

NAVIGATING CHALLENGES AND SEIZING OPPORTUNITIES IN GREEN ENERGY RESOURCE DEVELOPMENT IN INDIA

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Abstract

The advancement of sustainable energy sources in India is characterized by a multifaceted environment comprising both obstacles and prospects. This article explores the various facets of this undertaking, emphasizing the challenges encountered by governments, industry participants, including communities, while also shedding light on the hopeful opportunities for progress. Obstacles such as legal restrictions, finance limits, technology limitations, and infrastructure shortcomings impede the widespread use of renewable energy sources. Nevertheless, within these difficulties, there are substantial prospects for creativity, financial commitment, and enduring expansion. The abstract emphasizes the significance of cooperative endeavors among the government, commercial sector, and civil society in order to overcome obstacles and fully utilize the green energy resources in India. By implementing strategic planning, enacting policy reform, and fostering technological innovation, India has the potential to establish itself as a prominent worldwide force in the field of renewable energy production. This achievement would not only contribute to economic success but also promote environmental sustainability and enhance social well-being.

Keywords: Green Energy, Environment, Renewable Energy.

Introduction

Green energy, also known as renewable energy or clean energy, is energy that is generated from sources that have a minimum impact on the environment and are naturally renewed. Other names for green energy include clean energy and clean energy generation. Green energy technologies strive to minimise greenhouse gas emissions and prevent climate change while also encouraging sustainability and reducing dependence on limited fossil fuel resources. Green energy technologies also aim to promote sustainability. Solar power, wind power, hydropower, biomass, geothermal energy, and other forms of renewable energy are among the most important green energy sources and technologies. These sources are referred to be "green" because, throughout the process of producing energy, they release very few or no carbon emissions and their supply does not run out over time.

In order for the world to successfully transition to an energy system that is more sustainable and less harmful to the environment, the widespread adoption of renewable sources of energy is an essential component. It contributes to a reduction in air pollution, an improvement in energy security, the creation of green jobs, and a lessening of the effects of climate change, among many other advantages. Green energy technologies are continually advancing, which is making them more accessible and affordable for individuals, businesses, and governments all around the world. Green energy resources are also referred to as renewable energy sources because they do not have a negative impact on the surrounding ecosystem and naturally replenish themselves. These resources are thought to be sustainable because, in comparison to fossil fuels, they have a smaller impact on the surrounding ecosystem and they do not run out over the course of time.

Review of Literature

Sustaining increased & sustainable development remains the main focus of government strategies everywhere. A significant amount of energy and

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materials are needed for this activity in order to achieve sustainability. However, due to the massive waste byproducts produced in the process of achieving greater economic activity, the abundant use of such natural resources has resulted in serious environmental problems and negative effects on productivity as well as human health by raising the concentration of greenhouse gases (GHG) in the air. As a result, these activities also contribute to global ocean warming, temperature increases, melting of glaciers and ice sheets, and the global exhaustion of various species. These are referred to as the combined effects of rising greenhouse gas concentration ratios in the atmosphere, which produce global warming & climate change. In accordance with Bernstein et al. (2007) [2] as well as Lau et al. (2010) [1], through 2100, the average global temperature will have increased from 1.10C to 6.4°C, endangering the lives of half of the world's population, especially those who live near coasts. Additionally, the sea level will have risen by approximately 16.5 to 53.8 cm.

Analysis

The complexity of India's transition towards a more sustainable and environmentally friendly energy future is reflected in the fact that the country has both obstacles and possibilities in the development of renewable energy sources:

1. Challenges

Intermittency and reliability: Because renewable energy sources such as wind and solar are variable in their output, integrating them into the grid and ensuring their dependability can be difficult. It is vital to implement energy storage systems and smart grid technologies in order to solve this problem. The shift to green energy in India has substantial obstacles in terms of both intermittency and reliability. The availability of power from renewable sources such as the sun and the wind is highly dependent on the local climate. This intermittent nature can put a burden on the power system, which can result in oscillations in the amount of energy available, which in turn can impair the dependability of the electrical supply. It is essential to have options for energy storage, such as batteries, to store excess energy generated during times of high production so that it can be used during times of low generation. The technologies of smart grids and demand-response mechanisms both have the potential to contribute to the balancing of supply and demand. In order to provide a stable and consistent energy supply, it is vital to address these difficulties. As a result, green energy will become a viable source for meeting India's expanding energy needs. Developing an infrastructure for renewable energy sources will require a significant expenditure of capital. Obtaining financial backing and luring private

investment can be difficult, particularly for less ambitious ventures.

Competition for land and resources: The amount of land that is available for renewable energy projects may be restricted, and it may be in competition with agricultural and other land uses. It is necessary to find a balance between these competing needs. The development of green energy in India faces a critical challenge in the form of intense competition for land and resources. The requirement of land to host infrastructure for renewable energy sources, such as solar and wind farms, is in competition with the requirements of agriculture and the protection of the environment. This can lead to disputes over the usage of land, which may result in the relocation of communities and the disruption of ecosystems. It is essential to achieve a balance between the growth of renewable energy sources and the ethical use of land. Innovative solutions, such as dual land use (agricultural and solar panels), can help to reduce the likelihood of conflicts occurring. A healthy coexistence between the development of renewable energy sources and other land uses can be ensured by employing sustainable land management practices such as reforestation and wildlife conservation. These practices can assist reduce the negative influence on the environment.

Infrastructure: The process of modernising the electricity infrastructure in order to incorporate renewable energy sources can be time-consuming and expensive. The transition to cleaner forms of energy in India relies heavily on the construction of new infrastructure. It involves the extension and improvement of a number of different energy-related systems, such as power grids, transportation networks, and energy storage facilities, among other things. Modernising the power grid is absolutely necessary in order to integrate renewable energy sources in a way that is both effective and efficient, hence maintaining a reliable supply of electricity. The distribution of renewable energy sources, such as biofuels and electric vehicles, is made possible by improvements in the nation's transportation infrastructure. In addition, energy storage infrastructure, such as batteries and pumped hydro storage, can assist in mitigating the impact that is caused by the intermittent nature of renewable energy sources. These investments in infrastructure are crucial for establishing a robust and sustainable energy ecosystem that can fulfil India's expanding energy demands while simultaneously lowering the country's impact on the environment.

Environmental influence: Despite the fact that green energy is cleaner than fossil fuels, it is still possible for it to have an influence on the

environment. These consequences may include the modification of land use, the destruction of habitat, or the consumption of water in hydropower projects. Environmental influence is the term used to describe the significant effect that human actions have on the natural environment. These activities, which include industrialization, deforestation, pollution, and the burning of fossil fuels, are the primary contributors to climate change, the destruction of habitats, and the loss of biodiversity. The term "environmental influence" refers to both the negative consequences that humans have on the environment as well as the good actions that are being taken to reduce the severity of these impacts, such as sustainable development, conservation, and the shift to green energy sources. For the sake of ecological stability, the protection of natural resources, and the reduction of the negative impact that human activity has on the world, it is essential to have an understanding of environmental influences and to take action to solve them. To have the least amount of a detrimental impact on the surrounding environment and to ensure a better future for everyone, sustainable practices and responsible stewardship are necessities.

2. Opportunities

Abundant Renewable Resources Since India is blessed with a wealth of solar and wind resources, the country is ideally prepared for the widespread implementation of renewable energy sources.

2.1 Access to energy

Renewable sources of energy have the potential to help extend the availability of electricity in underserved and distant locations, thereby raising both living standards and economic opportunities. Individuals and communities are considered to have access to energy when they are able to find dependable and cost-effective sources of fuel and power to meet their day-to-day requirements. Lack of access to energy is a serious challenge in many parts of the world, particularly in developing regions. This lack of access to energy impedes economic development, education, healthcare, and overall well-being. The use of renewable energy sources such as solar and wind power can provide a long-term solution to the problem of providing adequate electricity to rural and isolated locations. Enhancing people's access to renewable sources of energy not only raises living standards, but it also lessens our reliance on nonrenewable fossil fuels, lessens our footprint on the environment, and helps create a global energy landscape that is more equitable and sustainable.

2.2 Job creation

Opportunities for job creation can be found in the green energy sector, particularly in the areas of manufacture, installation, and maintenance of

renewable energy systems. The development of renewable energy sources will undoubtedly result in the creation of new jobs. The field of renewable energy provides a considerable number of employment opportunities across a variety of stages, ranging from the production and installation of renewable energy systems through the research and maintenance of these systems. Production of solar panels, manufacturing of wind turbines, and the building of infrastructure for renewable energy sources are all industries that are creating new job opportunities. In addition, the use of green energy encourages the development of specialised workforces in a variety of fields, including energy efficiency, grid management, and environmentally responsible building practices. This job development not only helps to bolster economic prosperity, but it also helps to assist the transition to a sustainable energy future. In addition to these benefits, it also helps to reduce unemployment, stimulate innovation, improve energy security, and reduce greenhouse gas emissions.

2.3 Energy security

Improving energy security by decreasing reliance on imported fossil fuels is accomplished by increasing the proportion of renewable energy sources in the overall energy mix. Energy security is the certainty that a nation will have a steady, reliable, and inexpensive supply of energy to meet its demands without disruption or vulnerability to external shocks. This supply must be sufficient to meet the needs of the nation. It takes into account a variety of factors, including:

- **Diverse energy sources:** Reducing a country's reliance on a single energy source, such as fossil fuels, might make it less susceptible to supply disruptions. Diverse energy sources include renewables, nuclear, and imports.
- **Production of energy at home** encouraging production of energy at home increases a country's level of self-sufficiency and lessens its reliance on suppliers from other countries.
- **Resilience of the infrastructure:** In order to endure natural catastrophes, cyberattacks, and other types of interruptions, it is essential to have an energy infrastructure that is both robust and well maintained.
- **Utilising energy in a way that is both effective and efficient** cuts down on wastage and lessens a company's susceptibility to supply disruptions.

- Strategic reserves keeping strategic reserves of essential energy supplies, such as oil, can be an effective way to mitigate the impact of supply disruptions.

Because energy security is so important for maintaining economic growth, maintaining national security, and ensuring overall wellbeing, policymakers all around the world have made it a priority to address this issue.

2.4 Collaboration on a global scale

India has the potential to benefit from international collaborations, the transfer of technology, and funds made available through global climate agreements in order to expedite the development of green energy. In order to effectively handle urgent issues such as climate change, sustainable development, and the preservation of the environment, international cooperation is very necessary. It is imperative that nations collaborate in order to facilitate the sharing of information, technologies, and resources, as well as the formation of international accords and alliances. While organisations such as the United Nations make it easier for people to work together on global concerns, other initiatives, such as the Paris Agreement, encourage collective action to limit emissions of greenhouse gases. Collaboration improves emergency response efforts, encourages equal access to resources, and moves scientific research towards finding solutions to challenges that are shared by several parties. In today's interconnected world, international cooperation is very necessary to the construction of a future that is sustainable, safe, and wealthy for all nations and generations.

2.5 Innovation in technology

Constant advancement in green energy technologies, such as more sophisticated solar panels and wind turbines, has the potential to make renewable energy sources more productive and affordable. The term "innovation in technology" refers to the consistent development and progression of new ideas, methods, products, or services that lead to substantial advancements or breakthroughs in a variety of sectors. This can be accomplished through the application of various research methodologies. Innovation in technology is the engine that powers progress, economic expansion, and societal advancement. The following are important factors of technical innovation:

- Research and development (R&D): Putting money into R&D is absolutely necessary if one wishes to investigate novel ideas and methods of production.

- The implementation of digital technology into many businesses, such as artificial intelligence, the Internet of Things (IoT), and blockchain, is causing industries to undergo a transformation and opening up new opportunities.
- Innovations in sustainable materials, clean energy sources, and energy storage are essential to finding solutions to the world's most pressing environmental problems. Sustainability.
- Healthcare: Improvements in both the delivery of and outcomes from healthcare are brought about by developments in telemedicine, biotechnology, and other areas of medical technology.
- Automation and robotics: Automation and robotics are having a profound impact on a variety of industries, including agriculture, the supply chain, and manufacturing.
- Exploration of space: Innovations in space technology make it possible to explore space, communicate by satellite, and pursue commercial space endeavours.
- Cybersecurity: In this age of ever-increasing digitalization, improvements in cybersecurity are very necessary to preserve data and personal privacy.
- Mobility will be revolutionised in the near future thanks to developments in autonomous driving technology, electric vehicles, and environmentally friendly transit options.
- The fields of medicine and agriculture both stand to benefit from developments in genetic engineering, genomics, and personalised medicine made possible by biotechnology.
- Science of materials: Innovation in electronics, building, and aerospace is being driven by the use of cutting-edge materials that have distinctive features.

Technological innovation is a driving force behind both economic competitiveness and societal advancement. It provides answers to difficult problems while simultaneously generating opportunities for economic expansion and an improvement in people's quality of life.

2.6 Policy support

In order to encourage the adoption of green energy, the government of India has created supportive policies and incentives. These include tax exemptions, subsidies, and objectives for the amount of renewable energy produced. Support from public policy is essential to the growth of both technological innovation and environmentally responsible development. Research, investment, and the implementation of new technologies are all helped along by the framework that is provided by the laws and regulations of the government. This entails providing companies and individuals who are engaged in innovative endeavours with monetary incentives, tax exemptions, grant opportunities, and subsidy programmes. In addition, regulations have the power to establish criteria for environmental sustainability, safety, and ethical considerations, which in turn guides the creation of technologies that are responsible. The promotion of international cooperation and the safeguarding of intellectual property rights are both responsibilities that fall under the purview of national governments. Policymakers have the ability to accelerate development, overcome issues, and improve the general well-being of society when they connect policies with societal goals and establish an environment that is innovative and conducive to new ideas.

2.7 Participation of the community

Involving the local community in the design and development of a project can lead to improved acceptance and more sustainable results. Participation from the community is absolutely necessary for sustainable development. It entails including local inhabitants, organisations, and stakeholders in decision-making processes that have an impact on their lives and the environment in which they live. When it comes to technical advancement and environmentally friendly energy, including the community is beneficial for determining needs, concerns, and priorities. Input from the community can help influence the development of renewable energy projects, ensuring that the projects are in line with local values and that they minimise adverse impacts. In addition, participation cultivates a sense of ownership, encourages the adoption of sustainable practices, and gives individuals the ability to play an active role in the shift towards the use of cleaner technology. In the end, community involvement improves the success, acceptance, and equitable rewards of technological and environmentally friendly energy innovation.

In order to strike a healthy balance between these problems and opportunities, a concerted effort including the government, industry, and civil society is required. India is able to continue its

transformation towards a greener and more environmentally responsible energy system if it takes a strategic and long-term approach to tackling the concerns raised above.

Conclusion

The Indian government should maintain its focus on developing and enforcing policies and regulations that foster the expansion of renewable energy sources. This involves doing things like establishing concrete goals for the use of renewable energy, providing financial support for renewable energy initiatives, and maintaining a secure investment climate. The green energy policy and regulatory framework in India has a strong emphasis on long-term viability. In order to encourage investment in renewable energy, the government establishes clear targets, provides incentives, and ensures a stable investment climate. Grid integration is guaranteed by regulations, and new technologies are encouraged. Ecological protection is guaranteed by the use of environmental impact assessments in conjunction with a focus on local adaptation and community involvement. Gaining employment, training, and access to reliable energy sources for all should be top concerns. Climate pledges and technology transfer benefit from international cooperation. Energy conservation is encouraged through public education efforts, and waste management plans are developed to lessen human interference in natural systems. With this all-encompassing plan, India can more easily make the switch to renewable energy.

Conflicts of Interest

The authors declare there are no significant competing financial, professional, or personal interests that might have influenced the performance or presentation of the work described in this manuscript.

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