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# Renewable energy as a key factor for sustainable development in India

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***Abstract*---**Renewable power (wind, solar, geothermal & tidal power) is an unlimited source of energy that is generated by continuous regeneration. Renewable energy is distinguished by the fact that it may be obtained without causing environmental harm. Renewable resources have been discovered to have the capacity to provide answers to mankind's environmental challenges. India is the world's most populated nation, with higher energy consumption. Renewable power is one of the most important possibilities for obtaining this level of quality. Renewable energy now accounts for 37% of India's total energy consumption. Efforts have been taken in this article to highlight our country's existing and future renewable energy targets, as well as problems.

***Keywords*---**wind, solar, geothermal, tidal power.

## Introduction

The study of renewable power piques the attention of many scientific schools, economists, & most importantly, stakeholders who stand to gain from the usage of renewable energy technology all over the world. (A. Elamri et.2020, A. El Amri et.2020, M. Smith 2018, D. Bhowmik 2019, O. Lyulyov et. al 2021, D.T.A. Marcel 2019. I. Didenko 2021) .The notion of the movement of scientific interests from

energy fuels and environmental sciences ecological to other disciplines may be established using resource restrictions, sustainable energy, biomass, and CO2 emissions. Renewable energy's function and place in business economics, mechanical engineering, science technology, and computer science is making inroads (Y. Samusevych et.al 2021, S. Furmaniak, et. Al 2018, He, Shuquan. 2019, V. Pavlyk 2020, V. Panchenko et. Al 2020, Ya. Us, T. Pimonenko 2020, R. Miskiewicz 2020, R. Miskiewicz, 2018,Y. Kharazishvili et. Al 2020, H.Dzwigoł et al 2019).

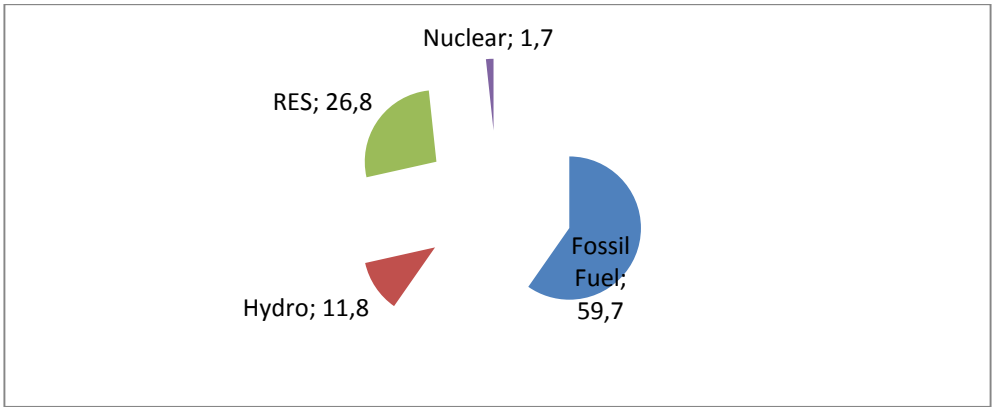
On our planet, energy comes in a variety of ways. Some of them may be utilised right away, while others need some kind of alteration. Energy is required for all developmental processes. The ultimate measure of a country's development is both energy output and consumption. Renewable power sources are becoming more important in terms of both the environment and the economy in all nations. Energy consumption is rising in every industry nowadays. Energy is, in reality, the most fundamental need for economic, social, and cultural progress. Living, creating, and consuming in a way that satisfies the needs of the present generation without jeopardising future generations' capacity to satisfy their own needs is a wide definition of sustainable development. It has become a major policy guiding idea in the twenty-first century. Renewable energies are a cost-effective and strategic way to achieve sustainable development while also responding to climate change and meeting energy demand (Yuksel 2008). It is a viable option for clean energy systems, thanks to the fast implementation of renewable energy technology. Using renewable energy sources can also help to mitigate the -ve effects of fossil fuel usage on the environment. (Renewables 2017 Global Status Report). As well as to combat climate change. (B. Wang et. al 2014). Renewable energy is also an effective instrument for assisting countries in their efforts to become energy self-sufficient. (B. Wang et. al 2018).

The uses of renewable power have a good impact on economic operations. (Shafiei and Salim 2014, Bhattachary et 2016, Paramati et 2018, and Rahman and Velayutham 2020). And they play an important role in raising the standard of living and economic development for any nation. In G7 countries, both renewable and fossil energy usage may have a favorable influence on economic growth. (Tugcu et al. 2012). As observed China’s economic growth is being aided by the use of renewable power. (Lin B et. al.2014). India's economic growth and financial development are also aided by the use of renewable energy as found using the Dynamic Ordinary Least Squares method. These findings were backed up by the reality that renewable power can totally replace fossil energy usage while also promoting economic growth.

It is one of the sources of power that is both cleaner and more dependable (Chr.Von Zabeltitz 1994). According to World Energy Council, 2013 Close to 73 percent of the energy requirement is generated by coal and oil, It is predicted that world electricity demand will be highest in 2030. According to the United Nations Environment Program (UNEP), Emission gaps report 2021 total GHG emissions are dominated by fossil CO2 emissions. There seems to be a necessity to develop new methods for producing power & only one of the resources RE is available at present. RE programs are thought to improve the quality of life of people in a variety of ways, including social, economic, and technical development. (H. Katuwal et.al 2009, A.

Sapkota et.al 2013). They provide a long-term solution to address the energy needs of a rising population (Irfan et.al 2019b).

Different RE sources minimize air pollution and greenhouse gas emissions while also enhancing people's health (Rehman et 2020, Irfan 2019). RE penetration generates jobs for the people and benefits the economy (Ram et.al 2020). As a result, India is anticipating renewable energy and technology. Energy is often recognized as the most important aspect of any country's long-term growth. After China, India is the world's 2nd largest nation in terms of population. Day-by-day energy Requirements for Lighting, heating, communications, computers, industrial equipment, transportation, and other uses of energy are critical in all economies. India ranks third in the world in terms of energy consumption, after China and the United States. India's per capita energy usage is 37% higher than the global average. The majority of India's energy system is centered on coal for power production and oil for transportation and industries. According to the Central Electricity Authority of India 2021 power generation share depends on different sources. (Fig.1).




Because of the negative environmental consequences of burning fossil fuels, present patterns of consumption are unsustainable in the long run. CO2 emissions from the burning of fossil fuels, in particular, have greatly increased CO2 concentrations in the atmosphere, enhancing the greenhouse effects and causing considerable climate change. Renewable energy provides an opportunity for our world to minimise carbon emissions. Renewable energy is the best source of sustainable development goals.

**Renewable Energy in India**

India remained in third place in 2021. Over the last several years, installed renewable power generating capacity has risen at a rapid rate. In its Nationally Determined Contributions (NDC) under the Paris Agreement for the period 2021-30, India committed to achieving the following goals:

- Reduce the carbon intensity of its Gross domestic product by 33-35% & from 2005 levels by 2030,

- Generate 40% of power from non-fossil, fuel-based power resources (by 2030) through leveraging technology and enabling low-cost international funding.

India is the only nation in the world that has developed renewable energy, with the Govt of the Ministry of New and Renewable Energy launching one of the world's biggest renewable power initiatives. Despite advancements in renewable energy adoption, it will not be enough to meet the Sustainable Development Goals 7 deadline. This is due to the fact that the use of fossil fuels contributes to climate change.

**India's current Sustainable Energy Status**

The Indian government has set a goal of adding 175 Giggawatt of renewable power capacity by 2022, with 100 GiggaWatt coming from solar, 60 GiggaWatt from wind, and 10 GiggaWatt from bio-power, and 5 GiggaWatt from small hydro-power. India has overtaken Italy to become the world's fifth-biggest solar power deployment nation in 2022. Solar power capacity has increased sixfold in the last five years from 6.7 GiggaWatt in Dec 2016 to 40 GiggaWatt in March 2021. Karnataka in India on 1st position producing solar energy 7355MW. Wind power had a potential of 20,000 MW (20 GW) in 1995, solar energy had a potential of 5 1015 kWh/pa, biofuel had a potential of 17,000 MiggaWatt, bagasse cogeneration had a potential of 8000 MiggaWatt, and small hydropower had a potential of 10,000 MiggaWatt. In 2006, the renewable energy potential was predicted to be 85,000 MiggaWatt, with wind power accounting for 4500 MiggaWatt, solar power for 35 MiggaWatt, and biomass/bioenergy for 25,000 MiggaWatt, and small hydropower accounting for 15,000 MiggaWatt. According to the Govt annual report of the Ministry of New and Renewable Energy (MNRE) for 2020–2021, Wind, solar, biomass, and small hydro, among other renewable energy sources, have a huge potential in India. India has a wind potential of more than 300 GiggaWatt at a hub height of 100 meters, a solar potential of 750 GiggaWatt provided 3 percent wasteland is made accessible, and a minor hydro potential of 20 GiggaWatt, and a bio-energy potential of 25 GiggaWatt, according to estimations. India now has a total installed renewable power capacity of 92.54 GiggaWatt, with 5.5 GiggaWatt being added between April 2020 and January 2021. India is a tropical nation that gets a lot of sunlight; thus, its solar potential is quite high. (40-42)

**India’s Future Target for Sustainable Energy Development**

To attain roughly 40 percent cumulative electric power installed capacity from non-fossil fuels-based energy resources by 2030, with the support of technology transfer. India is on track to meet these objectives. India has a total installed renewable power capacity of 92.54 GiggaWatt (excluding big hydro), of which 5.47 GiggaWatt was added between April 2020 and January 2021. Between April 2014 and January 2021, India's installed renewable energy capacity expanded by two-and-a-half times, while installed solar energy capacity was raised by 15 times. India is now ranked fourth in the world in terms of renewable energy capacity, 4th in wind power capacity, and 5th in solar power capacity.

Table 1
India Renewable power Sector in 2021

| Year | %Share of RE in Generation | % Share of RE in Total Installed capacity | Generation From RE Sources (in BU) | Total Generation from all RE sources (in BU) |
|---|---|---|---|---|
| | Up to Dec 2020 | Up to Dec 2021 | Up to Dec 2020 | Up to Dec 2020 |
| 2014-15 | 5.56 | 14.36 | 61.78 | 1110.18 |
| 2015-16 | 5.60 | 15.23 | 65.78 | 1172.98 |
| 2016-17 | 6.56 | 17.68 | 81.54 | 1241.38 |
| 2017-18 | 7.81 | 20.24 | 101.83 | 1303.37 |
| 2018-19 | 9.21 | 21.95 | 126.76 | 1375.96 |
| 2019-20 | 9.95 | 23.52 | 138.32 | 1390.93 |
| 2020-2021 | 11.00 | 24.53 | 111.92 | 1017.81 |

**Clean energy in India faces a number of issues**

- In the renewable power industry, there is no comprehensive regulatory structure. When some renewable energies need to expand, regulations that are incompatible with renewable energy development plans may be proclaimed.
- Institutes, agencies, and other stakeholders operating under the auspices of the Ministry of Natural Resources and Environment (MNRE) have poor inter-institutional interaction. Collaboration, coordination, and delays are all hindering progress in the generation of renewable energy sources. Investors are less interested in investing in this field as a result of the delays in implementing policies as a result of insufficient coordination among government agencies.
- Institutes, agencies, and other stakeholders under the Ministry of Natural Resources and Environment (MNRE) do not collaborate with one another. The absence of collaboration and coordination, as well as delays in the production of renewable energy, is limiting progress. Investment in this sector has declined as a result of the inability to execute policies on time owing to a lack of coordination among the many government agencies.
- To meet the necessity of developing the renewable sector, there are some financial obstacles, such as money allocation and budgets that are not issued on time.
- As a result of the right allocation of subsidies for traditional fossil fuels, the misleading impression is created that conventional fossil fuel power is more significant than renewable energy.
- Inconsistencies in the environment, natural catastrophes, planning, equipment failures, and profit loss all contribute to complicated risk problems that every renewable project installation faces.
- In the renewable energy business, there is a scarcity of adequately trained human resources. Furthermore, it is experiencing severe labor shortages.
- In metropolitan India, social acceptance of renewable energy is still lacking. The ability to utilize renewable energy in a consistent and widespread manner is dependent on public awareness. Society should be informed about renewable technology and its environmental advantages.

## Conclusion

The renewable energy industry faces significant challenges. Some are inherent in all renewable technologies, while others are the result of an unbalanced regulatory system and market. Energy security, economic prosperity, and environmental preservation are all necessary for a country's future generation to live in a cleaner, greener, and safer environment. India has recognized the need of recognizing and appreciating initiatives to improve sustainable development and promote renewable energy sources. Finally, renewable energy has significant long-term advantages. To close the gap between supply and demand, India has a lot of renewable energy potential. The most viable solutions for going forward are electric and hydrogen fuel-based automobiles. If this is accomplished, the clean energy sources' constraints will be readily overcome.

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