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Study on Current Renewable Energy Scenario in India

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ABSTRACT: ***Energy, as a strategic commodity, plays a critical role in every country's social and economic growth. Renewable energy sources have the potential to play a critical role in meeting energy demands. The majority of India's electricity is generated using traditional energy sources such as coal and mineral-based power plants, which contribute significantly to greenhouse gas emissions. Fossil fuels will become scarcer over the next several decades, resulting in energy shortages, rising energy costs, and energy insecurity. Increased usage of fossil fuels also harms the environment by emitting greenhouse gases. As a result, it is necessary to improve energy security while also lowering greenhouse gas emissions. As a result, capturing renewable energy has become a need in today's world. This study examines India's recent renewable energy situation. The current state of renewable energy, national renewable energy policies, and other difficulties and concerns are all covered in-depth in this article. This study helps to understand the Indian scenario of renewable energy as well as its important role.***

KEYWORDS: ***Energy, Geothermal, Renewable Energy, Solar, Wind.***

1. INTRODUCTION

India's economic prowess has begun to rise at an unprecedented rate in recent years. The reason for this is that India has become one of the most popular destinations for investors from industrialized countries. The massive inflow of FDI has resulted in more employment and improved quality of life. India is presently the world's fifth-biggest

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economy. In the recent decade, India has achieved great progress in the economic sector. In the recent decade, India has made significant investments in the renewable energy industry. Due to its geographical position, India presents an optimal and favorable climate for renewable energy(Eryuda 2017; Iyer et al. 2021; Kemenkes 2017). In the early 1980s, India became the first nation in the world to establish a ministry of non-conventional energy resources(Benedek, Sebestyén, and Bartók 2018; Eroğlu 2021; Lai et al. 2020; Saidi and Omri 2020). India is now implementing one of the world's biggest and most ambitious renewable capacity growth plans. India is one of the nations that produce the most energy from renewable sources. In January 2017, the government met its goal of installing 20 GW of solar electricity by 2021, four years ahead of schedule, thanks to both solar parks and rooftop solar panels. India has set a new goal of 100 GW of solar power generation by 2021. India is home to four of the top seven biggest solar plants in the world, including the world's second-largest solar park, with a capacity of 1000 MW, in Kurnool, Andhra Pradesh. By 2021, newer renewable energy sources are expected to rise dramatically, with India's wind power capacity expected to more than quadruple and solar power expected to almost triple from April 2015 levels(Brauns and Turek 2020; Harjanne and Korhonen 2019; Vera, Dufo-López, and Bernal-Agustín 2019; Zhu et al. 2020). India has set a goal of generating 40% of its total power from non-fossil fuel sources by 2021(Anand 2019; Goswami et al. 2020; Singh 2019; Stojkovikj et al. 2020).

1.1. Renewable Energy

Biomass energy, solar energy, wind energy, ocean energy, and geothermal energy are all examples of renewable energy sources. Renewable energy is energy that is derived from renewable resources. Renewable resources are those that may be utilized again since they are replaced naturally after a specific length of time. Due to population growth and economic development, the need for renewable resources is growing at an exponential rate. The depletion of non-renewable resources, as well as global warming-induced by overuse of non-renewable resources, are two important factors driving up demand for renewable resources. Nuclear energy reduces the need for nonrenewable

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resources such as fossil fuels, which are finite. In the future decade, it is expected that demand for renewable resources would skyrocket. Renewable resource usage on a big scale is expensive, and more study is required to make it cost-effective(Aboagye et al. 2021; Güney 2019; Shahbaz et al. 2020; Vakulchuk, Overland, and Scholten 2020).

1.2. Types of Renewable Resources

As a result, there are seven primary categories of renewable energy. And the advantages are that, depending on its geographical position and temperature, any nation in the globe may use at least one or two sources of renewable energy. Solar, geothermal, wind, ocean, hydropower, and biomass are the six primary kinds.

- Hydropower

Hydropower, also known as water power, is the conversion of water's potential energy into kinetic energy, which is then utilized to power turbines that generate hydroelectricity. In 2018, overall energy production was 26.7 PW, with hydropower facilities accounting for 16 percent of the amount. Hydropower is considered a renewable resource since the water cycle is an unending, continually recharging mechanism.

Hydroelectric power generating is sometimes seen as a mature or matured technology that is unlikely to improve further. However, there is still an opportunity for additional growth in small-scale hydropower, and with technical breakthroughs and the selection of highly favorable locations, the prices of small-scale hydropower plants may be significantly reduced.

Modern hydropower facilities are often chastised for their harmful environmental effect. Many people are displaced as a result of the land purchase and dam building, and there is a significant loss of flora and wildlife. This has a huge environmental impact. Displacement of indigenous local populations, sedimentation, changes in fish species, and worsening of water quality and human health standards are only a few of the most significant consequences. It is crucial to emphasize, however, that hydropower projects emit practically no greenhouse gases or air pollution.

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- Biomass

Biomass is a kind of fuel that is created from organic resources. It is a renewable energy source that may be utilized to generate electricity and a variety of other types of power. Biomass is divided into four categories:

- Woody Biomass
- Non-Woody Biomass
- Waste Processed
- Fuels

In most places of the globe, biomass resources are readily accessible. This has aided in boosting biomass energy's role. Biomass may contribute significantly to the world's energy requirements if advanced technology is applied. Although most biomass energy is now utilized in conventional methods such as domestic fuel, it is not always employed at a sustainable or industrial scale. Although, with the use of appropriate technology, biomass is becoming more financially feasible on a large scale in the current industrial world.

Biomass is used in a range of treatment methods since it is a complicated system with many alternatives. Biomass energy conversion may generate heat, power, and fuels, among other things. In household biomass-based heating systems, solid biomass is employed. Since the development of better stoves for cooking, biomass consumption has dropped in many developing nations. Gasification methods, which are still in the development phase, turn solid biomass into fuel gas. This technique produces gas that may be utilized to create energy and hydrogen. Biogas is produced via anaerobic digestion of biomass such as agricultural waste, manure, municipal trash, and plant waste, which results in the breakdown of organic materials. Biogas is widely produced in India from both plant and animal wastes. The energy provided by biogas may be utilized as a source of fuel or for warmth, such as cooking.

Biomass is a carbon-neutral energy source, making it a particularly appealing alternative. However, most of the best-suited energy crops demand more space and

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water than the food crop. Furthermore, pesticide usage influences water quality, which has an impact on plants and animals. As a consequence, using crop biomass removes nutrients from the soil.

- Solar Energy

The energy derived from the sun's solar radiation is referred to as solar energy. The sun emits more energy every day than the whole planet consumes in a year. Although just a little portion of the energy emitted by the sun reaches the planet, it is adequate to supply our energy requirements. Earth gets enough sun radiation per hour to meet its daily energy requirements. As a result, solar energy is classified as a renewable resource.

Solar energy is an extremely adaptable source of energy that may be used in a variety of ways. It can produce heat, power, light, and hydrogen, among other things. The amount to which solar energy is used is determined by a number several. The availability of low-cost and efficient technologies, as well as effective storage and end-use technologies, are among these considerations. Solar energy may be utilized in a variety of ways, including solar power, solar thermal heat, and photovoltaic power.

Solar energy solutions produce no carbon emissions when in use, however, they do produce carbon emissions during the production process. The reason for this is that toxic heavy metals, such as cadmium telluride, are used in the production of thin films in solar technology. This substance is also found in coal and oil, and it is emitted when they are burned. Solar energy needs a big space for energy collecting at the point of production. As a result, solar installations often conflict with present land usage and impair the area's nature. Soil compaction and erosion are caused by the building of solar systems over broad swaths of land. The cooling of the central tower system necessitates the use of water, which is a major problem in dry areas since an increase in water demand would put pressure on already scarce water supplies.

- Wind Energy

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The term "wind energy" refers to the power generated by the wind. The mean wind speed and frequency distribution of an area are two of the characteristics used to determine the amount of power that may be generated by wind turbines. It is believed that technological advancements would allow it to expand into new areas of growth.

While large-scale wind turbines are a mature technology, they may be located close to inside cities if there is a good mean wind speed and wind frequency dispersion.

However, small wind turbines are still being built near cities. One of the main reasons for this is that tiny turbine are less cost-effective than big turbines, and small turbines need more research to improve their efficiency and cost-effectiveness. Environmental and social concerns are often raised throughout the construction, manufacture, normal operation, and decommissioning stages of wind turbine installations. Acoustic noise emission, influence on bird behavior, shifting shadows generated by the rotors, aesthetic impact on the environment, and electromagnetic interference with television, radio, and radar signals are all highlighted as negative features of wind turbine utilization. In practice, wind turbine noise and visual effects are two of the most significant obstacles to the development of wind farms.

- Geothermal

The heat from the sun is referred to as geothermal energy. It has tremendous theoretical potential, but only a tiny portion of it can be categorized as reserves and resources in practice. The use of geothermal energy is widespread. Geothermal future contribution to the global energy sector will be determined by its technical capability, not its quantity. Low-temperature fields may be found in almost every country, while high-temperature fields required for traditional power generation are mostly found in locations with recent seismic, volcanic, and magnetic activity. There are several sites where geothermal energy might be exploited to supply additional electricity in the future. There is considerable potential for locating and exploiting submarine geothermal resources. One of the most promising possibilities shortly is the development of hot dry rock, along with improved drilling techniques. Some subsurface

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reservoirs hold brine with very high temperature and pressure, with water temperatures exceeding 375 degrees Celsius and pressures exceeding 220 bars.

The water is in a supercritical state under these circumstances. If supercritical steam could be recovered, it could supply ten times the energy that typical geothermal reservoirs give. However, the technology needed to collect and harness this kind of steam has yet to be created. There are two basic types of geothermal applications. The first is power generation. The second is direct geothermal energy applications, such as space heating and cooling, fish farming, manufacturing, and health spas. Direct use of geothermal energy has been demonstrated to be cost-effective, reliable, and environmentally acceptable all over the globe.

- Ocean energy

Tidal energy, wave energy, and ocean thermal energy is examples of diverse forms of ocean energy. The theoretical potential of all forms of ocean energies is relatively considerable, but ocean thermal energy has the largest potential. However, like other renewable energy sources, ocean energy resources are dispersed, making it challenging to employ.

The impact of a low-head hydropower system is created by the rise and fall of the tides. Watermills have been used to harness tidal energy for ages. Wave energy is still at the experimental stage, with just a few prototypes now producing the expected results. If the velocity of the sea currents is great enough, electricity may be generated. The numerous marine current energy turbines created typically overlap with those developed for wind turbines. Using certain technology, the natural temperature differential in the water might be the biggest source of renewable energy. Based on thermodynamic rules, the temperature difference should be as big as possible to create a technically practicable and relatively cost-effective system. Because ocean thermal energy conversion (OTEC) requires a temperature of about 20 degrees Celsius, this technique can only be used in tropical climates with deep water.

2. DISCUSSION

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2.1. Accommodation of Renewable resources in India:

Renewable energy resources must be accommodated to counteract exponentially expanding pollution while simultaneously meeting ever-increasing energy needs. India, fortunately, has a lot of renewable energy resources. Due to its geographical position, India presents an optimal and favorable climate for renewable energy. Now we'll look at and present examples of different renewable energy resource applications in India.

- Solar Thermal Power

Solar Thermal uses include space heating, cooking, water heating, and drying, among others. Solar Thermal Electric Power Plants are also capable of generating electricity. These plants create high-pressure steam by collecting the sun's energy at high temperatures. This steam is then utilized to create power in conventional generators. Photovoltaic cells, for example, might be used to directly convert the sun's energy to electricity. India is the world leader in solar power generation per watt, providing a solid foundation for the growth of this renewable energy resource.

Photovoltaic cells may be installed on roofs, avoiding the need for land. Grid-connected photovoltaic power systems have a total installed capacity of almost 4101.68 MW as of 2015.

- Hydro-electricity

India is rated sixth in the world in terms of hydroelectric power output. This gives this renewable energy resource a solid foundation and a lot of room to develop. This is India's most abundant renewable energy source.

The installed capacity is now about 40,661.41 megawatts (MW), accounting for 16.36% of India's total energy output. India's hydro potential is enormous; at 60% load factor, it is roughly 84,000 MW, and it can be economically utilized. Around 49 big hydropower facilities are now under development, with a total cumulative capacity of 15,006 MW, and are expected to be finished by 2021. There is also the possibility of 6,740 MW of installed capacity from mini, tiny, and micro hydel systems. Pumped storage projects with a total installed capacity of 94,000 MW are also evaluated. Pumped storage

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facilities may be beneficial for meeting peak load needs as well as storing excess power that can be utilized to generate electricity at no cost when rivers flood.

- Wind Power

The extractable power from wind is proportional to the cube of its velocity in theory, and energy output is also dependent on the turbine's rotor size and wind speed At an 80m hub height, the projected potential energy resources (wind-based) are 102,788 MW. As of March 30th, 2015, India's installed wind-generated electricity capacity was 22,645 MW.

2.2. *In Renewable Energy, the Leading Role Player*

India is leading the International Renewable Community and was a driving force behind the founding of the International Solar Alliance (ISA), an international organization comprising 121 nations located between the Tropics of Cancer and Capricorn. Within one year of the Framework Agreement's availability for signing, 47 nations had signed it and 18 had ratified it. As a result, on December 6, 2017, ISA became a legal organization with its headquarters in India.

3. CONCLUSION

To reduce dependence on decreasing fossil fuel supplies and combat climate change, a shift from petroleum-based energy systems to renewable resources is urgently needed. As India emerges as a leader in the burgeoning green economy, investors perceive a big opportunity. Renewable energy has the potential to provide a large number of jobs at all levels, particularly in rural regions. India is a developing country classified as an "emerging economy" by the World Bank. The renewable energy industry is predicted to increase dramatically as more emphasis is placed on renewable initiatives. National Solar Mission, National Mission for Energy Efficiency, National Mission for Sustainable Habitat, and National Water Mission are just a few of the programs that have been effective in promoting renewable energy technology throughout the nation. Renewable energy has had a tremendous impact on India's energy landscape. With a greater

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emphasis on renewable energy, India will undoubtedly become the global leader in this field.

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