

Renewable Energy for Sustainable Development in India

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Abstract

The research delves into the critical interplay between renewable energy and sustainable development in India. Analyzing data on installed capacities, expenditures, and capacity additions, the study underscores India's steadfast commitment to a greener future. Fluctuations in funding and capacity additions reveal the nation's adaptability and determination to navigate challenges. The narrative of progress is evident in India's strides towards adopting cleaner energy sources like solar, wind, hydropower, biomass, and geothermal energy, reducing carbon emissions and bolstering energy security. Amid these fluctuations, India's journey stands as a testament to the transformative power of sustainable development. The nation's resolute path, propelled by robust policies and technological innovation, showcases a harmonious coexistence between human progress and environmental preservation. Ultimately, the research paints a vivid portrait of India's pivotal role in global efforts to mitigate climate change, foster economic growth, and uplift communities through renewable energy-driven sustainable development.

Keywords: Renewable Energy, Sustainable Development, Conventional Energy, Non-Conventional Energy

Introduction

In response to increasing environmental concerns and the need for energy security, India has emerged as a global leader in the use of renewable energy. The country is quickly switching to greener energy sources due to its tremendous natural resources and dedication to sustainable development. The constant pursuit of solar, wind, hydropower, and biomass technologies is transforming India's energy landscape, lowering the country's carbon footprint, and boosting economic growth. "Renewable Energy for Sustainable Development in India" symbolizes the convergence of global sustainability needs with India's growth aspirations. Amidst climate concerns and depleting fossil fuels, renewable energy becomes pivotal. India's economic growth is inseparable from its energy demand, but traditional sources bear environmental costs. Guided by international commitments, India's shift to renewable energy sources like solar, wind, hydropower, biomass, and geothermal gains significance. This exploration unravels how renewable energy intertwines with India's development. It delves into policies, technology, socioeconomics, and global ties shaping this transition. The renewable energy's role not just in India's growth but in reshaping global sustainable paths.

Literature Review

Researchers such as Ganguly and De (2017) and Chatterjee and Choudhury (2018) have investigated the

impact of government efforts like as the National Solar Mission and Renewable Purchase Obligation, focusing on how they have accelerated development and technology uptake.

Scholars such as Bisen and Chandel (2018) and Singh et al. (2019) have analyzed solar irradiation data to find places with the greatest solar energy potential and advocate for targeted solar project implementation. Scholars such as Singh and Chandel (2019) and Jana and Dey (2020) emphasize the need of inclusive policy, job development, and community participation in ensuring that the benefits of renewable energy reach marginalized groups.

Objective of the study

The objective of this study is to investigate the role and potential of renewable energy for fostering sustainable development in India.

Research Methodology

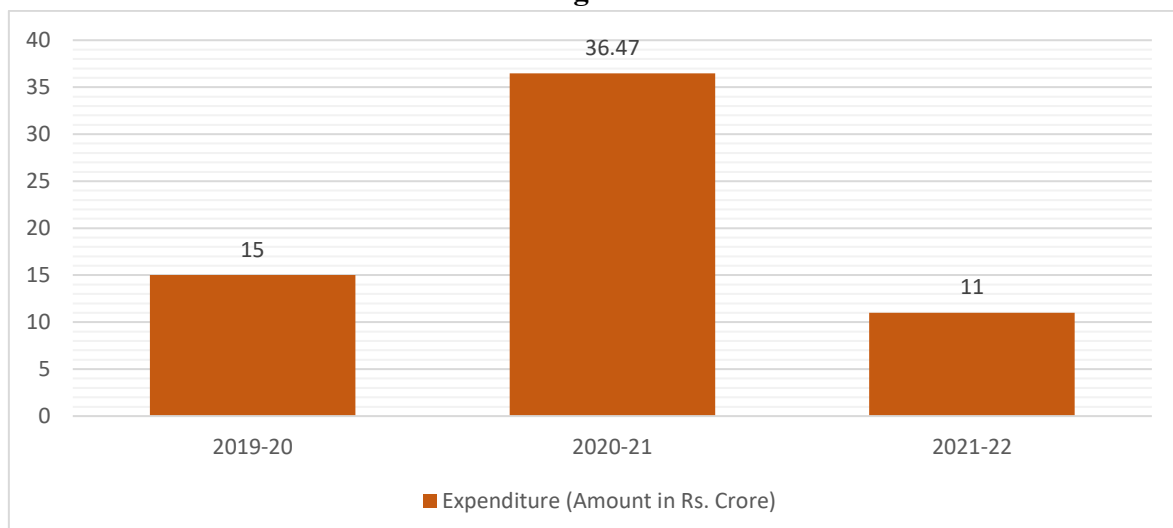
Secondary data will be acquired from government reports, academic publications, research papers, and energy databases. Data on renewable energy capacity, energy generation, investment patterns, and environmental implications will be obtained to assist the quantitative study.

Discussion

Expenditure on Renewable Energy

The "Expenditure on Renewable Energy" refers to the financial resources provided for the creation, research, and execution of renewable energy projects and initiatives. Countries throughout the world are progressively investing in renewable energy sources to decrease greenhouse gas emissions, combat climate change, and attain energy security in an era when sustainable and clean energy solutions are gaining popularity. This spending includes money for renewable energy technologies including solar, wind, hydropower, biomass, and geothermal. The expenditure data gives vital insights into a country's commitment to a more sustainable and ecologically friendly energy landscape. Understanding these financial allocations is critical for evaluating the development and efficacy of renewable energy policies and programs, which promote a greener and more sustainable future.

Fig. 1. Year-wise Expenditure of Renewable Energy Research and Technology Development Programs.



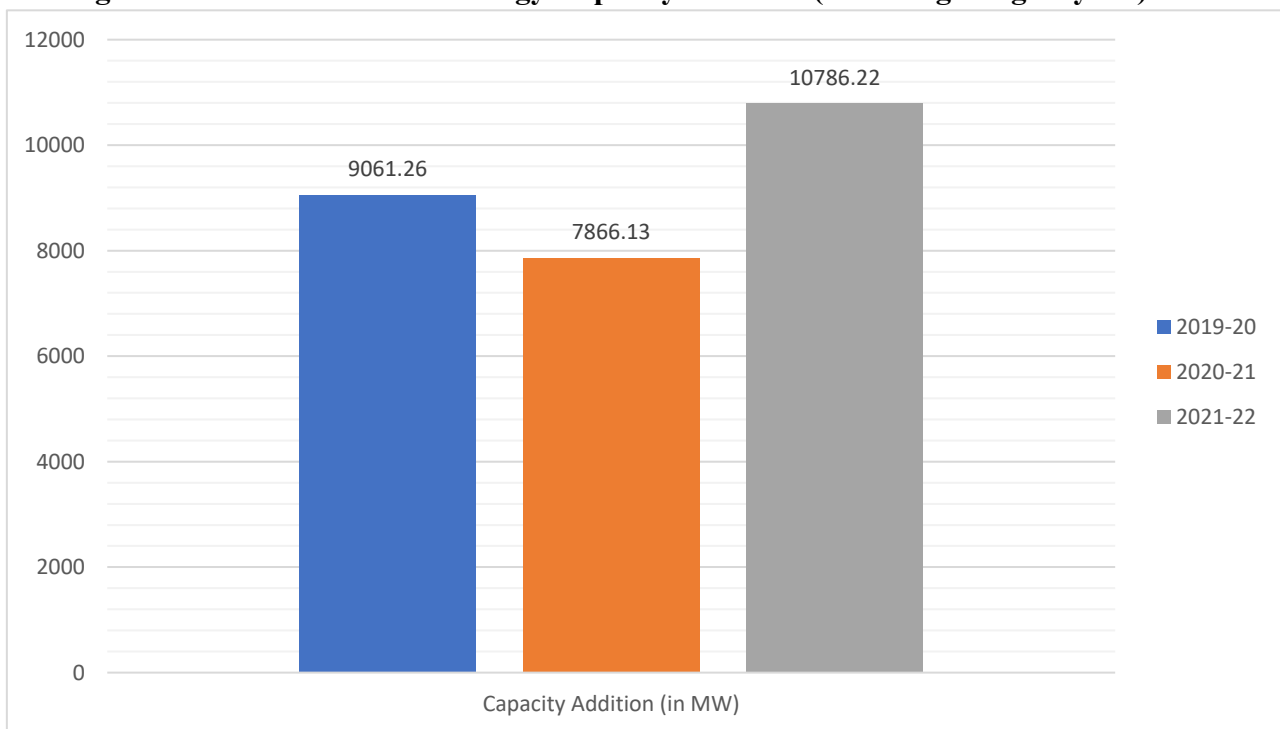
Source: Open Government Data Platform (OGD) India

In terms of the year In India, spending on the Renewable Energy Research and Technology Development Programs fluctuated. The expenditure in 2019-20 was 15 crore rupees. It climbed dramatically to 36.47 crore rupees in 2020-21, owing to an emphasis on green initiatives. In 2021-22, the expenditure fell to 11 crore rupees, presumably indicating economic constraints during the pandemic's lengthy duration.

Capacity on Renewable Energy

Renewable energy capacity is the greatest amount of energy that can be generated from renewable sources. It is critical in the transition to sustainable and environmentally friendly energy alternatives, lowering dependency on fossil fuels and mitigating climate change. This overview emphasizes the significance of renewable energy capacity as a critical indicator in the search of a more environmentally friendly and sustainable energy future.

Fig 2. Year-wise Renewable Energy Capacity Addition (including Large Hydro) from



Source: Open Government Data Platform (OGD) India

The data shows the Year-wise Renewable Energy Capacity Addition (including Large Hydro) in India. In 2019-20, the capacity addition was 9,061.26 MW. In 2020-21, it decreased to 7,866.13 MW, possibly due to economic challenges and pandemic disruptions. In 2021-22, the capacity addition significantly increased to 10,786.22 MW, reflecting renewed efforts towards sustainable development.

Conventional and Non-Conventional Energy Generation

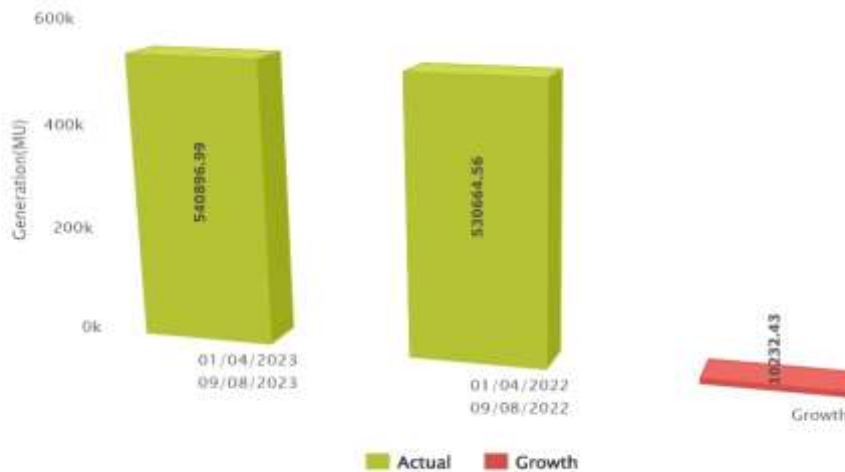
The energy spectrum encompasses conventional (fossil fuels) and non-conventional (renewable) sources. Conventional sources have historically powered societies but come with environmental drawbacks. Non-conventional options like solar and wind are gaining traction for their sustainable attributes. Transitioning to non-conventional sources is pivotal for a cleaner and more resilient energy future.

Fig.3 Renewable Energy Generation From 2022 vis vs 2023 – Apr 2023



Source: Central Electricity Authority

Fig 4. Conventional energy Generation 2022 vis vs 2023



Source: National Power Portal

Fig 3 shows the renewable energy generation between January 1, 2022, and April 1, 2022, with the same period in 2023. In 2022, 57,240.65 units were generated, while in 2023, it increased to 67,174.6 units, indicating a growth of 9,933.96 units. This growth reflects a percentage increase of approximately 17.36%. This positive trend underscores the rising adoption of renewable energy sources, showcasing a substantial 17.36% growth in renewable energy generation during the mentioned period. Fig 4. compares conventional energy generation between April 1, 2022, and August 9, 2022, with the same period in 2023. In 2022, 530,664.56 units were generated, while in 2023, it increased to 540,896.99 units, indicating a growth of 1,023.43 units. This growth reflects a percentage increase of approximately 0.19%. Despite its modest nature, this increase signifies a positive trend in conventional energy generation during the specified period. The two datasets, it's evident that renewable energy generation experienced a significantly higher growth rate of about 17.36% compared to the relatively modest growth of approximately 0.19% in conventional energy generation during their respective timeframes. This comparison underscores the accelerated adoption and potential of renewable energy sources, reflecting a growing shift towards cleaner and more sustainable energy generation practices.

Sustainable Development

The statistics on renewable energy for sustainable development gives a complete picture of India's efforts to create a cleaner and greener energy landscape. Renewable power installed capacity in various states and union territories demonstrates a tremendous increase of renewable energy projects like as solar, wind, hydropower, and biomass, demonstrating a rising commitment to sustainable development. This increase in capacity underscores the country's commitment to lowering its reliance on fossil fuels, mitigating climate change, and transitioning to a low-carbon economy.

The capacity augmentation year by year indicates the influence of external variables on renewable energy installations. The decline in capacity addition during 2020-21 might be attributed to pandemic-related problems such as supply chain interruptions, labour shortages, and project execution delays. The ensuing significant increase in 2021-22, on the other hand, demonstrates a comeback in renewable energy projects, displaying resilience and sustained efforts towards sustainable development.

In essence, renewable energy is India's proactive approach to sustainable development. The United States' commitment to renewable energy sources not only improves energy security and environmental sustainability, but it also prepares the road for economic development, job creation, and social inclusion. India plays a critical role in global climate change mitigation by pressing forward with renewable energy transitions, aligning with worldwide efforts to build a sustainable future for future generations.

Conclusion

In the pursuit of sustainable development, India's unwavering commitment to renewable energy sources emerges as a beacon of hope and progress. The exploration of renewable energy's role in shaping India's sustainable development narrative highlights a dynamic journey towards a greener and more resilient future. India's strategic embrace of renewable energy sources, including solar, wind, hydropower, biomass, and geothermal, signifies a pivotal shift from conventional energy paradigms to environmentally conscious alternatives.

This transition not only addresses energy security concerns but also embodies a proactive response to the global call for climate action. The data on installed capacities, expenditures, and capacity additions provide insights into India's resolute path. Fluctuations in funding priorities reflect a dynamic commitment to sustainable development, with heightened investments during pivotal junctures. The year-wise capacity addition data underscores India's resilience in the face of challenges, underscoring its determination to ensure a steady transition despite external factors. Amidst these fluctuations, the overarching narrative is one of progress. The data showcases India's significant strides in adopting cleaner energy sources, contributing to a reduced carbon footprint and enhanced energy security.

These achievements are underpinned by robust policy frameworks, technological innovation, and a growing awareness of the imperatives of sustainable development. In essence, the data illuminates the commendable journey of India's sustainable development through renewable energy. The nation's commitment to a cleaner, greener future echoes through the numbers, reflecting a determination to align with global efforts to mitigate climate change, foster economic growth, and uplift communities. As India continues to pioneer the transition towards renewable energy, its story becomes a testament to the transformative power of sustainable development. This journey symbolizes a beacon of hope for a world grappling with complex environmental challenges, reaffirming the belief that a harmonious coexistence between human progress and environmental preservation is not just attainable, but imperative.

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