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Comprehensive Analysis on Renewable Energy Development

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Abstract: ***This paper analyses the current state of renewable energy and the expanding need for it. India, like many other nations, is experiencing a growth in the demand for renewable energy for a variety of factors. In India, the importance of renewable energy has grown significantly. This type of energy is produced from naturally replenishing resources including sunshine, wind, water, and biomass. India has a high possibility of dominating the global renewable energy market because it not only has a suitable climate but also a big surface area. A summary of the situation, advantages, and recent advancements in renewable energy has been made.***

Keywords: ***Renewable Energy Scenario, Rising Demand Energy, Impairments, and Advantage of Renewable Energy***

I. INTRODUCTION

In accordance with the Prime Minister's declaration at COP26, the Ministry of New and Renewable Energy is planning to install 500 GW of non-fossil energy capacity by 2030. Nationally, 172.72 GW of capacity sourced from non-fossil fuel sources will have been constructed as of October 31, 2022. This consists of 6.78 GW of nuclear power, 119.09 GW of renewable energy, and 46.85 GW of big hydropower. As of October 31, 2022, this represented 42.26% of the nation's total installed generation capacity, or 408.71 GW.

According to the REN21 Renewables 2022 Global Status Report, India ranks fourth globally for installed renewable energy capacity (including large hydro), fourth for wind power capacity, and fourth for solar power capacity. A total of 14.21 GW of Renewable Energy (RE) capacity was added between January and October 2022, compared to 11.9 GW added between January and October 2021. Overall, RE sources have generated 151.94 BU from January to September 2022, up from 128.95 BU from January to September 2021 [1]. In order to act as a nodal agency for the development of renewable energy sources, the Government of India established a separate Department of Non-Conventional Energy Sources in 1982 [2]. This department was later expanded into a separate Ministry in 1992 and given the name Ministry of New and Renewable Energy (MNRE) in 2006.

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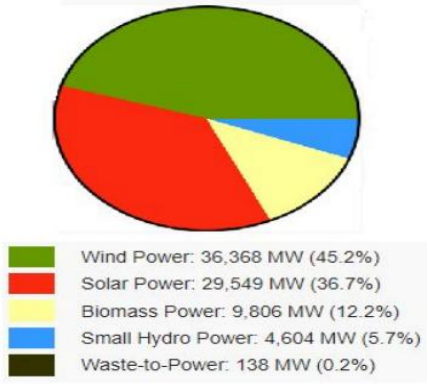
The National Institute of Solar Energy (NISE), National Institute of Wind Energy (NIWE), Sardar Swaran Singh National Institute of Bioenergy (SSS-NIBE), Solar Energy Corporation of India (SECI), and Indian Renewable Development Agency Ltd. (IREDA) are just a few of the independent organisations that support the Ministry. The following eight national missions were established as part of the government's 2008 "National Action Plan on Climate Change (NAPCC)" to support sustainable development, advance energy efficiency, and encourage the use of renewable energy sources: Solar mission, mission to improve energy efficiency, mission to promote sustainable habitat, mission to protect the Himalayan ecology, mission to promote a green India, mission to promote sustainable agriculture, and mission to promote strategic knowledge for combating climate change. Figure 1 depicts the installed capacity for renewable energy broken down by sector [3].

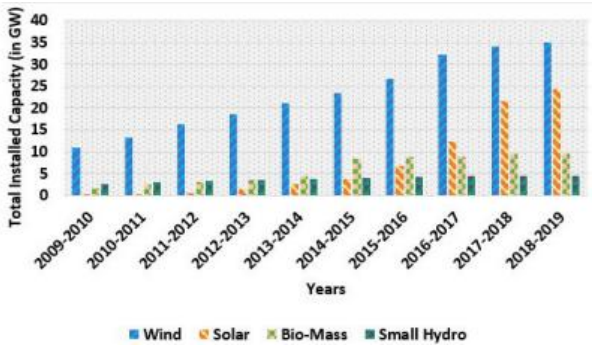


[Fig.1: Sector wise Breakup of Installed Capacity in Renewable Energy in MW] [3]

India will become one of the world's top producers of RE if this ambitious goal is met [4]. Figure 2 shows the installed RE capacity broken down by the kind of RE sources [5].

A. India has a Wealth of Undeveloped Renewable Energy Resources, Including as

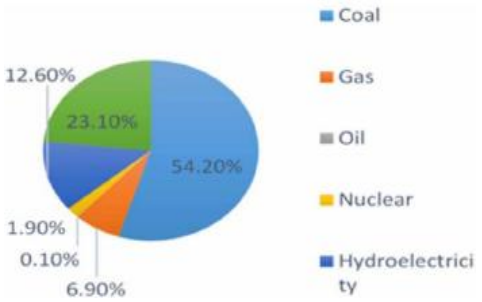
1. The enormous landmass has the ability to produce solar energy. Additionally, the majority of India's regions have high levels of solar exposure.
2. There are several zones and regions with high wind speeds, which can result in both offshore and on-land wind farms producing a large quantity of wind energy.
3. The respectable annual biomass production.
4. Additionally, India has a wealth of rivers and waterways that can generate a tiny amount of hydel power [6].



[Fig.2: RE Installed Capacity (in GW) of Various Sources in Recent Years] [5]

II. PRESENT SCENARIO OF ENERGY IN INDIA

If India cannot meet the rising energy demand, it would experience an energy catastrophe in the near future. This presents a significant problem and a source of concern for a developing nation like India. The fact that India consumes more energy per person than most other nations despite being the third-largest consumer of energy resources in the world behind the United States and the People's Republic of China is extremely remarkable.



[Fig.3: Major Energy Sources in India]

According to studies and data, India can end poverty and meet everyone's energy needs if its economy grows by 8% to 10% year until 2031–2022. India has to increase its capacity to produce power by three to four times and its primary energy supply by two to three times. In the 2019 Global Energy Transition Index, India came in at position 74 out of 115.

III. DEMAND FOR ENERGY IS RAPIDLY RISING

India is one of the nations that is developing the quickest in the globe, and as more things are built, there will be more need for things like electricity and other forms of energy. Numerous scenarios show that India only has two options for meeting its rising energy needs. The first is to continue to make energy savings across all sectors. In the second path, India must boost industrial growth while utilising a high percentage of renewable energy. In the first path, there is more use of fossil fuel and locking of the energy system into today's pattern - with an increased level of air pollution and uncertainties around meeting its sustainable target [7]. In India, the demand for energy will more than quadruple by 2030, while the need for electricity will treble [8]. India's population growth is the main obstacle to the nation's development and economic expansion. Due to its vast landmass and variable monsoon season, India has a tremendous potential for the production of renewable energy. India has a greater capacity for renewable energy than Germany, Japan, and several other wealthy nations, but its installed power generation capacity is still relatively modest. According to the International Renewable Energy Agency, India's energy demand has increased by 10% over the last ten years. Even though almost every hamlet in India now has electricity, millions of people still live in darkness. Around 200 million people in India still lack access to power for more than 12 hours, according to World Bank research. Less than 50% of homes have this access. A community is deemed electrified if 10% of its public structures and residences are wired into the grid. India imported some electricity from Bhutan in 2015 to meet its energy needs.

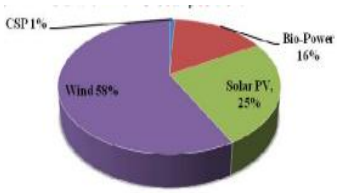
A. India Continues to Experience Rising Electricity Demand Due to the Following Factors

1. Low tariffs and the issue with coal distribution have kept private enterprises out of the market.
2. The under-recovery of fixed and variable expenses is still waiting and being postponed since banks are not giving working capital to the power sector.
3. The states of Uttar Pradesh, Andhra Pradesh, Tamil Nadu, Maharashtra, and Karnataka cannot pay all of their power bills.
4. Consumers who purchase electricity from non-government utilities must pay a fee from the state governments that is nearly twice as much as their regular electricity bills.
5. Power stations cannot buy coal because payments to railroads and coal businesses are made in advance.

India continues to experience severe energy poverty in spite of fast growth in adding electricity capacity. If the company carries on with the current energy resources and environmental regulations, fossil fuels will continue to outweigh renewable energy. Additionally, a sector of the economy might use coal more quickly than anticipated [9].

B. India's and the World's Stand on Renewable Energy

Since the last ten years, RE installations around the globe have continued to expand. Fig. 4 displays the capacity of solar PV, concentrated solar power (CSP), and wind power, with wind power having the biggest global share at 58%. Fig. 5 depicts the installed capacity of wind energy per country. In terms of installed RE capacity globally, wind power holds a lead of 370 GW. India holds the fifth-place position with 22.6 GW of capacity. Wind power continues to be the most popular renewable energy source in India right now, ranking fifth globally [10].



[Fig.4: Global Installed RE Capacity]

China is in first place with 114.6 GW of installed wind capacity. United States (US) follows in second place with 65.9 GW of

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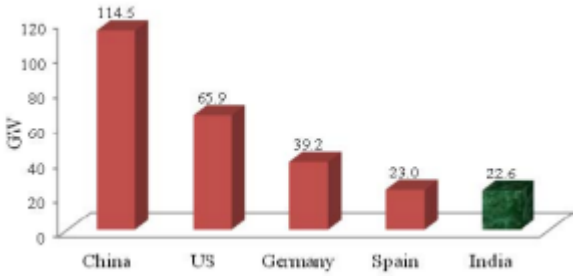
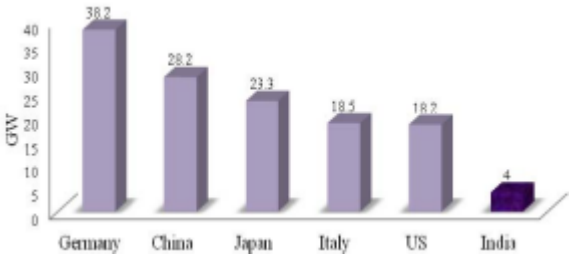
wind power capacity. According to Fig. 5, Germany and Spain are in third and fourth place globally for installed wind power capacity, respectively.



[Fig.5: Country wise Wind Installed Capacity]

For the global installed capacity of solar electricity [11]. One nation that has 38.2 GW of solar power capacity is Germany [12]. With 28.2 GW, 23.3 GW, 18.5 GW, and 18.2 GW of installed solar power capacity worldwide, China, Japan, Italy, and the US are in second, third, fourth, and fifth place, respectively [13]. India has increased its installed solar power capacity by more than 4 GW over the past five years, and as of the end of 2015, it ranked sixth, as shown in Fig. 6 [14].



[Fig.6: Major Country Solar Power Installed Capacity (GW)]

IV. IMPAIRMENTS OF NON-RENEWABLE ENERGY:

One major drawback of non-renewable energy sources, such as coal, oil, and natural gas, is that they are finite resources [15]. Once they are extracted and used, they cannot be replaced [16]. This means that eventually, they will run out, leading to an energy crisis [17]. The following are some impairments of non- renewable energy given below [18].

Finite Resource: Non-renewable energy sources, such as coal, oil, and natural gas, are finite resources. They cannot be replaced once they are extracted and used.

Energy Crisis: As non-renewable energy sources are depleted, there is a risk of an energy crisis. This means that we may not have enough energy to meet our needs in the future.

Environmental Impact: Extracting and using fossil fuels can have significant environmental impacts. These include air, water, and soil pollution, which can harm human health and ecosystems. Burning fossil fuels also releases greenhouse gases, such as carbon dioxide, which contribute to climate change.

Social and Economic Impacts: The extraction and transportation of non-renewable energy sources can also have negative social and economic impacts. These include the displacement of local communities, destruction of habitats, and dependence on foreign sources of energy.

Clean and Sustainable Alternative: In contrast, renewable energy sources, such as solar, wind, and hydro power, offer a cleaner and more sustainable alternative. They can be replenished and do not produce harmful emissions, making them a better long-term solution for meeting our energy needs.

V. ADVANTAGES OF RENEWABLE ENERGY

The following are some advantages of renewable energy; however, the following are the most significant advantages:

Climate Change Mitigation: India is highly vulnerable to the impacts of climate change, including rising temperatures, changing rainfall patterns, and increased frequency of extreme weather events. By transitioning to renewable energy sources, India can significantly reduce its greenhouse gas emissions, which contribute to climate change, and mitigate its impact on the environment.

Air Pollution Reduction: India faces severe air pollution issues, especially in its urban areas, resulting in detrimental effects on public health and the economy. Most of the air pollution is caused by burning fossil fuels for electricity generation, transportation, and industrial activities. Shifting towards renewable energy can help in reducing air pollution by eliminating or reducing emissions of harmful pollutants like particulate matter, sulfur dioxide, and nitrogen oxide.

Rural Electrification: Despite progress in recent years, a significant portion of India's population still lacks access to electricity, particularly in rural areas. Renewable energy, such as solar power, can provide decentralized and off-grid solutions for rural electrification, bringing electricity to remote and underserved communities, and improving their quality of life.

Economic Growth and Job Creation: The renewable energy sector has the potential to spur economic growth and create job opportunities in India. Investments in renewable energy infrastructure, manufacturing, installation, operation, and maintenance can generate employment opportunities across the value chain. Additionally, promoting renewable energy can attract investments and stimulate innovation, contributing to economic growth and development.

Sustainable Development Goals (SDGs): India is committed to achieving the United Nations' Sustainable Development Goals (SDGs), which include affordable and clean energy (SDG 7), climate action (SDG 13), and sustainable cities and communities (SDG 11). Emphasizing renewable energy is crucial for India to achieve these goals and ensure a sustainable and inclusive future for its citizens.

To meet the growing need for renewable energy, the Indian government has set ambitious targets for renewable energy capacity addition, implemented policy and regulatory measures to promote renewable energy investments, provided financial incentives, and facilitated technology transfer and skill development in the sector. However, addressing challenges such as the intermittency of renewable energy sources, grid integration, access to finance, and policy implementation remains critical for India's successful transition to a more sustainable energy future.

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VI. CONCLUSION

India has enormous potential for renewable energy sources, and over the past few years, the Indian government has made tremendous progress in this area. However, overall progress in the renewable sector has been noticeably slow because India hasn't yet been able to fully realise its potential. India's current and future energy plans heavily rely on renewable energy sources. If India follows its development goals, it will make progress towards its objectives of economic growth and the production of green energy, which will undoubtedly widen the window of opportunity for India's growth and development.

One of the most crucial industries for the growth of the human welfare and the economy of every country is energy. Although some nations have made significant financial investments in the energy sector, others, like India, continue struggle with energy shortages. Fossil fuels alone cannot meet India's rising energy needs; instead, the country must concentrate on a clean and efficient source of energy, such as natural gas and renewable energy.

DECLARATION STATEMENT

After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

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- **Data Access Statement and Material Availability:** The adequate resources of this article are publicly accessible.
- **Authors Contributions:** The authorship of this article is contributed equally to all participating individuals.

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