

Exploring India's Renewable Energy Policies: Contributions and Challenges in Achieving Sustainable Goals

¹Tanay Agrawal; ²Dr. Priya Makhija; ³Nikita M; ⁴Kokil T.N; ⁵Nishika V Jain;
⁶Mithali V Baradiya; ⁷Kaushik Parameshwaran
 Center of Management Studies

Abstract:- This paper explores India's renewable energy policies, their impacts, and the hurdles hindering sustainable goals amidst the country's rapid economic growth. The Indian government has shown a strong commitment to shifting towards renewable energy sources to combat climate change, reduce energy dependence, and ensure energy security. Key policies like the National Solar Mission and Wind Energy Policy have been instrumental in promoting renewable energy adoption, leading to significant growth in India's renewable energy capacity.

However, India faces challenges in managing the intermittency and variability of renewable energy sources, necessitating investments in grid infrastructure and energy storage solutions. Financial burdens, grid integration concerns, skilled manpower shortages, land acquisition issues, and environmental impacts are additional obstacles. This paper evaluates the contributions of India's renewable energy policies in reducing carbon emissions, expanding energy access, and fostering economic growth while examining the barriers to achieving sustainable objectives.

The analysis underscores the importance of a comprehensive approach that integrates policy measures with technological advancements, financial incentives, and international cooperation. While India's renewable energy policies have made considerable progress in promoting sustainable development, significant challenges persist. The study underscores the necessity for continuous policy refinement, increased investment in research and development, and collaborative efforts to address barriers to renewable energy integration. India's journey towards sustainability via renewable energy requires ongoing commitment and innovation to overcome these challenges effectively.

Keywords:- India, Wind Energy Policy, National Solar Mission, Japan, China, NAPCC, Sustainable Goals, Fossil Fuel, Government Spending, Policy Support, Technology Advancement, Budget, Biofuels, Sustainable Development, Energy Demand.

I. INTRODUCTION

Our research focuses on the substantial government spending over the past five years, totaling around 1.97 lakh crores, with a significant allocation of 4500 crores dedicated to high-efficiency PV solar modules. India embarked on its renewable energy journey in the early 1990s to address rising energy demands, reduce reliance on fossil fuels, and combat environmental issues such as air pollution and climate change. In 2008, the National Action Plan on Climate Change (NAPCC) was introduced, recognizing renewable energy as pivotal for sustainable development and setting ambitious targets for its integration into the energy mix.

The Aditya-L1 mission, India's maiden space endeavor to study the Sun and solar corona, involved over 15 years of meticulous work by scientists at the Indian Institute of Astrophysics (IIA), Bengaluru. Additionally, the Jawaharlal Nehru National Solar Mission, launched in 2010, aimed to foster solar energy development, initially targeting 20,000 MW of grid-connected solar power by 2022, later revised to 100,000 MW, successfully achieved by 2022.

The National Wind Energy Mission and National Bio-Energy Mission were initiated to bolster wind and bioenergy capacities, respectively, while the International Solar Alliance, launched in 2015 with France, aimed to bolster solar energy deployment globally, particularly in sun-rich regions. India saw remarkable growth in wind and solar power installations, with states like Tamil Nadu, Gujarat, Rajasthan, and Karnataka leading the way.

India actively participated in global climate conferences and committed to reducing carbon emissions through renewable energy adoption. In the 2023 budget, a notable 48% increase allocated 10222 crores to green growth and clean energy under the Ministry of New and Renewable Energy. The renewable energy sector in India made significant strides, particularly in solar and wind energy, driven by technological advancements and declining costs, rendering renewable energy increasingly competitive.

However, the journey towards a clean energy future continues, necessitating sustained efforts and policy backing to achieve sustainable goals.

II. REVIEW OF LITERATURE

➤ *The Role Played by India's Renewable Energy Policies in Accomplishing Sustainable Objectives. A few Instances of Past Research are as Follows:*

- According to Sanjeevikumar Padmanaban's research (2020), global warming, energy costs, and Global interest has increased due to the energy issue. To address the needs of its 1.36 billion and growing population, India aims to achieve 175 GW of electricity from renewable sources by 2022.
- The Indian government aims to create "green cities" that run entirely on renewable energy in each state of the nation, according to Subhashish Dey's paper from 2022. Emerging economies' technological advancements are primarily focused on ensuring long-term economic viability. While disregarding the recovery of the ecosystem. Thus, in these economies, the advancement in technology reduces the use of renewable energy. Remarkably, research to date has demonstrated that innovation in technology and environmental regulation can affect the amount of energy consumed in wealthy and developing nations.
- In 2016, Shashi Dubey The research highlighted the potential benefits of renewable energy sources, including energy security, accessibility, social and economic advancement, and the mitigation of climate change's negative effects on the environment and human health. There exist obstacles that tend to impede renewable energy sources' capacity to be sustainable and to slow down climate change. These issues include inefficient use of energy by humans, market failures, information gaps, and access to raw materials for the deployment of future renewable resources
- In 2022, Vipin Jain The study's findings attest to the noteworthy advantages of renewable energy sources for economic growth, including hydroelectricity, solar photovoltaics, wind, geothermal, and biomass power. Asian economies can benefit from using renewable energy in two ways. Benefit: accelerating economic growth and lowering CO2 emissions. The increasing demand for energy can be met by gradually replacing outdated power sources with more eco-friendly ones. As a result, Asian economies will be free to focus on their economic development rather than their carbon footprint or other environmental risks. Furthermore, the inclusion of renewables in the energy mix enables Asian economies to meet the Sustainable Development Goals.
- In 2020, Mohammed Abdul Majid To draw in private investment, the nation needs to take action. R&D should be used to build renewable technologies in order to overcome inadequate technology and the lack of infrastructure needed for them. The government ought to provide more funding to encourage this industry's innovation and research. The number of qualified individuals to instruct, demonstrate, maintain, and run renewable energy structures.
- 2020's Chiestina Kennedy In addition to assisting society in meeting clean energy targets, preserving food security, enhancing the regeneration and health of

forests, and safeguarding biodiversity, directing renewable energy towards transformed areas with reduced potential for conflict will also help. Our research demonstrates that every On areas that are anticipated to have little effect on biodiversity preservation and agricultural output, the wind and solar energy requirements of India's 2022 aim can be satisfied. It would take proactive landscape design in conjunction with appropriate incentive programmes from power buyers and financing institutions to prevent the second-most populous nation in the world from experiencing an increase in land scarcity in the future. On converted lands, renewable energy generation in India could supply more than ten times the country's 2022 target; however, new policies and initiatives must be developed in order to attain sustainable development.

- 2021's Ivory In the early 1980s, India emerged as the global hub for unconventional energy resources and became the primary energy collector. In India, the Ministry of New and Renewable Energy (MNRE) is in charge of renewable energy control. In addition, renewable power assets have an unfathomable growth trajectory through 2022, with notable developments including an approximate 15% overlap in sun vitality from April 2016 levels and an immense increase in wind control capability in India. India's entire network's potential for renewable vitality, whether it be framework-tied or intuitive, has significantly increased as of April 30, 2016. Its performance has surpassed the capabilities of India's massive hydroelectric control system.
- In 2020, Ramit Debnath Prior to the COVID-19 epidemic, India required price, regulation, risk allocation, and market design improvements. The load curves had been impacted by the widespread change in behaviour patterns, such as work-from-home policies. For instance, the total peak demand reduced requirements from business and state power distribution providers (DISCOMs) nationwide as a result of the lockdown, resulting in a 25% decrease on April 2, 2020.74% Much before the 2022 RE targets, such a shift could lead to structural changes in the Indian power sector. The improvements in the robustness of the Indian energy grid will result from these reforms, which will far outweigh the pointless political expenses.
- Daksh Ghai (2020) Since the SDGs were adopted in September 2015, India has demonstrated its unwavering commitment to the global goals throughout the past several years. India's commitment is demonstrated by its initiatives to provide electricity to rural communities, guarantee that girls attend and remain in school, provide sanitation, and homes for all, supplying youth with the tools necessary to compete in the global job market, and much more. India has also achieved great strides in assessing programme progress in relation to goals and using data for efficient policymak Ghai Daksh (2021) With the adoption of the Sustainable Development Goals (SDGs) in September 2015, India has demonstrated in recent years a strong commitment to the global goals. India's commitment is demonstrated by its initiatives to provide sanitation, empower rural people with

- electricity, guarantee that girls attend and stay in school, and providing all youth with the tools they need to succeed in the global job market, housing for all, and more. India has also made great strides in using data to inform effective policy decisions and track programme success in relation to goals.
- Kumar Sandeep (2013) According to the study's findings, state-level measures have been effective in filling the void left by the JNNSM first phase's underwhelming performance. JNNSM Phase II goal composition, which was recently revealed, is 3600 MW for the central region and 5400 MW for states. Modifications to policies and programmes in light of Phase I experience, along with the creation of 54 solar cities, are anticipated to have an effect on the National Solar Mission's success and raise awareness of solar-powered electricity generation and use in general.
 - Kumar Abhishek 2022 The market is developing more slowly than anticipated, despite the wind power industry seeing significant growth in the early years. In order to address the issues, the government must keep taking the necessary actions. The goal must be achieved by addressing a number of areas, including the privatisation of land, location-based auctions, egalitarian policies comparable to solar energy, and the streamlining of the land acquisition process in order to strengthen DISCOMs and increase their efficiency. Government can refocus on wind or strike a balance between the two. In order to improve grid stability, strengthen transmission lines, and increase efficiency, it is also essential to repower outdated wind turbines.
 - In 2022, Dhitashree Guha India's energy environment is incredibly flexible. Because there are several types of energy sources available, the nation can run large-scale energy producing programmes. However, the decades-long total reliance on fossil fuels has had a detrimental impact the economic climate. Thus, it also became essential to start using renewable energy. <https://gwcweb.org/2021/0/although%20India%20has%20made%20notable%20commitments%20to%20increasing%20renewable>
 - In 2021, Pravakar Sahoo The clean energy sector has not advanced enough despite India's noteworthy vows to increase investments in renewable and clean energy due to offtaker risk, a lack of infrastructure, a lack of financial intermediaries, and investors' weak understanding. Stifled private investment in the industry. Because of this, the government must encourage investment in greener energy sources and implement the necessary institutional adjustments to shift India's energy mix towards renewables.
 - In 2022, Naveen Kumar In order to reduce poverty, end hunger, advance education, enhance health, promote access to modern, clean energy, industrialise, and fight climate change, energy access is a key goal in the 2030 Agenda for Sustainable Development. The rapid depletion of resources is a concern for the future and may result in "an era of energy crises" for future generations. To achieve this, there needs to be a push for a decarbonised energy generation system as well as a green, sustainable economy.
 - In 2023, Michael Kwenejo Developing and impoverished economies continue to have very inadequate power supplies. The majority of these nations rely on natural gas and coal to generate electricity. In addition to harming people's health, fossil fuels contaminate the environment and cause global warming. Rich countries with lower carbon emissions from fossil fuel power plants include Germany, the United Kingdom, Switzerland, the United States, Canada, and others. For this reason, it is imperative that developing and undeveloped economies do the same. The challenges facing developing and impoverished countries are insufficient power supplies, the effects of their current power generation mix on the environment, global warming, and human health. Based on all the examined studies, it appears that these issues can be resolved with a combination of sustainable power sources. Geothermal, biomass, tidal, wind, solar, and hydropower are examples of renewable energy sources. Alternative energy sources therefore the amount of nuclear energy is little. They ought to be taken prisoner and put to use producing energy. According to published research, biomass, solar, wind, and hydropower are the most often used renewable energy sources.

III. RESEARCH METHODOLOGY

- *The Research gap in Exploring India's Renewable Energy Policies and their Contributions and Challenges in Achieving Sustainable Goals could Involve Several Aspects:*

Policy Implementation vs. Goals: Investigating the effectiveness of India's renewable energy policies in relation to its sustainability goals. Are there discrepancies between policy intent and actual outcomes?

Technological Innovations: Examining the impact of technological innovations on renewable energy adoption in India and how policies have facilitated or hindered these innovations.

Economic Viability: Analyzing the economic feasibility of renewable energy projects and evaluating if policy incentives are attractive enough to draw investments.

Environmental Impact: Assessing the environmental consequences of renewable energy projects and determining if policies adequately address environmental concerns.

Social Acceptance: Investigating public acceptance of renewable energy projects, including their impact on local communities, and evaluating policy considerations for social factors.

Regulatory Challenges: Identifying regulatory barriers and bureaucratic obstacles that may hinder the growth of renewable energy in India.

International Comparisons: Comparing India's renewable energy policies with those of other nations to identify best practices and areas for improvement.

Future Projections: Predicting the future of India's renewable energy sector based on current policies and identifying potential areas for policy enhancement.

By addressing these aspects, researchers can contribute to a deeper understanding of India's renewable energy policies and their role in achieving sustainability goals.

Potential objectives for research on exploring India's renewable energy policies and their contributions and challenges in achieving sustainable goals include:

Assessing Policy Effectiveness: Evaluating how effectively India's renewable energy policies promote the adoption of renewable energy sources and reduce greenhouse gas emissions.

Analyzing Sustainable Goals: Examining India's sustainable development goals (SDGs) and assessing the extent to which renewable energy policies align with and contribute to these goals.

Identifying Policy Gaps: Recognizing gaps or shortcomings in existing renewable energy policies that may impede progress toward sustainable energy solutions.

Evaluating Economic Impact: Analyzing the economic effects of renewable energy policies, including job creation, investment attraction, and cost implications for both government and consumers.

Assessing Environmental Benefits: Measuring the environmental advantages of renewable energy adoption, such as reduced air pollution and decreased reliance on fossil fuels, and linking them to policy initiatives.

Studying Technological Advancements: Investigating how technological advancements in renewable energy, such as solar and wind power, are facilitated or impeded by existing policies.

Examining Regulatory Framework: Exploring the regulatory framework surrounding renewable energy projects, including permits, licensing, and land use regulations, and evaluating their impact.

Analyzing International Comparisons: Comparing India's renewable energy policies with those of other countries to glean insights into successful strategies and potential areas for improvement.

Forecasting Future Trends: Predicting future trends in India's renewable energy sector based on current policies and external factors, such as global energy market dynamics.

Considering Social Impacts: Examining the social impacts of renewable energy projects, including community acceptance, resettlement issues, and local employment opportunities, and assessing policy responses.

These objectives should provide a solid foundation for research into India's renewable energy policies and their role in achieving sustainable goals.

➤ *Comparative Analysis of Policies*

The world can effectively address the complex issues it faces today by implementing the dynamic and comprehensive strategy called as sustainable development. By meeting the demands of the current generation, this approach hopes to preserve future generations' capacity to satisfy their own needs. A vision for the future that seeks a harmonic balance between social justice, economic advancement, and environmental preservation is known as sustainable development.

At its essence, sustainable development underscores the importance of prudent resource management, social inclusivity, and ecological resilience, recognizing the interconnectedness of economic, social, and environmental systems. As communities worldwide grapple with urgent imperatives such as mitigating climate change, preserving biodiversity, and enhancing overall well-being while safeguarding the planet's long-term health, sustainable development has gained widespread traction.

➤ *Sustainable Policies Adopted by China*

China has embraced a new vision of innovative, coordinated, green, open, and inclusive development, putting the welfare of its people first. Its proactive embrace of the 2030 Agenda and the execution of a ground-breaking national plan serve as testaments to this dedication. With the assistance of 45 ministries and agencies in an interministerial coordination framework, China has combined these initiatives with its 13th Five-Year Plan and other long-term development plans.

Furthermore, China has actively pursued international development cooperation in order to further global implementation efforts, with remarkable results (United Nations, 2022).

China has achieved significant milestones, including the eradication of extreme poverty and the assurance of food security. By the end of 2020, China successfully lifted 98.99 million rural residents above the poverty line, surpassing the targets of SDG 1 a decade ahead of schedule. Building on this success, China continues to prioritize agricultural and rural development while implementing a comprehensive rural revitalization strategy. In 2020, China achieved its 17th consecutive bumper harvest, ensuring the nation's food security remains firmly within its own control.

Moreover, China has taken proactive measures to address climate change and contribute to global sustainability efforts. Demonstrating a commitment to environmentally friendly policies, China has made significant strides in maintaining clean air, water, and soil.

Notably, carbon intensity has decreased by 18.8%, while clean energy now constitutes 23.4% of China's energy mix. Leading in photovoltaic and wind power generation, China aims to peak carbon dioxide emissions before 2030 and achieve carbon neutrality by 2060, providing impetus to global climate action and sustainable development worldwide.

China has also effectively managed the challenges posed by the COVID-19 pandemic through enhanced public health governance. Prioritizing the well-being of its citizens, China has made strategic advancements in pandemic response, investing in public health infrastructure and establishing a comprehensive social safety net covering over 1.3 billion people.

Economically, China has maintained steady growth and bolstered development resilience. With GDP surpassing 100 trillion yuan, China has made significant strides in infrastructure connectivity and sustainable transportation. Despite the pandemic, China's GDP grew by 2.3% in 2020, positioning it as the only major world economy to achieve growth.

Furthermore, China has upheld its responsibilities as a major global player by advancing international development cooperation. Championing shared values of peace, development, fairness, and democracy, China has actively promoted the alignment between the Belt and Road Initiative and the 2030 Agenda. Through initiatives such as the COVAX and vaccine assistance to developing countries, China has made substantial contributions to the global fight against the pandemic.

Recognizing the challenges posed by the COVID-19 pandemic to the global implementation of the 2030 Agenda, China stands ready to collaborate with other nations. This includes consolidating political will, enhancing means of implementation, and addressing the specific needs of developing countries to ensure inclusivity and progress for all.

➤ *Sustainable Policies Adopted by Japan*

Timed to the start of the COVID-19 epidemic, the world community reaffirmed its commitment to accelerating efforts to achieve the Sustainable Development Goals (SDGs), which were announced during the "Decade of Action." Since then, the epidemic has seriously threatened people's lives, means of subsistence, and dignity everywhere, especially affecting groups who are already at risk and obstructing efforts to achieve the SDGs. It has sparked a crisis in human security, making it imperative to use the SDGs as a guide for social change, imagining a new era and looking ahead. In order to overcome the obstacles presented by the COVID-19 pandemic and "build back better," this Voluntary National Review (VNR) examines Japan's efforts to promote the SDGs and evaluates progress.

Realizing the SDGs necessitates collaborative efforts from all stakeholders. Through an examination of Japan's domestic mechanisms for SDG promotion in this VNR, it was observed that frameworks like the "Japan SDGs Award," coordinated under the SDGs Promotion Headquarters led by the Prime Minister, have facilitated enhanced collaboration among diverse stakeholders, fostering heightened awareness and progress on the SDGs nationwide.

Notably, initiatives such as the designation of "SDG Future Cities" for outstanding contributions towards SDG achievement since 2018, alongside platforms like the "Public-Private Partnership Platform for Local SDGs" and "Local SDG Finance," have spurred momentum in promoting the SDGs, fostering a sense of ownership among citizens. Consequently, a movement to address regional challenges through the SDGs' principles has gained traction nationwide. While only 1% of local governments were engaged in SDG initiatives in 2017, the figure surged to 39.7% by 2020, with the Japanese government targeting a further increase to 60% by the end of FY2024.

The Government of Japan has delineated eight priority issues in its "SDGs Implementation Guiding Principles." This VNR outlines significant efforts made across each priority issue, both domestically and internationally, while considering the pandemic's impact.

Recognizing the SDGs' multifaceted nature, this VNR's preparation involved extensive consultations beyond governmental discussions, including engagement with the "SDGs Promotion Roundtable," civil society, youth representatives, and solicitation of public comments. Furthermore, to ensure a comprehensive evaluation, assessments from private sector members of the "SDGs Promotion Roundtable" have been incorporated, acknowledging the importance of diverse perspectives.

The drafting process of this VNR served as an opportunity to review SDG promotion frameworks and major initiatives, contemplating Japan's future SDG promotion strategies based on expert and citizen feedback.

Japan remains committed to collaborating with the international community, prioritizing human security principles to address global health challenges, achieve universal health coverage, and realize a society where the SDGs are attained, leaving no one behind.

➤ *Sustainable Policies Adopted by India*

India's dedication to the Sustainable Development Goals (SDGs) is evident in its alignment with the national development agenda encapsulated by the motto "Sabka Saath Sabka Vikaas" (Collective Efforts for Inclusive Growth). Supported by insights from the SDG India Index, which gauges progress at the subnational level, the country has established a robust model for SDG localization, emphasizing adoption, implementation, and monitoring at both state and district levels.

- *The Narrative below Underscores India's Advancements Across Various SDGs:*
- ✓ **Empowered and Resilient India:** India has effectively uplifted over 271 million individuals out of multidimensional poverty through economic empowerment, fostering improved access to essential services such as nutrition, healthcare, education, sanitation, and housing. These efforts have notably diminished inequalities, particularly among vulnerable groups.
- ✓ **Clean and Healthy India:** Through nationwide initiatives such as the Clean India Campaign and the National Nutrition Mission, India has achieved 100% rural sanitation and witnessed significant reductions in stunting, child mortality, and maternal mortality rates. The establishment of Ayushman Bharat, the world's largest health protection scheme, ensures universal health coverage for nearly 500 million individuals.
- ✓ **Inclusive and Entrepreneurial India:** India prioritizes social inclusion by ensuring universal access to nutrition, healthcare, education, and social protection while fostering entrepreneurial skills and employment opportunities. The Jan Dhan-Aadhaar-Mobile (JAM) trinity has facilitated financial inclusion for over 200 million women, empowering them economically.
- ✓ **Sustainable India:** India's climate action initiatives advocate for clean energy systems, resilient infrastructure, and eco-restoration. By electrifying all villages, reducing CO₂ emissions through energy-efficient appliances, providing clean cooking fuel to millions of households, and committing to renewable energy targets, India showcases its commitment to sustainability on a global scale.
- ✓ **Prosperous and Vibrant India:** India's burgeoning innovation ecosystem and young population contribute to its status as one of the fastest-growing emerging market economies. With ambitious goals to reach a USD 5 trillion economy by 2025, India focuses on inclusive and sustainable growth by bolstering manufacturing, infrastructure, investments, technological innovation, and entrepreneurship.

In alignment with the spirit of South-South Cooperation and its commitment to leaving no one behind, India actively supports developing countries through initiatives like the USD 150 million India-UN Development Partnership Fund. As India embarks on the Decade of Action, it remains committed to collaborative efforts with domestic and global stakeholders to accelerate progress towards a sustainable future for generations to come.

IV. FINDINGS

India has made notable progress in its renewable energy policies, showcasing a steadfast commitment to sustainable objectives. The key findings from the analysis are outlined below:

Ambitious Targets: India has established ambitious renewable energy targets, with the aim of reaching 175 GW by 2022 and an even more ambitious 450 GW by 2030. These targets underscore India's unwavering dedication to sustainable energy practices.

Solar Power Revolution: The growth of solar power in India has been remarkable, driven by initiatives such as the "Solar India" mission. This surge has positioned India as a global leader in solar energy markets.

Wind Energy Growth: India has significantly expanded its wind energy capacity, benefiting from favorable policies like the Wind Energy Mission.

Policy Initiatives: Key policies like the Ujwal DISCOM Assurance Yojana (UDAY) and the Renewable Purchase Obligation (RPO) mandate utilities to procure a specific percentage of power from renewables, fostering substantial growth in the market.

Investment and Innovation: Encouraging both foreign and domestic investment and fostering innovation in renewable technologies have been pivotal drivers of progress.

➤ *However, Persistent Challenges Include:*

Grid Integration: Integrating intermittent renewables into the grid remains a significant challenge, emphasizing the need to ensure grid stability and a reliable power supply.

Land and Resource Constraints: Challenges related to land availability and access to raw material resources for renewable infrastructure pose limitations.

Financial Barriers: The high initial capital costs associated with renewable projects can be a hindrance, although government incentives have helped alleviate this barrier.

Policy Implementation: Effective policy implementation at the state level is crucial for meeting renewable energy targets.

Environmental Impact: Balancing environmental concerns, especially in ecologically sensitive areas, is of utmost importance.

In summary, India's commitment to ambitious renewable energy targets, coupled with significant growth in solar power and supportive policies, reflects substantial progress. However, challenges like grid integration, resource constraints, financial barriers, effective policy implementation, and environmental considerations underscore the need for continuous strategic efforts in achieving sustainable energy goals through renewable sources.

V. CONCLUSION

In conclusion, India's endeavor to harness renewable energy for sustainable development is both commendable and ambitious. The nation has made remarkable progress in this realm, spurred by a deep recognition of the urgency to address environmental issues, enhance energy security, and drive economic growth. Key policies like the National Solar Mission and Wind Energy Policy have been instrumental in fostering the adoption of renewable energy, positioning India as a global frontrunner in this domain.

However, significant challenges persist despite these achievements. The intermittent nature of renewable energy sources and the imperative for grid modernization and energy storage solutions necessitate substantial investments. Financial constraints, grid integration complexities, and apprehensions regarding land acquisition and environmental impact further complicate the transition. Developing skilled manpower and human capital is critical to sustain the momentum of the renewable energy sector.

The study underscores the necessity of a comprehensive approach that encompasses policy refinement, technological innovations, financial incentives, and international collaboration. By forging partnerships with global counterparts and drawing insights from successful models worldwide, India can navigate these challenges more effectively.

India's trajectory towards sustainable energy holds immense promise, not only domestically but also on the global stage. It serves as a beacon, showcasing how emerging economies can transition to renewable energy while addressing pressing socioeconomic needs. This transition not only contributes to mitigating carbon emissions but also fosters energy accessibility and economic prosperity, aligning with the Sustainable Development Goals outlined by the United Nations.

In summary, India's renewable energy policies have made significant strides in advancing sustainable development. However, the road ahead demands sustained dedication, innovation, and cooperation. India's unwavering resolve to confront these challenges and its enduring commitment to renewable energy epitomize crucial steps towards a cleaner and more sustainable future, offering inspiration and guidance for nations worldwide.

REFERENCES

- [1]. Padmanabhan Sanjeev 2020 A review on renewable energy development Sergei A. Ostroumov.
- [2]. Dey Subhashish 2022 An overview on renewable energy
- [3]. Dubey Shashi 2016 A review on sustainable energy Institute of Paleobiology
- [4]. Jain Vipin 2022 renewable energy matters to achieve sustainable energy front energy
- [5]. Majid Mohammed 2020 Current status of renewable energy BMC

- [6]. Kennedy Christian 2020 renewable energy and land use in India Energy sustainability
- [7]. Ivory 2021 research study on sustainable development
- [8]. Debonath Ramit 2020 A review on increasing renewable generation in India
- [9]. Ghai Daksh 2021 India's position in sustainable goals
- [10]. Kumar Sandeep 2013 development of solar energy
- [11]. Kumar Abhishek 2022 A overview on wind energy
- [12]. Guha Dhitashree 2022 overview on sustainable energy
- [13]. Sahoo Pravakar 2021 India's energy mix and path ways for sustainable development
- [14]. Kumar Naveen 2022 progress of sustainable development
- [15]. Kwenejo Michael 2023 sustainability of power generation for developing
- [16]. Rohankar, N., Jain, A. K., Nangia, O. P., & Dwivedi, P. (2016). A study of existing solar power policy framework in India for viability of the solar projects perspective. *Renewable and Sustainable Energy Reviews*, 56, 510-518.
- [17]. KhareSaxena, A., Saxena, S., & Sudhakar, K. (2020). Solar energy policy of India: An overview. *CSEE Journal of Power and Energy Systems*.
- [18]. Upadhyay, A., & Chowdhury, A. (2014). Solar Energy Fundamentals and Challenges in Indian restructured power sector. *International Journal of Scientific and Research Publications*, 4(10), 1-13.
- [19]. Rathore, N., & Panwar, N. L. (2022). Outline of solar energy in India: advancements, policies, barriers, socio-economic aspects and impacts of COVID on solar industries. *International Journal of Ambient Energy*, 43(1), 7630-7642.
- [20]. e%20significant%20progress,and%20firmly%20promote%20poverty%20elimination.
- [21]. <https://sustainabledevelopment.un.org/memberstates/china>
- [22]. <https://sustainabledevelopment.un.org/memberstates/india>
- [23]. <https://sustainabledevelopment.un.org/memberstates/japan>
- [24]. <https://energysustainsoc.biomedcentral.com/articles/10.1186/s13705-019-0232-1>
- [25]. https://www.researchgate.net/publication/340583843_A_Comprehensive_Review_on_Renewable_Energy_Development_Challenges_and_Policies_of_Leading_Indian_States_With_an_International_Perspective
- [26]. <https://www.sciencedirect.com/science/article/pii/S2949753122000066>
- [27]. <https://www.tandfonline.com/doi/full/10.1080/23311916.2016.1167990>
- [28]. <https://www.frontiersin.org/articles/10.3389/fenrg.2022.829252/full>
- [29]. <https://www.mdpi.com/2071-1050/12/1/281>
- [30]. <https://www.ivoryresearch.com/samples/research-study-on-the-development-of-sustainable-energy-and-its-current-situation-india/>
- [31]. <https://journals.sagepub.com/doi/full/10.1177/0958305X20986246>

- [32]. <https://www.hindawi.com/journals/jse/2013/632364/>
- [33]. <https://link.springer.com/article/10.1007/s10098-021-02248-z>
- [34]. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9734359/>
- [35]. <https://www.sciencedirect.com/science/article/pii/S2211467X23000354>