

# A Review on Need of Adopting Renewable Energy in India

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**Abstract**— India became the world 3<sup>rd</sup> largest producer and 3<sup>rd</sup> largest consumer of electricity. The rapid increase in energy consumption in the present scenario and is moving fast towards the development of civilization.[1] Today we are dependent on fossil fuels to power our homes and to fuel our vehicles and mostly we are using the fossil fuels as a primarily heating medium. The huge consumption of fossil fuels has caused a severe damage to our environment and also these resources are limited and expensive but we are only seeing our convenience as we all know it very easy to use coal, oil & natural gas for meeting our requirements. To meet the crisis of energy in India it has been experienced to renewable sources like wind energy, geothermal energy, solar energy, tidal energy, bio-gas energy, etc. In this paper we have initiated to study about the renewable energy resources of the country. [4] In this research paper we have identified the utilization of renewable sources and their benefits to prevent our environment from the pollution created by the fossil fuels.

**Keywords**— Energy crisis, Fossil Fuels, Geothermal energy, Solar energy, Tidal energy, Wind energy.

## I. INTRODUCTION

In this era of competitiveness every country of this world wants to be in the forefront of developed countries by their intensive growth and generation of employment in its country. Due to the ecological disequilibrium caused by the rapid growth in industrial sector and also due to the growth in population the demand of energy has been increased which we can't be unhide & that results in the emission of immense amount of carbon. For a vast and highly populated country like India. We stand 6<sup>th</sup> in the entire world in phase of energy consumption & the dependency on single resources to meet the energy requirement of all the country is not a good idea. So India has to incorporate a non-carbon emitting resource which has become an integral part to maintain continuity and to decrease the burden on fossil fuels reserves. Also due to the huge consumption of fossil fuels it has created a lot of environment problems and which disturbs our ecological cycle.[3] So now its high time and we all have to focus on the generation of clean energy and the renewable energy has an potential for fulfilling the energy requirement of India but it is totally dependent on the effective generation and consumption of energy. In the present scenario Indian govt. is giving their full support to the renewable energy generation and soon we will be the work leader in terms of promoting and using of renewable energy. India is the largest consumer of fossil fuels like coal, petroleum, oil etc. This unmanageable growth in the usage of non-renewable energies like fossil fuels, natural gas, oil etc. has been led to an variation of demands & supplies of these fuels.[6] This will affect the uncertainty of future scope of non-renewable energies and this will results the nation to acquire the energy from other countries to attain the need of our country. So we have to adopt the culture of using renewable energy resources so that we can accelerate the enlargement of our energy sector in country and we can meet our requirements.

## II. RENEWABLE ENERGY RESOURCES IN INDIA

### 2.1 Hydropower

Hydropower is the most reliable and largest source of renewable power producing about 13.5 percent of the nation's electricity. India is the 7<sup>th</sup> largest producer of hydro electric power in the entire world. India hydroelectric power potential is estimated near about 1,48,700 MW. The hydro power plants basically convert the energy of flowing water into electricity. Basically kinetic energy of water is being converted to electrical energy. The most common sort of generating the electricity from hydro powerhouse uses a dam on a river to retain an outsized reservoir of water.[2] Water is than released through turbines in order that power are often generated.

However hydropower plants does not produce no air emissions but can affect the water quality and wildlife habitats. Therefore the designing of hydropower plants is now being changed so that we can minimize the impacts on the rivers. Some of the power plants are diverting some of the flow around their dams to imitate the natural flow. But while this we can improves the wildlife river habitat, but at the same time it reduces the power plant output. The hydro power plant are preferred to those place where there is heavy rainfall present such places are- Andhra Pradesh, Himachal Pradesh, Madhya Pradesh, Uttarakhand, Jammu & Kashmir, Maharashtra etc.[5][6]

## 2.2 Solar Power

Solar power in India is the fast developing industry. The country solar installed energy has been reached upto 34.404 GW till 29 feb 2020. The Indian government had an initial target of 20 GW capacities for 2022 which was achieved four years ahead of scheduled time period. In 2015 the target was raised to 100 GW of solar capacity by 2022, which also includes the 40GW of Roof top solar power plants, & targeting an investment of US\$100 billion. India has established nearly 42 solar parks to create land available to the promoters of solar plants.[7]

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 country added 3 GW of solar capacity in 2015–2016, 5 GW in 2016–2017 and over 10 GW in 2017–2018, with the common current price of solar electricity dropping to 18% below the common price of its coal-fired counterpart. By the tip of September 2019 India has installed quite 82,580 MW of renewable energy capacity with around 31,150 MW of capacity under various stages of installation. The main working of generating the solar power is that the heat energy which is released from the sun is being converted into electrical energy with the help of solar panels and then it will be transmitted to grid.[8]

The alternative energy is extremely beneficial for us as India is being situated between the tropic of cancer and therefore the equator, and having a median temperature of 25 degree Celsius – 27.5 degree Celsius and receives 260-300 clear sunny days each year. Major solar plants are located in Gujarat, Rajasthan, Orissa, Tamil Nadu.

## 2.3 Wind Energy

Wind energy is the most beneficial form of generating energies. From wind energy we can generate two forms of energies.

1. Electrical Energy
2. Mechanical Energy

Wind power generation capacity in India has significantly increased in recent years. As of 31st December 2019 the entire installed wind generation capacity of India was 37.505 GW, which is that the fourth largest installed wind generation capacity within the world. Wind generation capacity is especially spread across the Northern, Southern and Western regions.

Wind power costs in India are decreasing rapidly. The levelized tariff of wind generation reached a record low of ₹2.43 (3.4¢ US) per kWh, (without any direct or indirect subsidies) during auctions for wind projects in December 2017. Wind generation accounts for nearly 10% of India's total installed power generation capacity and generated 62.03 TWh within the twelvemonth 2018-19, which is sort of 4% of total electricity generation.[6]

## 2.4 Biomass Energy

Biomass energy is additionally referred to as Bio Energy. Bio energy means (Organic matter) like plants. If you have got burned wood in fire place or campfire you have got used bio energy. But we don't get all of our biomass resources from tress or the opposite plants. One third contributor of energy to India is biomass with a possible 80,467 MW. Which comprises of solid biomass, which is an organic & non fossil material of biological origins? Biogas is nothing but the assembly of methane and greenhouse emission with the assistance of anaerobic digestion of bio mass and then combusted to supply heat. After hydropower biomass is that the leading resource of renewable energy. As some utilities and power generating companies with coal powerhouse have found that replacing some coal with biomass may be a low cost choice to reduce unwanted emissions.

Also we can convert the biomass energy into gas with the help of a simple process called gasification. This gas can be burned and used in gas turbine and which is another way of generating electricity. [1]

Biomass may be converted directly into liquid fuels which are generally called as biofuels. As India is principally that specializes in producing biofuels, because biofuels are easy to move and possess high energy density. The foremost common biofuel is ethanol, an alcohol made of the fermentation of biomass which is high in carbohydrates. This largest source of ethanol is corn which we also call as sugarcane.

Another biofuel is biodiesel which might be made of vegetable and animal fats. Biodiesel will be used to fuel the vehicles or as a fuel additive to manage the emissions.

## 2.5 Geothermal Energy

Geothermal energy is that the heat from the world and it's a clean and sustainable. Heat is incredibly much cost effective and an environmental friendly thermal energy generated and stored inside the world surface. This can be an only energy resource that has not been exploited in any respect which is an unlimited power resource that's clean, reliable and residential grown. We are totally captivated with the usage of coal and due to this our environmental conditions are becoming worst & India soon will start exploring this source of energy. Because the heat has a potential of about 10,000 MW. Resources of heat range from the shallow ground to predicament and hot rock found some miles below the earth's surface and also are also down even deeper to the extremely high temperatures of molten rock called magma. This process takes place because of the slow decay of radioactive particles, the warm temperature produced inside the world and it happens inside all the rocks. Heat is thermal energy which is generated through the natural hot springs.

In India, by the time heat installed capacity is experimental; however the potential capacity is quite 10,000 MW.

Following are the six most promising heat power plants in India –

1. Tattapani in Chhattisgarh.
2. Puga in Jammu & Kashmir.
3. Cambay Graben in Gujarat.
4. Manikaran in Himachal Pradesh.
5. Surajkund in Jharkhand.
6. Chhumathang in Jammu & Kashmir

Corn ethanol and bio diesel provide only about 0.4% of total liquid fuels market. To increase our available supply of biofuels, researchers are testing crop residues like cornstalks and leaves, wood chips, waste food, & even trash as potential biofuel sources..

## 2.6 Nuclear Energy

Nuclear power is that the fifth largest source after the coal, hydro, gas & wind energy. As of March 2018 India has 22 nuclear reactors operational fewer than 7 atomic energy plants having the overall capacity of 6,780 MW. Atomic energy produced a complete of 35 TWh and supplied 3.22% of Indian electricity in 2017. 7 more reactors are under construction with a combined generation capacity of 4300 MW.

India's domestic uranium reserves are small and also the country relies on uranium imports to fuel its atomic energy industry.[6] As within the early 1990s Russia has been the foremost supplier of the fuel to India. Thanks to the shrinking in domestic uranium reserves, electricity generation from atomic energy plants in India has been declined to 12.83% from 2006 to 2008. After a waiver from the nuclear supplier group. (NSG) in September 2008 which allowed to commence the international nuclear trade. India has also signed the bilateral deals on civilian energy technology cooperation with several other countries including France, U. S., the UK, Canada & Asian country. India has also an uranium supplying agreement with Russia. Also an Indian private company has won a uranium exploration go for Niger. The working of nuclear energy plant is sort of interesting and is that the fastest way of generating a bulk amount of electricity.

As within the nuclear energy plant neutrons hit uranium atoms, splitting them. This split releases neutrons from the uranium that successively hit other atoms, causing a series reaction. This chain reaction is controlled with "control rods" that absorb neutrons. Within the core of nuclear reactors, the fission of uranium atoms releases energy that heats water to about 520 degrees Fahrenheit. This quandary is then accustomed spin turbines that are connected to generators, producing electricity.

## 2.7 Ocean Energy

There is an enormous potential of tidal and marine energy in India which might be produced from ocean. India features a long coastline of 7517 km which is marked along by numerous estuaries and gulfs which makes it more attractive for the event of marine energy projects. India's total wave potential is near about 40GW – 60 GW.

However compared with the developments in other renewable energy technologies, ocean energy technology like wave and tidal are in their nascent stage of development in India. Wave power depends upon the peak of the wave and its period. Primary estimates of wave energy potential along Indian coast is around 5-15 MW/m, therefore the theoretical estimated potential comes intent on be around 40-60 GW.[2] A study by IIT Madras and Credit Rating Information Services of Indian Ltd (CRISIL) have shown that western coast has higher wind generation potential compared to eastern coast.[3] they need identified potential locations for wave power development along the geographical region of India in Maharashtra, Goa, Karnataka and Kerala. Kanyakumari located at the southern tip of Indian peninsula has the very best power thanks to the results of refraction and powerful winds.[3] With currently available technologies, amount of power that may be generated using wave energy is way but the theoretical estimated potential.

Capacity Utilization factor for wave energy in India is within the range of 15-20%. For the tidal energy potential the most effective locations are the Gulf of Cambay and therefore the Gulf of Kachchh on the geographical region having the utmost tidal range of 8m-11m and having the common range of 5m to 7m. The Ganges Delta, Sunder Bans province is good for locating small scale tidal power plants. The tidal power potential in India is 8000-9000 MW within the gulf of cambay, 1200 MW within the gulf of Kachchh & but 100 MW within the sunder bans.

## III. REASONS FOR ADOPTING RENEWABLE ENERGY INSTEAD OF NON-RENEWABLE ENERGY

There are many reasons for adopting the culture of using renewable energy resources over the Non-Renewable energy resources. The explanations are listed below:-

- Renewable energy resources are ample in nature at free of cost while Non- renewable energy resources are restricted in nature and also they are present in nature in free of cost.
- There is no adverse effect of renewable source on environment but Non renewable energy sources creates a lot of pollution and is very harmful for our environment.
- A renewable source does not release any harmful gases in the environment while the other one emits the greenhouse gases in our environment.
- Renewable energy technologies use resources straight from the environment to come up with power. These energy sources include sunshine, wind, tides, and biomass, to call a number of the more popular options. Renewable resources won't run out, which cannot be said for several kinds of fuels – as we use fossil fuel resources, they'll be increasingly difficult to get, likely driving up both the price and environmental impact of extraction.
- The Non-renewable energies are not provided free of cost and also they are not distributed evenly in the world while the renewable resources are present in the nature in free of cost and also they are evenly distributed in the whole world.
- Renewable energy technologies required less maintenance rather than the non- renewable energy technology as they don't have any moving parts and also they don't rely on flammable, combustible fuel sources to operate.

- Renewable energy helps all people to save lots of money for the long run not only in maintenance but also on our budget items as they doesn't required to pay the number for the fuel.

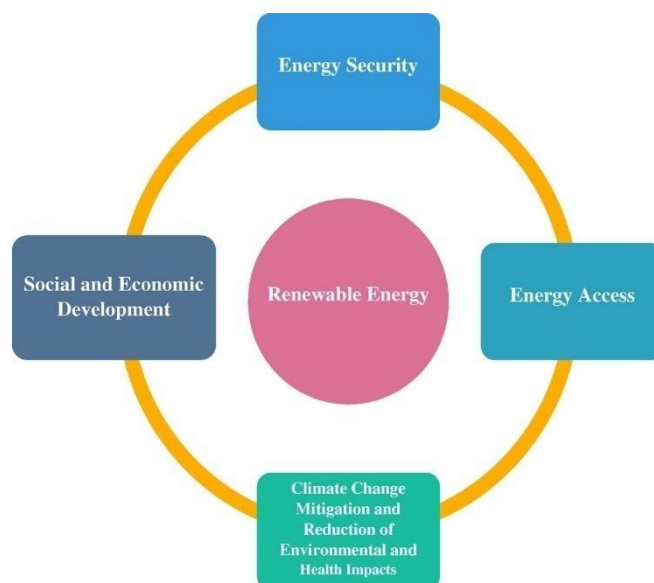
#### IV. ASSESSMENT OF RENEWABLE ENERGY BASED OF DIFFERENT CATEGORIES

**TABLE 1**  
**OVERALL ASSESSMENT OF RENEWABLE ENERGY OF INDIA**

| Category                     | Hydro         | Solar         | Wind          | Biomass                         | Geothermal                | Nuclear     | Ocean                      |
|------------------------------|---------------|---------------|---------------|---------------------------------|---------------------------|-------------|----------------------------|
| Efficiency (%)               | 85-90         | 15            | 35-45         | 20-25                           | 10                        | 33-37       | 3                          |
| Approx. Potential of India   | 148700        | 0             | 375050        | 80467                           | 10000                     | 0           | 49000                      |
| Area Requirement             | Very High     | High          | High          | Extremely High                  | Low                       | Very Low    | Very Low                   |
| Categories                   | Hydro         | Solar         | Wind          | Biomass                         | Geothermal                | Nuclear     | Ocean                      |
| Installed Capacity (MW)      | 45399         | 29549         | 36368         | 9806                            | 0                         | 6780        | 1                          |
| Cost                         | Very High     | Low           | Low           | Low                             | High                      | Low         | High                       |
| Risk                         | High          | Low           | Low           | Low                             | Low                       | Very High   | Low                        |
| Construction Time            | Vey High      | Less          | Less          | Average                         | High                      | High        | High                       |
| Waste Generation             | Nil           | Nil           | Nil           | Some waste                      | Nil                       | Toxic Gases | Nil                        |
| Operation & management costs | Low           | Very Low      | Very Low      | Very Low                        | Low                       | High        | Moderate                   |
| Carbon Di Oxide (kgco2/kwh)  | 0.04          | 0.1           | 0.02          | 1.18                            | 0.06                      | 0.025       | 0.02                       |
| Energy Sources               | Inexhaustible | Inexhaustible | Inexhaustible | Depends on Biomass Availability | Limited But Inexhaustible | Exhaustible | Variable But Inexhaustible |

## V. RENEWABLE ENERGY AND SUSTAINABLE DEVELOPMENT

We all know that renewable energy encompasses a direct relationship with sustainable development through its effect on the human development and economic productivity. Renewable energy resources provides the opportunities in energy security, social, and economic growth, energy crisis, and reduction in environmental and health effects.[4]



- 1) **Energy Security:** - the world energy security is usually used however there's no consensus on its precise interpretation. Energy security is predicated on the thought that there's continuous supply of energy. because the renewable energy source are distributed evenly round the globe as compared to fossil fuels and other non- renewable energy resources. The introduction of renewable resources may made contribution to increasing the reliability of energy sources, to be specific in areas which are often suffers from insufficient grid access.
- 2) **Social And Economic Development:-** Generally the energy sector has been taken as a key to the economic development having a powerful correlation between economic process and expansion of energy conversion. Globally per capita incomes are positively corelated with per capita energy use and economic process will be identified because the most essential factors behind increasing energy consumption. By a general survey in 2008 it's been proved that the use from renewable energy technology was about 2.3 million jobs across the globe wide which is able to also helps in improving health, education, gender, equality and environmental safety.[1]
- 3) **Energy Access:** The aim of the sustainable development is to confirm that the energy which is generating must be clean, affordable, available and accessible to any or all and this may only be achieved with renewable energy sources, since they're generally distributed across the world. Access concern have to be understood in an exceedingly local context and in most countries there's a difference between the energies within the urban and rural areas. [4]
- 4) **Climate Change Mitigation And Reduction Of Environmental & Health Impact:-** Renewable energy sources are utilized in energy generation and helps to scale back green house gases which mitigates in change of weather conditions, reduce environmental stress, and health complications which are related to pollutants from fossil fuels. The change in GHG emissions of India for 1980-2015.

The following policies recommendations emanating from the study that can help to mitigate climate change.

- All sectors and regions must invest in renewable energy technologies and policies.
- Reducing carbon foot print through the changes in life style
- More researches and innovations so that we can reduce the land size and makes the system more efficient.

## VI. RESULTS AND FINDINGS

Efficiency of the energy generation process intricate is highest in hydro power which is near about 85%-90% and least in the biomass and ocean energy.

Land requirement for biomass is extremely high in comparison to the other forms of energy however hydro power also needs the large land but less than the biomass.

In terms of installed capacity hydro power has the largest installed capacity in India.

The CO<sub>2</sub> generated is simply high for the biomass energy, & all other renewable energy involves the negligible or very less CO<sub>2</sub> emissions.

The overall project cost for the hydro & nuclear power plants are very high as they require high capital income to invest initially than the others.

Risk factor is very high in nuclear power plant which includes both the social and individual risk. As the nuclear power plant subjects to health fears due to its risky operation. That's why power generation from nuclear power plants are not been preferred so much in comparison to the wind, solar geothermal, etc.

However hydro power plants need a lot of construction time for installing a power plant. Geothermal, nuclear & ocean power plants are also needs time for construction but less than the hydro power plants. Solar & wind power plants needs a very less time for installation.

Waste generated are nearly negligible altogether the ability plants except the atomic energy where the highly radioactive wastes are produced and that they need a correct waste management plant for settling up the waste.

The operational and management cost is high for the nuclear power plant and these are very low for the solar, wind & biomass. However ocean power plant needs an moderate value of cost.

Energy source for wind, solar, geothermal and ocean are inexhaustible whereas for the biomass & nuclear energy it's exhaustible.

## VII. CONCLUSION

After viewing the present scenario of India, it has been cleared that the renewable sources are cost effective, user friendly and can easily beat the fossil fuels. Due to the inconsistency in energy distribution, renewable energy has the capability to become the foundation for fulfilling the country's future energy requirement. As these sources will remove the dependency of using the natural resources like coal, oil, gas etc. However there is also a great crash on the economic development of the country through the use of renewable energy as it can reduce the level of unemployment and give chance for improving our employment status. We all know thanks to our excessive growth within the population we face energy crisis as many parts of India are still surviving without electricity in their areas hence we are able to use the renewable energy as an panacea to the issues. But the growth of renewable energy sector is inhibiting due to the unavailability of capital. Future growth in renewable energy requires new technologies, favorable policies backed by innovative financing schemes. This paper is largely for all the stakeholders & government to require charge and discuss the program that favors renewable energy deployment. The Indian government should increase the financial backing within the sector of renewable energy in several styles of ways which incorporates the funds for demonstration projects. This is often only an summary which might help all people to encourage the utilization of renewable energy in a very more rapid & extensively way for the higher development of the country.

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