Chapter 19
Progress in Renewable Energy Technologies: A Review Outlook

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ABSTRACT

This research paper delves into the rapid progress of energy technologies for renewable sector in the distinctive context. The research analyses the important improvements across diverse sectors of renewable sector like encompassing solar, wind, biomass, hydropower, geothermal, and ocean energy. India's ambitious renewable energy vision and mission, as exemplified by the National Solar Mission and the Green Energy Corridor innovative techniques, have spurred significant growth in the sector. Similarly, it scrutinizes advancements in wind energy, biomass and bioenergy innovations, and the potential of geothermal and ocean energy sources in elaborate. Through previous scenario and an evaluation of the economic and environmental goods, this research gives a comprehensive view on India's renewable energy. It underscores the important role of technological advancement in propelling India's sustainable energy transition and stats the recommendations for policymakers, industry stakeholders, and researchers to further improve the country's renewable energy growth.

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1. INTRODUCTION

Østergaard et al. (2023) observed that the electric power is a fundamental pillar supporting the economic prosperity and well-being of nations. A resilient and evolving power sector plays a crucial role in ensuring sustainable growth within the Indian economy. It envisions that a substantial investment of USD 350 billion in various ventures and initiatives focused on renewable energy and cleantech could propel India to generate an impressive $212 billion in revenue, create 3.4 million jobs, and positively impact the lives of 919 million individuals by the year 2030. Recognizing the gravity of this issue, this edition will explore the renewable energy sector in India. It will be discussed about the sector's perspective, achievements, challenges, and the trajectory it is poised to take in the future works. The importance of renewable energy during global energy challenges and climatic difficulties is undeniable. With intensifying worries about waning fossil fuel reserves, energy security, and the pressing necessities to address climate change, renewable energy sources become a vital solution. The Panel formed with the inter governing bodies on Climate Change has explicitly accepted human interference on climate crisis, primarily attributed to greenhouse gas emissions from fossil fuel combustion. Nwokediegwu et al. (2024) observed that the outcomes, embracing the enhanced global temperatures, critical weather occurrences, and soaring sea levels, current significant hazards to ecosystems, economies, and societies world widely. Within this frame, renewable energy section resources like solar, wind, and another energy provide a sustainable alternate for fossil fuels. These advancements produce less greenhouse gas emissions in electricity production, manoeuvring a crucial role in lowering carbon footprints and make awareness of issues based on the climatic condition. Ravivarman et al. (2023) stated that the furthermore sustainable energy technologies are high in numbers, widely popular, and give more opportunities for decentralized energy generation, thereby improving energy security and resilience. Hence, the current happenings in global energy are pointed by a rising need for electricity, in particular in emerging economies such as India and China. Renewable energy sources showed the path to fulfil this mounting need while shortening reliance on finite and geopolitically sensitive fossil fuel reserves. Renewable energy predicts a vital role in tackling both worldwide energy difficulties and climate change. Not only does it give a sustainable, low-carbon energy option, but it also provides to energy security and development of economic, making it a significant element for a sustainable future. India's energy scenario gave an intricate connection of escalating energy demand, different energy sources, and an immediate need for sustainable alternatives. Grasping this context is essential for comprehending India's way in renewable energy. The country's energy necessity has consistently soared high, driven by growing population, urbanization, and industrialization. As per the IEA (International Energy Agency), country is more likely to surpass the China and become the largest energy consuming country by 2040. The Energy consumption of the country is pumped by sectors like industry, transportation, and residential use, with demand constituting a large portion. In the past, India has mostly depended on coal for producing electricity, with coal constituting a significant part of its energy mixture. Worku et al. (2024) noticed that the dependency on fossil fuels has increased apprehensions in spite of carbon emissions and air quality. Moreover, India possesses a distinct kind of energy policy encompassing natural gas, nuclear power, and hydroelectricity. The imperative for sustainable energy opportunities in India is propelled by various important factors. Firstly, as a participant in climate agreements by internationally, India is dedicated to reducing its carbon emissions and confronting climatically changes. Secondly, the diminishing environmental effects of fossil fuel-based energy production, such as pollution of air and ecosystem disruption, fuel the quest for cleaner alternatives. Lastly, the unpredictability of global fuel prices signifies the significance of energy security