [5] gasification. This system can eliminate problems associated with wind intermittency and provide a source of electrical energy functionally equivalent to a large fossil or nuclear power plant. Replacing natural gas with fuel derived from biomass gasification eliminates the use of fossil fuels, virtually eliminating net $CO_2$ emissions from the system. In addition, by deriving energy completely from farm sources, this type of system may reduce some opposition to long distance transmission lines in rural areas, which may be an obstacle to large-scale wind deployment.

### VII.6 Biomass Energy; The Potential Resource:

Increased production of biomass for energy has the potential to offset substantial use of fossil fuels, but it also has the potential to threaten conservation areas, pollute water resources and decrease food security. The net effect of biomass energy agriculture on climate could be either cooling or warming, depending on the crop, the technology for converting biomass into useable energy. The area with the greatest potential for yielding biomass energy that reduces net warming and avoids competition with food production is land that was previously used for agriculture or pasture but that has been abandoned and not converted to forest or urban areas. The global potential [6] for biomass energy production is large in absolute terms, but it is not enough to replace more than a few percent of current fossil fuel usage. Increasing biomass energy production beyond this level would probably reduce food security and exacerbate forcing of climate change.

## VIII. Renewable Energy Sources in Environmental Protection:

Renewable technologies are considered as clean sources of energy and optimal use of these resources minimize environmental [7] impacts, produce minimum secondary wastes and are sustainable based on current and future economic and social societal needs. Sun is the source of all energies. Sunlight and heat are transformed and absorbed by the environment in a multitude of ways. Some of these transformations result in renewable energy flows such as biomass and wind energy. Renewable energy technologies provide an excellent opportunity for mitigation of greenhouse gas emission and reducing global warming.

## IX.Conclusions:

Previously, India was negative in its approach and took a corner seat in most international conferences, but in Paris the Prime Minister of India introduced the concept of climate justice and drove home the message of sustainable development. The country stands fifth in the world in the production and consumption of electricity but we can’t deny the fact that the population of the country is also expanding. It is a high time that our country should concentrate more on energy efficiency, conservation and renewable energy.

In India per-capita land availability is low. Dedication of land for the installation of solar arrays must compete with other needs. The amount of land required for utility-scale solar power plants is about 1 $km^2$ (250 acres) for every 40–60 MW generated. One alternative is to use the water-surface area of canals, lakes, reservoirs, farm ponds and the sea for large solar-power plants. These water bodies can also provide water to clean the solar panels. Highways and railways may also avoid the cost of land by minimizing transmission-line costs by having solar plants about 10 meters above the roads or rail tracks. Solar power generated by road areas may also be used for in-motion charging of electric vehicles, reducing fuel costs.

To achieve the above goals in the desired timeframe, renewable energy should require financial support from the government in the form of subsidies as received by the fossil fuels. But already solar power is cheaper than imported coal. Solar is already a cheaper source to produce electricity than coal but in view of energy needs, it should require more political support and should be of the government than financial support to get it implemented at a faster rate.

For the above targets to be reached, it should be necessary to accelerate incentives for renewable energy such as accelerated depreciation, tax holidays, renewable energy funds, initiatives for international partnerships/collaboration, incentives for new technologies, human resources development, zero import duty on capital equipment and raw materials, excise duty exemption, and low interest rate loans.

We conclude that a broad range of intensive research and development is urgently needed to produce technological options that can allow both climate stabilization and economic development.

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