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India's Renewable Energy Resources and Their Potential

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ABSTRACT: Economic growth, energy security, greater access to energy, or mitigating climate change caused by global warming are all reasons for India to deploy renewable resources. India has become one of the most promising opportunities for renewable energy due to strong government regulations and an improving economy. The Indian government has devised several frameworks and regulations to encourage foreign investment in the country's renewable energy sector. This article seems to showcase India's key achievements as well as future possibilities and predictions for renewable resources. In this paper, the author talks about Renewable Energy Resources and their Potential. India's energy system has a lot of room for development. Renewable energy now accounts for just 0.37 percent of the primary commercial power generation, with fossil fuels accounting for 96.8% but also hydro as well as nuclear resources accounting for 2.77 percent.

KEYWORDS: India, Policies, Renewable Resources, Renewable Energy.

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 foreign direct investment (FDI) has resulted in more employment and improved quality of life. India is presently the world's fifth-biggest economy. In the recent decade, India has achieved great progress in the economic sector (Kumar & Jain, 2021). In the recent decade, India has made significant investments in the

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renewable energy industry. Due to its geographical position, India presents an optimal and favorable climate for renewable energy (Khan & Dwivedi, 2018).

1.1. Renewable Energy:

Renewable energy sources relate to biomass energy, wind energy, solar energy, ocean energy, or geothermal energy. Renewable energy is energy that is derived from renewable sources. Renewable resources are those that may be utilized again since they are replaced naturally after a specific length of time (Jun et al., 2021).

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 fossil fuel resources, 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 (Gola & Gupta, 2021).

1.2. Renewable Resource Types

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, wind, geothermal hydropower, ocean, and biomass are the six primary kinds (Yadav et al., 2021).

1.2.1. Hydroelectricity:

Hydropower, also referred to as water power, is the conversion of water's potential energy is converted into kinetic, which would then be utilized to power turbines that generate hydroelectricity (N. Jain & Awasthi, 2019).

In 2018, overall energy production was 26.7 PW, with hydropower facilities accounting for 16 percent of the amount. Hydropower is called a renewable resource since the water cycle is an unending, continually recharging mechanism (R. K. Jain et al., 2012).

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1.2.2. Current Technological Situation:

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 (Gupta et al., 2021).

1.2.3. Social and environmental issues:

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, or worsening of water quality for human health is just a few of the most significant consequences. It is crucial to emphasize, however, that hydropower projects emit practically no greenhouse gases or air pollution (Singh & Khan, 2012).

1.2.4. 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. 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. Even though most biomass energy is now utilized in conventional methods such as domestic fuel, this may not be employed at a sustainable as well as industrial scale. Although, with the use of appropriate technology, biomass is becoming more financially feasible on a large scale in the current industrial world (Meza et al., 2021).

1.3. The state of technology:

Biomass is used in a range of treatment methods since it is a complicated system with many alternatives. Biomass energy conversions may generate heat, power, or fuels, among other things. In household biomass-based heating systems, solid

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biomass is employed. Since the development of better stoves for cooking, biomass consumption has dropped in many developing nations. Gasification methods that are still in the development process 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 including agricultural residues, manure, municipal trash, or 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 (Van et al., 2020).

1.3.1. Environmental and social issues:

Biomass is a carbon-neutral source of energy, making it a particularly appealing alternative. However, most of the finest energy crops demand more space and water than the food crop. Moreover, pesticide usage influences water quality, it affects plants or animals. As a consequence, the usage of plantation biomass removes nutrients in the soil (Vakulchuk et al., 2020).

1.4. Solar Power:

The energy derived from the sun's solar irradiance 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 sustainable material (Güney, 2019).

1.5. The state of technology:

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 several variables. Access to low or efficient technologies, as well as an effective storage or end-use technologies, are among these considerations. Solar energy may be utilized in a variety of ways, including solar power, solar thermal heat, including photovoltaic power (Aboagye et al., 2021).

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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, including cadmium telluride, are used in the production of thin films in solar technology. This substance is also found in coal or oil, so 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, as well as erosion, is caused by the building of solar systems over broad swaths of land. The cooling of both the central towers system necessitates its use of water, which is a major problem in dry areas since an increased water demand would put pressure on already scarce water supplies (Levenda et al., 2021). Additionally, there is a potential for chemical spillage from plants, which might lead to groundwater pollution. Solar panel recycling is also a problem since there are few solar panel recyclers across the globe. Solar panel recycling is very essential since numerous valuable metals are utilized within the solar panels. These valuable recyclable metals are going to be wasted due to a lack of resources and infrastructure necessary to recover solar panels, which might lead to a shortage of these metals in the future.

1.5.1. Wind Power:

The term "wind energy" refers to the power generated by the wind. The mean wind speed but also frequency dispersion of a region is two of the parameters used to calculate the amount of electricity that could be generated by wind turbines. It is believed that technological advancements would allow it to expand into new areas of growth.

1.6. Current Technological Situation:

Although large-scale wind turbines are a mature technology, they may be located close to or inside cities if there is a good mean airspeed or wind frequency dispersion. However, small wind turbines are still being built near cities. One of the main reasons for this is because tiny turbines have become less cost-effective than big turbines, so small turbines need more research to improve their efficiency and finances (Burke & Stephens, 2018).

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1.6.1. Social and environmental problems:

Environmental and social concerns are often raised throughout the construction, manufacture, normal operation, or decommissioning stages of wind turbine installations. Acoustic noise emission, influence on bird behavior, shifting shadows generated by the rotors, aesthetic impact on the environment, including electromagnetic fields with television, radio, or 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 challenges in the development of wind farms.

Geothermal fluids include a range of gases, mostly nitrogen or carbon dioxide, with minor amounts of hydrogen sulfide or Mercure, ammonia, radon, and boron. The existing gas concentrations are not hazardous. The gas released by low-temperature thermal facilities is typically a fraction of both the gas emitted by elevated resources, which are commonly employed to generate power.

1.7. Ocean power:

Tidal energy, wave power, or ocean thermal energy is examples of diverse forms of ocean energy. The theories generally of all forms of ocean resources are relatively considerable, but ocean heat energy has the largest potential. Nevertheless, like some other renewable energy, marine energy resources are dispersed, making them challenging to employ.

1.7.1. Social or environmental concerns:

Marine technology has a low influence on the environment. Few facilities pollute the environment while they are in use. The tidal barrage is the exception since it has an impact on marine life. The construction of a big artificial sea-water lake behind it hurts fish reproduction and marine biodiversity. Another example is ocean wave energy conversion, which might result in carbon dioxide being released from saltwater into the atmosphere. Hardly any of the technologies we've explored so far seem to pose a significant risk to fish or aquatic habitats.

1.8. Solar Thermal Power:

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

1.8.1. Hydroelectric Power:

India is rated sixth worldwide in terms of hydroelectric output. This gives this renewable power resource a solid foundation or a lot of room to develop. This is India's most abundant renewable source. Pumped storage facilities may be beneficial for managing peak load needs as well as storing excess power that can be utilized to generate electricity at no cost when rivers flood.

1.8.2. Energy from Biomass:

70 percent of the country's population presently relies on biomass for their energy requirements. It's abundant, renewable, as well as devoid of greenhouse or other damaging gases. Forest or agricultural resources, including such plants and animals dung, make up the majority of biomass. To create energy, burning biomass is one possible approach. Biomass may be converted indirectly to a variety of biofuels, including methanol or ethanol, and then utilized in engines. Biogas, a kind of gaseous fuel, may also be produced via anaerobic fermentation from biomass. To supply electricity to the grid, the government has erected 288 biomass power plants but also cogeneration facilities with an installed output of 2,665 MW.

2. DISCUSSION

Electric power production is the most significant use for emerging alternative energy renewable sources such as wind, micro-hydel, solar, biomass, or trash. Renewable energy, also known as clean energy, is obtained from natural sources or procedures that are renewed regularly. Sunlight or winds, for example, continue to shine and blow even though their availability is dependent on time or weather. As

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a result, renewables are gradually substituting "dirty" fossil fuels in the electricity industry, resulting in fewer carbon and other forms of pollution emissions. However, not all "renewable" energy sources are favorable to the ecology. When considering the influence on wildlife, global warming, or other concerns, biomass, and huge hydropower dams provide tough decisions. Here's everything you need to know about the many sorts of renewable energy sources and how you may incorporate them into your own house. India's power demand is growing at a rapid pace, and the country's power production capacity is limited. As a result, India has been pursuing research, development, production, but also demonstrating zeal for the past three decades to find a solution to the country's perennial power shortage. India has gained access to several renewable energy technologies that may be employed in a variety of industries. With a large client base and a rising gap between producers and consumers, there are many chances with favorable geology as well as geography. This paper provides an overview of the potential renewable resources in the Indian context, evaluating the current situation, the country's energy demand, and projected consumption or production, intending to determine whether India can maintain its growth as well as a society using renewable resources.

3. CONCLUSION

Renewable energy is flourishing, thanks to technological advancements that are lowering prices and delivering on the promises of such a cleaner future. Solar and wind energy in the United States is smashing records and is being incorporated into the national electrical system without jeopardizing dependability. A renewable energy revolution is being fueled by wind and solar power. Here's all you need should know about renewable energy as well as how you can get involved at home. This article appears to highlight India's major successes as well as future renewable resource prospects and forecasts. The author of this article discusses renewable sources of energy as well as their potential. The energy system in India has a lot of opportunities for improvement. Renewable energy today makes up just 0.37 percent of main commercial power production, with fossil fuels contributing 96.8% and hydro and nuclear power contributing 2.77 percent.

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