

## Evolution and Utilization of Green Energy

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**Abstract:** Rapid depletion of conventional energy sources made us look after alternate energy sources which are non-conventional sources of generating power. Fossil fuels which are non-renewable in nature are becoming obsolete, and they are the main reason for GHG emissions, global warming, create serious threat to environment, they cannot be replenished in short period of time. The rapid increase in growth of industries, urbanization, mechanization, automation, changes in pattern of life, which accompanied in increase in load, give rise to generation of electricity. Advantages for adopting technologies for recovery of energy from renewable sources are to reduce the usage of fossil fuel, environmental pollution besides generation of substantial quantity of sustainable, green energy to meet the requirement of increasing demand. The main solution for production of electricity and to reduce major greenhouse gas (CO<sub>2</sub>) is replacement of present conventional sources with renewable sources and enhancing energy efficiency. In this paper, we would like to discuss about various sources of renewable energy, discuss their working, statistics in India and compare various parameters among them.

**Keywords:** *Non-conventional sources, Sustainable energy, renewable sources, pollution.*

### Introduction:

Fossil fuel is formed due to the natural process by anaerobic decomposition of buried dead organisms, they contain lot of chemical energy in them. They contain high amounts of coal, petroleum, and natural gas[1-2]. United States Energy Information Administration concluded that there is 86.4% of share for fossil fuels in power generation. Fossil fuels to form in the earth crust takes millions of years, 640 million years on an average. They are considered as non-renewable energy sources since they take millions of years to generate and their depletion rate is rapid.

21.3 billion tons of carbon dioxide (CO<sub>2</sub>), is being released due to burning of fossil fuels in which only half the amount can be absorbed. The estimated growth of CO<sub>2</sub> emissions due to burning of fossil fuels is expected to be 10.65 billion tons

In a survey it is observed that 7 million people die every year due to pollution from fossil fuels[3]. The continued use of non-renewable sources has an implication on our survival and health, both of which are undoubtedly connected with the impacts non-renewable sources on our environment.

Shifting from non-renewable sources to renewable energy sources is the underway to help reduce global greenhouse gas emissions. Clean and low carbon energy is the only logical choice for the future.

Source of generation	Generation in GWh (2016-2017)	%Utilization
Coal	9,44,861	76.5%
Diesel	275	0.0%
Nuclear	37,916	3.1%
Natural gas	49,094	4.0%
Wind	46,011	3.7%
Bio energy	14,519	1.1%
Solar	12,086	1.0%
Large hydro	1,22,313	9.9%
Small hydro	7,673	0.6%

Table.1 Electricity generation by source in India(2016-17)

The above table reveals the fact that almost 85% of sources of energy in India were non-renewable[4]. Demand for electricity and consumption will comprise an increasing of energy demand during coming decades. In recent years, the increasing prices of fossil fuels which is predicted by law of demand. Recently there is a concern about environmental issues of GHG emissions.

As on 31 March 2015, Indian had estimated coal reserves of 306.6 billion metric tons (338.0 billion short tons). It is the 5<sup>TH</sup> largest coal reserves in the world, hence coal is the predominant fuel for electricity generation in India and its consumption is increasing relentlessly to meet the requirement of energy demand of the nation. Due to eternal usage of coal

gases like CO<sub>2</sub>, SO<sub>2</sub>, NO is being emitted from thermal power plants in India. Emission of CO<sub>2</sub>, SO<sub>2</sub>, NO had been increased from 3,23,474.85 Gg to 4,98,655.78 Gg, 2,519.93 Gg to 3,840.44, 1,502.07 Gg to 2,314.95 Gg during the years 2001 to 2010 respectively. The emission per unit of electricity are estimated to be in the range of 0.91 to 0.95 kg per KWh for CO<sub>2</sub>, 6.94 to 7.20 grams per KWh for so<sub>2</sub>, 4.22 to 4.38 grams per KWh for NO. The future reserves of COAL is expected to end by 2088, GAS by 2060, OIL by 2052, depletion of fossil fuels will through mankind into dark. Due to all these issues and due to disadvantages of fossil fuels has renewed the interest in enhancement of alternative energy resources. Renewable energy is energy that is collected from renewable sources, which are naturally replenished, and which is inexhaustible. Some of the renewable energy sources are sunlight, rain, geothermal, tides, wind, water, bio energy, fuel cells, magneto hydro generation, piezoelectricity, urine. Enhancing renewable energy deployment is one of the solution to reduce GHG emissions. The significance of renewable energy sources comes together with climate change challenges associated with more usage of fossil fuel[5-6-12]. The advantage with renewable energy is that it is sustainable and is infinite, requires less maintenance than traditional one, less cost of operation, it produces very little or no waste products, has minimal impact on the environment, it can be operated on centralized and decentralized mode[13-15]. Environmental effects, externalities costs, finance, and economics each one these variables have a major impact on the application of renewable energies. To have a reliable power supply, a thorough research must be done on different ecological imbalances.

This paper reviews about different types of renewable energy sources, statistics in India, comparison of different parameters among them.

## 1. Renewable energies:

Earth's climate is unambiguous due to emissions[16]. To suppress the harmful effects, renewable energy provides mitigation measures. They include Solar, Wind, magneto-hydro generation, fuel cells, Hydro, bio energy, geothermal, tidal energy, biogas. Although, the installation cost may be high, they are effective than non-renewable sources on payback time consideration and leaves very little or no pollution.

### 1.1 Solar energy:

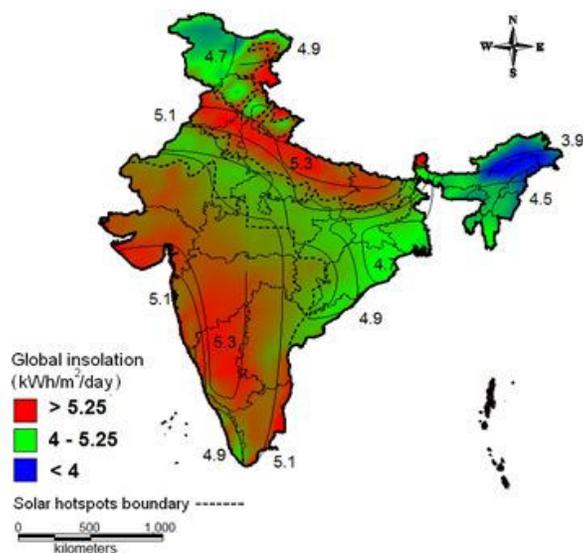
Earth's upper atmosphere receives 174 peta watts of solar radiation. sunlight is the main cause of production of fossilfuels. solar power unlimited hence it can meet the

demands of present modernized global, one of the most sustainable and reliable source which is free of cost[7].

It all began with invention of photo diode which converts light energy to electrical energy. Solar panels are made up of multitudinous of photo voltaic cells (PV CELLS). They are sandwiched with materials consisting higher number of electrons which ends up the upper part and lower part is sandwiched which lower of electrons dominating with positive charge. phosphorous is the upper material and boron is the lower material and silicon holds them together. Whenever radiation from sun hits the PV cells, it knocks off the excess electrons in the phosphorous layer. At the juncture point the kicked-out electron generates electricity at the silicon field. Due to imbalance of electrons between phosphorous and boron there is a prevailing electric field. The electron which is driven out from them drives the electricity through the juncture. The produced electricity is DC and is transformed to AC by inverters.

Despite advances in innovation, solar panels are the most expensive. The prices of silicon were dropping over past decade. As of December 2017, solar power had capacity of generating 17.05 GW electricity in India. Installed solar power reached 20,000 MW comprising solar parks and roof top solar panels, having a capacity of 1000 MW in Kurnool.

India became first to have larger solar park. By the year 2022, India is ambitious to generate 100 GW of electricity through solar.



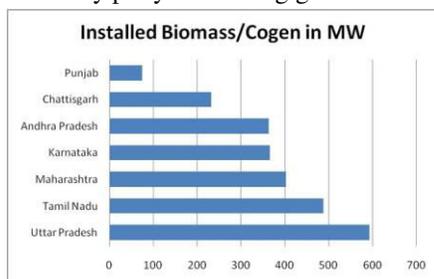
The above figure shows global insolation in different provinces in India.

## 1.2 Bio energy:

Dependency on non-renewable sources can be minimized to greater extent by using bio energy. Bio energy includes food crops, woody plants, forest debris, scrap lumber, waste residues, grassy plants, oil-rich algae, and organic component of industrial and municipal wastes[8]. It is carbon neutral electricity generated from organic waste which is renewable Bio energy comprises of bio-diesel, bio-gas ,bio-ethanol ,bio-mass, bio-pellets, bio-oil..

### 1.2(a) Biomass-energy

When burnt, the energy is discharge as heat which helps to generate steam that runs a turbine to make electricity[14]. Pollution control board has declared that emissions from burning bio energy are generally less than emissions from fossil fuels. The extended advantage of bio energy is that it's capability to convert into chemicals, fuels, products like crude-oil. Indian government is targeting a jatropa plantation area of 11.2 million hectors. The current availability of bio energy in India is estimated at about 500 million metric tons per year. 55 million tones municipal solid waste and 38 billion liters of sewage are generated. India has potential to generate 16881 MW electricity. Currently, more than 500 million units of electricity per year is being generated.



This graph shows installed biomass plants in India

### 1.2(b) Bio-diesel

Transesterification is the process used to derive bio diesel by fats or oils . The peculiar quality of bio-diesel is that it is not a petroleum product. It is a part of bio-fuels . An alcohol ester that procure physical properties homogenous to petro-chemical based diesel fuel is produced by reacting animal fats or vegetable oils catalytically with a small chain aliphatic alcohol ,generally ethanol or methanol. The produced bio-diesel is used in diesel engines. India holds 82.5 kVA , 100kVA, 140kVA diesel generators.

## 1.3 Geothermal energy:

With radioactive decay of elements such as potassium and uranium harnessing energy from geothermal turns out to

be the renewable, reliable, less emissive, sustainable and abundant energy source. This involves trapping of heat from core of earth and converting into electricity as earth's mantle is made up of very hot magma surrounding a solid iron center it produces tremendous amount of heat. Most of the electricity is generated by using hydro thermal source consisting water and heat as main ingredients. Almost everywhere deep down the ground earth surface maintain temperature between 50-60 degrees F .The three types of geothermal power plants are dry steam, flash steam, binary cycle. They use steam generated from hot water reservoirs found below the earth's surface. India has potential to produce 10,600 MW of power.



The figure shows geographical distribution of geothermal energy in different provinces.

## 1.4 Hydro energy:

Hydro power occupies a decisive position in renewable energy sources. It is the inevitable choice to optimize country's resource structure by leaping from fossil fuels to renewable sources. Hydro power plants procure energy from water having high currents. Water comprises of kinetic and potential energies. These energies help to drive the turbine and generate electricity[9-10]. Most widely used form of renewable energy. India is the 7<sup>th</sup> largest producer of hydroelectric power. Its capacity was 44,594 MW contributing 13.5% of its total utility power generation capacity. The estimated potential is 84,000 MW. 122.31TW was generated in India during 2016-17. It contributes about 10% of total electricity generation in India.

## 1.5 Wind energy:

Natural form of energy ,wind is blessed with capability of creating electric power .Harnessing energy from wind is one of the easiest and cleanest form of generating electricity[11]. Wind turbine use competence of wind which they turn into electricity. The speed of wind make the blades of rotor to rotate which is between 10-25 turns

per minute. A generator transforms mechanical energy into electrical energy. A motor orientates the nacelle so that it's rotor is positioned facing into the wind. Most usually between 20-100 meter makes up each turbine equipped with 3 blades. 3 MW power can be generated by modern turbines which are designed for wind speeds between 14-90 km/h and are equipped with braking mechanism to minimize wear and tear of turbines.

32,746 MW (as of 31<sup>st</sup> November 2017) wind power is installed capacity in India .In the year 2016-17 India added a record generation of 5,400 MW of wind power exceeding it's 4,000 MW target. At Paris climate summit in December India promised to generate 175 GW of renewable energy capacity by 2022 which includes 60,000 MW from wind .National offshore wind energy policy aiming to harness wind power along 76,000KM of India's coastline.

Urine which consists uric acid is a heterocyclic compound of carbon, nitrogen, oxygen and hydrogen with its chemical formula  $C_5H_4N_4O_3$ , urates and acid urates like ammonium acid urate. Copper in the presence of  $H_2O$  will be reacted with  $C_5H_4N_4O_3$ [17] . contacted with Zn. When Cu and Zn plates come in touch with  $C_5H_4N_4O_3$  electricity will be generated by the moment of electrons . Experimentally for 4 liters in 24 hours time 4.26V of voltage, 287 mA of current and 1.222 watts of power is generated .

This method is employed for generation of electricity in small scale.

## 1.6 Energy from urine

### COMPARISION:

Basis	Solar	Hydro	Wind	Geothermal	bio energy
1.Land requirement	High	Very high	High	low	Very high
2.Erection time	Low	Very high	Low	high	moderate
3.Pollution	No	No	No	No	little
4. Turnkey cost	Low	Very high	Low	High	Low
5.Operation cost	Very low	Low	Very low	Low	Very low
6.Energy souce	Inexhaustible	Inexhaustible	Inexhaustible	Limited places but inexhaustible	Based on availability of bio energy
7. Social risks	Low	High	Low	Low	Low
8.Efficiency(%)	40	80-85	45-50	12	85-90(cogeneration)
9. Qualification for work	Low	Moderate	Low	Moderate	Low
10.CO <sub>2</sub> emissions (kgCO <sub>2</sub> /KWh)	0.1	0.04	0.02	0.06	1.18
11.Installed capacity in India(MW)	17,050	44,594	32,720	3-5	5940.87

Table 2. Comparision of various criterion of solar,wind,geothermal,bio energy,hydro generation.

### Conclusion:

To bridge the gap between demand and supply keeping environment in concern due to tremendous increase in population,,uncontrollable usage of non-renewable sources affecting the global environment . Due to uncertain future of non-renewable resources and many other issues related to power can be resolved by advancing the current traditional method of generating power using fossil fuels by non-conventional, sustainable renewable energy sources which in turn gains the momentum for development of energy sector in country so that it can meet its growth aspirations.

Technologies like wind , solar, hydro, geothermal,bio energy must be implemented to make a country self-sustainable. This review is done in the overview hoping that it will encourage rapid and extensive research and development of renewable energy resources throughout the world.

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